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EDITORIAL

Surgical research in Sri Lanka: the way ahead

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The College of Surgeons of Sri Lanka celebrates 50 years at the helm of surgery in Sri Lanka. This issue highlights some of the giant strides made in surgical care and training over the past 5 decades and looks at the future envisaged by the College and its membership.

Annually over 300 million patients have surgery worldwide [1]. Few are enrolled in clinical trials, especially in middle- and low-income countries [2]. As stated by Søreide "without academic involvement of surgeons essential research questions in surgery could go unaddressed, surgical diseases could be neglected, and surgical trials addressing important questions might never be done." [2].

The enthusiasm for research has shown a welcome rise in the Sri Lankan surgical community. This is demonstrated by the steady increase in abstracts submitted and the number of oral of poster presentations at the College sessions over the last decade. A similar trend was observed at the Sri Lanka Journal of Surgery with a 5-fold rise in the number of scientific articles published over the same period. While numbers alone cannot be the yardstick, it is a significant stride towards improving research in the surgical sphere nationally.

The disparities in research and publications between the "global north" and the "global south" are stark [3,4] [table 1].

Table 1. Publication output by region, country or economy [4]

Rank	Region, country or economy	2018 world total [%]
	World	
1	China	20.67
2	United States	16.54
3	India	5.31
4	Germany	4.08
5	Japan	3.87
6	United Kingdom	3.82
7	Russia	3.19
8	Italy	2.79
9	South Korea	2.60
10	France	2.60
11	Brazil	2.35
12	Canada	2.35
13	Spain	2.13
14	Australia	2.10
15	Iran	1.89
-	EU	24.34

The conduct of quality research is hampered by the dearth of academic clinicians, funding limitations, heavy clinical workloads, limited relevance to career progression, indifference of administrators and policy makers and poor collaborative networks. The College has a leading role to play in advocating training in research methodology, developing registries and databases, and strengthening incentives and career progression pathways linked to quality research output.

Incorporation of research training within surgical programs has been shown to improve academic productivity [5] The requirement of the MD surgery programme for published research or a dissertation for board certification provides basic grounding in research for new surgeons.

Poor record keeping and migration of patients between provinces and hospitals hampers accurate data storage and follow up. Establishing electronic medical records linked to online institutional databases will help mitigate this [6]. The expertise of specialists with the master's in biomedical informatics, should be utilised in this endeavour [7].

The provision of a research allowance on submission of a research paper or presentation by doctors in the Ministry of Health incentivises scientific inquiry. Doctors and allied health personnel should be encouraged by professional colleges and the Ministry of Health to engage in research that is relevant and has impact nationally.

Professional colleges and medical schools have a responsibility to facilitate collaborative research, nationally, regionally and internationally. Academic sessions serve as a focal point for researchers to network and collaborate.

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Projects to enhance research output in resource limited settings such as the African Perioperative Research Group on post surgical morbidity [8] and the National Cancer Grid of India which promotes collaboration and mentorship in research conduct and training, benefit Sri Lanka as well [9].

The scarcity of local indexed journals for Sri Lankan researchers leads them to publish elsewhere. This has had a detrimental impact and impedes development of national journals and should be addressed by policy makers and administrators.

There is much to be done as we step beyond the jubilee year. The College and the journal must take a lead in this endeavour to equip the next generation of surgeons with tools to inquire and innovate.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

Paraumbilical hernia: an accompaniment of obesity

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Keywords: Incisional hernia; inguinal hernia; para umbilical hernia; predisposing factors; prevalence

Abstract

Introduction

Inguinal hernia, paraumbilical hernia and incisional hernias are common abdominal wall hernias encountered in surgical practice. Smoking, straining during micturition and/or defaecation, heavy manual work, chronic obstructive airway disease and obesity are some of the recognized predisposing factors for abdominal wall hernias in adults.

Objective

The study aims to estimate the prevalence of the common predisposing factors of abdominal hernias among adults of both genders.

Methodology

This is an institutional-based cross-sectional analytic study carried out in adult patients with abdominal hernias registered at a surgical clinic, Teaching Hospital, Jaffna, from January 2018 to December 2020. Interviewer administered questionnaire was used to collect the data from the patients. Data were analyzed by Statistical Package for Social Sciences version 2 1. 5% was used as a significance level.

Results

Among the 218 patients, 119 patients [54.6%] had an inguinal hernia, 80 [36.7%] had a paraumbilical hernia and 19 [8.7%] had an incisional hernia. 36 [16.5%] patients did not have any of the predisposing factors whereas 80 [36.7%] patients had a single predisposing factor and the remaining 102[46.8%] patients had multiple predisposing factors. 58 [26.6%] had the habit of smoking. 43 patients [19.8%] gave a history of straining during defecation and/or micturition and 49 patients [22.5%] suffered from chronic obstructive airway diseases. 98 patients [45.0%] were heavy manual workers and 98 [45.0%] were obese.

Conclusion

The prevalence of predisposing factors in each type of abdominal wall hernias varies. However, our study reveals, predisposing factors such as smoking, straining during defecation/ micturition, heavy manual work and chronic obstructive airway disease were more common with inguinal hernia while obesity was found more in common with a paraumbilical hernia. Patients with inguinal hernias tend to influence multiple predisposing factors.

Introduction

Protrusion of a viscous or part of a viscous can take place from the peritoneal cavity through the weakened area or defect in the abdominal wall [1, 2]. These abdominal wall hernias account for about 15-18% of operative procedures in a surgical unit. Inguinal hernia, incisional hernia and paraumbilical hernia are common types of abdominal wall hernias encountered in surgical practice [3]. There are recognized predisposing factors to abdominal wall hernias. Smoking cigarettes, straining during defecation and micturition, heavy manual work, chronic obstructive airway disease [COPD] and obesity are commonly found predisposing factors among patients with abdominal wall hernias[4].

Obesity is classified based on Body Mass Index. Clinical guidelines by the Endocrine Society of Sri Lanka classified obesity in Sri Lanka as BMI $\geq 25 kgm^2$. The prevalence of obesity in the Sri Lankan population was 9.2% [5, 6]. Identifying the prevalence of these predisposing factors among the types of abdominal wall hernias not only help for community health education about the prevention of hernias but is also useful to take measures to prevent recurrent hernias.

Methodology

This is an institutional-based prospective cross-sectional analytic study carried out in adult patients with abdominal hernias registered at a surgical clinic from January 2018 to December 2020, to analyze the prevalence of the selected predisposing factors in commonly encountered abdominal hernias among adults of both genders.

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Adult patients, aged more than 18 years, with inguinal, incisional and paraumbilical hernias were included. Patients with combinations of these hernias, recurrent hernias and other types of abdominal hernias were excluded.

Interviewer administered questionnaire was used to collect data. It contained biographical data of a patient, height [in meter] and weight [in kilogram] of the patient, type of abdominal hernia and the details of existing predisposing factors such as smoking, straining at defaecation or micturition, heavy manual work, and COPD.

Body mass index was calculated by using the standard formula, BMI= weight/height^2.

Those patients who were doing strenuous physical work for wages were considered for heavy manual work. Farmers, painters, welders, masons, cleaners and labourers were considered in this category. Those patients carrying out office work were not considered in this category. Teachers, bank staff, clerical servants and management assistants were considered as not performing heavy manual work.

Findings from the questionnaire were entered on an excel spreadsheet. The final analysis of data was carried out using Statistical Package for Social Sciences version 21. Descriptive analysis was conducted for all predisposing factors and each type of abdominal hernias. Fisher's exact test was used to determine the association of independent variables: predisposing factors with dependent variable; types of abdominal wall hernia by using the 5% significance level.

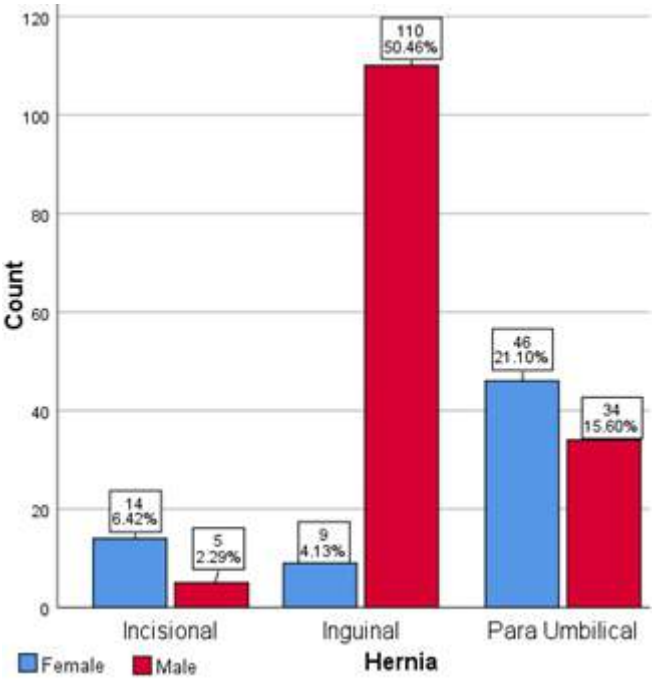

Figure 1. Gender distribution in common types of abdominal wall hernia

Results

There were 218 patients registered in the Professorial surgical unit with a hernia. 149 [68.3%] were males and 69 [31.7%] were females. The mean age was 54.07 ± 14.59 years. Among them 119 [54.6%] had an inguinal hernia, 80 [36.7%] had a paraumbilical hernia and 19 [8.7%] had an incisional hernia. Gender distribution in each type of abdominal wall hernia is shown in figure 1.

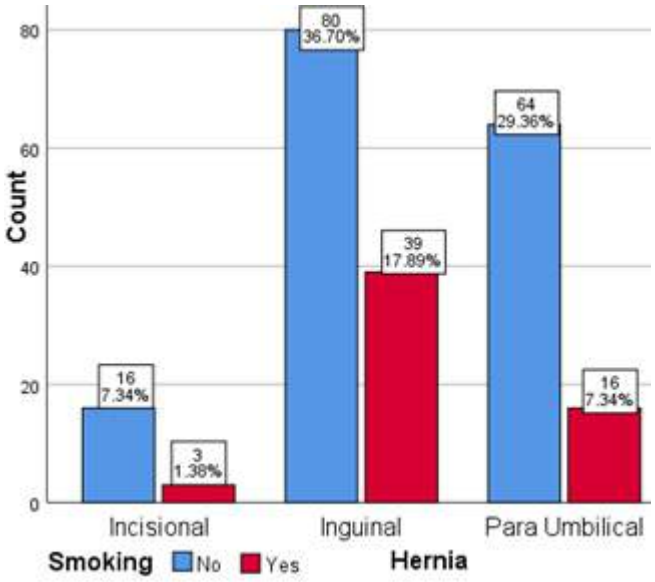

Figure 2. Prevalence of smoking among different types of abdominal hernias

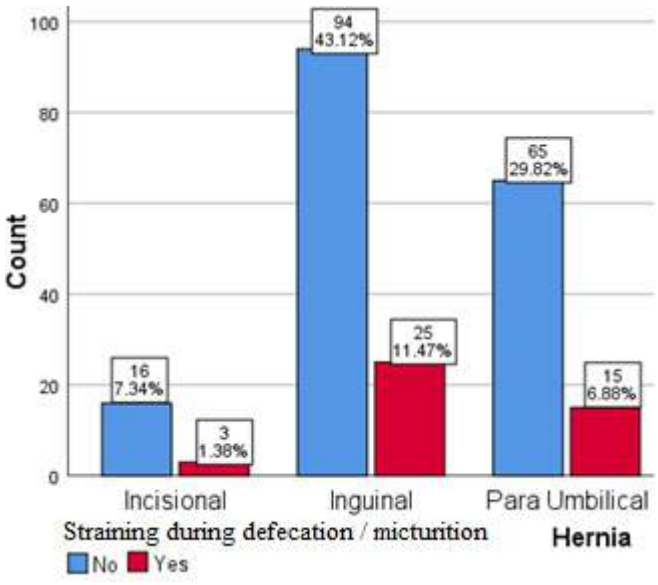

Figure 3. Prevalence of Straining during defecation/ micturition among abdominal hernias

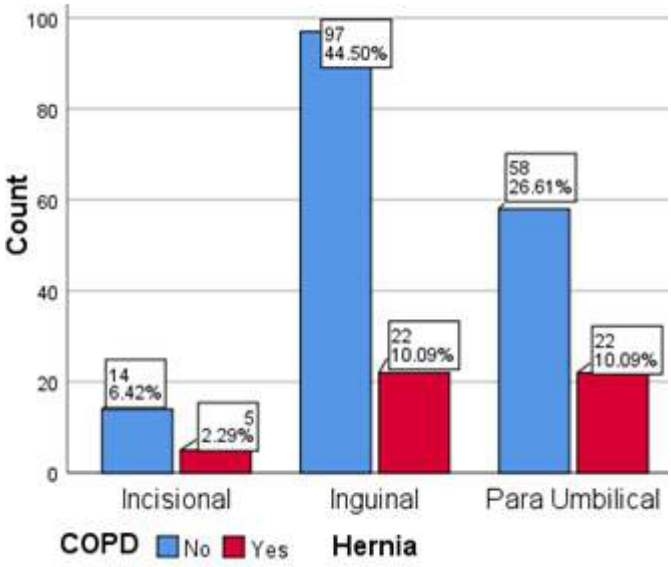

Figure 4. Prevalence of COPD among different types of abdominal hernias

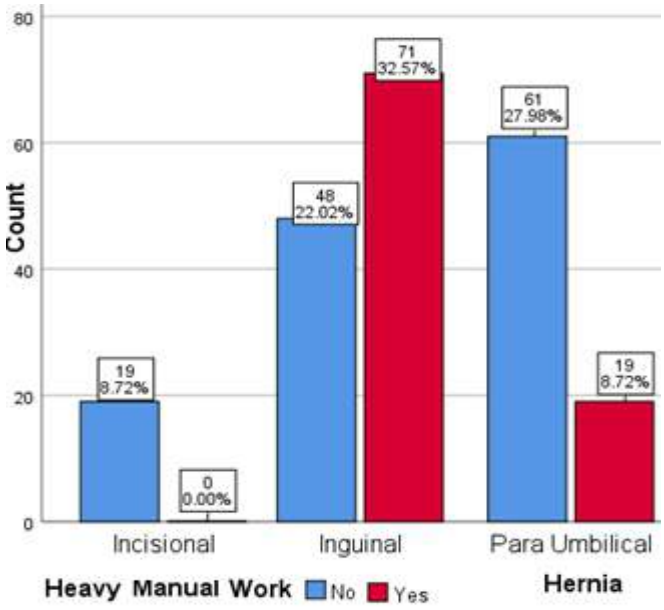

Figure 5. Prevalence of Heavy Manual Work among different types of abdominal hernias

Prevalence of selected predisposing factors in patients with incisional hernia, inguinal hernia and paraumbilical hernia are shown in figures 2-6.

Among the 218 patients with abdominal hernias, 36 [16.5%] patients did not have any of the predisposing factors. 58 [26.6%] had the habit of smoking. 43 [19.8%] patients gave a history of straining for defecation/micturition and 49 patients [22.5%] were suffering from chronic obstructive airway diseases. 98 patients [45.0%] were heavy manual workers and 98 [45.0%] were obese.

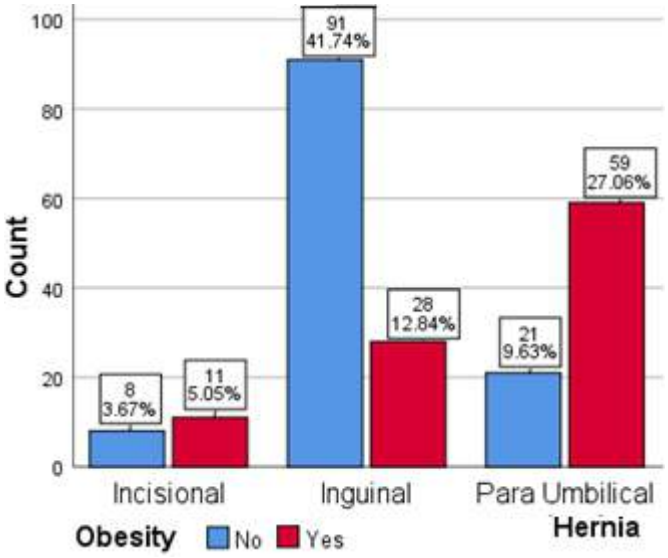

Figure 6. Prevalence of obesity among different types of abdominal hernias

Table 1. Summary of predisposing factor prevalence among different types of abdominal hernias

Predisposing factors	Incisional Hernia	Inguinal Hernia	Para Umbilical Hernia
Smoking [58]	3 [5.17%]	39 [67.24%]	16 [27.59%]
Straining during defecation/ micturition [43]	3 [6.98%]	25 [58.14%]	15 [34.88%]
COPD [49]	5 [10.2%]	22 [44.9%]	22 [44.9%]
Heavy manual work [90]	0 [0.0 %]	71 [78.89%]	19 [21.11%]
Obesity [98]	11 [11.2%]	28 [28.6%]	59 [60.2%]

Among the patients with a hernia who had a smoking habit most of them [67.2%] had an inguinal hernia and only a few [5.2%] had an incisional hernia which is noticeable in figure 2. Patients who had straining for defecation/micturition rarely [7%] were found to have incisional hernia while they frequently [58.1%] had an inguinal hernia, as illustrated in figure 3. COPD patients had an equal chance [44.9%] of developing inguinal and paraumbilical hernias but only 10.2% of them had an incisional hernia [Figure 4]. Heavy manual work is one of the important predisposing factors for hernia, which showed a significant difference with the type of abdominal wall hernia in our study [Fisher's exact test,

Table 2. Combination of predisposing factors among gender and types of abdominal wall hernias

Predisposing factors	No factors [n=36]	One factor [n=80]	Two factors [n=62]	Three factors [n=28]	Four factors [n=10]	All selected factors [n=2]
Male	24 [66.7%]	44 [55%]	45 [72.6%]	25 [89.3%]	9 [90%]	2 [100%]
Female	12 [33.3%]	36 [45%]	17 [27.4%]	3 [10.7%]	1 [10%]	0 [0.0%]
Inguinal hernia	23 [63.9%]	35 [43.3%]	38 [61.3%]	19 [67.9%]	3 [30%]	1 [50%]
Incisional hernia	3 [8.3%]	11 [13.8%]	4 [6.5%]	1 [3.6%]	0 [0.0%]	0 [0.0%]
PUH	10 [27.8%]	34 [42.5%]	20 [32.2%]	8 [28.6%]	7 [70%]	1 [50%]

p-value: 0.0001]. Considering all the patients who performed heavy manual work, most of them [79%] had an inguinal hernia, only 21% of them had a paraumbilical hernia and none of them developed an incisional hernia, as evidenced in Figure 5. The predisposing factor obesity showed a significant difference with the type of abdominal wall hernia [Fisher's exact test, p-value: 0.0001]. Moreover, out of all obese patients with an abdominal hernia, a higher percentage [60.2%] of them comprised of paraumbilical hernia and only a few [11.2%] of them comprised of incisional hernia, which is exemplified in Figure 6.

More than one predisposing factor was found in 102 patients [46.8%] with abdominal wall hernias. More male than female patients with abdominal wall hernias had more than two predisposing factors. Patients with inguinal hernia had more predisposing factors compared to patients with other types of abdominal wall hernias.

Discussion

The mean age of this study group with abdominal hernias was 54.07± 14.59 years. In India, the majority of abdominal hernia patients were found in the 41-50 years age group [7]. The highest incidence of inguinal hernia was found in the 51-60 years age group in Pakistan [3].149 [68.3%] of abdominal wall hernias were found in males. Many of the males are breadwinners of their families and do heavy manual work. Smoking habit is almost exclusively found in males in our culture. Abdominal strain during micturition, a manifestation of prostomegaly, increases with age. As such males develop abdominal wall hernias more than females [7, 8, 4].

Considering the prevalence of each of the common types of abdominal wall hernias in the loco-regional countries, the inguinal hernias are the most common type of abdominal hernia, followed by a paraumbilical hernia and incisional hernia [Table 3]. While this overall pattern of prevalence of each hernia type remains the same globally, it is interesting to note that the prevalence of paraumbilical hernia [35.7%] in this study [in Jaffna] is slightly higher when compared to its prevalence in other studies.

Table 3. Prevalence of common abdominal hernia types in different

Type of hernia	India	Pakistan	UK	USA	Jaffna [Sri Lanka]
Inguinal	77.81 %	76.35 %	82.05 %	88 %	54.6%
Paraumbilical	9.06 %	12.38%	3 %	2 %	36.7%
Incisional	3.12 %	2.7 %	6.50 %	10 %	8.7%

Considering gender distribution of abdominal wall hernias, inguinal hernias had a male: female ratio of 12.2:1 whereas paraumbilical hernia had a male: female ratio of 1:1.3 in this study [Figure 1]. A similar kind of gender distribution has been reported in studies from Pakistan and India [3, 8].

Smoking increases the risk of developing hernias fourfold [9]. Smoking reduces collagen synthesis, decreases the ratio of type I to type III collagen and it also increases the connective tissue degradation by reducing the inhibitor activity of anti-protease activity [10]. Smoking was a predisposing factor for 58 [26.6%] patients with abdominal wall hernias among them 39 patients presented with inguinal hernia. Sorensen LT et al demonstrated the association of smoking with inguinal hernia recurrence [11].

Straining during defecation and micturition, COPD and heavy manual work, cause increased intra-abdominal pressure. The increased intra-abdominal pressure can bring about secondary changes in tissue fibroblast. Thus the increased intra-abdominal pressure produces areas of weakness in the anterior abdominal wall resulting in abdominal wall hernias [10].

Predisposing factors causing increased intra-abdominal pressure had varying degrees of impact over the common types of abdominal wall hernias. Heavy manual work was found to have a significant difference with abdominal wall hernias [p= 0.0001] in this study. Many patients registering themselves in hospital surgical clinics are from a low socio-

economic background. They have increased physical activities during their work resulting in increased intra-abdominal pressure. Vijayakumar S et al described a higher incidence of bilateral inguinal hernia among patients with chronic cough and heavy weight lifting [7].

Increased intra-abdominal fat deposition in obesity causes increased intra abdominal pressure and exerts tension on the midline aponeurosis. The weight of excess fat deposited in the subcutaneous tissue in obesity exerts downward traction on the aponeurosis above the umbilicus. This changes the pattern of decussation of fibres around the umbilicus. The weakened area thus produced allows the appearance of a paraumbilical hernia [12, 13].

Ninety eight [45.0%] patients with abdominal wall hernia were obese. Obesity was found to have a significant difference with abdominal wall hernias [p= 0.0001] in this study. Out of 98 obese patients, 59 patients had an accompanying paraumbilical hernia. Ali S et al reported increased BMI as a significant predisposing factor for paraumbilical hernia [14]. Lau B et al pointed out the increased risk of incarceration of non-inguinal abdominal wall hernias with increasing BMI of patients [15]. The risk of hernia recurrence and postoperative complications are more with obesity [16]. Interestingly, lower incidences of inguinal hernias were reported with increasing BMI [17]. It has been suggested that pre peritoneal and intra abdominal fat can function as a barrier to prevent herniation across the inguinal hernia defects [18].

Pathogenesis of incisional hernia is influenced not only by patient-related factors and by biological factors, but also by surgery-related factors. The surgery-related predisposing factors are emergency surgeries, laparotomy for peritonitis, type of abdominal incisions, a technique used to close incisions and wound infections [10]. These predisposing factors were not included in this research study, which may be a limitation of this study. When the analysis was considered, the predisposing factors [independent variables] had few or no observations for incisional hernia [dependent variable] in this study. So, Fisher's exact test was used instead of the Chi-square test as reported in the literature for the method of analysis, [19].

Inguinal hernia is potentially protected by obesity to become clinically visible. So, an inguinal hernia is not a frequent accompaniment of obesity. On the other hand the results of our study as well as from findings of studies in literature, it seems obvious that paraumbilical hernia is a frequent accompaniment of obesity. Furthermore, it should also be noted that nearly half of the patients with abdominal wall hernias are influenced by more than one predisposing factor. So, an active search for possible predisposing factors in patients with abdominal wall hernia is important for their optimal management.

Conclusion

The prevalence of predisposing factors in each type of abdominal wall hernias varies. However, our study revealed that predisposing factors such as smoking, straining during defecation/ micturition, heavy manual work and chronic obstructive airway disease were more common with inguinal hernia while obesity was found more in association with a paraumbilical hernia. Patients with inguinal hernias tend to be associated with multiple predisposing factors.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

Clinico pathological characteristics and surgical treatment of carcinoma of the penis: a single surgeon experience

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Keywords: Penile cancer; squamous cell carcinoma of the penis; phimosis; circumcision

Abstract

Introduction

Carcinoma of the penis is a disease of older men with an increased incidence in 6th decade of life. It is a rare malignancy in men with an annual incidence of one in 100,000 worldwide. Squamous cell carcinoma accounts for more than 95%of the penile malignancies. It has a significant geographical variation worldwide with a high prevalence in African and Asian countries. Usually these patients present late resulting in devastating complications and treatment challenges.

Methods and materials

A retrospective analysis of data collected from 2009 to 2018 in four different provinces in Sri Lanka by the same author. Data were collected prospectively using a pro forma data sheet by the author. This study analyzed the clinico-pathological characteristics of consecutive patients with histopathologically proven penile cancer. Human papilloma virus (HPV) types, HPV-16 and HPV-18 were not assessed.

Results

Twenty eight patients with penile carcinoma were analyzed. The age ranged from 26 years to 86 with a mean age of 61.30.The commonest presentation was a non-healing ulcer on the glans (13/28). None of the patients had undergone circumcision and 10 patients had phimosis at presentation. Majority 67.85% of the patients presented within three months of recognizing the problem. Majority had involvement of the glans penis (24/28= 85.71%) at presentation. Palpable inguinal lymph nodes were found in 10 patients and eight of them had bilateral palpable inguinal lymphadenopathy. Surgical treatment varied from circumcision to total penectomy. Twenty four patients had conventional squamous cell carcinoma (SCC) while one patient had SCC in situ accounting for more than 85.71% of the tumour type to be squamous cell malignancy. Other types of malignancy detected were sarcomatoid SCC, Veruccous SCC and Basal cell carcinoma.

Conclusions

This study revealed that all patients were uncircumcised and 35.71% (10/28) of the subjects had phimosis at presentation which is considered as a risk factor for developing penile carcinoma. 35.71% of the patients were within the age group of 60 to 69 similar to international figures for age at peak incidence of the penile carcinoma. Commonest penile structures involved at presentation were foreskin and glans in keeping with international data. This observational study of penile carcinoma very clearly demonstrates and represents the similarity with the global pattern of this rare disease.

Introduction

Carcinoma of the penis is a rare malignancy in men. An incidence of 0.4% of all malignancies has been observed in United States and Western Europe whereas around 10% incidence has been seen in Asia, parts of Africa and South America. Men older than 50 years has the highest incidence [1] and is uncommon in younger men. Approximately 95% of these tumours are squamous cell carcinomas [SCC], which usually arise from the epithelium of the inner prepuce or the glans. Two thirds of the SCC are common [conventional] SCC. The other subtypes of SCC are warty carcinoma [7-10%], papillary carcinoma [5-15%], basaloid carcinoma [4-10%] and verrucous carcinoma [3-8%]. Sarcomatoid SCC accounts for 1-3% and has a very poor prognosis [2].

Known risk factors for carcinoma of the penis are lichen sclerosis [balanitis xerotica obliterance ,BXO], phimosis, cigarette smoking and chronic inflammation [3]. Human papilloma virus [HPV] infection is also a known predisposing factor for carcinoma of the penis and it accounts for 30% to 40% of the cases. HPV 16 and HPV 18 are the most common types of HPV involved in penile carcinoma [4]. There are two distinct pathways suggested for carcinogenesis of penile carcinoma namely; viral associated with HPV and none viral associated with other conditions as described above.

The objective of this study was to present a single surgeon experience of a consecutive series of penile cancer patients

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Table 1. Cases detected in different provinces during the study period

Year	N=28	Province
2009	3	North Western (Teaching Hospital Kurunegala)
2010	1	
2011	1	North Central (Teaching Hospital Anuradhapura)
2012	3	
2013	5	
2014	2	North Western (Teaching Hospital Kurunegala)
2015	1	
2016	4	
2017	1	
2018(till March)	2	
2018(March – June)	4	Sabaragamuwa (Teaching Hospital Rathnapura)
2018(July - Dec)	1	Western (The National Hospital of Sri Lanka

treated over a 10-year period detailing the clinicopathological characteristics.

The objective of this study was to present a single surgeon experience of a consecutive series of penile cancer patients treated over a 10-year period detailing the clinicopathological characteristics.

Methods

This is a retrospective analysis of cancer data collected prospectively from patients with histopathologically confirmed penile cancer treated by a single urological surgeon. The data was collected during a 10-year period from Jan 2009-Dec 2018. The study analysed the demographic data, clinical presentation, histopathological details and the initial surgical treatment of the primary tumour and regional lymph nodes. Tumour specimens were not tested for HPV DNA.

Results

Twenty-eight patients with penile cancer were seen during the 10-year period with a mean age of 61.3 years [range 26-86]. Twenty four patients [85.7%] were above 50 years of age [Fig 1]. The youngest patient was 26 years old at initial presentation with phimosis and an underlying mass, and had an aggressive course of the disease succumbing to it within 6 months. The patients were predominantly from 3 provinces of Sri Lanka, North Western [Kurunegala], North central [Anuradhapura] and Sabaragamuwa [Rathnapura] provinces where the author was the single urological surgeon serving 3 different tertiary referral hospitals. The final 6 month patient recruitment was from the western province, at the tertiary institution National Hospital of Sri Lanka [NHSL] served by 3 urological surgeons. The patients diagnosed from each province and the time periods are detailed in Table 1.

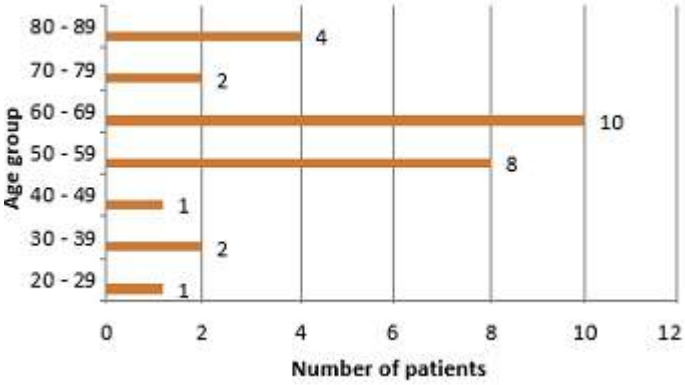

Figure 1. Age distribution

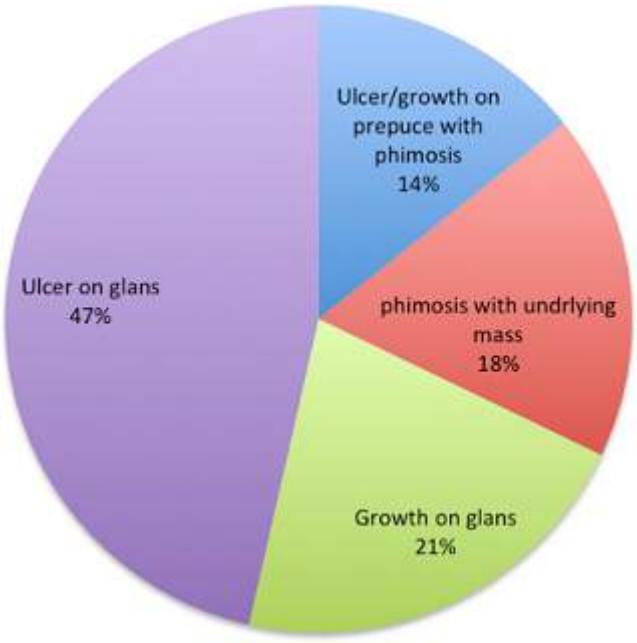

Figure 2. Clinical presentation

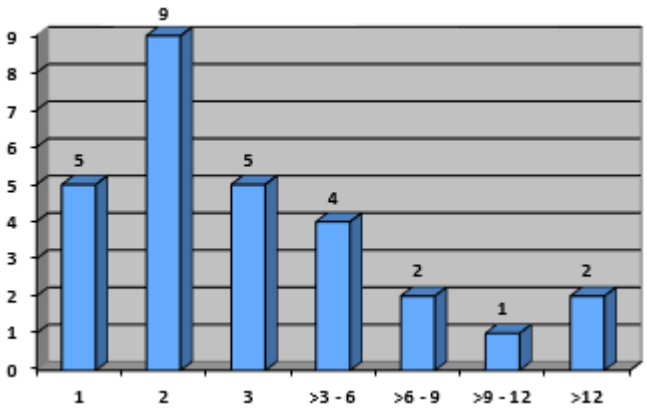

Figure 3. Duration of symptoms in months

All men were uncircumcised. Twenty-seven [96.4%] of them were Sinhalese with one Tamil patient. Muslims [circumcised men] were absent in this series. The commonest presentation was a non-healing ulcer on the glans penis [13/28] [Fig 2].

Ten patients [35.7%] had phimosis at initial presentation. The duration of symptoms shows that the vast majority [67.9%] had presented within 3 months of noticing the penile lesion [Fig 3].

Table 2. Histopathological grading of common SCC (n=25)

Grade [G]	No
G1 Well differentiated	12
G2 Moderately differentiated	12
G3 Poorly differentiated	1
G4 Undifferentiated	0

Table 3. Primary site of penile cancer

Foreskin alone	4
Glans alone	13
Foreskin and glans together	11

Table 4. Local spread within penis

External meatus:	4
Cavernosal tissue:	5
Spongiosal tissue:	5
Urethra :	2

Table 5. Type of surgical intervention

Type of surgical intervention	Number of patients
Circumcision alone	4
Circumcision + wide local excision (Partial Glansectomy)	8
Partial penectomy	12
Total penectomy	4

The commonest histopathological type was squamous cell carcinoma [SCC] accounting for 25/28(89.2%) of all men with penile cancer. Verrucous SCC and sarcomatoid SCC had one patient each and the remainder was a basal cell carcinoma. Of the common SCC patients [n= 25], majority of patients had well or moderately differentiated tumour grades table 2.

Analysis of the extent of the penile involvement at presentation showed 24/28 [85.7%] having glans penis involvement [thirteen exclusively glans penis] and 15/28 [53.6%] preputial [foreskin] involvement [4 foreskin alone]. Tables 3, 4 and 5 show the extent of penile involvement of the primary tumour and the surgical procedure offered to correct it.

Table 6 shows the clinical stage of primary tumour and lymph nodes in common SCC and verrucous SCC patients.

Partial penectomy, the most commonly performed procedure, was the surgical intervention for the primary tumour in 12 [42.8%] patients. The vast majority of the patients, 16/28 [57.1%] had no palpable inguinal lymph nodes [N0 disease] and were kept under long-term surveillance.

Table 6. 2016-TNM clinical classification of 26 SCC patients (sarcomatoid carcinoma excluded)

CLINICAL T STAGE (corresponds to pathological T categories)	No
Tis carcinoma in situ	1
Ta Non-invasive verrucous carcinoma	1
T1 Tumour invades subepithelial connective tissue	14
T1a without lymphovascular invasion and is not poorly Differentiated	4
T1b with lymphovascular invasion or is poorly Differentiated	10
T2 Tumour invades corpus spongiosum with or without invasion of the urethra	5
T3 Tumour invades corpus cavernosum with or without invasion of the urethra	5

Table 7. Surgical intervention for inguinal lymphadenopathy

Side of inguinal block dissection	Number of patients
Right sided block dissection	3
Left sided block dissection	4
Bilateral block dissection	3
No block dissection	2
Total	12

Palpable inguinal nodes were found in 12 patients and seven of them had unilateral palpable inguinal lymphadenopathy. Out of the five patients with bilateral lymphadenopathy, one patient had bilateral extensive lymph node enlargement not amenable for surgery and in another patient, lymph node FNAC revealed inflammatory cells only and kept under surveillance. Table 7 depicts the surgical procedures undertaken to treat the regional lymphatics.

Discussion

There were 3 notable publications on penile cancer from Ceylon [presently Sri Lanka] in the first half of the 20th century [5,7]. Surprisingly, there is a paucity of literature on the subject since then. Chalmers reported on the incidence of cancer in Ceylon for the year 1903 where there were 122 male patients of a total of 222. Cancer of the penis accounted for 32/122 [26.2%] of male patients [5]. Spittel sharing his experience expressed that carcinoma of the penis is an astonishingly common malignant disease in Ceylon. In a 4-year period [June 1911- June 1915], no fewer than 91 cases were operated by him at the General Hospital Colombo [now

NHSL], where he was one of three general surgeons [6]. He further stated that carcinoma of the penis is never seen in Moors who practice circumcision; it is most common in Singhalese cultivators. This fact is amply demonstrated in this study. Paul reported that in the year 1928, of 415 cases admitted with cancer to the General Hospital Colombo, 55 [13.3%] were penile cancer [7].

Today, carcinoma of the penis is a rare disease in Sri Lanka with only 90 new cases recorded during the year 2014 by the National Cancer Control Programme of Sri Lanka [8]. In this country, this condition is currently treated primarily by general surgeons, urological surgeons and oncological surgeons and this demonstrates the low number seen by an individual surgeon annually. The significant decline in the incidence of penile cancer in Sri Lanka in the past century is not yet explained. In the past 10 years the author had treated 28 patients with approximately 85% of them being over 50 years. All men in the present series were uncircumcised. This would explain the absence of a single Muslim patient in this series.

Daling et al in their population-based study in the USA identified an incidence of 35% phimosis in those with cancer of the penis who had not been circumcised in childhood. In the controls with no cancer, the incidence of phimosis was significantly lower at 7.6% (OR=7.4, 95% CI 3.7 to 15.0]

Hernandez et al reported a large series of almost 5000 cases of invasive penile carcinoma among men in the United States. Primary site of the disease was glans penis in 34.5%, prepuce in 13.2%, shaft of the penis in 5.3%, overlapping in 4.5% and unspecified in 42.5% among men in the United States [9]. In the current study the primary site of penile cancer were: glans penis [46.4%], prepuce and glans penis together [39.3%] and prepuce [14.3%].

In a study by Guimaraes and colleagues on 333 cases in Brazil found that 65% of the patients had common SCC, 5% papillary SCC, 4% basaloid SCC, 7% warty SCC, 7% varrucous SCC, 1% sarcomatoid SCC, 1% adenosquamous and 10% mixed. The worst prognosis has been reported in basaloid and sarcomatoid varients [10].

Verrucous SCC is usually felt to be of low malignant potential metastasizing rarely. In the present series common SCC was the most common accounting for 89.2% of patients with 1 patient each [3.6%] of the verrucous and the sarcomatoid variants of SCC. Basal cell carcinoma [BCC] of the penis, affecting one patient [3.6%] in this study, is reported as an extremely rare penile cancer in the world literature.

Penile BCC is a slow growing lesion unlikely to spread beyond local disease. Occurrence of recurrence has been rare even with wide local excision of the lesions. In 6688 cases of male BCC referred for Mohs micrographic surgery over a 25-year period, only 2 cases [0.03%] of penile BCC were found by Nguyen and colleagues [11].

As mentioned in Young's Practice of Urology published in 1926, penile cancer is primarily managed surgically, since the end of 19th century [12]. En-block removal of the penis, partial or total, with bilateral inguinal lymph nodes was espoused by the pioneer surgeons. This procedure is carried out even now in the 21st century. Lesions which are confined to the prepuce may be managed with circumcision alone as described by Young in his text in 1926.

Partial penectomy accounted for 12/28 [42.8%] of surgical procedures in the present series. Four patients with cancer confined to the prepuce in the present series underwent only a circumcision as the surgical procedure. No groin dissection was done in these 4 patients.

Circumcision is an option in the management of carcinoma of the penis. Any lesion confined only to the prepuce is considered as an indication for circumcision. Even in superficial glanular lesions [Tis], circumcision can remove the microenvironment favourable for HPV which could prevent chronic inflammation and invasive disease. Circumcision will allow proper physical examination of the glans penis in long-term follow-up [13]..

The most common surgical procedure for the treatment of primary tumour in patients with invasive SSC of the penis is partial penectomy. The main reason for this procedure is to allow the patient to void in a standing position and to have adequate sexual function while maintaining proper local control of the disease.

Total penectomy is the treatment of choice if partial penectomy does not allow excision of the lesion with negative margins and or adequate penile stump. Four patients [14.3%] in this series had to undergo total penectomy. The surgical treatment for the primary tumour were circumcision in 4 patients, local excision in 2, partial penectomy in 194 and total penectomy in 133 in the Brazilian study [10].

The most important prognostic factor with regard to the survival of patients with penile carcinoma is the presence of nodal involvement by the tumour. Small occult metastases cannot be detected by physical examination alone and dynamic sentinel node biopsy [DSNB] using 99mTc nano colloid technique was not available in author's practice.

Conclusion

Carcinoma of the penis as a rare malignancy in men with an annual incidence of one in 100,000 worldwide. In this cohort of patients it was revealed that all of them were uncircumcised and around 35% of them had phimosis at presentation which is a well known risk factor for carcinoma of the penis. Age of peak incidence and common penile structures involved by the disease in this series of patients are similar to that of international data.

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All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

Inguinal hernia repair under regional anaesthesia versus local anaesthesia: a comparative study

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Keywords: Lichtenstein repair; local anesthesia; inguinal hernia; inguinodynia

Abstract

Introduction

This study aims to compare Lichenstein's repair performed under regional anaesthesia and local anaesthesia.

Methods

This prospective study included two groups of 31 patients each with an uncomplicated inguinal hernia from surgical units of KMC affiliated hospitals. All patients underwent Lichenstein's tension-free repair either under spinal anaesthesia (group 1) or under local anaesthesia (group 2). Results from both groups were compiled and analysed.

Results

Mean age was 50.45 (SD 16.49) in group 1 and 50.61 (SD 12.04) in group 2. Median time taken for surgery was less under local anaesthesia (1.17 versus 1.5 hours). Postoperative pain was less in the local anaesthesia group at 24, 48 hours after surgery, and after 2 weeks of discharge. Group 1 had higher cases of urinary retention.

Conclusion

Lichenstein's repair under local anaesthesia was better concerning post-operative pain, complications and hospital stay.

Introduction

"Hernia is defined as an abnormal protrusion of an organ or tissue through a defect in its surrounding walls" [1].

Inguinal hernia is treated by open or laparoscopic surgery. Lichtenstein repair is an open tension-free repair technique using prosthetic mesh [1]. It can be done under general anaesthesia or regional anaesthesia or local anaesthesia [2,3].

Nowadays, local anaesthesia has gained popularity among surgeons as it results in better satisfaction rates and improves day-case rates [4]. Studies have shown local anaesthesia to be safe, cost-effective and associated with early postoperative recovery [5]. However, general or spinal anaesthesia continues to be popular in developing countries [6]. Hence the purpose of this study is to compare open inguinal hernia repair under local anaesthesia and regional anaesthesia.

Material and methods

This prospective observational study was done at KMC affiliated hospitals, Kasturba Medical College, Mangalore, India. It included 62 patients with unilateral uncomplicated inguinal hernia (age of and above 18 years). The study was completed between November 2018 and January 2020 after written informed consent and ethical clearance. Patients excluded:

a) Age <18 years
b) Obstructed or strangulated hernia
c) Allergy to lignocaine

The sample size was given by:

$N = 2*(Z\alpha+Z\beta)2 * \sigma2 / d2$

($Z\alpha = 1.96$ at 95% confidence interval

$Z\beta = 0.84$ at 80% power

σ = combined standard deviation [3]

d= mean difference = 0.72 [3](of pain scores between regional anaesthesia and local anaesthesia groups))

With a 95% confidence interval and 80% power [3], the sample size was calculated to be 31 for each group. A total of 62 patients were (31 in each group) enrolled for the study.

The study aimed to compare inguinal hernia repair under regional anaesthesia and local anaesthesia concerning post-operative pain, intraoperative complications, postoperative complications and recurrence.

Non-probability convenience sampling method was used. In group 1, spinal anaesthesia was used and under local anaesthesia in group 2. Lichtenstein tension-free hernioplasty using polypropylene mesh 6x11 cm was performed in all patients by experienced surgeons. Ceftriaxone 1 g IV injection was given 30 minutes before surgery.

In group 1, spinal anaesthesia was given using 0.5% bupivacaine in sitting/lateral position. In the other group, a 1:1 combination of 1% lignocaine and 0.5% bupivacaine with

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1:200,000 adrenaline solution [3] (15 ml each) was mixed with 60 ml of distilled water. 20 ml was injected at a point 2 cm medial to the ipsilateral anterior superior iliac spine deep to external oblique to block ilioinguinal and iliohypogastric nerves. 20 ml then was injected at the same point in the subcutaneous plane using a spinal needle in a fan-shaped manner to block the anterior cutaneous branches of the abdominal wall right up to midline. 15 ml was injected in the subcutaneous plane along the line of the planned incision. After opening the external oblique aponeurosis, 20 ml was injected deep into the external oblique above and below the incision.15 ml was injected into the cord just medial to the public tubercle to block the genitofemoral nerve. Mesh was anchored using 2-0 polypropylene stitches to an inguinal ligament in a continuous fashion.

Both groups were compared concerning intraoperative complications, duration of surgery, post-operative pain at 24 hours and 48 hours using a visual analogue scale (VAS). Wound hematoma, infection, testicular pain, urinary retention, headache, respiratory complications were assessed postoperatively. After discharge, patients were followed up after 2 weeks, 1 month, 2 months, 3 months and 6 months for wound complications / persistent pain. Recurrence was assessed 6 months after surgery. Student's t-test and chi-square test (SPSS version 17.0 package) were used.

Results

The mean age for group 1 was 50.45 (SD 16.49) years and for group 2 mean age was 50.61 (SD 12.04) years. The incidence of left-sided hernia was 58.1% (n=18) in both groups.

No intraoperative complications were noted in either group. Operating time was from the start of administration of anaesthesia till dressing.[3] The median time in group 2 was 1.17 hours versus 1.5 hours in group 1 (p = 0.007).

The pain was evaluated by using the VAS score (expressed out of 100) (Table 1). The mean VAS score at 24 hours and 48 hours for group 1 was 57.96 and41.79 for group 2 was 50.61 and 32.26 respectively. The difference in scores at both checkpoints was found to be statistically significant.

Urinary retention and headache were seen among patients of group 1. Wound related complications were found to be similar in both groups (Table 2).

Discussion

The present study included 62 patients (31 in each group) who underwent Lichenstein's open mesh repair - 61 of them were males and 1 female in group 2 with mean age comparable between the two groups. Patients in both groups had no significant intraoperative pain. Although some studies have shown that local anaesthesia was better only in the first few hours after surgery [5,7-8], pain relief was found to be significantly better under local anaesthesia at 24 hours, 48 hours after surgery in our study. 4 patients (out of 31) had persistent pain at 2 weeks after surgery in group 1 while none had in group 2 and this was statistically significant (p=0.039) (Table 3). Nordin P et al [9] in their trial concluded that local anaesthesia was better than general and spinal anaesthesia in the early postoperative period. Postoperative pain at 12, 24 and 48 hours after surgery was found to be significantly lower in the local anaesthesia group in the study by Goyal P et al [3].

Varied results in the literature have been noted regarding the duration of surgery. Studies by Goyal P et al [3], Ranani MS et al [5], Prakash D et al [8], Bhedi A et al [10] showed no difference in operative time between local and spinal anaesthesia whereas Goel A et al [6] reported longer operative time under local anaesthesia. Similar to studies by Yound DV [2], Song D et al [11], van Veen RN et al [12], Jain A et al [13], operative time was found to be shorter in our study in the local anaesthesia group. This was probably due to the time taken to administer spinal anaesthesia.

Table 1. Postoperative VAS scores

Post-operative pain scores	Group	N	Mean	Standard Deviation
24 hours	1	31	57.96	4.49
	2	31	50.61	2.74
48 hours	1	31	41.79	8.97
	2	31	32.26	3.80

Table 2. Post operative complications and hospital stay

Post-operative complications		Group			
		1		2	
		Count	Column N %	Count	Column N %
Hematoma	No	29	93.5%	30	96.8%
	Yes	2	6.5%	1	3.2%
	Total	31	100.0%	31	100.0%
Infection	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
Testicular pain	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
Urinary retention	No	26	83.9%	31	100.0%
	Yes	5	16.1%	0	.0%
	Total	31	100.0%	31	100.0%
Headache	No	28	90.3%	31	100.0%
	Yes	3	9.7%	0	.0%
	Total	31	100.0%	31	100.0%

Table 3. Follow up

Follow up		Group 1 Count	Group 1 Column N %	Group 2 Count	Group 2 Column N %
2 weeks hematoma	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
2 weeks pain	No	27	87.1%	31	100.0%
	Yes	4	12.9%	0	.0%
	Total	31	100.0%	31	100.0%
2 weeks infection	No	28	90.3%	30	96.8%
	Yes	3	9.7%	1	3.2%
	Total	31	100.0%	31	100.0%
1-month hematoma	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
1-month infection	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
1-month pain	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
2 months infection	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
2 months pain	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
2 months hematoma	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
6 months wound complication	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
6 months pain	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%
6 months recurrence	Yes	0	0%	0	0%
	Total	31	100.0%	31	100.0%

As reported by Young V [2], van Veen RN et al [12], Jain A et al [13] and Subramaniam P et al [14] urinary retention postoperatively was a significant complication in the spinal anaesthesia group in our study($p = 0.02$). No significant difference between wound-related complications was noted.

In our study, patients from distant areas were admitted who were allowed to stay until they opted for discharge. The criteria of pain at the time of discharge and hospital stay was not considered for final analysis as the duration was not based solely on the clinical condition but also affected by social and demographic factors for the patients.

Conclusion

In our study, Lichenstein's repair under local anaesthesia was found to have lower operative time and postoperative urinary retention and pain scores, which were statistically significant. No statistical difference was noted in the wound-related complications in both groups. Under local anaesthesia, the patient may be asked to cough intraoperatively to locate thin sacs as the abdominal musculature is not paralysed [13]. With some experience, local anaesthesia can be administered by the surgeon himself and this can be a cost-effective alternative in peripheral health centres. With no spinal anaesthesia related complications, Lichenstein's repair under local anaesthesia is appropriate. As our study included 62 patients, studies with a higher sample size may be needed to support our findings.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

Management of ureteropelvic junction obstruction in an era of minimally invasive surgery

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Keywords: Abscess; endoscopic drainage; superficial surgical infections

Introduction

Ureteropelvic junction obstruction (UPJO) is defined as a significant impairment of the drainage of urine from the renal pelvis to the proximal ureter. If not detected early and treated promptly this condition could result in persistence of symptoms spanning from recurrent urinary tract infections (UTI), urolithiasis and eventually complete loss of the affected kidney. UPJO is the most common cause of upper renal tract congenital anomaly. The reported incidence of UPJO may be as high as 1 in 1500 live births evident at routine antenatal ultrasound scan, however not all cases (in fact less than 10%) require surgical intervention.[1] The exact incidence of UPJO is less well-defined in adult population. It is seen more frequently in boys, with up to twice the number of reported cases being males. The left side is affected twice as often as the right side [2].

The aetiology of UPJO can be both congenital and acquired. Congenital causes thus far are more frequent. The primary cause of congenital UPJO is a functional obstruction as a result of ureteral hypoplasia or high insertion of ureter resulting in mechanical obstruction or due to entrapment of the ureter by crossing vessel [1]. An abnormal arrangement of smooth muscles in the UPJ is seen in ureteral hypoplasia. However in majority of cases the ureter is inserted into the most dependent part of the renal pelvis. But when the ureter is inserted high in the pelvis it may cause an acute angulation interrupting the free flow of urine.

Entrapment of the ureter may occur due to crossing of renal vessels, most commonly from an accessary renal artery or a large branching of a lower polar artery resulting in kinking of the proximal ureter and interruption of the free flow of urine. Acquired causes of UPJO may be either extrinsic causes such as retroperitoneal fibrosis, abdominal lymphadenopathy or intrinsic causes such as chronic inflammation due to impacted stones or ureteric tumour.

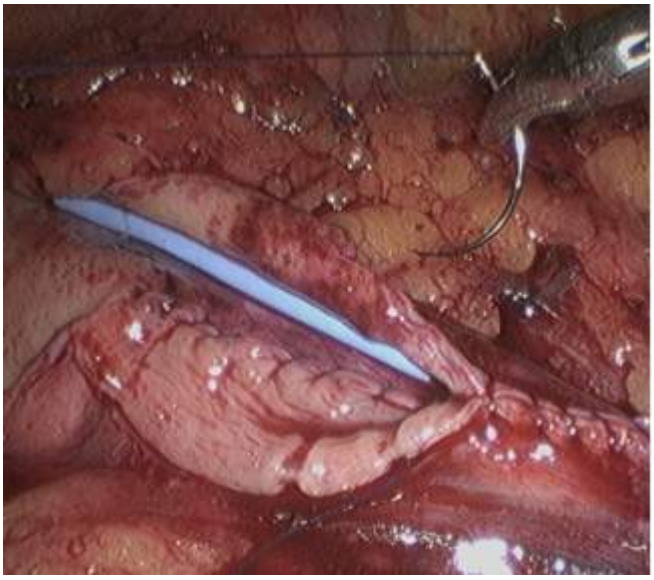

Figure 1. Laparoscopic pyeloplasty in progress with a double J stent in situ

The most successful treatment option for this condition is surgery, which involves excision of the diseased segment and reconstruction of redundant renal pelvis in to a funnel. The first open surgical procedure for UPJO was performed by Trendelenburg in 1886. Shortly afterwards, Fenger found the application of the Heineke–Mickulicz principle. His main application was to create a larger luminal diameter at the UPJO to avoid development of strictures. Various other techniques also evolved over the years. The more common ones being Foley Y-V plasty, Culp and de Weed spiral flap and the Scardino vertical flap [3]. However, the gold standard technique remains dismembered pyeloplasty which was described by Anderson and Hynes in 1951, which is open surgery through a flank incision [4].

In the latter part of 20th century percutaneous and endo-urological techniques emerged for the treatment of UPJO. Endopyelotomy is a technique developed based on a full-thickness lateral incision of the stricture using laser or cold knife. This principle was described earlier by Albarran.[5] Following the procedure, a stent is placed for some time as

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described earlier by Davis in 1943 as a post procedure step. On the other hand endopyeloplasty being a percutaneous technique incorporates the "Fenger-plasty" principle where laparoscopic shears and suturing devices are employed to treat UPJO [6].

Towards the end of the 20th century laparoscopic pyeloplasty become increasingly popular ((Figure 1). Regardless of whichever technique is employed, sound surgical judgment of the aetiology and proper reconstruction of the diseased segment is the critical factor affecting the long-term outcome. The aim of this study was to assess the patients presenting with significant primary UPJO and their outcomes following minimally invasive surgery.

Material and method

Retrospective data were collected and analyzed from March 2014 to December 2020, on a total of 52 patients presenting with evidence of congenital UPJO with significant hydronephrosis. After a detailed history and examination, all patients underwent a CT urogram followed by a Diethylenetriamine Pentaacetic Acid (DTPA) renal scan when indicated.

Patients who were symptomatic and found to have poor renal function evident by less than 5 mm cortical thickness in all three poles in the CT urogram and/or on DTPA scan showing split renal function (SRF) less than 15%, underwent nephrectomy. Patients with recurrence of UPJO with short strictures, underwent laser endopyelotomy while those with long strictures underwent redo-pyeloplasty. Patient who underwent open pyeloplasty were excluded from the analysis. All others who underwent standard Laparoscopic Pyeloplasty (LP) were further evaluated.

Demographically age and gender were noted. Clinical data evaluated included laterality, presentation, operative time and length of hospital stay. Following the surgery improvement of symptoms, renal function and degree of hydronephrosis were assessed. Surgical complications were classified according to the Clavien-Dindo classification.

Patients for laparoscopic pyeloplasty were placed in a lateral decubitus position following general anaesthesia. A 4-port entry technique was employed (two each 10mm and 5 mm trocar). Following a transperitoneal approach the ipsilateral colon was reflected to identify the dilated renal pelvis and the proximal ureter.

The cause of UPJO such as intrinsic stenosis or crossing vessels were identified. Laparoscopically proximal ureter and the renal pelvis were fully mobilized. Depending on the size of the renal pelvis, ureteric insertion and the aetiology, the reconstruction technique was tailored. In the presence of an aberrant vessel the renal pelvis was dismembered with the proximal ureter. The stenotic segment was excised and the ureteric end was spatulated. The enlarged renal pelvis was resected to reduce the size of the pelvis and to improve the urinary drainage as in classical Anderson–Hynes technique. The ureter and the renal pelvis was transposed ventrally to the vessels for complete the anastomosis. When an aberrant vessel was absent a Flap plasty, Y-V plasty (Figure 1) or Fengerplasty was done as required.

In cases of calculi in the pelvic calyceal system, the stones were removed by using laparoscopic grasping forceps. When difficulty was encountered a Flexible cystoscope was introduced through a laparoscopic port in to the renal pelvis and directed towards the stone. The anastomosis was performed using 4/0 PDS or vicryl over a 6F double J stent which was inserted in an antegrade manner. A non-suction drain was selectively placed through the lateral port incision into the perinephric space adjacent to the UPJ. Port sites were closed in a standard manner.

Catheter was removed on day 5 to 7. The stent was removed at 8 to 12 weeks. Follow-up studies were performed with an evaluation for symptom improvement, renal ultrasound and DTPA scan at six months or beyond. Subjective success was considered when there was an improvement of the symptoms. Objective success was considered when evident in an improved DTPA scan. CT urogram was performed when DTPA scan failed to demonstrate a satisfactory improvement. Recurrent UPJO was dealt by laser endopyelolotomy.

Results

Overall, 52 patients with UPJO were enrolled to the study. Eight patients who were symptomatic with SRF <15% on DTPA renal scan with thin parenchymal tissue on CT scan underwent laparoscopic nephrectomy. Two peadiatric patients (age 7 and 9 years) underwent open surgery due to the unavailability of peadiatric laparoscopic instrumentation. In addition, two other patients who had open surgery during childhood underwent laser endopyelotomy. Therefore, excluding those 12 patients, the rest (n=40) underwent standard LP (Table 1).

There was a slight male preponderance with mean age of 32 years. The mean BMI was 24.7 kg m-2. Majority (75%) of the patients were ASA II where 5 (12.5%) patients were CKD stage II. Thirty-three (82.5%) patients were symptomatic with loin pain and/or recurrent urinary tract infections. All patients had a primary UPJO and a significant hydronephrosis with an enlarged renal pelvis. Based on the DTPA renal scan, all had O'Reilly type B curve while SRF <40% was reported in 22(55%) patients.

Right and left sided UPJO were present in 21 and 19 patients,

Table 1. Clinical profile of patients with UPJO

Characteristics		Category	No (range)
Total No of patients			40
Gender		Male	22 (55%)
		Female	18 (45%)
Age (years)			32 (17 - 61)
BMI (kg m^{-2})			24.7 (14.6 – 37.7)
Comorbidities		Renal impairment	5
		Hypertension	9
		Diabetes mellitus	4
		Bronchial asthma	3
		Others	8
Presentation		Imaging detected	7
		Pain	23
		Urinary tract infections	10
Imaging findings	Hydronephrosis of	Solitary kidney	1
		Unilateral kidney	37
		Horse shoe kidney	1
		Lower moiety of a duplex kidney	1
	Other findings	Associate stones	7
		Aberrant vessels	11
	DTPA	$T_{1/2}$ > 20 min	40 (100%)
		SRF < 40%	22 (55%)

Table 2. Outcome following LP

Side	Left LP	19 (47.5%)
	Right LP	21 (52.5%)
Type of surgery		
	Anderson-Hynes	13 (32.5%)
	V-Y plasty	4 (10%)
	Flap technique	22 (55%)
	Fenger	1 (2.5%)
Conversion to open		0
Mean operation time (min)		176 (120-280)
Mean hospital stay (days)		3.5 (2-9)
Complications	Overall	15 (35.5%)
Early (<6 months)	Prolonged drain	2
	Recurrent UTI	7
	Anuria	1
	Port site infection	2
Late complications	Recurrent UTI	3
	Stricture	2
Outcome	Success rate	35 (87.5%)
	Laser Endopyelotomy	2

Table 3. Comparison data with similar studies

	Rass weiler[16]	Moon[17]	Lopez-Pujals[18]	Jarrett[14]	Klingler[19]	Turk[20]	Present study
Patients	143	170	47	100	40	49	40
Approach	RP	RP	TP	RP	TP	TP	TP
Mean op. time (min)	125 (37-368)	140 (58-290)	340 (200-717)	260	NA	165 (90-140)	176 (120-280)
Mean hospital stay (days)	5 (3-10)	3 (2-14)	2 (1-3)	3.3	5.9	3.7 (3-6)	3.5 (2-9)
Complications	6.3%	7.1%	6.4%	12%	2.5%: Stricture 2.5%: Urinoma	2%: Leak	5%: Leak 5%: Stricture
Conversion to open	0.7%	0.6%	2.1%	0	5%	N/A	0
Mean follow up time (months)	63 (3-137)	12	19 (2-55)	11.7	23 (6-42)	23 (1-53)	22 (7-81)
Success	94.4%	96.2%	93.6%	96%	87.5%	98%	87.5%

RP: Retroperitoneal **TP:** Transperitoneal

respectively. There were three occasions where the surgery was technically challenging which included a LP done for a solitary kidney patient, horseshoe kidney and on a lower moiety of a duplex kidney.

Thirteen (32.5%) patients underwent Anderson-Hyens technique where as a crossing lower polar vessel was encountered in 11(27.5%) patients. But in the majority the flap techniques were undertaken where the redundant pelvis was used to widen the UPJ similar to a rotational flap. Seven patients who had renal stones underwent stone extraction. Flexible cystoscopy through the 10 mm port was used to facilitate the stone extraction in difficult cases. (Table 2)

All operations were completed laparoscopically. The mean operative time was 176 min (range 120–280 min). There was no conversión to open surgery. Blood loss was negligible and there was no need for any transfusions despite surgery being done on CKD patients with low baseline haemoglobin levels. Mean post-operative hospital stay was 3.5 days (range 2–9 days). The Foley catheter was removed after 5 to 7 days except in 2 patients and the stents were removed after 8 to12 weeks in the majority.

Overall there were 15(37.5%) complications according to the clavien dindo classification. Majority (30%) were minor complications. Recurrent or persistent UTI was settled with antibiotics and removal of ureteric stent prematurely. Two patients who had prolong drain, of which one was a nephrotic syndrome patient, were managed conservatively with fluid restriction and prolong catheterization. Two other patients develop port site infections and were managed with oral antibiotics. One patient with a solitary kidney developed anuria soon after stent removal. Immediate ureteroscopy revealed the endo button of the suture had migrated down the ureter which was obstructing the lumen. Dormia basket extraction of the button and restenting was done after which he recovered completely.

The mean follow-up was 22 months (range 7 - 81 months). The overall success was 87.5% where all patients who had pain showed a marked improvement of their symptoms. SRF >5% improvement was seen in 11(27.5%) patients while functions remained stable in 27(67.5%) patients. Two patients who had further deterioration of the renal functions were managed with laser endopyelotomy. However, 3 other patients developed recurrent UTIs despite stable renal function, are managed conservatively up to now.

Discussion

UPJO is the commonest congenital abnormality encountered in the ureter. Although the problem is congenital, the clinical presentation occurs late in life. In adults, intermittent abdominal or flank pain which worsens during brisk diuresis (Dietl's crisis) is often the presenting complaint. However some may present with abdominal mass, nausea, vomiting or haematuria following minor trauma. Rarely patients will present with an infection resulting in pyonephrosis. In others, it is an incidental finding following modern imaging [7].

The main aim of investigations is to diagnose the degree and site of obstruction in order to plan treatment options. Diuetric renography using Tc 99m (DTPA) is the commonly used diagnostic tool which shows a type B curve according to O'Reilly [8]. Normally, the time required for the clearance of 50% of the accumulated radionuclide (t1/2) is less than 10 min, while t1/2 of more than 20 min is suggestive of a significant obstruction. Also, DTPA has the added advantage of measuring the glomerular filtration rate. However, MAG3 is the radiopharmaceutical agent of choice for this purpose replacing DTPA in the current era. It provides a better gamma image with low background activity with faster clearance than DTPA. Unfortunately, the cost as well as its availability has been the limiting factor for its frequent use in Sri Lanka. On the other hand, CT or MRI has the added advantage of providing a detailed anatomy of the pelvis and ureter also the presences of aberrant hilar vascular anatomy.

The main aim of treatment is to achieve relief from symptoms and to prevent deterioration of renal function. The indications for surgical intervention include pain associated with infection/stone formation, asymptomatic obstruction with SRF<40%, more than 10% deterioration in SRF during the follow up and grade 3 or 4 renal pelvic dilatations on imaging.[9] However if SRF <15 - 20%, with enlarged renal pelvic diameter (AP length more than 50mm) on imaging, pyeloplasty will not have a significant impact on the UPJO. Therefore, in such instances patients undergo nephrectomy for symptom relief, as in our series.

Over the last century, the surgical options for UPJO has been pyeloplasty, endopyelotomy, endopyeloplasty and nephrectomy. Open pyeloplasty was performed through a lumbotomy or supracostal lateral wall incision. The success rate was >90%, and the procedure has stood the test of time.

The first published laparoscopic pyeloplasty cases date back to 1993, as reported by Schuessler and colleagues [10]. Laparoscopic pyeloplasty, a minimally invasive surgery replicating each step of open surgery provides excellent success rates. The main advantage is avoiding a large and arguably more painful flank incision which may lead to a “flank bulge” due to denervation of muscles which can be prevented. Therefore, laparoscopy provide an added advantage of decreased analgesics requirement, shorter hospital stay, early return to activity and better cosmesis

compared to open surgery.[11]

Both trans-peritoneal and retroperitoneal approaches may be employed in performing laparoscopic pyeloplasty. The preferred approach is usually decided by the surgeon. But many urologists prefer a the transperitoneal approach as it gives a distinct advantage of increased working space and more familiar anatomy as was in our case series.

The pyeloplasty technique may vary. The indication for each technique are identical to that with open surgery. Anderson-Hynes remains as the most popular technique. However other techniques also have shown similar outcomes. Laparoscopic pyeloplasty was not adopted initially due to the technical demand of intracorporeal suturing which is difficult to master to the novice surgeon. Despite the development of easy anastomotic techniques such as endostitch, laser welding and technology such as robotics, surgeons from low middle income countries such as ours do not have access to them. Therefore, it is important to master intracorporeal suturing technique and rely on less expensive suture methods.[12] This lead to longer operative times initially until the surgeon had mastered the technique of intracorporeal suturing.

Table 3 summarizes literature on laparoscopic pyeloplasty including those series of more than 40 patients who were evaluated based on the renograms. Although the reported success rate is above 87% in all these studies, there seems to be no standardized assessment of the outcome. The actual success of therapy therefore should be a measure of the relief of symptoms, increase in SRF >5%, and improvement of renogram pattern at one year follow up.[13] Although long-term follow up data is sparse; generally, failures following laparoscopic pyeloplasty tend to occur within the first year. The average time to failure is around 3 to 11 months (mean =4.6 month).[14] Recurrence following laparoscopic UPJO is around 2 to 5%. The main causes for recurrence are severe peripelvic and periureteric fibrosis due to urine leak, ureteral ischaemia due to extensive dissection, inadequate haemostasis and failing to diagnose lower pole crossing vessels. These patients would require a redo-pyeloplasty, endopyelotomy or ureterocalicostomy. Other common complication included infection and pyelonephritis which can be treated conservatively as in the present study. The overall reported incidence of conversion to open surgery was 0 to 6.4%. Though enodopyelotomy is a less invasive technique its success is 80%. This is best suited for short strictures less than 1.5cm. The ureteric stent must be left in-situ for at least for 8 weeks. Therefore, this procedure is reserved for patients with recurrence after pyeloplasty and for elderly patients.[15,16]

Endopyeloplasty is a rarely used technique where a percutaneous tract made. Using a 26F nephroscope, a standard vertical incision is made and horizontal suturing is done. In the present day it is rarely used, as it does not provide a definitive treatment.

Nephrectomy is indicated for missed UPJO with poorly functioning kidney which are symptomatic. If an accessory crossing vessels if found during nephrectomy there is heightened concern of a contralateral crossing vessel of the remaining kidney. Thus, close follow-up of the opposite kidney with ultrasonography is recommended.

Laparoscopic pyeloplasty along with robotic pyeloplasty have gained popularity globally. These minimally invasive techniques have now become the surgical treatment of choice for UPJO. As this laparoscopic technology is still in its infancy in many centers in Sri Lanka, the number of patients in this series also remains small. With the development and advent of new laparoscopic urology centers in the country, we are likely to witness their incorporation as standard care for UPJO, resulting in better patient outcomes.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

Morphological variations of lung lobes and fissures: a preliminary study

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Keywords: Pulmonary; lobes; fissures; anatomy; morphology; cadaveric

Abstract

Introduction

Anatomical variations of the lung lobes and fissures have implications in diagnostic radiology and thoracic procedures. The prevalence of these variations is not reported in Sri Lanka.

Methods

A cross-sectional study was conducted on cadavers to assess the morphological variations of lung lobes and fissures. The presence and absence of lung lobes and fissures were reported in addition to describing the completeness of the major lung fissures.

Results

A total of 24 lungs in 12 cadavers were studied. Inferior accessory fissures were noted in one right and one left lung of two independent cadavers. Two cadavers had no horizontal fissures, and one left lung had an incomplete oblique fissure posteriorly. Azygos lobe was not observed in this study sample.

Conclusions

The morphology of lung lobes and fissures demonstrate a notable variability, on par with previous reports. Further studies with a large sample size in our population are necessary for generalizable results.

Introduction

During the embryonic development of the lung, the visceral pleura folds into the obliterating spaces surrounding lobar bronchi, forming lung fissures. The oblique fissure of the left lung separates it to the upper and lower lobes. The right oblique fissure separates the right middle lobe from the right lower lobe while the horizontal fissure separates the right upper lobe from the right middle lobe. However, the separation of these lobes by the said fissures is often incomplete in contrast to the textbook descriptions [1]. Moreover, accessory fissures are formed due to the anomalous development of the lung. The presence of incomplete or accessory fissures is associated with the anatomical variations of the lung lobes, which adds to the complexity of the lung morphology.

Knowledge of the anatomical variations of the lungs is important for the radiologists to interpret radiographs, for the thoracic surgeons to plan segmental resections/lobectomies and for the bronchoscopists in minimally invasive endoscopic procedures. The reported prevalence of morphological variations of the lung lobes and fissures vary widely in different populations [1]. Despite these variants being well reported in the literature, to our knowledge, there are no publications about a Sri Lankan population. Thus, in this preliminary study, we intended to describe the frequency of morphological variations of the lung lobes and fissures in a Sri Lankan population.

Methods

This descriptive cross-sectional study was conducted at the Department of Anatomy, Faculty of Medicine, University of Colombo. Consent to conduct studies on the self-donated cadavers was obtained from the next of kin. The study protocol conformed to the guidelines set out by the Declaration of Helsinki.

A sample of adult cadavers of Sri Lankan origin was selected using simple random sampling. Cadavers with a history of lung malignancies, pulmonary tuberculosis, congenital malformations, and those who underwent thoracic surgeries were excluded from the study. Cadavers were fixed with phenoxyethanol mix as described in detail elsewhere [2]. Two incisions were made bilaterally along the mid-axillary lines. The anterior thoracic cage was removed after cutting the clavicles at their midpoints and ribs along the mid-axillary lines. Bronchi were transected approximately 1 cm proximal to the hila and the lungs were removed from the thoracic cavities. Subsequently, lungs were inspected for anatomical variations. Fissures were categorized as complete, incomplete, or absent. The presence or absence of accessory fissures or lobes were also reported.

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Results

A total of 24 lungs in 12 cadavers were studied. Male: female ratio was 1:1. The age of the cadavers ranged from 34 to 86 years. The anatomical variations of major lung fissures and lobes in the study population and a gender-based contingency table are provided in Table 1 and Supplementary Table 1, respectively. Inferior accessory fissures were noted in one right and one left lung of two different cadavers [Figure 1]. Two cadavers had no horizontal fissures [Figure 2], and one left lung had an incomplete oblique fissure posteriorly [Figure 3]. Azygos lobe was not observed in this study sample.

Figure 1. Inferior accessory fissure [black arrowhead].

Figure 2. Absent horizontal fissure

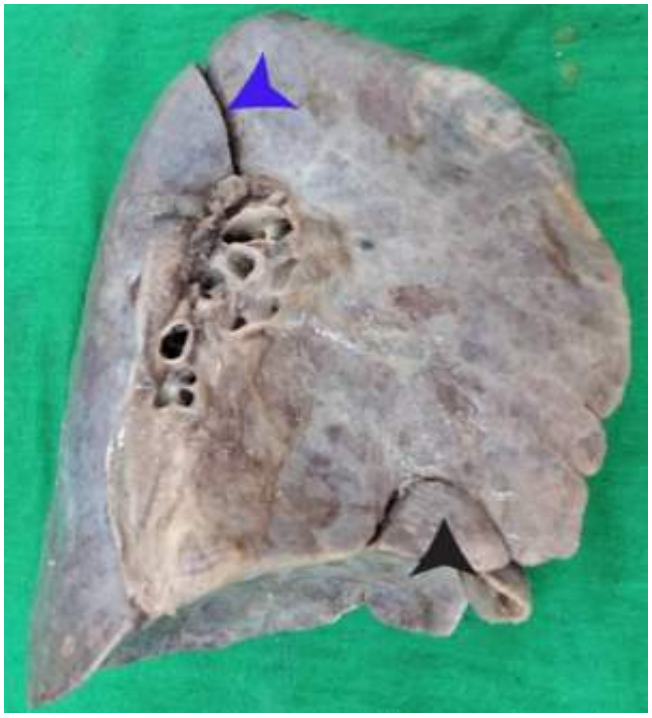

Figure 3. Incomplete oblique fissure [blue arrowhead] and an accessory lobe [black arrowhead]

Table 1. Variations of the major lung fissures and lobes [N=12 patients]

			Right Lung	Left Lung
Fissures	Horizontal	Incomplete	0	N/A
		Absent	2 [17%]	N/A
	Oblique	Incomplete	0	1 [8%]
		Absent	0	0
	Accessory Fissures		1 [8%]	1 [8%]
Lobes	Accessory lobes		3 [25%]	1 [8%]

Discussion

Pioneering cadaveric studies by Medlar in 1947 shed light on morphological variations of the lung lobes and fissures [3]. With the understanding of the importance of such variations in planning thoracoscopic surgeries, numerous anatomists and clinicians attempted to consolidate the patterns of these morphological variations. To provide a framework for such surgical procedures, in 1997, Craig and Walker proposed an extensive anatomical classification of the pulmonary fissures [4]. This comprehensive classification incorporated not only the presence or absence of fissures but also their completeness.

In our study, oblique fissures were present in all cadavers, with only one left oblique fissure being incomplete. This finding is consistent with the majority of previous reports, where oblique fissure was consistently noted, with at least 50% of the oblique fissures being complete [see Supplementary Table 2]. However, incompleteness of the

oblique fissure was more commonly noted anteriorly [1, 5] in contrast to our finding where it was deficient posteriorly. The frequency of absent horizontal fissure was on par with the previous reports.

The commonest morphological variation of the lung is accessory fissures [6]. We noted 8% of the cadavers had accessory fissures, while all of them were inferior accessory fissures surrounding the medial basal segment [S7] of the lung. This, too, is in accordance with the literature where inferior accessory fissures are found commoner than superior accessory fissures [6-8]. Intriguingly, however, we did not observe left accessory fissures delineating azygous lobes in our study despite it being reported to be very common in certain populations [1, 8, 9].

Knowledge of common anatomical variations of the lung lobes and fissures is important for radiologists since the presence of accessory and incomplete fissures are well known for confusions in interpreting radiological images, particularly pleural effusions and mass lesions [6, 10, 11]. The appearance of fluid tracking may be obscured along the incomplete fissures in pleural effusion [12]. Diagnosis of endobronchial mass lesions may be delayed in the presence of incomplete fissures where the distal lung collapse may not occur when the adjacent lung segments are communicating with each other through the incomplete fissure [11], a phenomenon known as "collateral air drift" [10]. Accessory lung fissures could be mistaken for consolidation or atelectasis.

Anatomical variations of the fissures and lobes have implications in segmental resections and lobectomies. The degree of completeness of lung fissures is reported to be associated with short-term postoperative complications following segmental resections and lobectomies for non-small cell carcinoma of the lung [13] and minimally invasive endoscopic procedures for emphysema [14]. Notably, incomplete major lung fissures lead to air leaks following segmental resection [10]. Thus, the presence of incomplete lung fissures warrants the thoracic surgeon to examine these regions carefully during lung resections to ensure the incomplete fissures are stapled adequately when separating conjoint lobes [11]. Similarly, additional lobectomies may be necessary during lung resections for malignant neoplasms if the tumour occurs in a region with an incomplete fissure [1]. The presence of incomplete fissures is also associated with poor long-term surgical outcomes of curative resections for early adenocarcinoma of the bronchus [9, 15]. Moreover, infections could easily spread between the adjacent lobes due to the presence of incomplete fissures [11].

Limitations

There is an ongoing debate where post-mortem changes and fixation with formaldehyde could lead to overestimation of the incompleteness of the lung fissures [1]. The results of phenoxyethanol fixatives on this are less clear. Because of this reason, we did not intend to report the absolute lengths or the degree of incompleteness of the fissures. Moreover, this was a preliminary study, where the sample size was limited.

Conclusions

The morphology of lung lobes and fissures demonstrate a notable variability, in par with previous reports. Further studies with a large sample size in our population are necessary for generalizable results.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

Pilot study to assess the role of minimal access surgery in the management of superficial surgical infections

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Keywords: Abscess; endoscopic drainage; superficial surgical infections

Abstract

Introduction

The standard treatment for an abscess since time immemorial has been Incision and Drainage [I&D] without primary closure at most sites. Post-I&D, pain and ugly scar are the most common complaints in these patients. In this study, we have evaluated the role of minimal access surgery [MAS] in the management of superficial surgical infections.

Materials and methods

This was a prospective study, comparing the clinical and cosmetic outcomes of patients undergoing conventional I&D of superficial abscesses and those undergoing MAS [5mm incision for a port of 5mm diameter] drainage.

Results

A total of 50 patients were recruited, out of which 2 patients had a spontaneous rupture. 25 patients underwent I&D and 23 underwent MAS drainage. The mean age was 35.8 ±13.5 years, mean size of the abscess was 6 ± 1.9 cm. Baseline characteristics like age, sex distribution, duration of symptoms, size of the abscess and volume of the pus drained were comparable between the two groups. Resolution of pain and redness was achieved earlier in MAS drainage compared to conventional I&D. Resolution of induration was statistically insignificant. Duration of the need for dressing and duration of return to daily activity was less with MAS drainage. Scar size was significantly less in the MAS drainage group. Staphylococcus aureus was the most common organism isolated, and both groups had comparable rates of complications and recurrences.

Conclusion

Our study has shown that MAS drainage offers earlier recovery along with better cosmetic outcomes.

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Introduction

Wounds and abscesses have been recognized even in ancient history; the earliest recorded evidence being found in historic Greco-Roman texts [1]. Incision and drainage [I&D] with or without antibiotics have generally been considered an adequate treatment modality for abscesses. This is however associated with postoperative morbidity like requiring repeated dressings and scar related problems. Ultrasound-guided aspiration is another frequently used modality that offers several advantages like cosmesis, and a less morbid postoperative course. However, patients may require multiple sessions for complete resolution of the abscess. Minimally access surgery [MAS] drainage marks a paradigm shift in the treatment of superficial surgical infections.

In this study, we have evaluated the role of minimal access drainage in breast, perianal and gluteal and other superficial abscesses and found that MAS drainage offers added advantage of direct visualization of the abscess cavity, the walls of the cavity [diagnostic], thereby aiding in the scraping of the walls [therapeutic] of the abscess cavity. There is little documented literature available for MAS drainage of superficial infections. This is the first pilot study to assess the role of MAS drainage in the management of superficial infections.

Materials and methods

This study was a single centre, in hospital, prospective, clinical interventional, comparative, cohort study. A formal ethical clearance was taken before the conduct of the study. All the patients visiting the surgery outpatient department/casualty at our tertiary care academic institute were recruited under the study protocol. A total of 50 patients were recruited in the study, out of which 2 patients had spontaneous rupture of the abscess and were thus excluded. Patients aged 18 – 65 years, with superficial abscesses of >3 cm size, were included. Pregnant, hemodynamically unstable patients were excluded from the study. All the patients underwent routine blood investigations, pre-anaesthetic check-ups, ultrasonography of the abscess. All procedures were performed under general anaesthesia. The patients were divided into two groups: group A: conventional I&D and group B: MAS drainage. Their distribution was done based on chits kept inside sequentially numbered opaque envelopes

bearing either of the names [following the allocation concealment procedure] [2].

Patients were divided into two groups:
Group A: conventional I&D – 25 cases
Group A1: breast abscess – 10 cases
Group A2: anorectal abscess – 12 cases
Group A3: others – 3 cases – one case each of inguinal, back, and anterior abdominal wall abscess.

Group B: MAS drainage – 23 cases
Group B1: breast abscess – 14 cases
Group B2: anorectal abscess – 9 cases
Group B3: others – no cases were present in this group.

Perioperatively all the patients were empirically given amoxicillin + clavulanic acid, 1.2 G IV or 625 mg oral TDS and metronidazole 400 mg IV or 500 mg oral TDS, and antibiotics were changed according to the culture report, once available.[3]

Patients in group A: Under General anaesthesia, with aseptic precautions, the abscess was examined, and the most fluctuant point was marked with a sterile marker. The adequately sized incision was made over the point of maximum fluctuation. All the pus contained in the abscess cavity was drained out and sent for microbiological study [gram stain and culture]. Septations were broken down using blunt dissection using finger or sinus forceps. Thorough wash was given using warm Normal saline. The cavity was packed with betadine-soaked gauze with no drains. The wound was left open for continuous drainage and healing by secondary intention.

Patients in group B: Under general anaesthesia, with aseptic precautions, the abscess was examined, and the most fluctuant point was marked with a sterile marker. A 5mm small stab incision was made at the point of maximum fluctuation. Now, a single 5 mm port was inserted [figure 1] and egress of the pus was aspirated [figure 2] and collected for pus culture and sensitivity. The abscess cavity was visualized using a 5 mm 0°-degree telescope [figure 3]. A suction cannula was inserted through the 5-mm port and any remaining pus was aspirated. The abscess cavity was washed with normal saline repeatedly until there was a clear return.

CO2 insufflation was performed at low pressure of 5mm of Hg, to expand the cavity for better visualization. When all the pus had been drained, septations were broken down Maryland forceps blindly. The abscess cavity was visualized again for any remaining septations for confirmation of completion of the procedure. A repeat normal saline wash was given in the end. A 14 fr closed suction drain was inserted through the same incision site and CO2 gas was allowed to escape. The incision site was closed over the drain using 2-0 silk sutures.
Post-procedure the wound was examined for resolution of redness and induration. Drain output [if present] was monitored. It was decided that in case of failure of resolution of the abscess after primary operation, the second operation if needed would be I&D. Patient satisfaction was analyzed concerning the size of the scar, and duration of time to resume normal activity. These patients were followed up for 90 days postoperatively. Scars after both the procedures are shown in figures 4 and 5.

Results
The mean age in group A was 36.2 ± 13.6 years group B was 34.4 ± 11.4 years. Group A had 56% female patients and Group B had 74% female patients.

1. Resolution of pain:
The duration to the resolution of pain in both the groups remained around 6 days with no statistically significant difference, as shown in table 1.

2. Resolution of redness:
Redness resolved earlier in the MAS group as compared to the I&D group. Sub-group analysis revealed significant differences amongst patients with breast abscesses. However, no such difference was observed in patients with another abscess group as shown in table 2.

3. Resolution of induration:
There was no statistical difference concerning the resolution of induration in both groups as depicted in table 3.

4. Duration of dressing:
Patients in the MAS drainage group required dressing for a shorter duration of time [7.7 days v/s 8.7 days, p = 0.007] as compared to the I& D group. A significant difference was noticed in the breast abscess group but not in the anorectal abscess group. [Table 4.]

5. Duration of hospital stay:
Both groups of patients required hospital care for about 2 days which was statistically insignificant, as shown in table 5.

6. Return to daily activities:
There was no significant difference in the time taken to return to daily activities, about 7 days in each group as shown in table 6.

7. Size of scar:
The size of the scar was significantly smaller in the MAS group against the conventional I&D group, as shown in table 7.

Table 1. Resolution of pain in days

Site	Group A: Conventional I&D (days)	Group B: MAS drainage (days)	P value
Overall	6.8 ± 2	5.8 ± 1.5	0.15
Breast abscess	6.7 ± 1	5.6 ± 1.6	0.68
Anorectal abscess and others	7.4 ± 2.5	6.2 ± 1.5	0.50

Table 2. Resolution of redness in days

Site	Group A: Conventional I&D (days)	Group B: MAS drainage (days)	P value
Overall	5.8 ± 1.5	4.5 ± 1	0.004
Breast abscess	6.6 ± 1.6	4.4 ± 1	0.002
Anorectal abscess and others	5.4 ± 1.3	4.6 ± 1.1	0.19

Table 3. Resolution of induration

Site	Group A: Conventional I&D	Group B: MAS drainage	P value
Overall	6 ± 1.6	6.7 ± 1.1	0.10
Breast abscess	6.7 ± 1.1	6.6 ± 1.5	0.92
Anorectal abscess	5.9 ± 2	6.9 ± 0.6	0.14

Table 4. Duration of dressing in days

Site	Group A: Conventional I&D	Group B: MAS drainage	P value
Overall	8.7 ± 2.1	7.7 ± 1.5	0.007
Breast abscess	8.3 ± 2	6.9 ± 1	0.04
Anorectal abscess and others	8.9 ± 2.3	7.7 ± 1.9	0.36

Table 5. Duration of hospital stay in days

Site	Group A: Conventional I&D	Group B: MAS drainage	P value
Overall	2.8 ± 1.2	2.5 ± 1	0.37
Breast abscess	2.1 ± 0.7	2.1 ± 1	1
Anorectal abscess	3.6 ± 1	3.1 ± 0.78	0.25

Table 6. Return to daily activities in days

Site	Group A: Conventional I&D	Group B: MAS drainage	P value
Overall	7.8 ± 3.2	6 ± 2.3	0.08
Breast abscess	5.6 ± 1.2	5.1 ± 1.5	0.43
Anorectal abscess	9.7 ± 3.1	7.6 ± 2.7	0.12

Table 7. Size of scar

Site	Group A: Conventional I&D	Group B: MAS drainage	P value
Overall	3.4 ± 0.6	0.7 ± 0.2	<0.05
Breast abscess	3.7 ± 0.8	0.75 ± 0.2	<0.05
Anorectal abscess	3.4 ± 0.6	0.6 ± 0.2	<0.05

Discussion

An abscess is a localised collection of pus or fluid that is walled off due to local tissue reaction. It is a part of the defence mechanism of the body against infective organisms wherein, the body walls off a local inflammatory reaction. This does not allow infection to spread elsewhere. However, it hinders the action of antibiotics.

Breast abscess

The incidence of lactational breast abscess is approximately 0.4 to 11 % [4]. They develop following mastitis in 5%–11% of the patients [8]. Non-lactational abscesses are more common in obese and smokers because of periductal mastitis [5]. The usual signs of a breast abscess include redness, warmth, tenderness and swelling. [6]

Ultrasonography has been described as a primary investigation of choice in patients having an abscess or signs of acute inflammation. The presence of interstitial fluid and hypoechoic wall of abscess cavity is diagnostic of breast abscess. Patients without such signs can be managed with antibiotics alone. The presence of abscess mandates the need for surgical intervention [9].

The commonest organisms found in mastitis and breast abscess are coagulase-positive Staphylococcus i.e, Staphylococcus aureus and Staph. Albus [7]

A study by Chandika et al [2012] randomized patients into 2 groups: USG guided aspiration with 16G needle v/s I&D under general anaesthesia. All patients received tablet

Cloxacillin 500mg TID for 10 days. 65 patients over 14 years of age and with abscess size > 5cm were recruited, 93.1% were cured with a single aspiration while 6.9% required re-aspiration. There was no conversion to I&D, with the mean duration of healing of 24 days in each group [10].

Naeem et al randomized patients into Aspiration v/s I&D. All patients received amoxicillin + clavulanic acid 625mg TID and metronidazole 400mg twice daily until culture reports were available. Pregnant patients and abscesses >5cm were excluded from the study. With 32 patients in each group, 18.8% in the aspiration group required 2 aspirations and 34.4% required multiple aspirations. Mean healing time was 45 days in the I&D group against 19 days in the aspiration group. [11]

We could not find any studies related to minimal access drainage for the treatment of breast abscess. Our study is a pilot study to assess the role of minimal access drainage of breast abscesses.

Perianal abscess

Among all anorectal pathologies, abscesses account for 0.4%, and fistulas account for 0.8% [12]. Perianal abscess like other abscesses requires surgical drainage for adequate drainage and faster recovery. Superficial abscesses can be drained in the emergency room, but higher and deeper abscess requires regional or general anaesthesia for proper examination and drainage. There is no role of 'antibiotic alone' therapy as part of conservative management and all abscesses must be drained either by I&D or other means.

Wright [13] et al compared the minimally invasive technique to open incision and drainage. In their study, I&D was performed on 329 children. 60.2% of the abscess occurred in the groin/ perineal region. 202 patients underwent conventional I&D and packing and 127 [38.6%] underwent minimally invasive drainage. Median length of hospital stay decreased from 2 days [IQR 1-2] in conventional group to 1 day [IQR 1-2] in the MAS group [$p < 0.001$]. there was also a decrease in the total hospital costs with the use of the MAS technique [$p < 0.001$].

Safety et al [14], used a MAS approach in pediatric patients for perianal abscesses. They found lesser pain postoperatively and similar efficacy to conventional I&D. The authors excluded patients less than 18 years of age, those suffering from inflammatory bowel and fistulae. There was no difference between both groups as far as the rate of recurrence, readmission, hospital stay, or total cost were concerned. The traditional group [46 patients] had more postoperative complications. [$p < 0.01$]. The MAS group had 96 patients with lesser complications and better compliance.

Gaszynski et al [15] performed a study on 63 patients with subcutaneous abscesses. All 27 patients in the incision and drainage group required general anaesthesia and 10 were lost to follow up. MAS group had 36 patients and 27 required general anaesthesia. The rate of compliance was 100%.

Data regarding the comparison between minimal access surgery and incision and drainage in the Indian population is still lacking in number and quality.

This study has shown that MAS drainage offers a good cosmetic outcome and earlier resolution of symptoms in the breast abscess group though no significant difference was observed in the anorectal abscess group. The wound size is smaller and dressing time is lesser after MAS drainage. In MAS drainage we can directly visualise the abscess cavity via a telescope and ensure that all loculi are broken. This might result in faster healing and recovery. The loculi are broken via a trocar and with a scope using blunt dissection similar to that in conventional I&D. Visualisation with the scope is necessary to ensure that all loculi are addressed to prevent recurrence and early recovery. In our study, the difference in the period of dressing is around 1-2 days. The size of the scar differs from about 2.5 cm between the two groups. A smaller wound should heal faster which was consistent with our results. The difference in the period was 1-2 days which is not too high. A wound of 3-5 cm is itself a small wound, which might have resulted in a lesser difference in the period between a 0.7cm wound and a 3.4cm wound to heal. Although it was a randomised study, there are confounding factors including patient factors and environmental factors which play a role and is a limitation of this study. MAS drainage should be considered as a treatment option for breast abscesses and non-inferior to conventional I&D for treatment of anorectal and other superficial subcutaneous abscesses. Although we did not evaluate the cost difference among the two procedures, the MAS drainage is likely to be costly as compared to conventional I&D. However, some patients might prefer MAS drainage if given the option of both MAS and conventional I&D. Further, over time MAS drainage might become the standard of care resulting in its incorporation in government hospitals where the cost might not be an issue at least for the patient.

Conflict of interest statement: The authors declare that they have no conflicts of interests or financial ties to expose. Written informed consent was taken from each patient before the procedure. The study was performed with prior ethical approval from the institute ethics committee.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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SCIENTIFIC ARTICLE

First paediatric live donor liver transplant in Sri Lanka with 1 year outcome : challenges for the future

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Keywords: Liver transplantation; child; live-donor; paediatric

Abstract

Introduction

Liver transplantation in the paediatric age group is demanding due to smaller body proportions and physiology. This paper describes the first successful paediatric liver transplant in Sri Lanka along with its one-year outcome. Describing the challenges faced during the process, we highlight the factors that need to be considered for a sustainable programme in the future.

Methodology

A 9-year-old girl who had progressive familial intra hepatic cholestasis type 3 was referred to us with features of end stage liver disease. She was identified as a suitable candidate for liver transplantation. Her 38-year-old mother was selected as the donor, who was evaluated for suitability of a left lateral segment donation.

Results

The first paediatric liver transplantation was performed in July 2020. The child's mother donated the left lateral segment weighing 325g. During the postoperative period the child developed outflow tract obstruction at the hepatic venous anastomosis. This was managed with a percutaneously placed stent. Six months after transplant, she developed an acute rejection that required steroids. Treatment of rejection was complicated with multiple liver abscesses caused by Aspergillus. The infection was treated with systemic antifungals and drainage. At one-year post transplant, the recipient had recovered from the trauma of surgery and had normal liver biochemistry, a patent hepatic venous stented anastomosis and complete resolution of the abscesses. We faced dual challenges in dealing with a live liver transplant donor and a young child who was the recipient. Our success, on this occasion, was underscored by the multidisciplinary contribution from specialists scattered across the island combined with state-public partnership.

Conclusion

To offer a sustainable live donor liver transplant service for the future, many other aspects, beyond surgery itself, need to be addressed.

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Introduction

Liver transplant [LT] is the ultimate cure for many paediatric liver diseases. Biliary atresia is the commonest primary aetiology requiring LT in children across the world. Among the rest, autoimmune liver disease, metabolic and genetic liver diseases such as Wilson disease, progressive familial intrahepatic cholestasis and liver malignancies predominate [1,2]. Paediatric liver transplant [PLT] is demanding due to the inherent nature of smaller body proportions. The history of paediatric liver transplant dates back many decades in affluent countries with over 85% five-year survival being reported worldwide [3,4]. This first successful paediatric liver transplant in Sri Lanka [SL] was performed in 2020, a decade after the first adult liver transplant was performed in SL [5]. We share our experience of the first PLT at the completion of the first post-transplant year while looking at how the future for a sustainable PLT programme could be achieved in the country.

Presentation

A 9-year-old girl from Jaffna, diagnosed with end-stage liver disease due to progressive familial intrahepatic cholestasis type 3 was referred for LT. She was diagnosed with chronic liver disease at two and a half years of age. Since the age of 8, she had experienced several episodes of liver decompensation including hepatic encephalopathy, and was frequently hospitalised. Though she was identified as a candidate for LT, there was no paediatric liver transplant service existing in SL at that point of time. However at age 9 years, she was referred to the Colombo North Centre for Liver Diseases for consideration for liver transplant. On examination, she exhibited growth failure, was jaundiced and had early clubbing. Her liver function was impaired with INR, albumin and bilirubin being 2.35, 1.9 g/dL and 169 micromol/L respectively. Following initial assessment and medical optimisation, she underwent comprehensive assessment for the suitability for LT.

Following multidisciplinary discussion, she was listed for LT as she was identified as stable to withstand surgery in the absence of contraindications for LT.

Assessment of the donor

Following detailed evaluation, the child's 38 year old healthy mother with a BMI of 22 kg/m2 was selected as the donor. Donor evaluation was carried out in two phases; initial assessment included the donor's vital organ assessment and psychological fitness for surgery. Next, liver anatomy and function were evaluated in detail. The liver attenuation index and fibro scan were used to exclude fatty liver. The donor's biliary anatomy showed favourable features for left lobe donation [6] – the segment IV biliary duct drained to the right side. The left duct was 2 cm in length. The left portal vein had a long extra hepatic path. The left hepatic artery was 3 mm in diameter and had a lower division. There were no sizable branches arising from left artery. The middle hepatic vein joined the left and the common trunk, which had an extra-hepatic course. Segment II and III veins joined to give a 1.2 cm common opening. The total estimated left lateral section volume was 230 ml [23% of the total donor liver volume].

Surgery and follow-up

Surgery was carried out in July 2020 at the Colombo North Teaching Hospital, Ragama. Specialists from the Lady Ridgway Hospital, National Hospital of Sri Lanka, Teaching Hospital Peradeniya and General Hospital Chilaw worked together as a team. The left lateral liver graft with part of segment IV weighing 325g was harvested from the donor after 6-hours of surgery with a 250 ml blood loss.

The native liver explantation took 4 hours with a blood loss of 175ml. Total implantation took 40 minutes. Left hepatic vein-caval anastomosis was performed with 6/0 polypropylene without triangulation. Portal vein anastomosis was completed with 6/0 polypropylene. The hepatic artery was anastomosed with 8/0 polypropylene using visual magnification of 4.5. Duct-to-duct biliary anastomosis was done with 6/0 polydiaxone [figure 1]. Total surgery time was 8 hours. While the donor was managed at North Colombo following surgery, the recipient was extubated and transferred to a neighbouring private hospital for postoperative intensive care. The first 24 hours following operation was stormy and required high dose inotropic support, which was later tailed off.

The child continued to have high ascitic drainage in the postoperative period. Subsequently, doppler study and a hepatic venogram revealed hepatic venous outflow obstruction with a significant pressure gradient. Thus, on postoperative day 53, she underwent percutaneous stenting of the hepatic venous anastomosis by our interventional radiology team [figure 2].

Six months following surgery, the patient's liver function started deteriorating and a liver biopsy revealed moderate rejection. Rejection was managed successfully with methylprednisolone. With increased immunosuppression, the patient developed multifocal liver abscesses yielding Aspergillus species. The liver abscesses were treated successfully with antifungals and aspiration. At one year post transplant the child had good graft function and showed satisfactory catch-up growth.

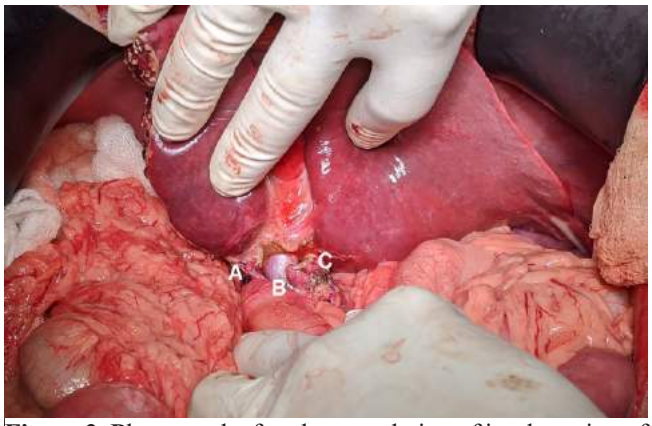

Figure 2. Photograph after the completion of implantation of left lateral section.
A - Bile duct **B -** Portal vein **C-** left hepatic artery

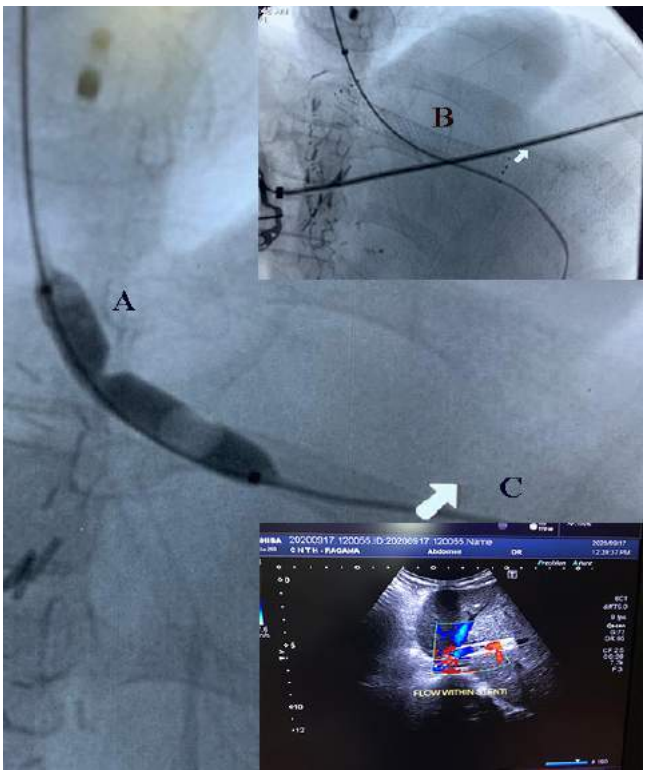

Figure 2.
A - fluoroscopy image showing the kink in the balloon placed across the left hepatic vein anastomosis,
B - stent placed across the anastomosis,
C - blood flow after placing the stent.

Discussion

Liver transplantation is one of the most expensive surgical procedures, especially when recovery becomes protracted, like in our patient. The current estimated cost of liver transplant is between 10 and 12 million Sri Lankan rupees. Being a low middle-income country, a large majority of our patients cannot afford this financial burden. Transplant programs established in private institutions will not cater to the needs of the large majority of Sri Lankans. In India, alhough liver transplantation has flourished, all top-rated liver centres are run by private institutions, which cater to overseas patients and local patients with financial resources [7].

The child we report was from an extremely poor socio-economic background, unable to afford private medical care. Though the surgery was performed in the non-fee levying state health sector, there were many other costs implications in the care of this patient; several trips from Jaffna to Colombo, lodging and treatment, especially during the time of protracted recovery. Fortunately, the junior members of our team who came to the fore, carried out an online patient support campaign to fund the child while the corporate hospital provided free postoperative intensive care. These multiple commercial support inputs eventually helped us overcome the challenges we faced after the transplant. A system that will utilize the goodwill of the general public and ensure continued support of the corporate sector will need to be fostered to fill the gap between demand and available free health care resources to make liver transplantation successful in selected public institutions for the benefit of the majority [8].

The first PLT was performed 10 years after the first successful adult liver transplant in SL [5] and reflects the challenges faced by a fledgling transplant program. The challenge was to bring together liver surgeons, adult and paediatric anaesthetists, paediatric hepatologists, interventional radiologists and liver-trained pathologists, who worked in different parts of the country, under one umbrella. At present, because there is no dedicated liver transplant institution, trained specialists are scattered in different parts of the country. Even though the first PLT was performed, the real challenge remains, which is to deliver a sustainable service. At present, for successful outcomes, it is essential for individuals of multiple disciplines to work in harmony and supporting each other. This report is a case in point. Eventually, with the increasing numbers of trained personnel and with greater experience, individual centres will become a flourishing reality.

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All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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REVIEW ARTICLE

Fifty liver transplants: a single centre experience of haemodynamic management in liver transplantation for cirrhosis [part 2]

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Keywords: Liver transplantation; cirrhosis; non-alcoholic fatty liver disease; alcohol related liver disease

Abstract

Globally, an estimated one million deaths occur annually due to complications of cirrhosis. Cirrhosis with end stage liver disease [ESLD] is a leading cause death due to non-communicable diseases in Sri Lanka. Non-alcoholic fatty liver disease [NAFLD] and alcohol related liver disease [ARLD] are the principal causes of ESLD due to cirrhosis in Sri Lanka. Liver transplantation remains the only curative treatment for such patients. Multiorgan dysfunction and hemodynamic instability characteristic of ESLD adds to the complexity of perioperative care in liver transplantation. Maintenance of stable hemodynamics including optimal hemostasis forms the core of the anaesthetic strategy in liver transplantation.

1. Introduction

Advances in hemodynamic management have contributed significantly to excellent outcomes following liver transplantation for ESLD in high volume centers. Despite limited resources the team at CNCLD strives to adopt an evidence-based approach to haemodynamic management in liver transplant. This approach coupled with innovation and perseverance have been key factors which enabled the team at CNCLD which carried out the first liver transplant in 2011, achieve the milestone of fifty liver transplants in 2020..

2. Haemodynamic monitoring

Haemodynamic instability [HDI] during liver transplant [LT] is a risk factor for major adverse cardiovascular events, graft dysfunction and death. Multiple factors including fluctuations in cardiac preload, contractility, afterload, arrhythmia, electrolyte disturbance, and factors related to the graft result in HDI.

Monitoring of invasive arterial and central venous pressure, urine output, blood gases, lactate, electrolytes, and coagulation supplemented by advanced hemodynamic monitoring is essential to identify and treat HDI during LT.

The pulmonary artery catheter [PAC] remains a valuable tool particularly in patients with porto-pulmonary hypertension . Mixed venous oxygen saturation though traditionally used as a measure of oxygen supply-demand balance, correlates poorly with cardiac output in liver transplantation.

Trans-esophageal echocardiography [TEE] is used owing to its versatility in providing real-time information on intra cardiac flow, volume and pressure, structure, function, and the presence of embolic material. This information is not readily available with other types of haemodynamic monitors. The inability to measure rapid changes in pulmonary and systemic vascular resistance are significant limitations of TEE. Access to PAC and TEE at CNCLD is limited by cost and logistical factors.

Calibrated pulse wave analysis based hemodynamic monitors e.g., PiCCO [Pulse index continuous cardiac output], LiDCO plus [Lithium dilution cardiac output] provides clinically useful information in the setting of LT. Rapid changes in vascular resistance and the presence of vasoactive drugs in LT, limits the usefulness of uncalibrated pulse wave analysis-based monitors including Flowtrac®. Esophageal Doppler cardiac output monitor is a useful adjunct to other advanced haemodynamic monitors in stable cirrhotics . Due to limited resource a combination uncalibrated cardiac output monitors, Flowtrac® or LiDCO rapid® and esophageal doppler are used to guide hemodynamic therapy for LT at CNCLD. Delays in procuring disposables limits our ability to use a uniform monitoring protocol.

3. Haemodynamic management

Specific strategies are required to manage hemodynamic derangement unique to the pre-anhepatic [dissection], anhepatic and reperfusion phases. A goal directed strategy targeting volume responsiveness, cardiac output and stroke volume is associated with a less positive fluid balance, reduced duration of post-operative ventilation and reduced length of ileus . A restrictive fluid strategy combined with vasopressors, facilitates low central venous pressure [CVP], reduction of portal venous pressure, intraoperative bleeding,

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pulmonary complications, duration of ventilation and length of ICU stay . The haemodynamic strategy adopted at CNCLD aims to achieve haemodynamic goals utilizing the minimum volume of intravenous fluid and blood products in combination with vasopressors and inotropes.

4. Intravenous fluid

The potential benefits of a restrictive fluid management strategy in LT are well recognized . Balanced salt solutions are the preferred crystalloid in LT . Solutions with a high sodium content should be used with caution as fluctuation of serum sodium concentration in the hyponatremic cirrhotic could result in osmotic demyelination. Metabolism of both acetate and lactate by the liver is compromised during liver transplantation. The lack of data relating to the use of buffered acetate containing balanced solutions in LT, the risk of acetate induced myocardial depression and the inability to assay acetate, limits the use of buffered acetate solutions in liver transplantation . Use of compound sodium lactate solutions in donor hepatectomy is associated with higher lactate, peak total bilirubin concentration, a prolonged prothrombin time and lower albumin concentration when compared to those treated with acetate containing solutions. These changes attributed to compound sodium lactate however did not result in an increase in complications or a prolonged hospital stay .

Compound sodium lactate solutions should be used with caution in pediatric recipients of live donor liver grafts until further evidence becomes available regarding its safety in comparison to normal saline . Compound sodium lactate is the crystalloid of choice for adult liver transplantation at CNCLD. Hourly blood gas analysis permits close monitoring of lactate. When compared with an albumin-based regime, crystalloid use in live donor liver transplant [LDLT] is associated with better outcomes .

5% albumin is widely used as a replacement fluid in liver transplant. Albumin a molecule critical to the integrity of the endothelial glycocalyx, expands intravascular volume with minimal effect on portal venous pressure. This fluid however, may contribute to albumin shift out of the intravascular compartment.

At CNCLD, 5% albumin is used if a large volume of ascitic fluid is drained in the dissection phase, if large volume crystalloid use is anticipated and in the presence of a steep rise in serum lactate precluding the use of compound sodium lactate. A plasma albumin above 25 g/l is targeted until the hepatic synthesis of albumin is restored, usually around the third postoperative day .

The use of synthetic starch colloid solutions in critically ill patients has been associated with an increase in the need for renal replacement therapy . The use of synthetic starch solutions in liver transplant is not widespread in the absence of robust evidence regarding its safety in this setting.

At CNCLD, all intravenous fluids are infused via a rapid infuser which delivers fluid at 37°C, at rates of up to 750ml/minute. Inline volume and pressure monitors and air detection systems are useful safety features incorporated in this device.

5. Vasopressors

Restrictive use of intravenous fluid results in greater dependence on vasopressors to maintain hemodynamic stability. Though the use of vasopressors, preoperative renal dysfunction and postoperative anemia have been identified as predictors of early post LT renal dysfunction, this relationship may reflect severity of underlying ESLD and the requirement for vasopressors rather than causality .

Terlipressin, a splanchnic vasoconstrictor improves renal perfusion, reduces the risk of post-operative acute kidney injury [AKI], small for size graft syndrome and is used in the management of portal hypertension .

Vasopressors have a volume sparing effect. This results in a lower fluid balance at the end of LT. This is true even of older patients with higher MELD scores, larger blood loss, given greater volumes of blood products. A reduced positive fluid balance was associated with a lower incidence of postoperative acute kidney injury; shorter duration of ventilation and ICU stay . In patients with a positive fluid balance, use of vasopressors reduced the need for renal replacement therapy and improved 1 year mortality. Noradrenaline [NE] is preferred to dopamine, adrenaline, and vasopressin as the first line vasopressor. The low endogenous vasopressin levels in ESLD results in a rapid response to exogenous vasopressin. Vasopressin is useful in managing the vasoplegic syndrome, which occurs predominantly in the reperfusion phase of liver transplantation.

Vasopressin is synergistic with NE and is added when NE dose exceeds 0.1 µg/kg/min .

Hemodynamic management for liver transplantation at CNCLD is outlined in 'Guide to Hemodynamic Management in Liver Transplantation-CNCLD [Annexure 1].

6. Inotropes

The combination of a preoperative ejection fraction less than 50%, prolongation of QT interval and diastolic dysfunction is strongly suggestive of underlying cirrhotic cardiomyopathy. Left and right ventricular dysfunction are common, particularly during reperfusion. Dobutamine is the inotrope of choice at CNCLD. Inhaled nitric oxide, prostacyclin,

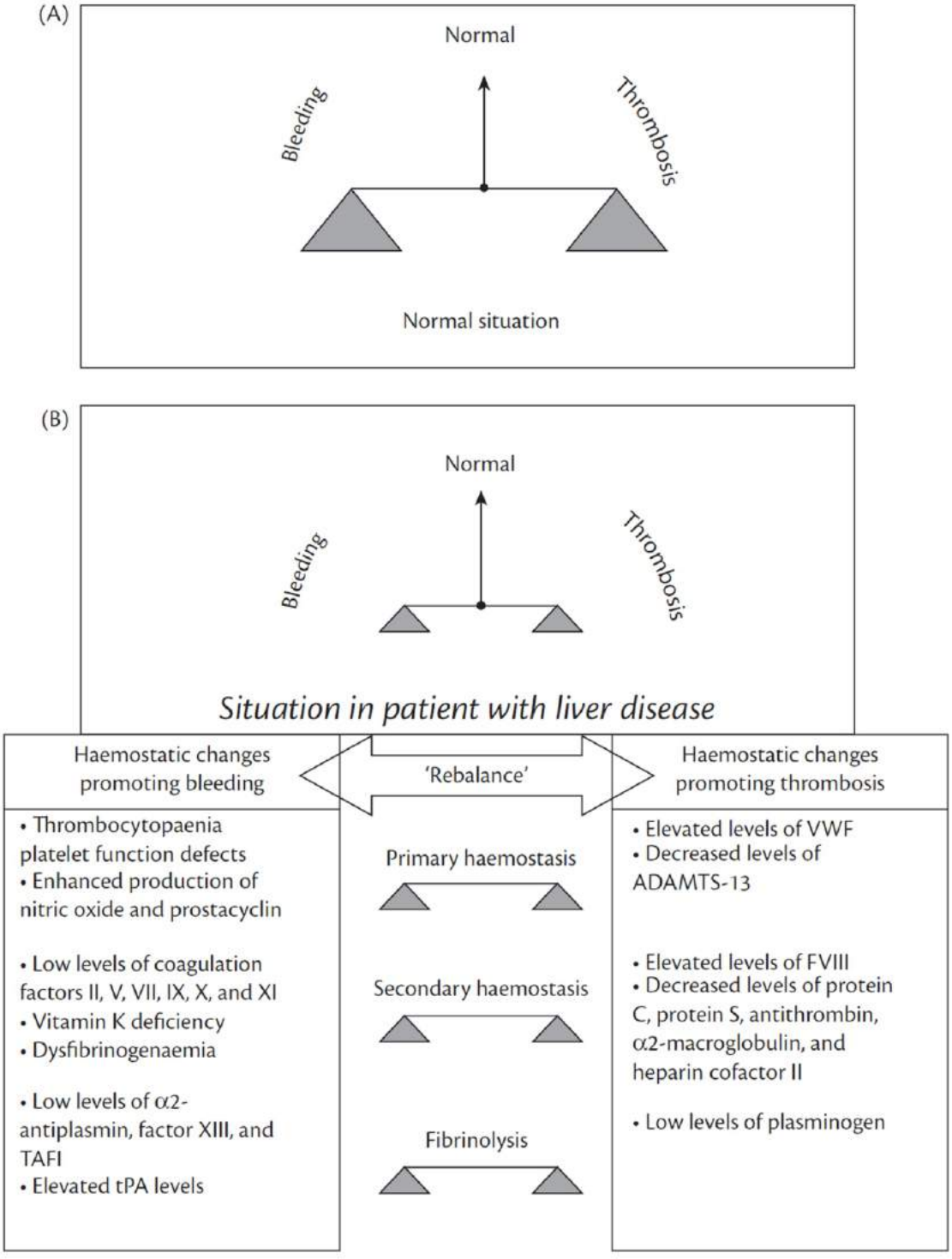

Figure 1. The concept of rebalanced hemostasis in patients with liver disease: Communication from the ISTH SSC working group on hemostatic management of patients with liver disease.

[Courtesy: Journal of Thrombosis and Haemostasis, Volume: 19, Issue: 4, Pages: 1116-1122, First published: 31 March 2021, DOI: [10.1111/jth.15239]

intravenous milrinone and extracorporeal membrane oxygenation [ECMO] have been used to treat porto-pulmonary hypertension.

7. Rebalanced hemostasis and management of coagulation

Chronic end stage liver disease is characterized by derangements in primary and secondary hemostasis and fibrinolysis [Figure 1].

ESLD is characterized by re-balanced hemostasis with reduced hemostatic reserve [Fig 1]. This precarious balance could tilt to a hyper or hypocoagulable state induced by stressors including surgery, infection, or ischemia-reperfusion injury. Standard tests of coagulation; platelet count, prothrombin time [PT], activated partial thromboplastin time [APTT] and fibrinogen levels are of limited value in complex acquired disorders of hemostasis as seen in ESLD. PT is unaffected by changes in levels of protein C and S. Use of PT and INR to guide correction of coagulopathy in ESLD results in over correction of coagulopathy.

Increased levels of Von Willebrand factor [VWF] and reduction of VWF cleavage protein ADAMTS-13 predisposes to thrombosis despite thrombocytopenia [18].
Hyperfibrinolysis is not readily detected by standard tests of coagulation. Hyperfibrinolysis during the pre-anhepatic phase and fulminant hyperfibrinolysis with diffuse bleeding in the anhepatic and reperfusion phases should be treated with antifibrinolytics. Hyperfibrinolysis in the reperfusion phase is usually self-limiting and resolves spontaneously. Resolution of hyperfibinolysis is an early indicator of graft function. In the absence of profuse bleeding, prophylactic use of hemostatic products prior to invasive procedures and liver transplantation is not recommended.

Dynamic, whole blood point of care viscoelastic hemostatic tests [VHT] such as Thromboelastography [TEG®] and rotational thromboelastometry [ROTEM®] indicates the status of clot formation, clot strength and fibrinolysis within a short turnaround time. VHT guided hemostatic therapy does not increase the risk bleeding or thrombotic complications [19].

VHTs reliably predict bleeding and need for blood products in LT resulting in reduced usage of blood products, a lower rate of complications and improved survival after LT[19].

ROTEM, EXTEM MCF correlates with platelet count and fibrinogen levels. EXTEM A5, an early indicator of impaired clot firmness secondary to critically low levels of platelets and fibrinogen levels, is a good linear predictor of EXTEM MCF. FIBTEM MCF which correlates with fibrinogen levels is used to differentiate low platelet count from a low fibrinogen level, as the cause of impaired clot firmness [20, 21].

The lack of facilities for Point-of-care VHT testing within the operation theatre complex at CNCLD limits its usefulness in managing rapidly evolving coagulopathy.

8. Transfusion of blood products

Advances in surgery, anaesthesia and VHT guided coagulation therapy have revolutionized management of bleeding in liver transplantation. Increased requirement for blood products could reflect coagulopathy and severity of underlying ESLD. VHT guided management of coagulation reduces the risks of fluid overload, raised pulmonary arterial and portal venous pressure and adverse effects attributed to blood products [22-24]

The use of FFP in LT needs to be considered carefully due to concerns regarding its safety, and lack of evidence of benefit particularly when used to in the setting of impaired thrombin generation [19, 25]. The number of units of packed red cells and the volume of plasma transfused correlates with reduced one year survival following liver transplant [22, 26]. Transfusion related immune modulation and risk of infection, neutrophil-mediated exaggerated inflammatory response to tissue damage and ischemia-reperfusion adversely impact outcome following LT. Red cell transfusion is an independent risk factor for early acute kidney injury post liver transplant [27]. Platelet transfusion is a risk factor for acute lung injury, graft injury and correlates strongly with poor post-transplant outcome [22, 28-30].

Advances in perioperative care, evidence linking blood products with adverse outcomes, use of protocols based on VHT and the availability of factor concentrates have led to a reduction in transfusion requirements [19, 31]. At CNCLD, management of coagulopathy in LT is based on the Essen university A5 protocol [19]. The use of platelet concentrates and fresh frozen plasma is restricted to patients with significant bleeding and is guided by VHT. Cryoprecipitate use as the source of fibrinogen is guided by VHT, in the presence of clinically significant bleeding. The use of factor concentrates is limited due to high cost. Leukocyte depleted red blood cell transfusion is based on need.

9. Enhanced recovery after liver transplant surgery

Adoption of a protocol of evidence-based interventions including the use of advanced hemodynamic monitoring, adherence to a restrictive fluid protocol, viscoelastic test guided use of blood products and monitoring the depth of anaesthesia has resulted in improved outcome following LT.

Adoption of such a protocol is associated with early extubation, early mobilization, reduction of postoperative ventilation, postoperative complications, length of intensive care and hospital stay and cost. Adoption of the protocol has been linked to a rapid pace of recovery even in the sicker, high MELD patients [32-34].

Achievement of enhanced recovery following LT is a surrogate marker of the quality of perioperative care. Since adoption of this strategy, 20% of patients undergoing LT at CNCLD have been extubated in operation theatre and fast tracked to discharge.

10. Summary

Haemodynamic management in liver transplantation for cirrhosis is challenging due to a complex interplay of factors associated with ESLD, liver graft, surgery and anaesthesia. As complex changes in haemodynamics and coagulation in this setting are better understood adoption of evidence based haemodynamic management, haemostatic interventions guided by viscoelastic hemostatic interventions in combination with an enhanced recovery protocol have resulted in improved outcomes following liver transplantation.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Annexure 1

Guidance for Haemodynamic Management in Liver Transplantation at the Colombo North Center for Liver Disease (CNCLD)

Preoperative assessment and optimization

- Detailed clinical assessment (ABG if SpO2 less than 93%)
- Screening test – Six-minute walk distance more than 250m
- Echocardiography – Ejection fraction more than 50% and mean pulmonary arterial pressure below 40mmHg
- Dobutamine stress test, exercise testing, serum creatinine prior to coronary angiogram following multidisciplinary consensus
- Nutritional assessment and optimization
- Graded exercise regime, incentive spirometry
- Counselling

Intraoperative management

- Pre induction ECG, NIBP, SpO_2, forced air warmers
- Femoral and radial intra-arterial blood pressure. Nasopharyngeal thermometer
- Right internal jugular vein: a) Central venous catheter, b) haemodialysis catheter coupled to Belmont© rapid infuser
- 'Flowtrac' / 'LiDCO' connected to femoral artery and Oesophageal doppler
- MAP +/- 20% pre-induction pressure
- Cardiac index 2.5-3.5L/kg/m^2
- Stroke volume variation less than 12-15%
- Contractility – Peak velocity (PVel) >65 cm/s
- Systemic vascular resistance index 1500 – 2400 dynes/s/cm^5/m^2
- Central venous pressure < 5 mmHg, Central venous oxygen saturation 60-70% and serum lactate
  Rotational thromboelastometry: Hemostatic therapy of bleeding guided by ROTEM: *based on clinical assessment in combination with Essen University A5 protocol*)
  Sampling for ROTEM: Base line, 15 minutes prior to anhepatic phase, 15 minutes after caval clamp, 15 minutes prior to reperfusion, 15 minutes, and 45 minutes after reperfusion and 15 prior to extubation or transfer to intensive care unit, 15 min following hemostatic intervention
- Hemoglobin 7-9g/dl
- Urine output 0.5ml/kg/hour
- IV fluid: Compound sodium lactate / 5% albumin (0.9% saline if Na+ <130meq/l)
- Noradrenaline, dobutamine, vasopressin (Up to 4.8u/hr), calcium gluconate infusions to achieve above targets.
- Vasoplegic syndrome (SVRI < 800 & CI > 5 despite vasopressin 2u/hour and noradrenaline 1micg/kg/hr) – Methylene blue (1-2mg/kg over 10-15 minutes, 2mg/kg/hour infusion), hydroxocobalamin (125-250mg bolus / 250-500mg/hr infusion: Max 5g), Intravenous enriched immunoglobulins
- Coordinate with surgeon to control application and release of vascular clamps
- Boluses of 1:200,000 adrenaline, calcium gluconate during reperfusion
- Consider fast tracking if alert, intact gag reflex, respiratory rate 12-18/minute, normothermic, normal blood gas, no excessive bleeding, nearly normal ROTEM, single vasopressor, noradrenaline dose less than 0.1micg.kg/min, UOP> 0.5ml/kg/hr

Courtesy: Bhagya Gunetilleke, Colombo North Center for Liver Disease, Faculty of Medicine, University of Kelaniya, Sri Lanka

REVIEW ARTICLE

Impact of COVID-19 on postgraduate education and mental wellbeing of surgical trainees: a systematic review

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Keywords: COVID-19; SARS-CoV-2; postgraduate surgical training; trainees' perspective; mental wellbeing; postgraduate education; systematic review

Abstract

Introduction

Coronavirus disease COVID-19 is a global pandemic that has produced adverse effects on many facets of the health care system including surgical specialities. In this systematic review, we aimed to comprehensively analyze the global literature on the impact of COVID-19 on surgical education and the mental wellbeing of surgical trainees.

Methods

We searched PubMed, Scopus, LILACS, Ovid MEDLINE, Web of Science, Google Scholar and Cochrane CENTRAL between 1-January 2020 and 20-January 2021 and performed a systematic review of all observational and experimental studies on the impact of COVID-19 on postgraduate surgical trainees of all specialities. Operative and clinical exposure, surgical education and mental wellbeing were assessed as outcome measures.

Results

Fifty-nine studies including 11544 surgical trainees were analyzed. The majority of the trainees were general surgical trainees [n=4435, 38.4%]. Most studies [n=40, 67.8%] were conducted at national level in high income countries [n=9480; 82.1%]. Most studies reported a significant reduction in the operative exposure [range 45.7-100%] including elective, emergency and other clinical encounters. The mental health of trainees was affected [11.3-100%] and depression [10.6-40.8%], anxiety [31.7-69%] and burnout [7.1-68%] were noticed. Concerns on contraction and transmission of COVID-19 infection and delays in surgical training and career progression were also reported.

Conclusion

COVID 19 pandemic had caused a considerable impact on surgical training, teaching, learning activities and mental well-being of the trainees. Measures should be taken to mitigate these effects to improve surgical training in the era of the COVID pandemic.

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Introduction

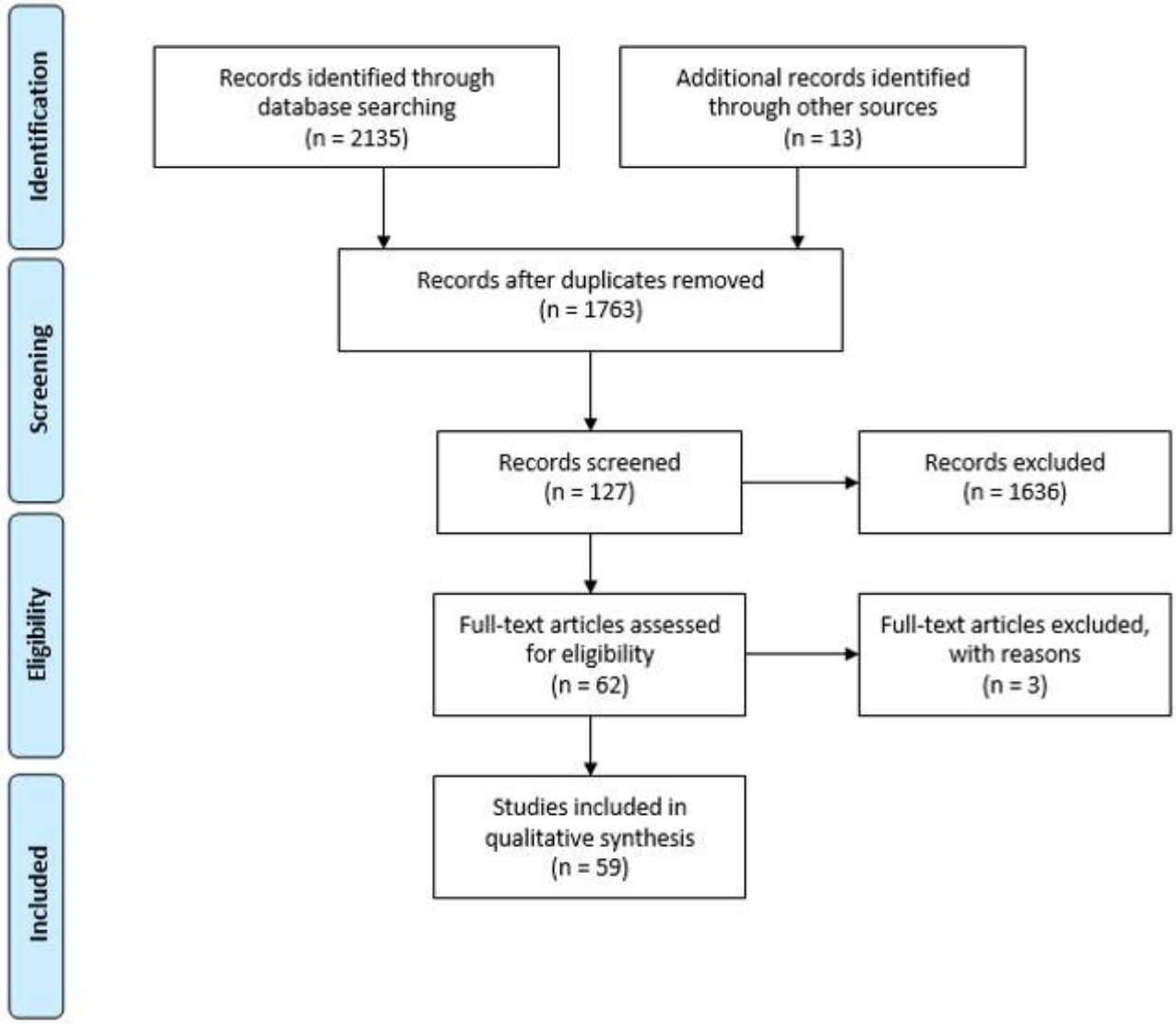
On 11th March 2020 Coronavirus disease COVID-19 was declared a global pandemic by the World Health Organization [1]. As of September 2021, greater than 200 million cases and over 4.5 million deaths have been reported globally [2]. The COVID-19 pandemic has produced significant effects on various aspects of human life including the global economy [3, 4]. Furthermore, a considerable impact on various types of health care and services including the surgical sub-specialities has been noted [5-7]. With the current rising trend in the incidence of COVID-19 and lack of results on the long term efficacy of vaccines, future implications remain uncertain [8].

Both undergraduate and postgraduate training programs were also affected during the COVID-19 pandemic. The impact on surgical training was more pronounced. In surgical training, the development of technical and hands-on skills is a mandatory component among many other aspects. Several aspects such as reduction in clinical and operative exposure, cancellation of professional courses and exams and reduction of foreign training and prospective fellowship opportunities have caused major concerns in relation to surgical training [9, 10]. Several studies have attempted to describe the impact of COVID-19 on postgraduate education and the mental wellbeing of surgical trainees. However, to date, an objective assessment and systematic review of published literature have not been performed. A timely review is necessary to objectively assess the existing literature which would be useful for future recommendations. Therefore, we aim to perform a systematic review of published global literature in relation to the impact of COVID-19 and surgical education and the mental wellbeing of surgical trainees.

Methods

A systematic review of the literature was performed including all observational and experimental studies on the impact of COVID-19 on postgraduate education and mental wellbeing of surgical trainees of all specialities. The systematic review was performed in accordance with the PRISMA guidelines.

Figure 1. PRISMA flow chart



The primary objective of this systematic review was to perform a comprehensive analysis on the impact on the postgraduate education of surgical trainees of all specialities.

Search strategy

Articles published between 1 January 2020 and 20 January 2021 in PubMed, Scopus, LILACS, Ovid MEDLINE, Web of Science, Google Scholar and Cochrane CENTRAL were searched using specified search terms in the title or abstract fields. The detailed search strategy is provided in the supplementary file. Articles published in all languages and all surgical subspecialties globally were included.

Articles that mentioned both subjective and objective assessments of the impact of COVID-19 on surgical training were included in the analysis. The reference lists of all selected full papers were also assessed to identify additional papers for the systematic review.

All articles were screened for eligibility by two independent investigators based on the titles, abstracts and keywords of citations from the electronic databases. Full texts of all selected records were assessed for eligibility. All studies describing the clinical and operative exposure, surgical education / continuous professional development activities and mental wellbeing among trainees of all surgical specialities were included. Opinions/ perspectives were excluded from the analysis. Eligible studies were determined by consensus between two investigators. In doubtful instances, the opinion of senior investigators was sought.

Data extracted from individual studies were organized into three main categories;

1] Operative and clinical exposure

2] Surgical education and continuous professional development

3] Psychological aspects and mental wellbeing

Table 1. Percentage distribution of trainees from various subspecialties

Surgical specialty	N	%
General	4435	38.4
Ophthalmology	1650	14.3
Orthopedic	1077	9.3
Neurosurgery	1036	9
Urology	975	8.4
Otolaryngology	903	7.8
Plastic	344	3
Other	1124	9.7
Total	11544	100

Finally, the available data were tabulated and assessed qualitatively. A meta-analysis could not be performed due to considerable variations in the study methodology, assessment tools and reporting [Table-S1].

The quality of the included cross-sectional studies was assessed using Joanna Briggs Institute [JBI] critical appraisal checklist for cross-sectional studies. Each study was graded based on the cumulative points and percentage [Poor <50%, Fair 50-75%, Good >75%].

Results

Characteristics of included studies

A total of 2135 studies were identified after the initial search. The process of selection of studies and elimination is summarized in the PRISMA flow chart [Figure 1]. After excluding the duplicates and non-relevant studies during the initial screening, a total of 127 full texts were assessed for eligibility. Finally, 59 studies describing responses of 11544 surgical trainees were included in the study. The majority of trainees were general surgical trainees [n=4435, 38.4%] followed by ophthalmology [14.3%], orthopaedic [9.3%] and neurosurgery [9%] [Table 1].

Studies were conducted among trainees from different countries [low and high income] and settings and at different levels of training. Most studies [n=40, 77.6% of total sample size] were conducted at the national level, 8 [13%] among trainees from multiple countries, 5 [7.2%] at multiple centres within a single country and 6 [2.1%] at single centres. The response rate was mentioned in 23 studies with an average response rate of 52.4% [range 12.2-100%]. Most of the studies [n=49, 83%] used a non-validated subjective questionnaire for the assessment of the impact on surgical training. The number of participants who had been infected with COVID-19 at the time of the survey was mentioned in 10 studies with a total number of 98 out of 1963 infected trainees. The prevalence of COVID -19 in this subgroup was 5% [range 2.2-8%]. The quality of the included cross-sectional studies are shown in table S1 and the majority were either fair [30.5%, 18] or poor [69.5%, 41].

The majority were conducted in high income countries [n=9480, 82.1%] followed by low-middle income countries [n=1734, 15%] and upper middle income countries [n=330, 2.9%].

Impact of COVID-19 on operative and clinical exposure

A total of 51 [n= 10270 trainees, 89%] studies assessed the impact of COVID-19 on operative and clinical exposure [Table S2-supplementary file]. Five studies [n=602, 5.9%] used pre-tested questionnaires [11-16]. Only 3 studies [1.8%, n=180 trainees] performed an objective assessment of the reduction in the number of cases compared to pre-pandemic data by means of hospital and trainee records [Table S2]. Most studies reported a significant reduction in the operative exposure [range: 45.7-100%]. Reduction in urgent/ emergency surgeries and trauma surgeries were mentioned in four [n=1061, 10.3%] and 2 studies [n=234, 2.3%] respectively [range: 50-80%] [Table S2]. A national-level study conducted in Ireland, which assessed the number of the orthopaedic operative procedure using trainees logbook records showed no reduction in nine specified trauma procedures in 2020 compared with 2018 and 2019 [17]. Data regarding laparoscopic and endoscopic procedures were reported only in 2 studies and both showed a considerable reduction [18, 19]. Out of 51 studies, 39 studies [n=8587, 83.6%] reported on the non-operative clinical exposure in surgical training. Fifteen studies [n=3253, 31.6%] reported a reduction in outpatient clinic encounters [range 41.1-83%] [Table S2]. Interestingly, the utilization of outpatient encounters using telehealth facilities [range 25-99%] was reported in 6 studies [n=681, 6.6%] [Table S2]. Apart from the above, reduction in on-call experience and ward-round based learning were reported in 6 studies [range 54.3-79%] [Table S2].

Impact on psychological aspects and mental wellbeing of surgical trainees

Out of 59 studies, 46 [n=8786, 76.1%] assessed the impact on mental health among surgical trainees [table S3-supplementary file]. However, only seven studies [n=1933, 22%] used at least one validated scoring tool in the assessment of anxiety [Generalized Anxiety Disorder Assessment [GAD-7]: n=1534, 17.4%], depression [Patient Health Questionnaire [PHQ-9]: n=1492, 17%], burnout [Modified Maslach Burnout inventory score: n=223, 2.5%] and stress [Mini Z burnout survey: n=349, 4%] [Table S3]. Four studies [n=379, 4.3%] used pre-tested questionnaires [Table S3]. Out of 46, 17 studies [n=3797, 43.2%] assessed the anxiety, depression and stress among trainees [Table S3].

Except for one study, all have reported high levels of anxiety [31.7-69%], depression [10.6-40.8%] and stress [28-54.8%] among trainees. However, Osama.et.al [n=112, 1.3%] reported a reduction of Modified Maslach Burnout inventory score [$p < 0.001$][20]. Reduction in working hours among trainees may have contributed to this observation [12]. The majority of the trainees [n=5065, 57.6%] reported concerns about contracting COVID-19 infection or transmitting the virus to family members or friends as the reason for the impact on mental health. In addition, reduction in surgical exposure /clinical training [n=5687, 64.2%], inadequacy of personal protective equipment [n=3727, 42.4%] and redeployment to other units [n=2357, 26.8%] were reported as other reasons. Aziz et.al [n=1102, 12.5%] reported that although 65.1% of the respondents had 5 or more off-duty days compared to the pre-pandemic period, 33.1% reported more burnout and 72.7% were concerned about contracting or transmitting the virus to their family and friends [21]. Interestingly, Johnson et al. reported that 50.4% of respondents had no anxiety according to the GAD-7 score [GAD-7 score < 5][22].

Impact on surgical education and continuous professional development

Forty-one studies [n=7971, 69%] assessed the impact of COVID-19 on surgical educational activities [Table S4-supplementary file]. Thirty-three studies [n=6427, 80.6%] reported an increase in the utilization of web-based teaching activities including webinars, online symposiums, lectures and videos of surgeries. Responders from 3 studies [n=414, 5.2%] reported the usefulness and likelihood of continuing online educational activities after the pandemic [Table S4]. Chang et.al [n=229, 2.9%] reported that the average satisfaction regarding online-based teaching was lower compared to conventional teaching activities [23]. Nine studies [n=731;9.1%] reported an increase in research activities and projects among surgical trainees due to reduced clinical workload [Table S4]. Payne. et.al evaluated the impact of redeployment of responders to ICU and reported that 97 % [n=32] reported that the redeployment had a positive impact on gaining knowledge and confidence in managing critically ill patients [24]. Bandi et al. has reported the usefulness of utilizing a dissection laboratory for Otolaryngology trainees [25].

Discussion

Although the direct impact of the COVID-19 pandemic on the health of the public in terms of morbidity and mortality is widely known, there are subtle ramifications due to the pandemic which are not clearly revealed. One such consequence is the impact on postgraduate medical training, especially in the surgical specialities [16, 17]. This is because surgical training includes both clinical patient care and also accumulation of technical and operative skills. Most components of surgical training have been affected due to the delays in acquiring adequate training and increased psychological stress [26].

In this systematic review, the impact on surgical training was considerable in all three aspects analyzed such as operative and clinical training, surgical educational activities and mental wellbeing. The overall operative exposure was reduced by 45.7-100%, while urgent/ emergency surgeries and trauma surgeries were reduced by 50-80% [Table S2]. Furthermore, studies have also shown a considerable reduction in laparoscopic and endoscopic procedures, outpatient clinic encounters, on-call experience and ward-round based learning. Measures taken to control the disease spread such as social distancing and lockdown have led to cancellation or delay of elective operations and minimizing patient visits at outpatient clinics. Restriction of routine clinical activities protects health care workers and patients from the viral transmission. Furthermore, personal protective equipment can be prioritized and preserved for the care of COVID-19 positive patients who need mandatory treatment. Moreover, important resources such as hospital beds and intensive/ critical care beds may be reserved for symptomatic and critically ill COVID-19 patients.

Several studies reported a reduction or delay of postgraduate educational or continuous professional development programs [Table S4]. However, as a measure to overcome this problem, increased utilization of online teaching activities such as online symposia, webinars, lectures and videos of surgeries were conducted. Although several studies mentioned the usefulness and likelihood of continuing such activities after the pandemic, few studies reported that the average satisfaction of online-based teaching was lower compared to conventional teaching methods [Table S4].

The reduction in clinical activities and operative exposure has a potential negative impact on postgraduate surgical training as the acquisition of clinical expertise and surgical skills are greatly dependent on the level of clinical exposure and hands-on operative experience. Delay and postponement of such activities would negatively impact the career progression of surgical trainees. Due to the reduction of clinical workload, a considerable proportion of surgical trainees may not be able to fulfil their criteria in terms of clinical rotations and surgical exposure leading to delays in accreditation and qualifications for memberships or fellowships of postgraduate surgical colleges.

The physical and mental well-being of postgraduate surgical trainees were also negatively affected during the pandemic. Almost all studies that described the level of psychological wellbeing reported high levels of anxiety, depression and stress. However, a few studies reported a reduction of burnout

compared to the pre-pandemic era which can be attributed to the reduction in working hours. Importantly, most trainees reported concerns about the inadequacy of personal protective equipment, redeployment to different non-surgical units, contracting COVID-19 infection and transmitting to family members and loved ones as considerable sources of stress. In this systematic review, we found 10 studies describing 98 out of 1963 infected trainees with a considerable prevalence of 5%. Furthermore, delays in fulfilling criteria for accreditation due to reduction in surgical exposure /clinical training were additional concerns [Table S2].

Several positive aspects were also highlighted in these studies. Nine studies reported an increase in research activities and projects among surgical trainees due to reduced clinical workload [Table S4]. Online global platforms have enabled surgical trainees and surgeons to conduct worldwide collaborative researches on the surgical aspects of COVID-19 [27-29]. Web-based educational activities and conferences played an important role during the pandemic to enhance continuous professional development [30]. On a positive note, web-based activities are readily accessible with considerable cost-effectiveness for the organizers and the participants. Few studies evaluated the impact of redeployment of surgical trainees to ICU and reported that 97% had a positive impact on gaining knowledge and confidence in managing critically ill patients.

Limitations

We identified several limitations in the published studies. The majority of studies did not utilize objectively validated assessment methods. There were considerable variations in the methodology and the reporting of findings precluding a meta-analysis. The majority of the studies were rated as either fair or poor. Although short term impact has been discussed, the long term implications seem unpredictable.

Conclusion

COVID 19 pandemic has caused a considerable impact on surgical training, career progression teaching-learning activities and mental well-being of the trainees. With the ongoing global pandemic and lack of data on the long term efficacy of vaccines or treatment to date, future directions of the pandemic remain uncertain. Therefore, implementing alternative options to mitigate the negative effects on surgical training should be actively considered.

Authors' contributions: Authors' contributions: OB, KG and UJ designed the tables; collected, analyzed, and interpreted data; and wrote the article. OB, KG and UJ formulated the concept and design of study, acquisition of data and analysis and drafting the article. DNS contributed to design and concept of study, revising it critically for important intellectual content and approval of the final version to be published. All authors have read and approved the final version of the manuscript.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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REVIEW ARTICLE

Autonomously functioning thyroid nodule: a patient-based review

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Keywords: AFTN; thyrotoxicosis; solitary nodule

Abstract
Autonomously Functioning Thyroid Nodule (AFTN) is a rare cause of hyperthyroidism. AFTN, first described by Emil Goetsch in 1918, is the presence of a single hyperfunctioning thyroid nodule, which is not under the control of the pituitary/thyroid axis.

The current theory on the development of hyperfunctioning nodules is the constitutive activation of Thyroid Stimulating Hormone Receptor (TSHR) due to a somatic point mutation and mutations of Gsa.

The reported incidence of AFTN is about 1% on the investigation of thyroid nodules. Only about 10% - 30% become hyperfunction. Due to the rarity and lack of understanding of its characteristic clinical behaviour, AFTNs are often overlooked and undertreated. The ensuing review is based on a 36-year-old female who underwent left hemithyroidectomy for an AFTN and is well to date.

There are two main issues in the diagnosis and management of AFTN. The first is that the diagnosis is not always made as most patients with AFTNs are functionally euthyroid. The other is the paucity of data in the literature to offer evidence-based individualized management for patients.

As there are no tissue diagnostic criteria for AFTN; clinical, biochemical and radiological assessments to establish TSH independent nodular hyperfunction will clinch the diagnosis. Surgery and Radioiodine ablation remain the main forms of treatment for AFTN. Other methods such as percutaneous ethanol injection therapy (PEIT), laser ablation (LA), radiofrequency ablation (RFA) have a limited role in the management of an AFTN. The newer methods alluded to above will need further evaluation and a better definition of exact roles in the management of an AFTN.

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Introduction
Hyperthyroidism usually refers to increased synthesis and secretion of thyroid hormone from the thyroid gland.

Thyrotoxicosis refers to the clinical syndrome of excess circulating thyroid hormones, due to any cause. The incidence of hyperthyroidism in iodine–sufficient western world is 0.2% - 1.3% [1]. The common causes of Hyperthyroidism are diffuse toxic goitre (Graves Disease), toxic nodular goitre (Plummer Disease), and toxic phase of autoimmune thyroiditis. Rarely, an Autonomously Functioning Thyroid Nodule (AFTN) will cause hyperthyroidism. Hyperfunctioning malignant thyroid metastases, drug-induced hyperthyroidism and factitious ingestion of excess thyroid hormone are rare causes of toxic symptoms, especially in the iodine sufficient regions.

AFTN is the presence of a single hyperfunctioning thyroid nodule, which is not under the control of the pituitary/thyroid axis using Thyroid Stimulating Hormone (TSH). AFTN was first described by Emil Goetsch in 1918. Goetsch demonstrated a high concentration of mitochondria in hyperfunctioning thyroid nodules. [2]. In 1960 Tremblay and Pearse did studies and further established the findings of Goetsch. Subsequently further study, AFTN achieved recognition as a separate cause for hyperthyroidism and was known as "Goetsch's disease" by the 1980s [3].

The reported incidence of AFTN is about 1% on the investigation of thyroid nodules [3]. Most are inert and only about 10% - 30% become hyperfunction and cause subclinical or overt thyrotoxicosis [4]. Due to the rarity and lack of understanding of its characteristic clinical behaviour, AFTNs are often overlooked and undertreated.

Case description
A 36-year-old female had been investigated and treated for a left-sided thyroid nodule for 2 years in another institution. She had been having compressive symptoms such as orthopnoea for 1 year before presentation to our institution. At the onset her illness, her thyroid profile showed a hyperthyroid picture with low TSH - 0.006microIU/ml (0.4-4.0), high free T3 (fT3) - 5.5pg/ml (1.5-4.1) and normal free T4 (fT4) - 0.871ng/dl (0.8-1.7). An ultrasound scan of the

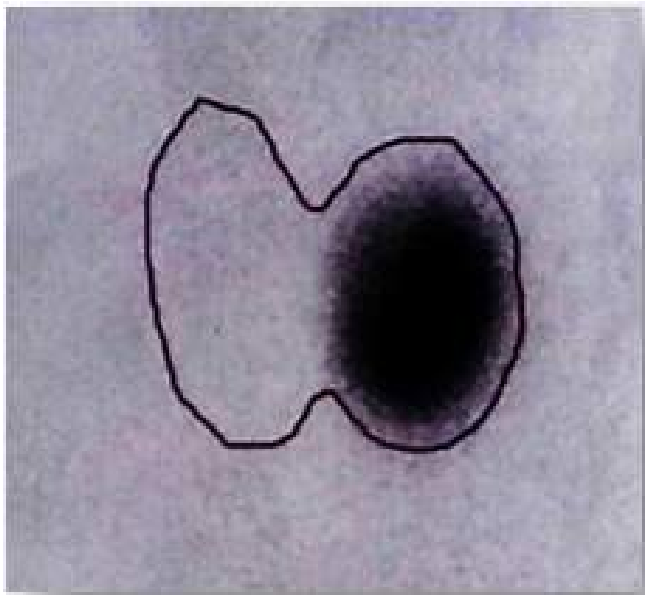

Figure 1. Radioisotope scan of the thyroid gland 20 minutes after injection of 145mbq of Technetium-99m Pertechnetate

Figure 2. X-Ray of the cervical spine

neck showed a 3.3 x 2.2cm solitary, predominantly cystic nodule in the left lobe with increased vascularity. No calcifications were seen and the rest of the gland plus neck anatomy were unremarkable. Fine Needle Aspiration Cytology (FNAC) showed a Thy 2/ Bethesda II colloid cyst. Radioisotope imaging demonstrated a high uptake in the left lobe with a non-functioning right lobe (Figure 1). She was started on a block and replacement therapy.

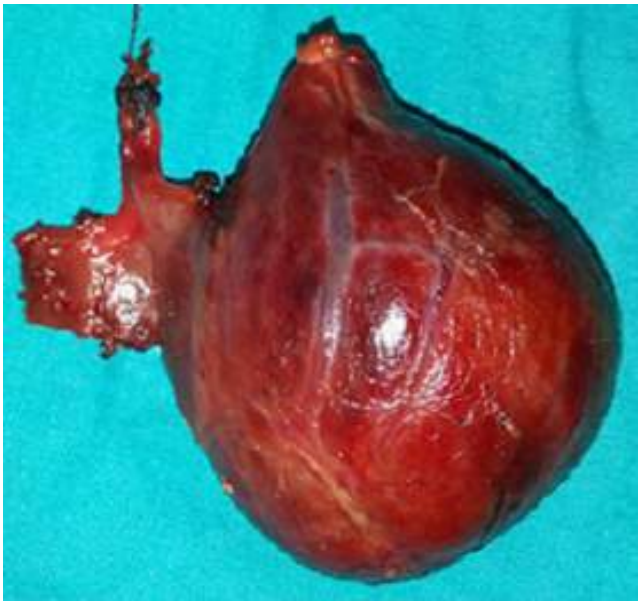

Figure 3. Left hemithyroidectomy specimen

She was referred for consideration of surgery to our unit. At that time she was clinically and biochemically euthyroid. The possibility of a thyroid hemi-agenesis was considered, in the referral, erroneously, due to the appearance of the isotope scan.

The left-sided nodule has grown to 5cm in its largest diameter with radiologically benign character. X-Ray of the cervical spine showed mild narrowing and gross shift of the trachea to the right (Figure 2).

Repeat FNAC confirmed a Thy 2 lesion. A diagnosis of an AFTN was made and she underwent left hemithyroidectomy (Figure 3).

A single benign colloid cyst was noted in the histopathological report. Her clinical and biochemical profile postoperatively was euthyroid clinically and biochemically confirming the diagnosis of AFTN. She is well 10 months after surgery and not on thyroxine replacement at present.

Discussion

A hyperfunctioning/ toxic AFTN or Goetsch's disease is now known as a toxic adenoma. AFTNs occur in every age group with a female preponderance. Toxic AFTNS are common in the elderly (>60 years) [3]. The classical clinical presentation is a single thyroid nodule with features of toxicity.

The majority of AFTNs are nontoxic as alluded to above. Most patients present due to cosmetic reasons, compressive symptoms or fear of cancer.

In the diagnosis and management of AFTN, there are two main issues. The first is that that the diagnosis is not always made as most patients with AFTNs are functionally

euthyroid. The other is the paucity of data in the literature to offer evidence-based individualized management for patients.

Aetiology

The current theory on the development of hyperfunctioning nodules is the constitutive activation of Thyroid Stimulating Hormone Receptor (TSHR) due to a somatic point mutation and mutations of Gsa [5]. They are gain-of-function mutations. Pathophysiologically, the development of somatic mutations, progression in nodular growth and achieving autonomic activity has a strong connection to Iodine deficiency [6]. Small clones of cells with TSHR may grow to overcome inhibition by paracrine inputs; achieving an autonomic state [7]. The incidence of these mutations ranges from 8% - 80% [5]. The absence of TSHR and Gsa mutations was noted in some AFTNs pointing out that further assessment of molecular pathways in AFTN is required [5].

On perusal of the literature, AFTNs have been described in some patients with Acromegaly. Exposure to long-term surges of growth hormone has been postulated as the possible reason for this.

Outcome of AFTNs

The progression of AFTN is variable. Outcomes can be categorized on activity (function), morphology, local effects of the nodule and pathological (possibility of malignancy) nature of the AFTN.

As mentioned earlier, about 10% - 30% may become 'hot/ toxic' nodules, but the majority will stay as 'cold/ nontoxic' nodules [4]. A nontoxic nodule may become toxic between 1 – 11.8 years.

This may be one of the reasons why more toxic AFTNs were detected in the elderly [3]. The conversion probability is higher in larger nodules. Nodules larger than 3cm are said to be more likely to be toxic [3,4]. The annual conversion rate is around 4% [8].

These facts signify the importance of close follow up of a non-toxic AFTN, clinically and biochemically after initial diagnosis.

Hot nodules may have variable activity levels demonstrating subclinical hyperthyroidism, overt thyrotoxicosis and elevated T3. Subclinical hyperthyroidism is the common outcome of most hot nodules. Our patient had subclinical hyperthyroidism with a 5cm AFTN. She underwent left hemithyroidectomy due to gross deviation of the trachea to the right (Figure 2) and compressive symptoms. A lesser percentage of these nodules become thyrotoxic (especially nodules > 3 cm) and commonly suppress extranodular normal gland activity which may render them invisible with low uptake of tracer at scintigraphy as in this patient.

An interesting biochemical finding in some AFTN is the presence of high T3. The likely explanation of the high T3 is an increase in primary production from the gland or peripheral conversion. High T3 has been demonstrated in both cold and hot nodules. Our patient initially presented with high T3 and normal T4 levels.

The pathological basis behind an AFTN being cold is the poor iodination of thyroglobulin due to decreased capacity of iodide transport. They retain the ability to organify iodide and may become hyperfunctioning/hot with time. This transition is hypothesized to happen in periods of excess iodine intake [9].

Morphologically an AFTN may remain the same, increasing or decreasing in size [10]. Some studies have noted the disappearance of the nodule as well [11]. Growing nodule compressing on the blood supply of its own has been postulated as the possible reason. Transient thyrotoxic events may occur following acute haemorrhagic infarction of an AFTN [3].

AFTNs are essentially benign conditions. Primary malignancy in the AFTN or the gland with toxic AFTN [12] is a concern but it is rare [13]. Studies have shown the incidence of malignancy in AFTN to be around 3% [13]. Most malignancies are papillary or follicular in origin. H ürthle cell carcinoma has also been reported in some patients [14].

AFTN is very rare in children with incomplete data on malignancy risk [15]. In a child with a solitary thyroid nodule, a primary malignancy should always be excluded [16].

There is a consensus that hyperfunctioning thyroid nodules are rarely malignant [13]. Biopsy of hyperfunctioning nodules is not done routinely. Hence a hyperfunctioning thyroid carcinoma may masquerade as an AFTN. Studies have shown that around 50% of malignancies in toxic nodules are follicular carcinomas [17]. The size of the lesion, rapidity of growth, ultrasonic features and response to conventional treatment help arrive at a definitive diagnosis. As the majority are follicular lesions FNAC would not provide histological confirmation of malignancy and a hemithyroidectomy is required to confirm the diagnosis. If RAI was the primary treatment a non-responsive nodule (concerning thyrotoxicosis) would indicate the possibility of malignancy [17].

Diagnosis

As there are no tissue diagnostic criteria for AFTN; clinical, biochemical and radiological assessments are done to arrive at a diagnosis. The main goal is to establish TSH independent nodular hyperfunction.

Complete thyroid profile of TSH, fT4 and fT3 should be performed. TSH per se as a screening tool to diagnose AFTN is less sensitive. A recent meta-analysis has demonstrated 50% of scintigraphy proven AFTNs have a normal TSH [18]. Free T3 is paramount as low TSH and normal free T4 (fT4) is a frequent finding as in this patient.

An ultrasound scan (USS) of the thyroid will commonly reveal a single thyroid nodule with benign characteristics. Ultrasonically, suspicious features like microcalcifications are present in 50% AFTNs, invariably leading to FNAC to exclude a malignancy [19]. USS would also help morphological differentiation of an AFTN from a diffuse or a multinodular goitre and delineate cervical lymphadenopathy suggestive of a different diagnosis.

Subclinical or overt hyperthyroidism should indicate the need for scintigraphy. Even with normal TSH, scintigraphy is recommended in the investigation of a solitary nodule of thyroid exceeding 1 – 1.5cm [20]. It will confirm the hyperfunctioning nodule and suppression of extranodular gland activity. This latter point is essential in differentiating an AFTN from Graves [15]. In Graves' background activity is present on scintigraphy. Both these entities can coexist and are known as Marine – Lenhart syndrome [21]. Such patients may need scintigraphy following suppressive thyroxine therapy to demonstrate the AFTN. The use of SPECT/CT fusion imaging is an upcoming imaging modality with higher sensitivity and specificity on diagnosing AFTN [22]. Apart from the radiation-induced complications in a nuclear medicine intervention, there are several pitfalls of scintigraphy concerning the assessment of AFTNs. Less than 1cm cold nodules may be missed and posteriorly placed nodules may be displayed 'warm' (falsely) due to superimposed thyroid tissue. Some nodules are discordant and may fail to organify 123 I (preferred tracer) and fail to show the activity on scintigraphy. As mentioned earlier, cytological diagnosis is inconclusive. It may help exclude a malignancy, which is rare on an AFTN.

Treatment

A cold nodule may be left alone with periodic examination for an increase in size (ultrasonography +/- FNAC) and conversion to a toxic nodule (biochemical thyroid profile). They may undergo surgery due to other reasons such as poor cosmesis, compressive symptoms or suspicion of malignant conversion. Prophylactic treatment for cold nodules is not advocated [23]. However, levothyroxine therapy for cold nodules had been studied with debatable results. Exogenous T4 will suppress TSH, resulting in a lack of nodular growth and subsequent shrinkage [24].

Hypersecretory nodules need treatment to relieve the patient of symptoms as well as avoid cardiovascular and bony complications of untreated hyperthyroidism. Hot nodules will respond to pharmacological measures like anti-thyroid drugs (ATD), but toxicity will invariably recur once the treatment is stopped [25]. The only place for ATD therapy in the management of AFTN is to make a patient euthyroid in preparation for surgery or radioiodine 131I ablation (RIA).

The definitive treatment for a hot nodule would be surgery, RIA and minimally invasive therapies (MIT) like percutaneous ethanol injection therapy (PEIT), laser ablation (LA) or radiofrequency ablation (RFA). MITs are mainly useful in dealing with smaller AFTNs [26]. In general, multiple sessions are required to achieve acceptable results. The way forward would be to make a patient-tailored approach assessing pros and cons along with the availability of resources.

Surgical management minimally requires a hemithyroidectomy (lobectomy + isthmusectomy). The enucleation of AFTN is inadequate [23]. Swift resolution of hyperthyroidism is achieved yet should be balanced against the well-documented complications of thyroidectomy. Post-treatment hypothyroidism has not been described of and recurrence is unlikely. Total thyroidectomy (TT) is not indicated in an AFTN as it is a solitary benign lesion. TT carries the risk of complications of total thyroidectomy in addition to lifelong thyroxine therapy.

Radioiodine ablation is suitable in all nodules, preferably <5cm. The relative ease of therapy should be weighed against radiation-induced side effects and treatment failures. Following RIA treatment, hyperthyroidism will take months to settle. Studies have shown that at 1 year following RIA, development of hypothyroidism is less than 20% and recurrence of hyperthyroidism at 3% [27]. Patient-based careful dose calculation may produce a more favourable outcome [28].

PEIT is a safe method when guided with USS colour Doppler. Exacerbation of symptoms, a significant number of recurrences (35%) and temporary vocal cord paralysis have been reported [27]. Furthermore, resistance to diffusion of ethanol in solid AFTNs and ethanol leakage-induced pain renders its use limited. It also has been shown to cause periglandular fibrosis making subsequent surgery difficult [29].

USS guided thermal ablation techniques like LA and RFA have shown to be effective as solo therapies in small AFTNs. In larger AFTNs, thermal ablation techniques in tandem with RIA produce a quicker resolution of hyperthyroidism than RIA alone [30]. Post-procedural pain, haematoma formation and transient vocal cord paralysis have been reported [29].

Salient points

- AFTNs are rare but identification and treatment especially in subclinical hyperthyroidism are essential in avoiding toxicity-related complications.
- Thyroid scintigraphy is the standard diagnostic technique.
- Surgical and non-surgical therapies should be applied in a patient-tailored manner.
- Newer techniques and further study will enable clinicians of the future to offer evidence-based individualized treatment for most patients
- The treatment will be curative.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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REVIEW ARTICLE

Best option for total hip replacement in young: evidence from National Joint Registry of United Kingdom and Australian Orthopaedic Association National Joint replacement Registry

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Keywords: Total hip arthroplasty; young patients; bearing surfaces; joint registry

Abstract

Introduction

Implant longevity is crucial in determining the clinical success of THA. Hence THA in young patients will need careful consideration as the failure and revision rates of THA are higher due to high functional demands.

Method

Reviewed the latest evidence from the 17th annual report of the National Joint Registry (NJR) of United Kingdom and the 2020 annual report of Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) to determine the optimal mode of fixation, bearing surface and the head size for THA in a patient before the age of 55 years.

Results

In THA of patients under 55 Years, the 10 Year RR was highest in Uncemented fixations compared to other modes but this difference is insignificant according to the AOANJRR. Uncemented and hybrid fixations were preferred over cemented fixations but uncemented was the predominant mode of fixation and this preference was rising over the past years. COC and COP bearing surface combinations reported to have the lowest 10 YRR and the use of COP in young patients has been rising both in the UK and Australia in the recent past. In COC the head size of 40mm showed the best survival rate and in COP 36mm was the largest size with better survival. In COP the increased quality with XLPE (ultra-high molecular weight polyethylene) has been the reason for the ability to use a larger head size with low dislocation rates better survival with low wear compared to Non-XLPE used in the past.

Conclusion

Both Registries favour the use of Uncemented or Hybrid fixations with COC and COP bearings in patients <55 years and COC and COP bearings were compatible with best survival rates. Improved wear resistance with modern XPLE has been the reason for better survival with COP and the ability to use larger head sizes like in COC, reducing the risk of dislocations. Uncemented /Hybrid fixation with COC with 40 mm head size or modern XLPE COP with 36mm head size would be the best choice for a THA in a patient <55 years of age.

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Introduction

Total Hip Arthroplasty (THA) is performed worldwide is increasing according to the International Joint registries as it is one of the most successful surgical procedures in orthopaedics, which can provide a high satisfaction rate and significant improvement in quality of life for the patient. [1-3]

Arthroplasty in a young patient is challenging due to a higher risk of failure and revision as these are often more complicated primary surgeries warranted by early OA due to congenital, developmental, or traumatic anatomical abnormalities and the higher risk of wear and secondary loosening caused by high functional demands [4-6].

By the end of this decade, more young patients will have THAs, increasing the percentage of Primary THAs among <65 years of age, up to 52% [7]. As a consequence, the number of revisions is expected to increase dramatically. The same authors reported around 5% revision risk for THA in patients at age 70 years, and the risk increased up to 29% for the age category 50–54 years [7,8].

According to the recently published 17th annual report data from The National Joint Registry (NJR) of United Kingdom [9] which is comprised of 1,191,253 primary hip replacement records with a potential of 16.75 years of follow up, Overall revision rate for patients <55 Y at 10 years was 8.29% for females and 6.96% for Males. At 15 yrs these rates increased up to 12.95% and 10.68% for females and males respectively.

In the Australian Orthopaedic Association National, Joint Replacement Registry (AOANJRR) [10] is another important registry where 499,439 primary total conventional hip replacement procedures were reported for the period from 2003 to 2019. In its 2020 annual report the calculated Overall revision rates for patients <55 Y at 10 years were 6.2% for

Table 1. Data from Table 3.H6 of the 17th report of The National Joint Registry (NJR) [9]

Kaplan-Meier estimates of 10-year revision rate (95% CI) of primary hip replacements in <55-year population by gender and fixation.					
Male	<55	10Y RR	Female	<55	10Y RR
Cemented	5149	4.84	Cemented	7918	4.97
Uncemented	38216	7.35	Uncemented	40360	7.13
Hybrid	10878	5.23	Hybrid	13998	4.20
Other	16942			9432	
Total	**71,185**			**71708**	

females and 5.7% for Males. At 15 yrs these rates increased up to 9.7% for females and 8.7% for males, indicating in both registries young females had a higher revision rate compared to young males.

The objective of our article is to evaluate the results from the latest Annual reports of Both NJR and AOANJRR to determine the best choice of implant eg: Fixation method, bearing surfaces and the Head size when THA is considered in <55 Y old patients.

Mode of Fixation

In the United Kingdom, the proportion of all cemented THA has nearly halved despite the stable absolute number of cemented implants used annually. Proving the popularity of hybrid and uncemented implants, the use of uncemented THA doubled and the hybrid THA use has tripled over the same period. Mean ages for all Cemented, Uncemented and Hybrid used patients are 73.0 (+/-9.1), 64.4 (+/-11.3) and 69.1 (+/-10.9) respectively indicating the Uncemented implants were more prevalent among Young. As expected, Uncemented and hybrid fixations were more commonly used in patients <55 years of age. Considering the 10 Y revision rates Hybrid fixations had better survival compared to Uncemented fixations, but whether this difference is statistically significant is not determined. Still, the use of Uncemented fixations was nearly 3 times more than hybrid fixations among patients <55. [9]

Unlike in UK, according to AOANJRR, uncemented fixation was the most preferred choice to cemented and Hybrid fixations throughout and this was more obvious for the age category <55 Years. This preference for uncemented fixation has further increased from 51.3% in 2003 to 60.8% in 2019. For the same period when hybrid fixation increased from 34.8% to 36.3%, Cemented fixation declined from 13.9% to 3.0%.

Considering all categories of age, the rate of revision for Cemented THA compared to Hybrid THA was insignificant. Cementless THA has a higher rate of revision compared to Hybrid THA. Except for the post-operative 1st month where Cementless THA shows a higher revision rate compared to Cemented THA, the revision rate of Cementless THA compared to Cemented THA was insignificant. Specifically, for patients aged <55 years, there is no difference in the rate of revision when comparing fixation methods but it's worth noting that the number at risk for cemented was significantly low as the predominant fixation type was uncemented.

Even though the 10 Y revision rate for Hybrid fixations was 5.0 (4.2, 6.0) compared to Uncemented fixations 5.4 (5.0, 5.8), when considering the number, the use of Uncemented fixations were nearly 5 times more than hybrid fixations among patients <55 years of age. [10]

Bearing Surface Combinations

Many factors such as age distribution among patients, disease pattern, efficacy of the medical supplies of the country and payment types, may affect the choice of bearing surface.[11]

In UK, since 2012 there has been a marked increase in the use of COP (Ceramic on Polyethylene) bearings in all 3 types of fixations but more significantly in Uncemented and Hybrid fixations. There was a corresponding decrease in the use of COC (Ceramic on Ceramic) bearings. When specifically considering Uncemented fixations, Patients receiving COC [Men age 58.7] and COP [Mean age 63.0] bearings tend to be younger than those receiving MOP (Metal on Polyethylene) [Mean age 69.9] indicating COC and COP implants were more frequently used among the young. Similar trend can be seen among hybrid fixations.

Even among cemented fixations where COC is absent there was a 10Yr mean age difference between the MOP (74.2) and COP (64.5), indicting the use of COP was more frequent among younger patients.

The failure rates for COP bearings remain particularly low and it is encouraging that these are becoming more widely used with time. According to the NJR relatively good results obtained with COC and COP bearings in younger patients are striking [9].

Unlike in NJR in UK the AOANJRR reported XLPE (ultra-high molecular weight polyethylene that has been irradiated by high dose (>50kGy) gamma or electron beam radiation)

Table 2. Data from Table 3.H6 of the 17th report of The National Joint Registry (NJR) [9]

Kaplan-Meier estimates of 10-year revision rate (95% CI) of primary hip replacements of <55 years of Age by gender, fixation and bearing. (from Table 3.H6 of 17th NJR 2020)						
	<55 Male			<55 Female		
	Cemented	Uncemented	Hybrid	Cemented	Uncemented	Hybrid
MOP	2,137	4,766	1,750	3,665	5,813	2,489
10Y RR	6.19	5.45	6.54	5.53	4.36	4.53
(95% CI)	(4.95-7.73)	(4.53-6.56)	(5.01-8.50)	(4.62-6.61)	(3.61-5.25)	(3.50-5.84)
COP	2,953	9,898	5,449	4,162	10,276	6,551
10Y RR	3.44	3.76	3.48	4.25	3.86	3.3
(95% CI)	(2.59-4.57)	(3.08-4.58)	(2.55-4.73)	(3.32-5.42)	(3.17-4.69)	(2.43-4.49)
COC		19,937	3,198		21,496	4,565
10Y RR		4.6	3.46		4.46	3.15
(95% CI)		(4.22-5.01)	(2.74-4.35)		(4.10-4.86)	(2.57-3.86)
Total	5,149/71185	38,216/71185	10,878/71185	7,918/71708	40,360/71708	13,998/71708
10Y RR	4.84	7.35	5.23	4.97	7.13	4.2
(95% CI)	(4.04-5.79)	(6.96-7.76)	(4.58-5.98	(4.30-5.73)	(6.76-7.51)	(3.70-4.77)

Table 3. Data from the table HT30 of Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2020 [10]

Cumulative Percent Revision of Primary Total Conventional Hip Replacement by Bearing Surface (Primary Diagnosis OA)				
	Total	Revised	10Y-RR (95% CI)	15Y-RR (95% CI)
Metal/Non XLPE	35265	2821	6.5 (6.2, 6.7)	
Metal/XLPE	165771	5792	4.6 (4.5, 4.7)	6.3 (6.1, 6.6)
Ceramic/XLPE	91245	2484	4.3 (4.1, 4.6)	5.9 (5.4, 6.4)
Ceramic/Non XLPE	7986	582	7.2 (6.5, 7.9)	
Ceramicised Metal/Non XLPE	297	50	12.5 (8.9, 17.3)	
Ceramicised Metal/XLPE	25323	724	3.8 (3.5, 4.1)	
Ceramic/Ceramic	94733	3876	5.0 (4.8, 5.1)	7.1 (6.8, 7.4)

and non XLPE separately when reporting on Polyethylene acetabular component. When reporting the femoral head component, they reported Ceramic and ceramicised metal separately. As a result, Australian Registry has evaluated 10 bearing surface combinations and 8 of which have been used in more than 5,000 procedures. [Table 2].

Ceramicised metal/XLPE combination has the lowest rate of revision at 10 years followed by Ceramic/XLPE. Ceramic/XLPE rates were better than MOP and even COC even at 15 years of follow up. But the Registry urges caution in the interpretation of this result as this bearing is a single company product, the lower rate of revision could be due to limited product combinations of femoral and acetabular prostheses. [Table 3].

Clearly, Ceramic/XLPE has a statistically significant lower rate of revision compared to metal/XLPE after 2 years HR=0.83 (0.77, 0.91), p<0.001.] For Ceramicised metal/XLPE compared for metal/XLPE this significance was evident even after 1 year as 1Yr - 2Yr: HR=0.59 (0.46, 0.76), p<0.001 & beyond the 2nd year: HR=0.61 (0.54, 0.70), p<0.001. Interestingly, when compare Ceramic/Ceramic vs Metal/XLPE for the entire Period there was no statistically significant difference among the revision rates. [HR=1.00 (0.96, 1.05), p=0.826]. [10]

Irrespective of the type of fixation type, in both registries, Metal-on-metal bearings continue to perform worse. As noted in several Joint Registries and review articles, serious complications such as Adverse Reaction to Metal Debris(ARMD), Adverse Local Tissue Reaction (ALTR), metal granuloma (Aseptic LymphocyticDominated Vasculitis Associated Lesions(ALVAL), toxic and carcinogenic effects of cobalt ions are serious complications caused by metal debri of these implants.[12-15]

Head size

As uncemented COC and COP being the fixation and bearing surfaces with best survival rates in the age group of <55 years, it is worth to see the best head sizes for the same. NJR indicates a statistically significant differences between four head sizes (28,32,36 and 40mm) (P<0.001) for uncemented COC hips.

Even though the numbers are small, survival rate for head size of 40mm was the best while the highest failure rate reported with the head size of 28mm. Head sizes of 32mm and 36mm showed similar failure rates, yet the rates were poor than for rate of head size 40mm. For, Uncemented COP hips, similar four head sizes showed a statistically significant difference among the survival rates. When the best implant survival is with 32mm and 36mm head sizes, the 28mm and 40mm heads shows the worse outcomes.[9]

Stability of the THA is an important factor to determine the outcome of a THA and larger head size will provide more stability to the THA. But, traditionally the higher revision rates were noted with larger head sizes when used with non XLPE. According to AOANJRR the use of modern XLPE has clearly allowed the use of more larger head sizes without increasing the revision rates [10].

Table 4. Data from the table HT31 of Australian Orthopaedic Association National Joint Replacement Registry (AOANJRR) 2020 [10]

Ten-year revision rate of primary total conventional hip replacement by polyethylene type and head size (Primary diagnosis OA)			
		>32mm	32mm
XLPE	10Y RR	4.9(4.7-5.1)	4.1(4.0-4.3)
	N at risk	8921	14344
Non XLPE	10Y RR	14.2 (9.8-20.4)	7.0(6.1-7.9)
	N at risk	10	1399

Conclusion

Both Registries favour the use of uncemented/Hybrid fixations in patients <55 years and COC and COP bearings were the favourites and compatible with the best survival rates. There has been a marked increase in the use of COP bearings in young patients both in the UK and Australia in the recent past. Due to the improved wear resistance of modern XLPE, the ability to use a larger head size has been possible with COP bearings similar to COC implants, reducing the risk of dislocations. Uncemented /Hybrid fixation with COC bearings with 40 mm head size or modern XLPE containing COP bearings with 36mm head size would be the better choice for a THA in a patient <55 years of Age.

Abbreviations:

THA – Total Hip Arthroplasty
COP – Ceramic on Polyethylene
COC – Ceramic on Ceramic
MOP – Metal on Polyethylene
NJR - The National Joint Registry
AOANJRR - Australian Orthopaedic Association National Joint Replacement Registry
XLPE - ultra-high molecular weight polyethylene
Non XLPE – Non-ultra-high molecular weight polyethylene

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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REVIEW ARTICLE

Pathogenesis of neuropathic foot ulcers in diabetes: understanding current concepts

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Keywords: Diabetic neuropathy; foot ulcers; deformity; callus formation; miccroangiopathy; microvascular disease

Introduction

The diabetic foot ulcer can occur in one out of four diabetic individuals during their lifetime [1]. Ischaemia, neuropathy, or a combination are the primary risk factors for non-healing foot ulcers. In the presence of these elements, even trivial trauma can trigger ulceration [2]. Moreover, neuropathy is associated with 85% of these ulcers [3] and ischaemia is associated with 10-60% in different case series [4]. Neuropathic foot ulcers can occur in three ways; deformity related trophic ulceration, trauma-Infection related non-healing ulceration, superadded peripheral vascular disease-related ulceration.

This account is on the classic pathway of microangiopathy leading to peripheral neuropathy, deformity and ulceration. This group of patients will present with callus leading to ulceration. They represent 30% out of all types of diabetic foot ulcers [4].

Diagnosis of neuropathic foot

On examination, a classical hammertoe or clawfoot deformity [5] may be present in the advanced disease state. Although sensory, motor, autonomic components exist, testing for all the components is not essential. Thus clinically checking the protective sensation [testing with monofilament] and vibration sensation for the presence of diabetic peripheral neuropathy are useful [6]. However, this will be influenced by the thickness of the area of the foot test [7].

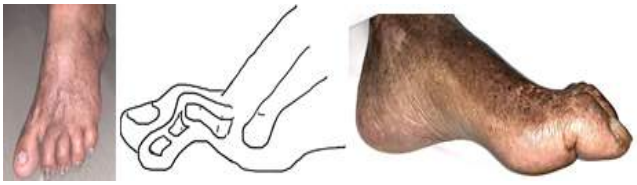

Figure 1. Claw toe and Hammer toe deformities

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Figure 2. Abnormal pressure points

	Pressure distribution in claw foot deformity.
1	Tip of toes rather than the pulp of the toes.
2	Metacarpal heads compressing tissues proximal to ball of foot, thickness of the plantar fascia and the stiffness of soft tissues of these patients, can amplify the pressure on the metatarsophalangeal joint,
3	Prominent PIP joints on the dorsal side [usually with ill-fitting foot wear that can lead to repetitive trauma]. In the background of sensory neuropathy this can lead to ulceration.

Clinical progression

The hallmark of neuropathic foot disease is the deformity. This is described as a claw foot with loss of foot arches [6].

The claw toe deformity [Figure 2]

The clinical examination and radiological evidence show appearance of motor neuropathy effects in the small muscles of the foot. The characteristic fatty infiltration of intrinsic muscles seen on MRI is regarded as indirect evidence of the motor neuropathy. subsequent loss of lumbrical action produces the claw toe deformity with inability of the extending proximal interphalangeal joints. This is called intrinsic minus foot where the long flexors are unopposed at that joint [5,6].

The claw deformity can be augmented by additional factors like joint capsule changes and plantar aponeurotic ruptures.

	Contributing factors are the.
1	Effect of tendoachillis shortening that plantar flex the foot and shifts more pressure to fore foot present in diabetic patients particularly increase the pressure on the metatarsophalangeal joint
2	Limited joint movements of subtalar joint and first metatarsophalangeal joint
3	Thickness of the plantar fascia and the stiffness of soft tissues of these patients, can amplify the pressure on the metatarsophalangeal joint

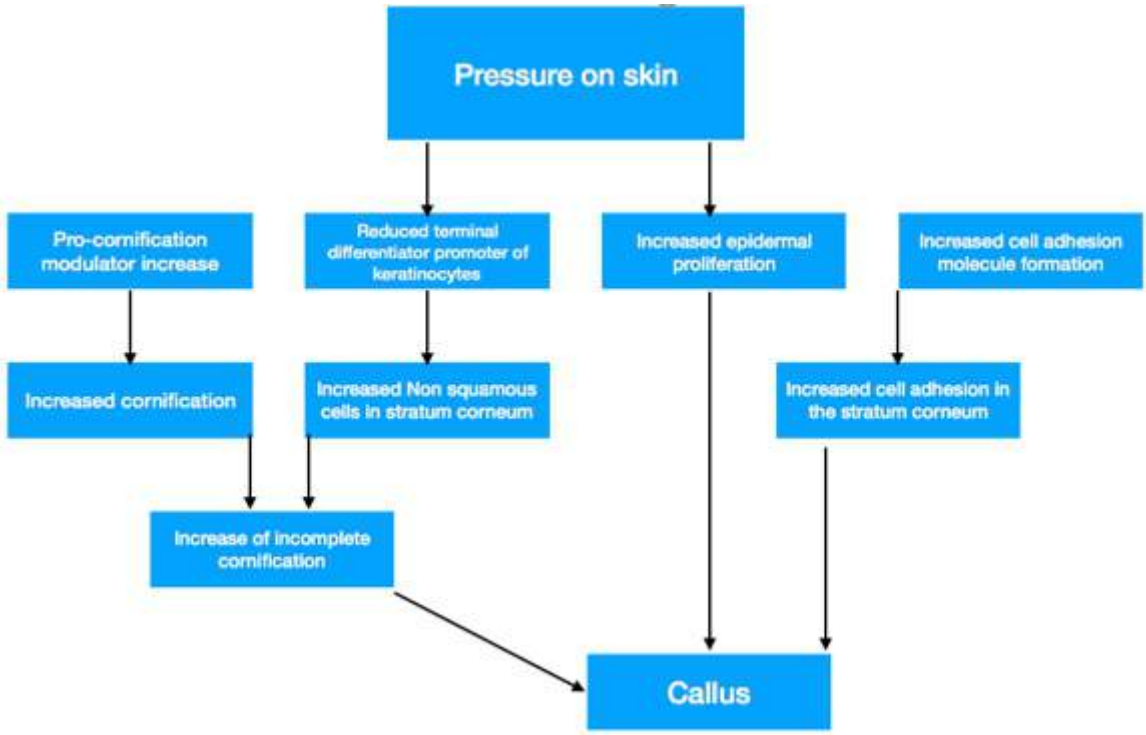

Figure 3. Bio-mechanical forces contributing to callus formation

The net effect of abnormal load experienced by metatarsophalangeal joints cause the retrograde buckling of metatarsal heads. This creates another foot deformity. This shifts the normal pressure points on the ball of the foot proximally in to the smooth glaberous instep region of the foot [8].

This part of the foot is not suitable to bear weight of the entire body unlike the ball of the foot. These deformities create three types of abnormal pressure points on the forefoot [9].

Callus formation

These changes of the skeleton will eventually affect the skin as it is the interphase between the skeleton and the surface that we walk on. When a thin skin that is not suitable for repeated pressure experiences this from both directions [vertical and frictional], it usually responds by focal vertical proliferation over the pressure areas. This response is supported by an increase in vascularity around the pressure point. This increased activity of the basal cell layer will push out more cells in too superficial layers. The natural process of producing granules of keratin that fills up the cell will form a thicker than normal keratin layer at the top. The natural shedding of this layer is slower at this area of hyperkeratosis [callus]. The biomechanical changes that accelerate callus formation are given in figure 3. The process is a complex genetic alteration that produces more keratinocytes that have an increased amount of keratin. This produces incomplete cornified cells that are resistant to desquamation than normal keratinocytes [10].

Callus and infection

Although this natural phenomenon is protective of the normal pressure points as a response to increasing pressure, the callus on the new pressure points will be mobile and may act as a different pressure point on the unprepared subcutaneous tissue. This abnormal friction between layers of skin and underlying tissue will produce a bursa known as an adventitious bursa. [Figure 5] Some authors have recognised the callus on a diabetic foot with deformities as a foreign body

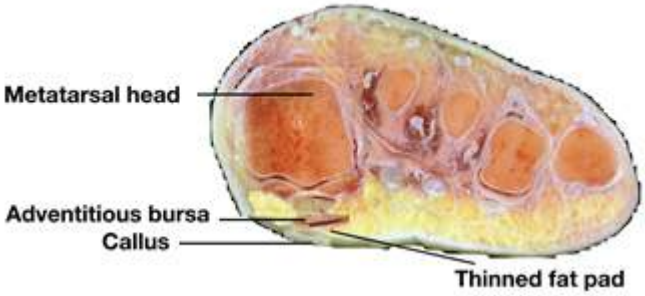

Figure 4. Pressure imbalances

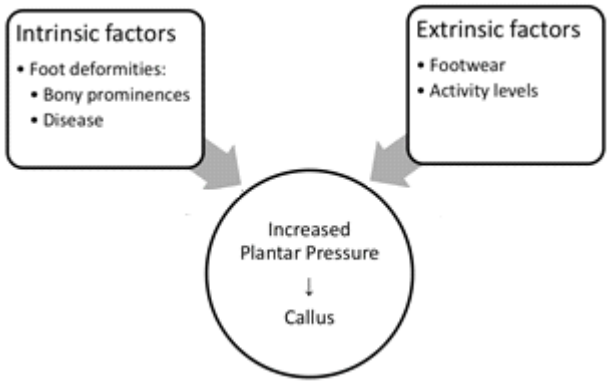

Figure 5. The cross sectional relationship of deformity to callus

that produce additional focal pressure on to deeper tissue. [10,11,12,14]

These calluses are prone to the effects of drying out as the water content or the moisture of the skin is also less in the background of decreased sweat gland activity of the plantar aspect and reduced sensation [15]. On magnification, there will be cracks on the callus that can even connect the already damaged underlying thin tissue layer or the adventitious bursa resulting from the callus itself. This step is the beginning of a vicious cycle of infection that can worsen the ulcer. At the initial stages, these infected cracks can be concealed by a thick callus till overt signs of infection take over the local tissue.

This simplified discussion on neuropathic ulcer development without superadded macrovascular disease is not complete without some understanding about the underlying pathogenesis of peripheral neuropathy due to hyperglycaemia.

Peripheral neuropathy and Hyperglycaemia

Diabetes Mellitus is identified as a derangement in metabolism characterised by prolonged hyperglycaemia due to abnormal insulin activity or/and insulin production. Long-standing hyperglycaemia results in alternations of the vascular structure and function leading to damage and failure of organ systems [17]. Two somewhat distinct vascular pathologies are described in longstanding diabetes: a small calibre vessel disease affecting the arterioles and capillary network of organs, and larger vessels disease [macroangiopathy] characterised by atherosclerosis in medium to major arteries. The scope of this section of the review is to discuss the pathogenesis of microangiopathy leading to peripheral diabetic neuropathy.

In general, neuropathy, nephropathy and retinopathy are considered microvascular complications of diabetes. Neuropathy seen in diabetes is a collection of neuropathies grouped according to the main fibre type affected [motor, sensory, and autonomic] and pattern of involvement of the body. Among these diabetic polyneuropathy [DPN] is the commonest form and the most common complication found among individuals with long-standing diabetes[17,19].

Distal diabetic neuropathy is characterised by axonal loss in multiple foci, which starts from distally that includes large and small diameter nerve fibres. Apart from axonal degeneration, decreased myelinated fibre numbers in cross-sections, coexisting demyelination foci, regeneration of nerve fibres and re-myelination are also seen [17,19].

Metabolic and vascular dysfunction are major contributors to the pathogenesis of DPN. An abnormal cascade of metabolic derangements due to chronic hyperglycaemia impacts adversely on nerve perfusion. The blood supply and the microvascular distribution of the nerve, consist of epineural and endoneurial circulation. Microcirculation is the basic functional unit responsible for maintaining perfusion pressure thus a steady supply of nutrients. It has a complex self-regulatory system controlling capillary permeability and small muscle tone changes affecting the calibre of vessels with its blood flow according to local metabolic demands [20,21]. The deranged biochemical state gives rise to microcirculatory dysfunction that eventually results in structural changes of nerves at the cellular level. These changes will produce a loss of function of affected nerves.

High glucose levels trigger a change in levels of nitric oxide [NO] bioavailability that counter reactive oxygen species [ROS] accumulation in the endothelium which eventually leads to its dysfunction[22,23]. This initial trigger signals several pathogenic pathways implicated in diabetic complications. These include elevated polyol pathway activity, nonenzymatic glycation, and protein kinase C levels that carry physical changes leading to microvascular complications [24].

Biochemical pathways activated in hyperglycaemia

Irreversible nonenzymatic glycation of proteins cause

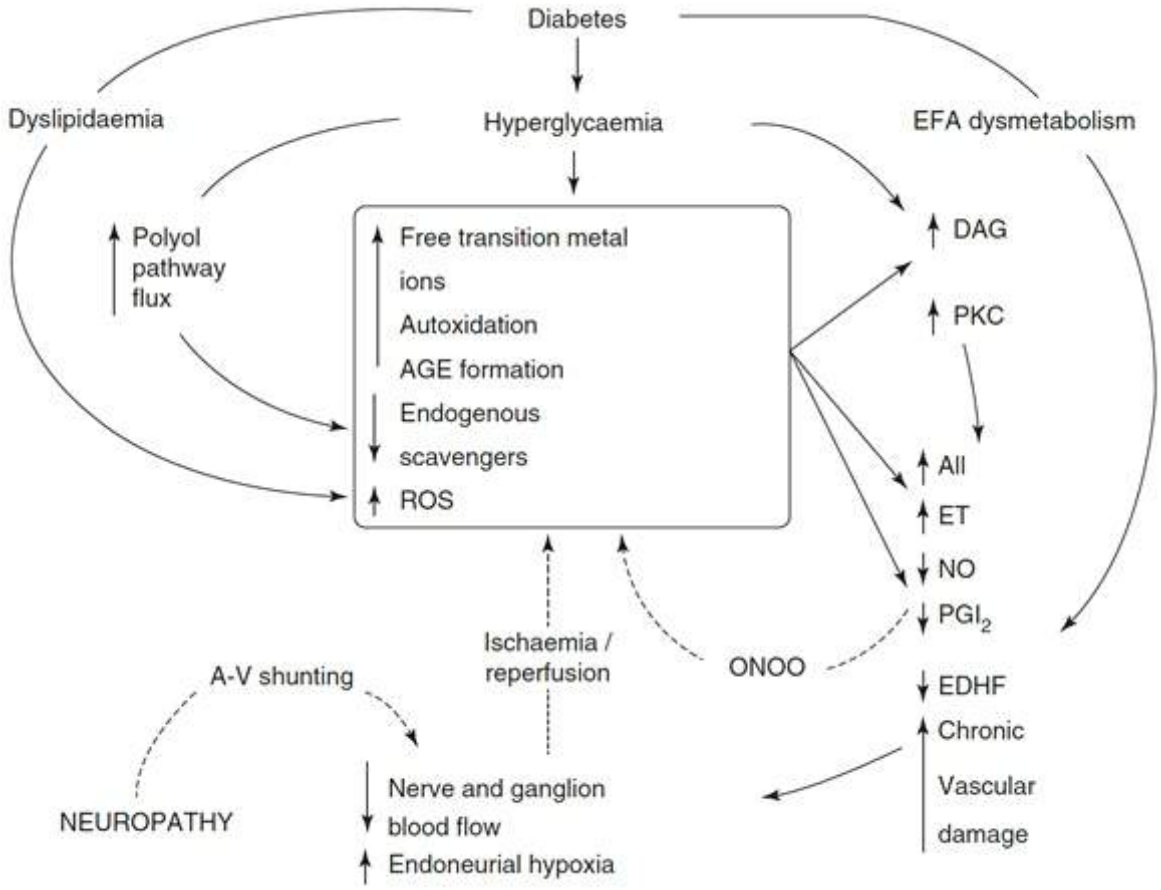

Figure 6. Alteration of metabolic pathways in hyperglycaemia. AII, angiotensin 2; AGE, advanced glycation end product; A-V, arterio-venous; DAG, diacylglycerol; EDHF, endothelium-derived hyperpolarising factor; EFA, essential fatty acid; ET, endothelin-1; NO, nitric oxide; ONOO, peroxynitrite; PGI2, prostacyclin; PKC, protein kinase C; ROS, reactive oxygen species [18]. Adapted with permission from author

abnormalities of function by altering their molecular conformation, altering enzyme activity and disrupting receptor functions. These advanced glycated end-products [AGEs] are a heterogeneous group of molecules formed by the irreversible nonenzymatic glycation of plasma and cellular proteins. AGEs can amplify its disruption of cellular function by interfering with both intra and extracellular structure and function further cross-linking. This does not limit to proteins but also lipids and nucleic acids. These are responsible for various complications seen in diabetes [25]. This process is considered one of the initiating factors for nerve demyelination.

Protein kinase C is an enzyme present throughout the cell that plays a role in an array of intracellular signalling pathways. An important consequence of PKC activation is ROS generation. This ROS production and PKC ability to decrease eNOS activity amplify the cumulative effect of ROS on endothelial cells. The resulting abnormal accumulation of sorbitol in peripheral nerves causes depletion of myoinositol and a decrease in Na-K- ATPase levels adversely affects the nerve function [26].

Furthermore, the increased cellular glucose levels drive more glucose into the polyol pathway which is also known as the sorbitol pathway. Polyol pathway requires NADPH for aldose reductase as a substrate that reduces NAD+ in the reaction in sorbitol reductase [26].

The alterations in the intracellular milieu and vasomotor functions result in structural vascular changes seen in microangiopathy; thickening of the capillary basement membrane, specific vascular cell apoptosis, hypoplasia and swelling of epithelial cells. These changes are seen mainly in the endoneurial vasa novorum with degeneration of pericytes, perivascular basement membrane thickness increase and microthrombi. These structural changes disrupt most of the cellular functions of vessels by increased permeability, changes in auto-regulation of blood flow to distal nerves. These were evident in vivo studies that show the endoneurial blood flow diverted to epineural circulation by shunting hence imparting steal phenomena. [17,19,26].

All of the above pathological mechanisms collectively account for the development of distal peripheral neuropathy.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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REVIEW ARTICLE

An overview of the management of renal malignancies in von Hippel-Lindau syndrome

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Abstract

Von Hippel-Lindau [VHL] syndrome is a hereditary multisystem cancer syndrome characterized by a wide range of benign and malignant tumours. Renal neoplasms are the commonest solid organ malignancies associated with VHL seen in 25–45% of patients. Management of renal tumours is determined by multiple tumour related and patient-related factors and decision making is often difficult due to its multifocal nature and bilateral involvement. Its tendency for frequent recurrences further complicates the clinical picture. We review the existing literature on the management of renal malignancies in VHL syndrome focussing on observational strategies, minimally invasive approaches, nephron-sparing surgery and radical surgery. Furthermore, we provide the Sri Lanka perspective in the management of renal malignancies in VHL syndrome. Surgeons that manage such patients should be cognizant of extra-renal manifestations of VHL and the importance of a multidisciplinary team and referral pathways. Proper follow-up and selecting patients for suitable as well as minimal interventions such as minimally invasive techniques and nephron-sparing approaches is crucial in the management to provide acceptable cancer control while preserving renal functions. In Sri Lanka, establishing proper referral pathways to dedicated centres with a multidisciplinary team equipped with facilities to deal with renal as well as extra-renal manifestations would improve expertise, quality of care and reduce patient discomfort and default rate.

Introduction

Von Hippel-Lindau [VHL] syndrome is a hereditary multisystem cancer syndrome with an incidence of 1:36000 live births [1]. Around 4% of renal cancers are estimated to be associated with hereditary cancer syndromes [2]. Of which, VHL was the first hereditary cancer syndrome to be described in association with renal cancers.

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Renal neoplasms are the commonest solid organ malignancies associated with VHL seen in 25–45% of patients [2]. It develops due to a germline mutation of the VHL tumour suppressor gene in the short arm of chromosome 3 [3]. VHL has an autosomal dominant inheritance through familial transmission, however, 20% of the patients may develop due to sporadic mutation [4]. Its wide spectrum of clinical manifestations demands clinical attention through multiple disciplines. VHL syndrome is characterized by a wide range of benign and malignant tumours. These include central nervous system [CNS] tumours commonly cerebellar haemangioblastomas, retinal angiomas, renal tumours, pheochromocytomas, endolymphatic sac tumours, pancreatic cystic lesions and neuroendocrine tumours and cystadenomas in the epididymis and broad ligament.

Among these tumours, management of renal tumours is determined by multiple tumour related and patient-related factors and decision making is often difficult due to its multifocal nature and bilateral involvement. Its tendency for frequent recurrences further complicates the clinical picture. We review the existing literature on the management of renal malignancies in VHL syndrome. Furthermore, we provide the Sri Lankan perspective in the management of renal malignancies in VHL syndrome.

Genetics and pathogenesis

Transcription of the VHL gene results in a protein complex responsible for the degradation of hypoxia-inducible factor [HIF]. HIF is otherwise responsible for the enhanced expression of angiogenic and growth factors such as VEGF [angiogenic], PDGF ß [growth] and TGF α [mitogenic] which promote cellular proliferation. So failed degradation of HIF would result in overexpression of the above proteins which ultimately leads to uncontrolled cellular proliferation resulting in carcinogenesis. HIF independent mechanisms also exist which involve loss of extracellular matrix framework via fibronectin which further contributes to carcinogenesis [Figure 1] [5, 6].

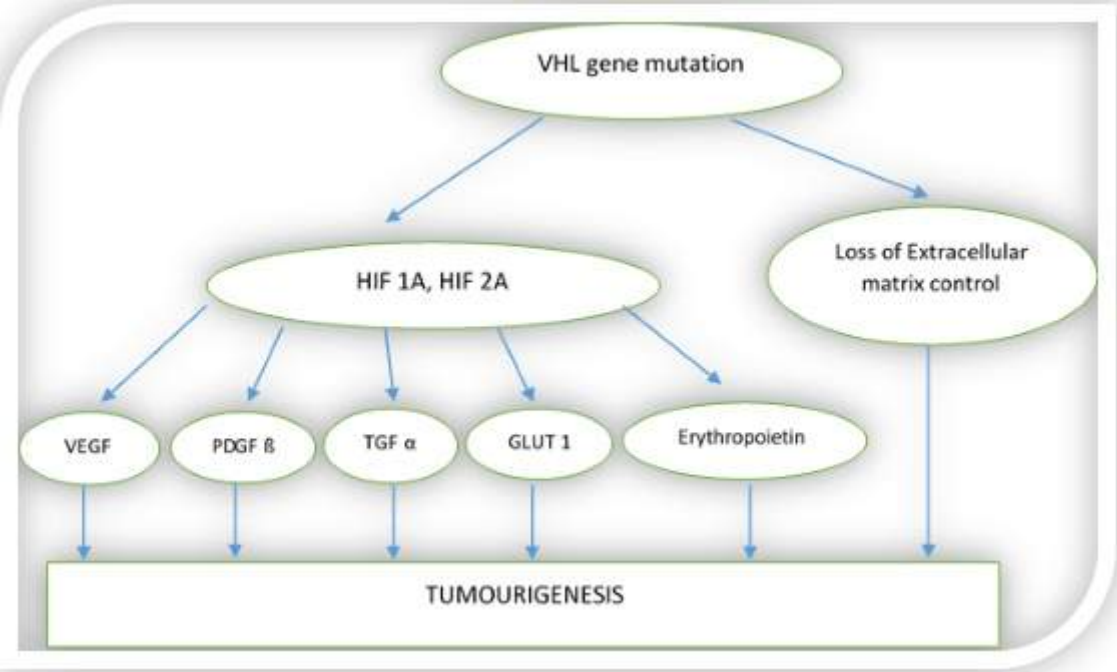

Figure 1. The genetic basis of carcinogenesis/ tumorigenesis in VHL syndrome

This disease is an excellent example of Knudson's two-hit hypothesis [3]. As the mutated gene is already present in one allele of all the cells, the development of the disease requires a second hit on the remaining allele. Either the somatic mutation, deletion, loss of functional variants or methylation of this gene manifests the disease in vulnerable organs. The type of mutation determines the phenotype of the disease [7]. For example, a missense mutation is mostly associated with pheochromocytoma.

VHL is classified into two types according to the presence of phaeochromocytoma [7]. The presence of missense mutation is more likely to cause pheochromocytoma as in type 2 [with either high risk or low risk for concurrent renal cell carcinoma] and mostly, the deletion and loss of functional variants would cause type 1 disease with a very low risk of phaeochromocytoma [Table 1].

Table 1. Classification of VHL syndrome into type 1 and 2

Type	Organ manifestations
Type 1	Very low risk of pheochromocytoma
	CNS Haemangioblastomas, pancreatic lesions, Renal cell carcinoma [RCC]
Type 2	A - Pheochromocytoma, CNS tumours, Retinal tumours
	B - Above [A] + RCC, Pancreatic lesions
	C - Pheochromocytomas

Screening and diagnosis of VHL syndrome and renal tumours

During the process of genetic testing, the altered gene will be detected in peripheral leucocytes almost always in familial inherited cases. In cases with de novo mutation, the mutated gene might not be present in all cell types [mosaicism] and therefore may or may not be seen in peripheral leucocytes. The possibility of transmitting the gene to their offspring is also affected by the presence of a mutation in germ tissues [3, 8].

VHL gene analyses are available with 100% accuracy in experienced laboratories but they are expensive [2]. Clinical criteria for VHL syndrome are very useful in the diagnosis in resource-limited settings [9]. The clinical diagnosis criteria vary with the presence of family history. In patients with a positive family history of VHL, one or more of the following lesions including retinal hemangioblastoma, cerebellar or spinal cord haemangioblastoma, phaeochromocytoma, renal clear cell carcinoma or multiple renal or pancreatic cysts would suffice. In the absence of family history, two or more of the following groups of lesions should be present. These include i] ≥2 retinal, spinal cord or brain hemangioblastomas, or a single hemangioblastoma in addition to visceral organ lesions [multiple renal or pancreatic cysts]; ii] renal clear cell carcinoma; iii] adrenal or extra-adrenal pheochromocytoma and iv] rare lesions including internal lymphoma, papillary cystadenoma of the epididymis and broad ligament, and neuroendocrine tumours of the pancreas [9]. VHL genetic test is warranted in those with atypical manifestations without a family history. Genetic testing should be offered following

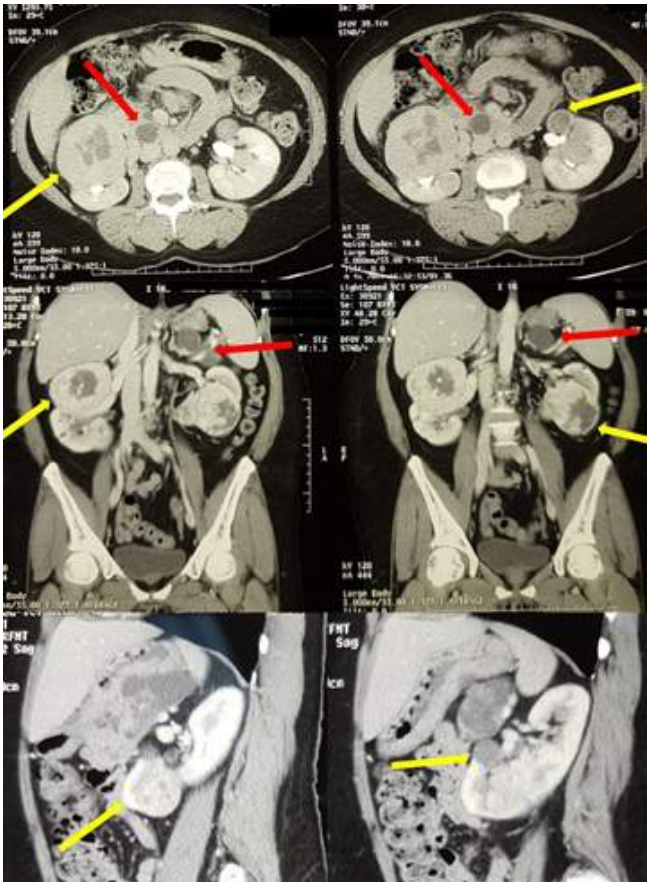

Figure 2. CT scan images of renal tumours in VHL syndrome showing bilateral solid and cystic lesions indicated by yellow arrows. Pancreatic cystic lesions are indicated by red arrows

detailed genetic counselling.

Renal manifestations are typically characterised by multiple renal cysts and renal tumours often as clear cell renal cell carcinomas [RCC]. Development of renal tumours are rare before the age of 20 years and the mean age is 44 years [10]. Although RCC may present with haematuria, the presence of this symptom indicates a late stage of the disease [11]. Before the utility of computed tomography CT scans, 13-42% of the patients died due to metastatic complications of the disease [11]. At present, mostly, these lesions are detected as part of the surveillance process because the initial presentation is usually of non-renal pathology such as CNS tumours.

In patients diagnosed with VHL syndrome, contrast-enhanced [CT] of the abdomen and pelvis is usually performed to detect visceral lesions starting at the age of 18 and further frequency of follow up imaging is determined by the disease manifestations [Figure 2] [12]. Renal tumours are seen as simple or complex cystic lesions or solid renal masses [12]. Ultrasonography [USS] or abdominal magnetic resonance imaging [MRI] are useful to further characterise indeterminate lesions. Additional investigations include serum metanephrines for pheochromocytoma and MRI of the brain and ophthalmological assessment for CNS and eye manifestations [2].

Management of renal malignancies in VHL syndrome

Management strategy should involve a multidisciplinary approach due to the complexity of the disease and concurrent bilateral involvement [Figure 3]. A high chance of recurrence renders the patients more prone to repeated surgical intervention and subsequent loss of renal function. The management approach for malignant renal tumours is more towards nephron-sparing treatment options keeping in mind to optimally preserve renal parenchyma. Strategies to preserve the functional status of remnant renal tissue should also be considered with optimization of patient comorbidities such as diabetes, hypertension .etc.

Nephron sparing surgery [NSS]

A major difficulty in decision making is when the patient is having bilateral multifocal tumours, especially if one or more of them are exceedingly large. Nephron sparing approaches should be considered first without compromising the oncological outcome to delay the renal replacement therapy due to surgical intervention. Improvements in imaging modalities such as USS, CT and MRI have contributed to the effective surveillance programme and smaller tumours [< 3cm] with low malignant potential can be safely monitored [11]. The consensus cut off for surgical management in VHL is taken as more than 3 cm [11]. Apart from the size of the tumour, age of diagnosis, synchronous tumours and type of mutation was associated with the rate of growth of VHL tumours are considered in the setting of non-surgical management [13]. A multicentre study of RCC in VHL patients showed higher cancer-specific 5-year survival in

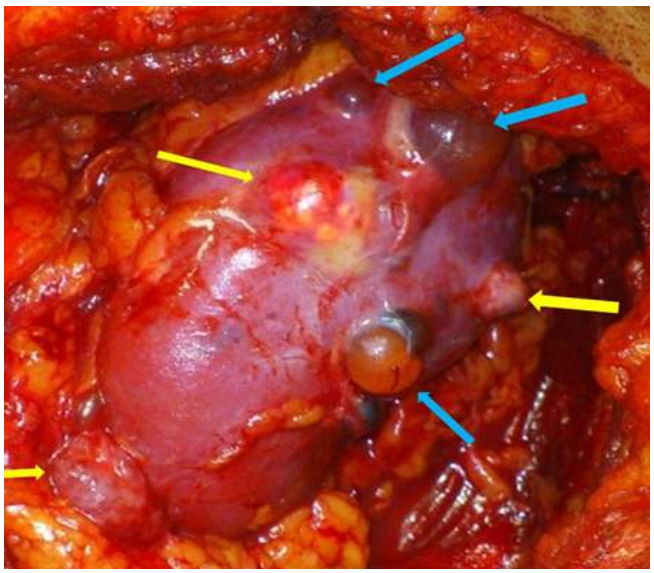

Figure 3. Image showing a kidney with multiple tumours [yellow arrows] and cysts [blue arrows]

NSS compared to radical nephrectomy [100% vs. 95%] [14].

Studies have shown the value of intraoperative USS in NSS for hereditary renal cancer syndromes where 25% of occult lesions were detected. However, further studies are needed before recommendations for routine practice [15]. Apart from the general advantages of laparoscopy, the place for laparoscopic NSS may be beneficial to prevent access-related complications in future operations. Otherwise, the advantage of laparoscopy in NSS is uncertain but a relatively shorter duration of acute kidney injury [AKI] [Odds ratio [OR]: 3.87] was observed in one study [16]. The exact role of laparoscopic partial nephrectomy, and the ideal patients for this procedure, has yet to be determined.

In cases where there are bilateral tumours requiring radical nephrectomy on one side and NSS on the other, performing both surgeries simultaneously may lead to a higher chance of AKI, especially in patients with already compromised renal function. In such cases, it may be advisable to avoid simultaneous bilateral surgeries.

Performing one side, specifically, the NSS first may allow adequate time for the operated kidney to recover from surgery. This might help in reducing the morbidity due to AKI during the subsequent operation following a waiting time of 4-6 weeks [17].

Radical Nephrectomy

Radical nephrectomy should be preserved for the patients in whom an NSS does not allow a significant functioning future renal remnant. Roupret et al suggested that VHL associated RCCs tend to be bilateral and multifocal and have a high chance of local recurrence following NSS [18]. The chance of recurrence and metastatic potential is more if the tumour size is more than 7 cm. These types of patients often require a more invasive approach.

Very rarely, bilateral tumours which are not amenable for nephron-sparing approaches or associated with the end-stage renal disease require bilateral radical nephrectomy with renal replacement therapy [RRT]. There are concerns regarding tumour recurrence with subsequent immunosuppressive therapy following renal transplant and the optimal latency time between nephrectomy and transplantation [19]. In a case-control study, Goldfarb et al found no difference in renal function, graft survival and patient survival between patients with VHL who underwent transplant after a mean duration of dialysis of 26 months and the control group [transplant patients without VHL] [20]. Furthermore, there was no association between the pre-transplant dialysis period and subsequent development of metastatic disease [20]. However, more evidence is needed before recommendations. A special emphasis is required in live related donor transplantation because of the risk of the donor having VHL mutation which might cause the development of RCC in the remaining kidney.

Minimally invasive techniques

Minimally invasive focal therapies such as radiofrequency ablation, cryoablation and microwave therapy via either percutaneous or laparoscopic approaches show promising oncological outcomes with sparing of renal parenchyma in treating smaller tumours that are recurrent and multifocal [21]. However, these patients need more frequent monitoring and follow up. Furthermore, due to the possibility of multiple lesions, preoperative high-quality imaging and discussion with a radiologist are important [2]. Experience with ablative procedures in VHL patients is increasing globally and even in the local setting. A case series from Sri Lanka has shown successful implementation of ablative procedures [17].

A 10-year retrospective study on percutaneous cryoablation performed among 308 patients with renal tumours showed local recurrence and metastasis rates of 10.1% and 6.2% respectively [22]. However, in this study, only 6 patients had VHL syndrome [22]. In another series of 14 VHL patients [12 had a single kidney], salvage probe ablative therapy was performed in 33 tumours [average diameter 2.6 ± 1 cm] using percutaneous cryoablation [n=13], radiofrequency ablation [n=14], and laparoscopic cryoablation [n=3 without significant complications or reduction in renal functions [23]. During a mean follow-up of 37.6 months [range 12-82], CT or MRI showed suspicion of recurrence in 4 patients of which, 3 underwent re-ablation. The cancer-specific and overall survivals were 100% and 92% respectively [23].

There is more data with RFA than with cryoablation for the treatment of renal tumours associated with VHL syndrome [2, 24]. The ideal size of a tumour should be between 1 cm and 3 cm for ablation and a 5 mm margin is needed for complete ablation by RFA [24]. A cystic or solid lesion measuring 1 cm should be monitored until it increases more than 1 cm before ablation. Tumours less than 1 cm are not ablated due to difficult characterisation, difficult targeting for ablation and very low risk of metastasis even if they contain RCC [24]. The major complication rates for ablative procedures are 0 – 8% in VHL disease which is lower than surgical resection 6 –14% [24]. Major complications following ablation include intestinal perforation, ureteral strictures, bleeding requiring intervention and residual or recurrent tumours [24].

In VHL disease, regular follow up of renal lesions is recommended due to high recurrence rates. Generally, cross-sectional imaging should be conducted at least yearly to detect recurrences in these high-risk patients [24].

Observational strategies

Simple renal cysts are usually followed up without any invasive interventions as they are usually asymptomatic and the risk of containing RCC is very low. Complex renal cysts should be monitored with close observation and serial imaging with a specific focus on their malignant potential. Solid components in otherwise benign-looking renal cysts contain foci of RCC.

Tumours smaller than 3cm can be followed up with close surveillance due to their seemingly low metastatic potential. Walther et al suggested that nephron-sparing surgery in small tumours with the threshold of tumour diameter as 3 cm showed favourable outcomes about metastasis and renal function [25]. However, with the newer ablation techniques tumours larger than 1 cm are subjected to ablation without waiting for the tumour to exceed 3 cm, to avoid invasive surgery.

Sri Lankan perspective

According to 2018 GLOBOCAN estimates, renal cancers are the 15th commonest cancer with an age-standardised rate of 0.8 per 100,000 population [26]. The data on the proportion of VHL among RCC patients is restricted to tertiary care centres [27, 28]. A cohort from a tertiary care centre showed that out of 285 renal cell carcinomas only 6 patients [2.1%] had VHL syndrome [17, 27]. In Sri Lanka, renal cancer patients are treated by urologists, once surgeons and general surgeons throughout the country. The majority of cancer care is delivered through government hospitals although the private sector also plays a role in the urban setting [29]. However, renal cancers associated with VHL syndrome should be managed by experienced centres with a multidisciplinary team with necessary minimally invasive treatment facilities and facilities for managing other manifestations of VHL.

The data on the clinical characteristics and outcomes of renal tumours with VHL syndrome is very limited in Sri Lanka. Only 1 case series described 6 patients, [mean age= 35.1 years [range: 24-54], males=5] with VHL syndrome with multiple bilateral renal malignancies with a median follow-up of 36 months [range: 12-72]. Different combinations of radical nephrectomy [n=2], partial nephrectomy [n=7] and focal therapy [n=6] were used appropriately. Only two patients developed new lesions which were successfully managed with focal therapy [17].

A proper referral and prospective registry is needed for these patients for better management, follow up and further research. Due to the epidemic of chronic kidney disease in Sri Lanka, demands for RRT is high and patients are concerned about RRT due to the financial implications. Patients often face psycho-social disturbances due to the stigma related to hereditary cancers and the risk of needing future RRT [17]. Thus sometimes, patients are reluctant to divulge the positive family history. Therefore, clinicians should be aware of this and be empathetic towards these psychosocial problems. Counselling regarding the availability of treatment in the form of surgery and minimally invasive procedures would reduce the anxiety of patients [17].

Conclusion

VHL is a hereditary cancer syndrome associated with recurrent, bilateral and multifocal tumours.

Surgeons that manage such patients should be cognizant of extrarenal manifestations of VHL and the importance of a multidisciplinary team and referral pathways. Proper follow-up and selecting patients for suitable as well as minimal interventions such as minimally invasive techniques and NSS-based approaches is crucial in the management to provide acceptable cancer control while preserving renal functions. In Sri Lanka, establishing proper referral pathways to dedicated centres with a multidisciplinary team equipped with facilities to deal with renal as well as extra-renal manifestations would improve expertise, quality of care and reduce patient discomfort and default rate. Additional Information and Disclosures

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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MINI REVIEW ARTICLE

Live donor kidney transplantation in a COVID 19 positive patient: case report and literature review

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Keywords: COVID-19; renal transplantation; kidney; real-time Polymerase Chain Reaction (PCR) positive

Abstract

Introduction

Coronavirus disease 2019 [COVID-19] has become a pandemic resulting in a large number of deaths. The complications of COVID-19 are severe in post-transplantation patients on immunosuppression, resulting in more mortality. Therefore renal transplantations [KT] were stopped temporarily in Sri Lanka during the peak of the COVID-19 epidemic. And a few months later when the KT was restarted only patients who were real-time polymerase chain reaction [PCR] test negative was accepted for KT. This case report describes a live donor KT done on a patient who recovered from COVID-19 infection but had persistently positive PCR test.

Case presentation

A 29-year-old male with end-stage renal failure due to chronic kidney disease of unknown aetiology underwent a live donor KT. He had COVID-19 infection more than 4 weeks before the KT and was asymptomatic with normal chest X-ray [CXR] and white cell count [WBC]. But his PCR was positive. The donor was a 41-year-old male. The KT was done on 2nd February 2021. He had no significant postoperative complications.

Discussion and conclusions

The main diagnostic tests for COVID-19 infection are PCR and Rapid antigen tests. PCR detects the viral genomic RNA. It is known that patients who clinically recover from COVID-19 infection continue to excrete RNA particles. These are detected by PCR. Therefore it is suggested that if a patient clinically recovers from COVID-19 and has normal WBC, CXR and 6 weeks after the onset of initial infection can undergo KT safely despite having a positive PCR.

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Introduction

The Coronavirus Disease 2019 [COVID-19] is caused by severe acute respiratory syndrome coronavirus 2. It was first detected in Wuhan, China in 2019 and at present, it has become a pandemic [1] [2]. By February 2021, according to the World Health Organization [WHO] data, 223 countries were affected causing 2.5 million deaths out of 114 million confirmed cases [3]. According to the ministry of health of Sri Lanka, at the end of February, Sri Lanka had a total of 93,595 confirmed cases and 586 deaths [4].

Coronavirus is a Ribo Nucleic Acid [RNA] virus. It is transmitted by respiratory droplets and contact with contaminated surfaces [5] [6]. Healthcare workers are at higher risk of getting infected especially under specific circumstances in which procedures producing aerosols are performed; i.e., endotracheal intubation [7]. Few studies have reported the presence of Coronavirus in faeces. But there is no evidence of feco-oral transmission of COVID-19 [8].

The onset of symptoms is from 2 to 14 days from the time of exposure. But the patient can infect others from 3 days before the onset of symptoms to 10 days after the onset of symptoms. But this can vary depending on the viral load [9]. COVID-19 real-time polymerase chain reaction [PCR] and rapid antigen test [RAT] are the commonly used diagnostic tests in Sri Lanka. This is done on a nasopharyngeal swab. These tests detect viral RNA. Therefore following recovery from COVID -19 infection some patients persistently excrete viral RNA and become positive on PCR test. But it is shown that patients who clinically recover and more than four weeks after the onset of infection are not a source of infection despite being PCR positive [10] [11].

Due to immunosuppressive drugs given for patients undergoing kidney transplantation [KT], post-transplantation infections including COVID -19 is associated with higher morbidity and mortality [12] [13]. In addition post, KT patients and patients on haemodialysis are at a higher risk of acquiring COVID- 19 due to increased exposure to staff and others in hospitals [14]. This case report describes a live donor KT [LDKT] done on a post COVID- 19 infection patient who had persistently positive PCR test and negative RAT.

Case report

A 29-year-old male with End-Stage Renal Disease [ESRD] on regular Haemodialysis [HD] was planned for an LDKT. He was diagnosed with chronic kidney disease of unknown aetiology 7 years ago. His weight was 60 kg with a BMI of 24kg/ m2. His native urine output was 100ml/day. While awaiting LDKT, in December 2020, the patient developed shortness of breath and fever. COVID- 19 PCR was positive. The LDKT was postponed and the patient was transferred to the National Infectious Disease Hospital [IDH] for further care of COVID 19. He recovered and was discharged after a negative PCR test. A further home quarantine was done for 2 more weeks.

He was admitted again for LDKT in January 2021. During this admission, the PCR was weakly positive [CT value more than 30] and COVID- 19 specific antibody level was also positive. The patient was asymptomatic since the time of discharge from the IDH. The patient was referred to the national COVID- 19 Committee for expert opinion. According to the expert committee, since the patient was asymptomatic from the time of discharge from IDH and his antibody levels were positive, the positive PCR was considered due to persistent RNA remnant excretion from the initial infection. Therefore permission was granted for LDKT.

His basic investigation results were; C reactive protein [CRP] -16 mg/l [<6], White cell count [WBC] – 8410/ mm3[7-11], haemoglobin - 8 g/dl [11-16], serum Sodium - 140 mmol/l [136-145], serum Potassium - 4.6mmol/l [3.5-5.1], total serum calcium - 8.7mg/dl [8.6-10.2] and serum Magnesium - 1.7 md/dl [1.6-2.6]. The Chest X Ray [CXR] was normal.

He underwent LDKT after 6 weeks after the initial diagnosis of COVID-19 infection, despite positive COVID-19 PCR. Basiliximab, Methylprednisolone, Mycophenolate mofetil [MMF], Tacrolimus were used as induction agents and Prednisolone, MMF and tacrolimus were used as maintenance agents. A second dose of Basiliximab was given on postoperative day 4.

The donor was a 41 year male with a body mass index [BMI] of 23.7 kg/m2. The right kidney was harvested. An end to side anastomosis was done between the renal vessels of the donor kidney and the external iliac vessels of the recipient. The donor ureter was anastomosed to the recipient's bladder [ureteroneocystostomy]. The total ischemic time was 108 minutes.

The patient developed immediate polyuria. His urine output [UOP] in the first 24 hours was 7000ml. UOP on day 2 was 3500ml. Post-op CRP value was 9 mg/l and the serum creatinine was 2.07 mg /dl on day 2 and it was 1.2 mg/dl on day 3. He had an uneventful postoperative recovery and was discharged from the hospital on post-transplant Day 7.

Discussion

This case report describes the first case of LDKT done in a recent COVID-19 positive patient with persistently positive PCR in Sri Lanka.

The COVID-19 pandemic has resulted in an overall mortality rate of 2.2% in the world and an overall mortality rate of 0.62% in Sri Lanka [4]. Renal Transplantation [KT] is the best long term option for patients with ESRD. During the recent COVID-19 pandemic all KT were temporarily stopped. This is due to the fear of COVID-19 infection-related complications in a transplant recipient receiving immunosuppressive drugs. The available evidence also indicates that the outcome of COVID-19 in transplant recipients is worse compared to the non-immunosuppressed population. For example in a study done in France among post-transplant recipients, the mortality was 1% in non-COVID-19 patients and it was 24% in patients with COVID-19 infection. The other risk factors associated with increased mortality were obesity, diabetes mellitus, asthma and chronic pulmonary diseases. And in another study done in Spain among transplant recipients, the case fatality rate was 27.8%. [12] [13]. This increased mortality is probably due to long-term immunosuppression causing a lack of T cell function [15].

Clinical features of infections are also reduced in intensity in patients on immunosuppressants. Therefore the diagnosis of infection may be delayed. The commonly described clinical features of COVID-19 include fever, cough, shortness of breath, headache, loss of taste and sense of smell sensations, sore throat and diarrhoea. In one study fever, shortness of breath, cough and diarrhoea occurred only in 70.2%, 49.1%, 63.8% and 30.4% of transplant recipients [16].

Common investigations done in patients with suspected COVID 19 include CXR, CRP, WBC and Computerized Tomography of the chest [CT]. One study reported an incidence of abnormalities in CXR and CT as 79.7%. [16]. The other findings are an elevated CRP and leukopenia [WBC less than 4000/ mm3]. In COVID-19 the reported incidence of leukopenia is about 17.8% [16]. And the reported levels of CRP was 41.0 - 68.5 [17] [18]. The pre-transplantation investigation findings in the present case were, normal white cell count i.e. 8410/ mm3 [7000-11000], the CRP was 16 mg/l [<6] and the chest X-ray was normal.

Treatment of COVID-19 in post-transplant recipients is mainly symptomatic and supportive. In post-transplant recipients reducing the doses of immunosuppressants is also tried [19]. At present, the transplantation is done only on

patients who are COVID-19 PCR negative. But studies have reported that about 9% to 14.5% of patients who have recovered and tested negative with PCR became positive on retesting [20]. This is due to the excretion of the viral genome rather than active viral particles. In a study done on 87 patients with re positive PCR, no active virus particles were detected on virus culture [21]. This again confirms the above fact that the PCR positivity is due to the viral genome rather than active virus particles. Also, a systematic review found that there were no active virus particles beyond 9 days of the illness. Another study found that there was no infection to the close contacts of their positive patients [22]. Also, evidence shows that patients who clinically recover from COVID-19 and are more than four weeks after the onset of infection are not a source of infection despite PCR being positive [10] [11]. But it has been shown in patients with chronic kidney disease the duration for viral clearance is prolonged. In one study it was found that the mean duration of viral clearance was 32.4 ± 12.3 days in patients with chronic kidney disease [23]. Therefore we recommend that the kidney transplantation can be done on a post-COVID-19 patient with chronic kidney disease, who is clinically well and after 6 weeks of the onset of infection despite having a positive PCR.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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PERSPECTIVE

Is the climate emergency editorial relevant to surgeons?

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Keywords: Climate change; carbon footprint; greenhouse gases; GHG; surgical services

Introduction

The sequence of anthropogenic greenhouse gas (GHG) emissions causing climate change is now universally accepted[1]. To highlight the urgent need to reverse climate change, editors of 231 leading international medical journals[2] published a common climate emergency editorial[3] in their September 2021 issues. The signatory journals include those with a widespread reach as well as surgical journals.

The eminent editors set the tone of the editorial at the outset, when they state that "health is already being harmed by global temperature increases and the destruction of the natural world, a state of affairs health professionals have been bringing attention to for decades. The science is unequivocal; a global increase of 1.5°C above the pre-industrial average and the continued loss of biodiversity risk catastrophic harm to health that will be impossible to reverse"[3]. This article attempts to draw the relevance of this unprecedented editorial and the climate change discussion to surgical practice.

Global climate change discussion

The first assessment report (FAR) of the IPCC[4] in 1990 warned that "major health impacts are possible" which three decades on seem to have been proven correct. Later publications by the IPCC including AR5[1] are widely accepted and form the basis for many international actions. Climate change featured strongly in the September 2021 General Assembly of the United Nations. Climate discussion will continue when global leaders meet at the UN Biodiversity Conference (COP15), virtually in October 2021, and physically in April 2022 in Kunming, China. Leaders will convene at UN Climate Change Conference (COP26) in October 2021 in Glasgow, UK.

Impact of health care services on climate change

The interaction between healthcare and climate change is well summarized by Lenzen et al in the Lancet Planet Health[5] who state that, "although the health impacts of pollution and environmental change are well recognized, the environmental impacts of health care have received less attention". The paper concludes that 1-5 % of the global environmental impact is caused by health care provision. This is made up by 4.4% of greenhouse gases, 2.8% of particulate matter, 3·4% of NOx, and 3·6% of SO2. Other published data indicate 10% of greenhouse gases in the US [6] are produced by the health care sector.

Impact of surgery on climate change

Initially the connection between surgery and climate change was not apparent or ignored by the surgical community. In a groundbreaking event, a consensus conference held in 2011 between the Association of Surgeons of Great Britain and Ireland (ASGBI) and Royal College of Surgeons in Ireland (RCSI), concluded in a Consensus Statement On Cost-Effective And Sustainable Surgery[7] in May 2012. In its introduction, John MacFie, President, ASGBI says "as far as we are aware this is the first attempt by surgeons to collectively address the issue of environmental change". The role of the surgeon is summarized by Eilis McGovern, President, RCSI who said "at first glance, the relationship between surgical practice and climate change might not be obvious. However, there is now ample data to show that health service delivery is a major source of carbon pollution. It is timely, therefore, for surgeons to consider how we might adapt our practice in a way which reduces the surgical carbon footprint and, at the same time, maximizes cost-effectiveness [7]".

Operating theaters are 3-6 more energy intensive than the rest of the hospital 8. Modern surgery is dependent on increased use of energy devises, supporting machinery including imaging devises and robotics, single use consumable instruments, advanced implants, and large operating theater suites, and patient transport systems including fixed wing and rotary wing aircraft. The evidence supporting the hypothesis that these changes have a higher climate cost must be examined.

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Woods et al showed that robotically assisted laparoscopy had a larger carbon footprint compared to laparoscopy and laparotomy in a series of 150 procedures[9]. Siu et al who completed a systematic review of reusable versus disposable laparoscopic instruments: costs and safety, noted a paucity of comparative studies and inconclusive evidence[10]. Authors concluded that further research is needed to address the issue taking into consideration wider environment and financial cost benefits. Guetter et al who reviewed green operating theaters too found an absence of comparative studies[11]. Authors found many opportunities for research and application of green technology in the field. Research has shown that the Carbon footprint, and by implication the climate cost of each surgery is dependent on the type of surgery, duration of surgery, consumables, equipment used, type of theater, type of power supply, and modes of transport involved[12].

A paucity of research papers prevents establishment of a clear verdict on the climate cost of surgery. Of the available evidence, some studies indicate increased climate cost with surgical procedures involving more equipment as in minimal invasive methods and robotics. Other studies are inconclusive as they were not properly structured. Much of the climate cost surgery is through the supply chain as well as running the operating theaters[8]. Both areas can be adapted to more ecofriendly systems. Although it was trendy and convenient to use disposable consumables it may be time to return to re-usable consumables which are showing evidence of a lower climate cost[8]. The research and resolution of the climate question is, and should be, of prime relevance to surgeons. When assessing the efficacy of any surgical method, its climate cost too should be factored in.

Mitigation and reversal of climate change

A country like Sri Lanka, which yearns to move its surgical practice and services to global excellence, will embrace new technology modern science has to offer. This may lead to a higher climate cost in the short term. The global need to mitigate climate change should not stifle advancement of surgery in Sri Lanka. Modes of climate change mitigation must be found to compensate for the higher costs of expansion of surgery. Scientists have identified a rational approach to mitigation of climate change through the AR5 - section on mitigation[13]. This document is due for an update when the full AR6 report is released by the IPCC in 2022.

Conclusion

Evidence shows that global health care services contribute to the greenhouse gas emissions and other forms of pollution leading to climate change. A significant part of this may be through provision of surgical services. It is relevant that surgeons quantify this contribution and identify modes of mitigation. Many global industries have changed in a bid to reduce the climate cost. Field of surgery is not exempt from this need for change[7]. For change to be universally successful, adaptations need to be at multiple levels including personal and domestic, individual practice, institution and community, national and international. Surgeons by training are expected to be pragmatic and adaptable. This quality could be a key in climate change mitigation in future surgery.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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PERSPECTIVE

A synopsis of surgical training in Sri Lanka: the past

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First of a three part series based on personal correspondence with Professors Arjuna Aluwihare, A.H. Sherriffdeen and Channa Rathnathunga on their experience and memories of surgical training in Sri Lanka.

The documented history of surgical training dates back to over two millennia where Sushruta describes the ancient equivalence of modern skill workshops in 'Sushruta Samhita' [1]. Surgery is an arm of medicine that requires dexterity coupled with an unconditional surrender to patient well-being as those who 'go under the knife' have the utmost faith in the surgeon. Surgical training in modern medicine dates back to medieval times where training and licensing were required to perform surgery in London during the late 14th century. Training in surgery has largely been an apprenticeship, which has evolved with time into a structured curriculum-based programme. This article aims to describe the evolution of surgical training in Sri Lanka during the past six decades based on personal communication with three senior surgeons in the country. The information is based on their personal experience as surgical trainees and administrators in postgraduate training.

From the early 19th century, surgeons were deployed to Sri Lanka from the United Kingdom [UK]. Following the era of British Surgeons, by the early 20th century Sri Lankan-born surgeons in the likes of S.C Paul, A.M. De Silva and R.L Spittle took over the craft of surgery. There is not much published literature on the evolution of modern surgical training in Sri Lanka. However, it was mostly based on the British system largely influenced by the colonial ruling. In the early days, the entire training took place in the UK at renowned hospitals such as The Kings College, St. Thomas's and The Royal London hospital, following which they completed the fellowship exam of the Royal College of Surgeons [FRCS]. M.A De Silva was the first Ceylonese surgeon to obtain the title of FRCS [2]. By the mid 20th century, the pathway to becoming a surgeon changed to completing the 1st part of the FRCS in Sri Lanka coupled with a short training in the UK and completion of the fellowship. Prof. Aluwihare recalls his early days with the famous surgeon, Dr. Bartholamews during the early 1960s. Performing a tracheostomy on a sick child as an intern medical officer had further reinforced his liking towards surgery. Pursuing his ambitions, he was able to sit for the first part of the FRCS in Sri Lanka. The second part had to be completed in the UK following which he chose to pursue an academic pathway at Cambridge and London before returning to Peradeniya in 1971. According to Prof. A.H Sheriffdeen, like most newly qualified doctors in Colombo, he chose to work at the Mental Institute in Angoda as it provided ample time to study for his FRCS primary exam. At that time [the late 1960s] following the primary exam a young surgeon had to go through 18 months of general surgery and 6 months of orthopaedics/ trauma before flying off to the UK for the FRCS final exam. The teaching hospitals in Colombo and Kandy have been the only approved centres by the RCS for this local training until the late 1970s. Following the completion of the fellowship, they were posted for 6 months in a NHS post after which they returned to Sri Lanka. According to professor Channa Rathnathunga, the healthy relationship between the British and Sri Lankan surgeons helped the trainees to get placements at RCS accredited units in the UK. The gala that followed the completion of the part I exam in Colombo and later in Kandy was the 'landmark event' that strengthened this relationship according to Prof. Rathnathunga. Sri Lanka being a popular destination for English examiners for obvious reasons helped this tradition to perpetuate for years to come. From 1971 onwards the RCS has made it compulsory to spend one year at a NHS trust hospital before sitting for the final fellowship exam, a rule that applied only for trainees from the subcontinent.

Upon return, most surgeons had to function as a resident surgeon under a senior colleague till a post was vacant. This time period, according to Prof. Sheriffdeen, provided space for reflective learning while functioning as a surgeon. The cost of the primary FRCS exam in the early days was borne by the government, alleviating the burden on trainees. However, the cost of travelling to the UK had to be borne by the trainees. The economic policies in the late 1960s till late 70s had allowed only £3 to be released as foreign currency. Professor

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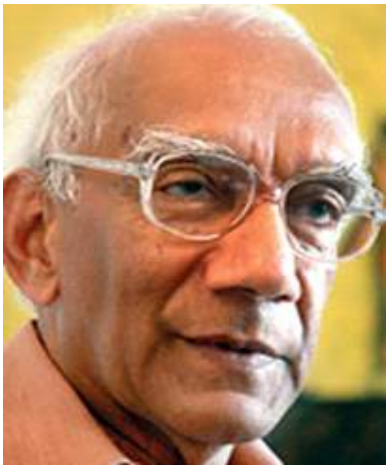

Prof. Arjuna Aluwihare,

Prof. A.H.Sheriffdeen,

Prof. Channa Rathnathunga

Three of the senior surgeons who have gone through surgical training in Sri Lanka during 1960s and 70s. They have all served as chairpersons of the board of study for surgery at the PGIM

Rathnathunga feels that these difficulties prompted some of the talented trainees to stay back in the UK after completing their training.

There had been no formal teaching programme for surgical trainees apart from several lectures by eminent surgeons at that time. Most of the training has been 'learning on the job' type. Training course at the RCS and some of the leading hospitals in London were available for those who could afford them. According to Prof. Rathnathunga, Sri Lankan trainees were solid in their surgical principles and basic skills compared to the English counterparts owing to the high volume of patients they experienced during the mandatory 2 years of local training. However the year spent in the UK helped them to be more conversant with the advanced technology, which has helped at the FRCS exit examination.

As S. Sivaganesh states in his editorial to the Sri Lanka Journal of Surgery, 1980 was indeed marked a 'watershed' in postgraduate medical education in Sri Lanka with the establishment of the Postgraduate Institute of Medicine [PGIM] [3]. However, the initial attempt at forming a local authority for postgraduate training in the mid 1970s has failed. Prof. Sheriffdeen refers to this as the 1st Phase of the PGIM, which was then called the Institute of Postgraduate Medicine [IPM]. The Government Medical Officer Association [GMOA] had been one of the strongest opponents to a local system. The 'Phase II' of the PGIM, which took effect in 1980, has been a success and locally accredited postgraduate qualification under a board of study [BOS] for surgery was established.

Apart from general surgery, the main specialties of orthopaedics, cardio-thoracic, plastic and genitourinary surgery were established practices by the 1960s. There were no separate training programmes for sub specialties and the qualified surgeons took up the disciplines based on requirement of services or influence of their trainers. With time the subspecialties were established based on individual preferences and the lobbying capabilities of the said individuals. At a time when the Ministry of Health did not possess projections for the requirements of specialists, self-funded training and equipment acquired through grants have paved the path to establishment of sub- specialties preceded by the development of the practice at the respective institutions.

With the establishment of the PGIM, the BOS in Surgery became the sole authority of accrediting surgical practice in Sri Lanka. However lateral entry for FRCS qualified trainees was allowed following completion of the MS part II exam. With the sub-specialties gradually branching out, the BOS in surgery eventually had to accommodate subspecialty boards affiliated to it. Surgical training during the post PGIM era will be discussed in the second part of the series.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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PERSPECTIVE

A synopsis of surgical training in Sri Lanka: the present

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Second of a three part series based on personal correspondence with Dr. Upali Banagala, Prof. Ranil Fernando and Dr. Ranjan Dias on their experience and memories of surgical training in Sri Lanka.

The establishment of the Post Graduate Institute [PGIM] of Sri Lanka in the early 1980s helped to streamline the postgraduate medical training in Sri Lanka. The specialty of surgery, like all other specialties, which lacked a formal local qualification, also started to shape up its own homegrown training programme. This article describes the changes that took place in surgical training following the establishment of the PGIM based on personal communications with past chairpersons of the board of study for surgery.

The previous requirement of the fellowship of the Royal College of Surgeons [FRCS] in England was replaced by the Master of Surgery [MS] offered by the University of Colombo as the prerequisite to practice as a specialist surgeon. However the title of FRCS to date remains a common post nominal amongst surgeons more as a symbol of prestige or recognition.

The inception of the PGIM as well as the establishment of the MS examination has not been a smooth journey. According to Dr. Upali Banagala the first batch of candidates eligible to sit for the part I examination was under pressure by the trade union to boycott it. Only two candidates had sat for the exam, following which they had had to face turmoil. However by 1980 the examination process was accepted by the fraternity and eight candidates including him self had been able to successfully face the second part I exam conducted by the PGIM.

Part I of the MS conducted by the PGIM became the selection test for young surgeons to embark on surgical training. The entry exam took shape from the Part I of the FRCS, which was more or less the same structure as today's exam. Candidates hoping to take up Ophthalmology and ENT surgery also had to sit for the common part I exam. Ophthalmology, which deviated from MS part I in 1993, has agreed for a common selection exam again after almost three decades.

The local training following Part I of the MS had been 3 years in the early 1980s following which they had to sit for the part II examination. All candidates had to under go training in general surgery and the main specialties in the likes of neurosurgery, orthopaedics, urology, cardiothoracic and trauma surgery. The sub-specialty rotations were added to the training programme with time. During this transition period, those with FRCS qualification were exempted from some pats of the training but had to complete the MS part II examination along with a post MS training period prior to obtaining board certification. During the early days the foreign placement was allowed for three years with one being without pay. The RCS in England had operated an overseas directives training scheme, which provided training opportunities for local trainees through the PGIM during the 1980's. Later on the College of Surgeons had mediated several training slots under the Medical Training Initiative of the RCS. However most trainees adopted to finding jobs through the direct applications to National Health Services vacancies through personal recommendations.

Even during the post PGIM era the lack of a structured formal training programme was felt. The board of study had introduced in-service training assessment during the early 90's under Prof. Aluwihare's chairmanship. However neither the trainers nor trainees took this up formally till the latter part of the next decade [2000-2009]. In around the same time the surgical education and training sessions [SETS], a teaching session for registrars on Saturdays at the college of surgeons, started to take shape. National trauma management course [NTMC] and several other training courses organized by the specialty associations also took shape during this time.

The current title of Doctor of Medicine [MD] Surgery for the surgical postgraduate qualification was adopted in 2011. The circumstances behind this change runs back for about two decades. Dr. Banagala recalls how the University of Colombo offered him a black cloak for the postgraduate convocation since MS was a master's degree as opposed to the MD of the physician's, which was regarded a Doctoral degree. As a result

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a] **Dr. Upali Banagala** is a past secretary and a chairman of the board of study for surgery. Being an orthopaedic surgeon himself, he was instrumental in creating the speciality qualification of MD orthopaedics.

b] **Prof Ranil Fernando** was the chairman of the board of study for surgery from 2012 to 2015.

c] **Dr. Ranjan Dias** held the chairmanship of the board of study from 2015 till 2018.

the entire batch of surgical postgraduates in that year had boycotted the convocation. The current red cloak with a pink lining was subsequently established as a result of this incident. Dr. Banagala recalls how the MS awards continued to be awarded after honoring MD holders of all specialties. After much negotiation with the University of Colombo, the PGIM awarded the degree of MD surgery for the first time in 2011.

The specialty boards in surgery were established at the PGIM in 2009 with co-opted members from each board representing the board of study for surgery. The first and the only specialty board to branch out as a separate training programme and to have its own postgraduate qualification to date is the board of study in orthopaedics. Second part of the MD orthopaedics was held for the first time in 2011. The six month orthopaedics training for general surgical registrars have reduced to 4 months while the initial one year general surgery training for orthopaedics trainees have been pushed down to six months at present. Currently there are nine specialty boards functioning under the board of study in surgery viz: General Surgery, Gastrointestinal Surgery, Surgical Oncology, Urological Surgery, Paediatric Surgery, Plastic Surgery, Cardiothoracic Surgery, Vascular Surgery and Neuro Surgery [1].

General surgery also branched out into seven special interest areas [Upper gastrointestinal surgery, Hepato-pancreato-biliary surgery, Lower gastrointestinal surgery, Vascular surgery, Breast Surgery, Endocrine surgery and Trauma surgery] [2] during the same time, with trainees having to declare their special interest after completing MD part II examination. Two out of the three years of post MD training, currently has to be done in a specialized center of the declared interest. Professor Ranil Fernando who took over from Dr. Banagala as the chairman of the board of study points out that, the concerns regarding super saturation of general surgery speciality and the objective of giving an academic background with an enhanced training, were the principle driving forces of this branching out. In the backdrop of specialization it was mandatory for the trainers to submit a formal audit to the PGIM prior to being recognized as a training centre.

Decade starting from 2011 saw several paradigm shifts in the examination structure as well. Professor Fernando recalls the discussions held by the board of study opting for a complete overhaul of the MD part II examination structure. Also during this time the RITA was given more emphasis and it was made mandatory to return the assessment forms at regular intervals to be qualified for the exam. The trainees having to submit a minimum of one paper or three abstracts to be assessed by an examiner nominated by the board added prominence to the research component. The changing of the examination structure with the introduction of structured essays and MCQs for the MD part II exam was implemented in 2014. However the overall changes to the clinical and viva exams took shape in 2015 under Dr. Ranjan Dias. The clinical short and long cases were replaced by objectively structured clinical exams [OSCE] and observed history taking while the objectively structured vivas [OSVE] replaced the older viva-voce in principles, pathology and operative surgery.

Introduction of external assessors [both local and foreign] for the exam was another pioneering initiative that took place post 2015 [3]. According to Dr. Dias this is the first time a local postgraduate exam had adopted a process to assess the exam and the performance of individual examiners. Currently the general Medical Council [GMC] and the Royal College of Physicians & Surgeons of Glasgow have accepted the MD surgery qualification for license and membership without further assessment. The in-service assessment and the board certification structure also saw several changes. At the end of the post MD training it is mandatory for the trainees to undergo a desk assessment of the portfolio and a viva-voce examination by three senior examiners prior to board certification.

During the four decades since the inception of the PGIM, postgraduate surgical training in Sri Lanka has undergone significant structural changes for the better. Further changes to ensure a surgeon with sound skills; humane attitudes and a strong desire for progress will be a continued requirement. It will also be pertinent to formulate an assessment tool to assess whether the changes to the process are transferred to the 'end product' in the form of a continuous appraisal throughout a surgeon's career. Although the assessment of learning outcomes of the training programme is beyond the scope of this article, the third part of this series will shed light in to what each specialty envisages for the future of surgical training in Sri Lanka.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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PERSPECTIVE

Future direction of surgical training and services in Sri Lanka

Third of a three part series envisioning the future of training and services of the surgical specialties in Sri Lanka

Future directions of breast surgery in Sri Lanka

Breast surgery has traditionally remained primarily within the scope of general surgeons and Oncological Surgeons in Sri Lanka. While this has ensured the availability of surgical treatment for diseases of the breast at all secondary and tertiary care hospitals, a relative lack of advancements and availability of newer techniques were observed in Sri Lanka, especially when compared with other branches of general surgery including gastrointestinal and hepatobiliary surgery. For instance, sentinel lymph node biopsy (SLNB) and wide local excision (WLE) for breast cancer are not offered on a regular basis in Sri Lanka at present [1], although SLNB and WLE have been the routine practice and included as the standard of care in most guidelines for over two decades [2, 3]. Many factors are known to have contributed to this situation including lack of training, heavy workload, lack of availability of mammography and other advanced imaging and lack of pathology services for intraoperative assessment of sentinel lymph nodes [4].

With the objective of improving the quality of surgery for breast disease, Sri Lanka Society for Breast Surgeons (SLSBS) was established in 2021. These objectives are highlighted in the vision of SLSBS which is to "Ensure the delivery of equitable high-quality breast surgical care throughout Sri Lanka". By providing a platform in sharing latest developments in breast disease and surgery, SLSBS hopes to provide its members with the opportunities to learn from experts in the field as well as sharing knowledge and learning from each other's experiences. Furthermore, SLSBS is expected to provide the platform for all surgical specialties working with diseases of the breast to obtain the necessary infrastructure and resources for provision of high-quality breast surgical care all throughout Sri Lanka.

SLSBS has identified several key areas as immediate priorities to improve the quality of treatment of breast disease in Sri Lanka.

1. Establishment of breast clinics at all teaching and district general hospitals
2. Ensure the availability of at least one functional mammo graphic machine to all districts in Sri Lanka
3. Providing access to all general surgeons to multi-disciplinary meetings (MDMs) that include Oncologists, Radiologists, Pathologists and Surgeons with special interest in breast surgery.

These approaches are expected to increase the recognition of breast surgery as a defined specialty in Sri Lanka and would also ensure the provision of new knowledge and coordination of care which ultimately would benefit women with diseases of the breast in Sri Lanka.

Dr A De Silva (President), Prof. S Senevirathne (Editor), Sri Lanka Society of Breast Surgeons.

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Future of Cardiothoracic and Thoracic Surgery in Sri Lanka

Cardiothoracic Surgery in our Island nation has improved to great heights over the last two decades. However, there is still a lot more work to be done in order to provide a high-quality service to our patients, in keeping with world standards. There are mainly two arms to this future development. They are improving the accessibility to cardiothoracic surgical services and super-specialization of the specialty.

The current number of surgeries performed seem to be thoroughly inadequate to keep up with the ever-growing demand. This leads to long waiting lists resulting in increased mortality and morbidity among patients awaiting surgery. We hope to overcome this by setting up a couple of more centers, and increasing the capacity of the existing units. The aim would be to centralize services and have a few high-volume centers to cope with the ever-increasing demand for surgery. The National Heart Centre to be set up in Colombo will be the pinnacle of this effort.

Once the number of commonly performed cardiothoracic surgeries increase, then we will be able to concentrate on super-specialization in order to offer the full range of cardiothoracic surgical services currently practiced across the world, to our patients. These include Heart and Lung transplant, ECMO, minimally invasive cardiac surgeries and arrythmia surgery. The heart transplant programme although commenced, need a boost and revival while the ECMO programme which has been off ground for a while is increasingly being used to salvage the critically ill patients. Minimally invasive cardiac surgeries have also commenced in the form of MIDCAB. However, this needs to be extended to minimally invasive valve surgeries, etc.

Paediatric cardiothoracic surgical services have improved tremendously over the past 15 years after the commencement of a separate service which now caters to approximately half of the yearly need for newly diagnosed patients. However, the capacity needs to be significantly increased not only to manage the new patients each year but also to cater to patients deferred surgery each year and to patients needing repeated interventions. The worldwide goal in paediatric cardiothoracic surgery is to provide timely surgery for all the patients with congenital heart disease. To achieve this in Sri Lanka, trained surgeons in paediatric cardiac surgery are the prime necessity. Measures are underway to create the specialty of paediatric cardiothoracic surgery by year 2022 which will pave the way to increase the number of paediatric cardiothoracic surgeons to achieve the above goal and help establishment of new centers providing the service. This will help to expand the service to establish a Grown-Up Congenital Heart [GUCH] programme for the country, a paediatric Extra Corporeal Life Support [ECLS] service, paediatric heart transplantation and to offer complex biventricular repairs and surgery for hypoplastic left heart syndrome in the time to come.

Thoracic surgical service had been established at Chest Hospital, Welisara several decades ago. This has been later named as the National Hospital for Respiratory Diseases [NHRD]. The new era of dedicated Thoracic surgery with modern facilities such as VATS [Video Assisted Thoracic Surgery] began in 2007 and has evolved since then. Now there are four board certified Thoracic surgeons. Currently NHRD is the only tertiary referral center for the entire country. It provides surgical and bronchoscopic procedures for diagnosis and treatment of various chest related pathologies ranging from infections, malignant diseases to complicated chest trauma. With the qualifying of more surgeons and the improvement of infrastructure, the services could be expanded to the level of performing Lung transplantation and Robotic surgery. The establishment of new units will improve accessibility in the future.

Dr A. D. Kapuruge [President], Dr M De Soysa [Secretary], Dr K Singappuli, Dr S Handagala and Dr T Harishchandra [Editor] of Association of Cardiothoracic Surgeons.

Progress and future of endocrine surgery in Sri Lanka

Endocrine surgery is an emerging specialty world over [1]. The specialty of endocrine surgery in Sri Lanka had very humble beginnings and it has progressed rapidly as the Postgraduate institute in of Medicine [PGIM] gave due recognition by making general surgery with special interest in endocrine surgery one of the specialties recognized by the PGIM for board certification and 3 surgeons have chosen this specialty so far. It is evident that endocrine surgery as a standalone specialty will develop in Sri Lanka with the passage of time. Those undertaking treatment of endocrine disorders must encourage more people to take up the specialty and fine tune the training process in order to deliver the best in endocrine surgery to the patients [1, 2 &3].

In terms of the service commitment in endocrine surgery most general surgeons and surgeons of other disciplines undertake thyroidectomy and there is a need to standardize management of surgical endocrinology with development of guidelines. While some guidelines are available for thyroid diseases, much more needs to be done to optimize management. Majority of the endocrine surgical work will be dealt with by general and other surgeons in the foreseeable future. There is a need to develop at least 3 or 4 centres of excellence to deal with difficult, complex, and recurrent surgical endocrine problems to offer the best care to patients.

The role of technology in endocrine surgery is an issue that needs careful consideration especially in the future. Advances in technology have undoubtedly helped the standard of care but the access to investigations and treatment is not equitable. It would be desirable to have well equipped laboratories and radiology departments which will provide access to investigations of the four main endocrine organs namely the thyroid, parathyroid, adrenal, and endocrine pancreas, to all patients, at least in teaching hospitals.

In terms of surgery and management, the role of the endoscope, the robot and other newer devices in endocrine surgery need to be clearly defined for Sri Lanka. The main issues that need to be resolved are availability, sustainability, safety, and the cost effectiveness of these techniques. The mere possibility is not a criterion to recommend a procedure for standard practice, the relevant factors and circumstances must be analyzed before a decision is made [4, 5]. While there is no doubt that technological advances will need to be incorporated into the practice of endocrine surgery in Sri Lanka, a careful deliberation and prudent decision making is the need of the hour.

There is a lamentable lack of robust evidence in the practice of endocrine surgery world over. In Sri Lanka there is hardly any reliable evidence emanating from the main centres. The need to collect our own data and make the practice of endocrine surgery evidence guided cannot be overemphasized [3].

There is much work to be done in terms of policy making, training, service provision and research in endocrine surgery in Sri Lanka. The process has been started and the need is to sustain the effort and move the specialty forward so that endocrine surgery in Sri Lanka will be able to match the best practices in the region, if not the world over.

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Future direction of general surgery

At the onset, surgeons used to perform surgeries on the whole body. However, with the advent of precise knowledge and high precision skills lead to ramification of surgery into speciality surgery and general surgery [1].

Still, the general surgeons carried out most common surgical procedures and bore the brunt of the surgical emergencies including trauma. At this stage, who would care for trauma [non-orthopaedic] and other emergencies, where and how the surgical training would be given, and how to keep up with the increasing knowledge and growing complexity of the surgical procedures were the main challenges surgeons of this country faced.

Special Interest training

To face these challenges, the Association of General Surgeons of Sri Lanka [AGSSL] and the Speciality Board of General Surgery of the Post Graduate Institute of Medicine [PGIM] of Sri Lanka introduced a significant change to their training schedule by introducing a special interest to their doctorate, the MD surgery degree. There are seven such domains of special interests [2].

With this change, we expect to have surgeons with exceptional skills in a particular domain and supervise and manage more general surgical problems and emergencies.

Special interest associations and professional bodies

Already few special interest associations have been formed under the AGSSL and collaborations established with several others. Main objective of this move is to engage with relevant surgical and non- surgical colleagues. In future, these associations will be further strengthened to nuture the special interests of general surgery.

Cluster system

The need to have a good inter-hospital and inter-unit referral system cannot be overemphasized. For example, one general surgeon could refer a patient to his colleague trained in a particular special interest.

The general surgeons will be proposing and supporting a cluster hospital system to promote sharing hospital resources-both human and infrastructure. The cluster would consist of a few close-by hospitals functioning as one trust. This will allow general surgeons to improve their interest while attending to day to day work. All necessary infrastructure will be provided to the particular hospital while the post should be advertised with the relevant interest.

Above is a challenging but worthwhile task that would need the support of the AGSSL, the College of Surgeons of Sri Lanka [CSSL], the Health Ministry, and many other stakeholders. We have already initiated a dialogue with the Ministry of Health in this regard, who have accepted the proposal on principle.

Continuous Professional Development, Audit and Research

The other areas that need improvement include maintenance of registries and records, research, and audit. Finally, multidisciplinary management teams would be the base for a protocol-driven system, which is essential for the equitable delivery of modern healthcare. High volume patient turnover and continuous professional development would also

facilitate collaboration with the international surgical fraternity.
Surgery is an evolving field, and the general surgeons of Sri Lanka are very much keeping abreast of these developments to serve the nation in the years to come.

Dr H.L.D.S Ariyaratne [President] and Dr U Samarajeewa [Secretary], Association of General Surgeons of Sri Lanka.

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Hepato-pancreatico-biliary [HPB] surgery in Sri Lanka

Historically, HPB surgery was performed in relatively small numbers by the general surgical fraternity. Noteworthy amongst them were Dr K Yoheswaran at the Sri Jayawardenapura General Hospital, renowned for his prowess in pancreatic surgery and Professor Mohan De Silva who pioneered pancreatic surgery, at the Colombo South Teaching Hospital. Professor A H Sheriffdeen performed major liver resections with limited resources during his time at the University Surgical Unit of the NHSL.

The cornerstone for the progress of HPB surgery in Sri Lanka has been subspeciality training. Over the past two decades, Sri Lankan surgical trainees have trained in high volume, tertiary HPB surgery units in the UK, Australia and Hong Kong and obtained board certification in Gastrointestinal or General Surgery with a special interest in HPB surgery. This has led to an expansion in the spectrum of HPB surgery performed with vastly improved outcomes. Several units in teaching hospitals now have dedicated HPB surgery divisions, that serve as referral centres and perform complex HPB surgery including liver transplantation with outcomes comparable to international centres of excellence.

The Professorial Surgical Units at Colombo South Teaching Hospital [CSTH], Kalubowila, under Professor Aloka Pathirana, North Colombo Teaching Hospital [NCTH], Ragama under Professor Rohan Siriwardena, National Hospital of Sri Lanka [NHSL], Colombo under Professor S Sivaganesh and Teaching Hospital, Peradeniya [THP] under Professor Arinda Dharmapala perform the bulk of advanced HPB surgery in the country. The work in these units is augmented by advanced ERCP and endosonographic facilities and diagnostic and interventional radiological services at these centres.

In addition to the establishment of tertiary HPB surgical units, the concurrent development of specialist services in diagnostic imaging, interventional radiology, advanced ERCP and endosonography, critical care, oncology, and the multidisciplinary approach to complex pancreatic pathologies have had a major impact in improved care and outcomes in these patients. A new group of well-trained HPB surgeons taking up appointments at these established centres including Dr Suchintha Tillakaratne [NCTH], Dr Buddhika Dassanayake [THP], Dr Duminda Subasinghe [NHSL], Dr Malith Nandasena [CSTH], Dr Prabath Kumarasinghe and Dr Sandun Bulathsinhala are guaranteed to expand Sri Lankan HPB surgery to new horizons in the years to come.

The Sri Lanka Hepato-Pancreato-Biliary Association [SLHPBA] an affiliate of the International Hepato-Pancreato-Biliary Association [IHPBA] has served to foster links with regional and international experts in HPB surgery and enhance training opportunities. Over the coming years the SLHPBA has an ambitious agenda towards developing HPB surgery in the country. This includes enhanced educational activities in the form of biannual HPB master classes, the development of interactive online training modules for postgraduate trainees, establishing a national HPB surgery registry and formulation of national care pathways and guidelines for common conditions.

The establishment of care pathways leading to tertiary HPB surgical and liver transplantation units will go a long way to deliver state of the art care and improved outcomes. Clustering HPB surgeons, allied specialities and infrastructure in these tertiary units also facilitates efficient use of manpower and equipment in the years to come.

Prof S Sivaganesh [President], Sri Lanka Hepato-Pancreato-Biliary Association [SLHPBA]

Progress and future of colorectal surgery in Sri Lanka

World's first hospital dedicated to diseases of a single organ was started by Frederick Salmon in 1835 in City of London, United Kingdom and still lead the way in colorectal surgery as St Mark's hospital [1]. Worldwide, colorectal surgery has become a rapidly evolving specialty over recent years. Newer technologies and techniques are increasingly being used and have become part of surgical armamentarium [2]. Colorectal surgery gained it's recognition with introduction of 'colorectal interest in general surgery' and has become one of the most sort after training opportunities as part of the residency training by Postgraduate Institute of Medicine [PGIM] in Sri Lanka.

Existing researches indicated patients undergoing colorectal surgery may require a second operation 2 to 5.8% of the time [3]. Recognition of colorectal cancer as one of the successfully screened, prevented and treated conditions with emerged evidence on better outcome of colorectal interventions [4] carried out by 'colorectal surgeons'

highlighted the need to fine tune the skills of surgical trainees by a dedicated training process to deliver improved patient outcome.

At present there is no consensus and agreement in terms of managing various colorectal conditions in Sri Lanka thus stressing the need to implement guidelines, registries on diseases, regular national audits, and research. The lack of reliable data platforms on surgeries conducted within the country highlights the need for a registered database. Formulation of national guidelines, implementation of national registries on colorectal cancer, familial colorectal conditions, inflammatory bowel disease has started since the inception of Sri Lankan Association of Colorectal Surgeons[SLACS] in July 2021.

Minimal invasive surgery including laparoscopy and robotic surgery has been a major revolution in surgery and clearly has become a core technique in colorectal surgery [5]. Sri Lankan colorectal surgeons are acquiring mastery of the applications of laparoscopy but denied of opportunity to exposure in robotic surgery in evolution [6]. A number of new approaches have already evolved, some even aggressively marketed, even though they have not yet been sufficiently established or their impact adequately studied. It should be in the interest of colorectal surgical specialty to develop objective guidance to such efforts and determine the goals and possible benefit/risk analysis. They are yet to apply advancements in managing patients while critically assessing the role of some minimally invasive approaches, application of artificial intelligence, preoperative patient optimization, or comparing the outcomes of different innovative approaches to colorectal diseases.

Even though bulk of colorectal work is being carried out by various specialists in surgery, gastroenterology, oncology, pathology, and radiology; Sri Lanka as a country has an unmet need of at least one or two centers of excellence where advanced and complex colorectal and abdominal surgical care can be delivered in relevant specialties. It would provide a common platform to train and guide future colorectal surgeons in taking Sri Lankan surgical skills to world arena.

Dr W Wijenayake [President], Sri Lankan Association of Colorectal Surgeons [SLACS]

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Future Directions of Services and Training in Neurosurgery

It is just more than a half century since establishment of Neurosurgery unit in Sri Lanka in 1956 under Dr Shelton Cabral [1]. Since then neurosurgery has progressed to a level where today is comparable to the international standard.

Dr Colvin Samarasingha well known neurosurgeon initiate and got down the first MRI machine into the country and installed at the NHSL. Introduction of microscopic neurosurgery was pioneered by Dr Lal Gunasekara the farther of modern neurosurgery. Novel chapter of neurosurgery began in 2010 when the state of art Neuro Trauma Centre was opened as a result of hard work done by Dr Sunil Perea [1], who revolutionized modern neurosurgery in Sri Lanka. Each and every neurosurgeon in the country has dedicated and contributed to the development of neurosurgery.

One of the major mile stone of neurosurgery in Sri Lanka was establishment of Neurosurgeons Association of Sri Lanka in 2006 under the leadership of Dr Jaliya Lokuketagoda to bring all neurosurgeons in the country together [1].

Initially there were only two neurosurgeon in the country for 22 million of population, but now the number has risen to 24 Neurosurgeons serving in all nine provinces, including private sector.

According to WHO criteria there should be 0.5 to 1 neurosurgeons per 100, 000 population, hence Sri Lanka need at least 110 neurosurgeons [7]. Major obstacle for not having adequate number of neurosurgeons in the country has been identified as the lack of a structured neurosurgery training program.

Our main objective for next five years is to establish Neurosurgery MD program there by attracting more trainees in to the system to full fill the minimum number of neurosurgeon requirement within next 25 years [3,4].

As the number of neurosurgeons increase we are hoping to establish more fine subspecialties among neurosurgery improving the quality of neurosurgical care. The recent establishment of Paediatric neurosurgery unit at Lady Ridgway Hospital and Epilepsy Neurosurgery Unit at the NHSL provide a highly specialized service [2,3,4].

Despite most proportion of spinal trauma , degenerative spinal disease and almost all the spinal tumours being managed by the neurosurgeons, sometimes care given was not satisfactory due the time constraints. However our future plan of specialized spine centers intended to be establish in Ragama, Digana and Anuradhapura will cater for the whole nation [2]. Further expansion of neuro trauma care is another objective for the near future.

We as the association of Neurosurgeons of Sri Lanka are happy to declare that we are achieving our goals of development of neurosurgery in a timely fashion for the benefit of the public of Sri Lanka.

Dr Nirukshan Jayaweera [Consultant Neurosurgeon, Lady Ridgeway Hospital for Children], Neurosurgeons Association of Sri Lanka

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Future direction of Oncological surgery in Sri Lanka

Oncological surgery in Sri Lanka cannot be separated from the history of the of Cancer Institute at Maharagama , which was built in 1961. Initially general surgeons with a special interest in head and neck surgery, oesophageal and other intra abdominal surgery, breast surgery as well as sarcoma surgeries were stationed at this hospital and performed complex cancer surgery resections and reconstructions. Over a period of time this hospital acquired a complete oncological infrastructure with facilities such as surgery, chemotherapy, target therapy, radiotherapy with latest therapy planning systems, bone marrow transplantation, immunohistochem-istry , PETCT etc. which paved way for a comprehensive multidisciplinary management of cancer patients under a single roof.

In this backdrop, Post graduate Institute of Medicine initially incorporated cancer surgery to the MD surgery registrar training programme. Surgical Oncology was later recognized as a as a separate training programme for senior registrar training consisting of 2 years of local post MD training followed by 1 or 2 years of overseas training. At present the recognized cancer surgery training units are located at Maharagama, Kandy , Galle and Kurunagala. There is also a separate speciality board for Oncological surgery to oversee the training programme. The Speciality board has laid down a prospectus for Oncological surgical training and this format has to be full filled by any current or future trainee to be eligible for accreditation in Oncological surgery.

The National Cancer Control Programme along with the ministry of health has putout a National Strategic Plan for future direction of Oncological facilities in Sri Lanka. As a part of this programme 9 regional cancer centers were developed to cover 9 provinces of the country and at present there 22 oncosurgeons in government service. The future projection is to further expand these units by upgrading existing facilities and the specialised cadre. In addition some oncosurgeons are attached to universities and some are permanently working in the private sector . So there is much potential to absorb many enthusiastic trainees to the exiting field of cancer surgery training of which has the hallmark of exposure to complex surgeries in high volume centers in a multidisciplinary setup .

Oncosurgical units currently provide complex Oncological resections , plastic surgical reconstructions, laparoscopic surgery, diagnostic and therapeutic endoscopy including stenting , chemotherapy port insertion, HIPEC and any other surgical support required by the cancer patients. All these OncoSurgery units work in close collaboration with the clinical oncology units in the same hospital. Regular multidisciplinary meeting with the Oncologist, Oncological surgeons, Pathologists and Radiologists are held to discuss complex and interesting cases thus providing best possible care to the patient. Addition of new facilities such as Robotic surgery and intra operative radiotherapy therapy are some areas we are lacking at present and should be thought as projects for future. We have developed strong collaborations with many high end centers such as Royal Marsden hospital UK, Christie Cancer hospital in Manchester and number of other hospitals in the UK and Australia who regularly request for our trainees. Sri Lanka association of Surgical Oncologist was also established to look into different aspects of oncological surgery.

In future we plan to specialize in different areas of Oncological surgery such as breast, endocrine, head and neck ,sarcoma etc. to give an overall better care to the patient. For

these sub specialized surgeons to have adequate work in their chosen fields, we are currently looking at ways of improving infrastructure facilities and referral pathways .

Dr K De Silva [President], Sri Lanka Association of Surgical Oncologists

The future direction of orthopaedic surgery

Orthopaedic surgery is a rapidly advancing field where novel engineering technology is leveraged to improve patient care. The most recent advances in orthopaedic surgery are in the fields of diagnostics, reconstruction techniques for joint instabilities, and arthroplasty.

Better diagnostic techniques make our jobs easier and improve overall patient outcomes. Since Roentgen invented X rays in 1895, medical imaging has improved to a great extent. Currently, we rely on MRI scans for soft tissue pathologies, which has now evolved to 7 Tesla resolution and dynamic scans. CT scans have enabled better visualisation of bone; recent advances in 4D CT scans help us better understand joint instabilities and impingement.

Moving from low radiation options to no radiation options, biplanar videography has been validated to study small joint kinematics.

A low radiation option for fluoroscopy is available in the theatre, enabling the 'mini fluro scanner' for small joints safer for patients and surgeons. 'O-arm' imaging devices provide 3-D visualisation and multiplanar image visualisation at the same time for complex spine and shoulder surgeries.

Arthroscopy is possible for every joint, enabling minimal access surgery. The chip-on-tip Nano Scope combines 1 mm imaging sensors, LED lighting, image management, and tablet controlling device. Nano Scope combined with Wide-Awake Local Anaesthesia No Tourniquet surgery [WALNT] helps perform diagnostic procedures at the bedside. This can massively reduce costs for operating theatres and facilitates patients' return to everyday life early.

Computer-assisted surgery [CAS] and robotic-assisted surgery [RAS] improve the positioning of implants during joint arthroplasties and spinal surgeries. Most studies have reported that computer-assisted navigation reduces the chances of implant malpositioning, improving the consistency of positioning and alignment.

3D printed models are used for complex fractures and osteotomies. In contrast to conventional templating, the current fracture templating is done on 3D models and 3D printed models. This gives the surgeon a better understanding of the reduction and fixation of a difficult fracture.

Moving forward with this technology, many developed countries use custom-made implants for challenging arthroplasty cases such as revisions and tumour reconstructions. The fractures are also given similar importance with custom made fixation devices and custom printed instruments/ cutting jigs.

Educating future Orthopaedic surgeons has reached new heights with 3D printed soft tissue models. Currently, there are 3D printed soft tissue models which almost simulate a real joint with ligaments. These are used for surgical training instead of cadavers, overcoming the costs for maintaining cadaver labs and avoiding ethical issues related to human cadaver use.

These advancements in every imaginable facet of Orthopaedics will transform how we treat patients and push the boundaries of what's possible. Ultimately, what matters are the patient outcomes and quality of life. My hope is that the future orthopaedic surgeon will have better tools and techniques to improve the lives of patients and achieve feats that we can only dream of.

Dr Rukshan Sooriyarachchi [President], Sri Lanka Orthopaedic Association

Future of Paediatric Surgery in Sri Lanka

The specialty of paediatric surgery in Sri Lanka, has grown progressively over the last 30 years. Even though specialised paediatric surgical services was offered in the country since 1960's, the appointment of the first board certified consultant paediatric surgeon took place in the early 1990's. Since then, about 25 paediatric surgeons have obtained board certification with the Post Graduate Institute of Medicine [PGIM] . Over the last few years, many trainees have also taken up the specialty of paediatric surgery, adding to the existing pool of qualified specialists in the near future.

Until a few years ago, Lady Ridgeway Hospital for Children [LRH] was the only training centre for paediatric surgical subspecialty training. Later on, teaching hospital - Kandy was recognised as a training centre a few years ago. Relevant measures are being undertaken for the accreditation of teaching hospitals Galle and Sirimavo Bandaranayake hospital - Peradeniya [SBH] as additional training centres in the near future and this will increase the capacity for training of future specialists in paediatric surgery, both local as well as international.

For a considerable period of time, specialised paediatric surgical services were available only in Colombo, Kandy, and Galle districts. Currently, the services have been expanded to cover most of the areas of the country and plans are underway to establish paediatric surgical units at each provincial general hospital level.

In the developed world, certain paediatric surgical services are being centralised resulting in the development of centres of excellence for provision of specialised services such as

organ transplantation and management of rare, complex congenital anomalies such as bladder exstrophy [1]. In future, with the establishment of adequate paediatric surgical services across the country, centralisation of services could be achieved utilising main children's hospitals such as LRH & SBH.

Minimally invasive surgery is performed in most paediatric surgical centres in Sri Lanka, at present. In future, it will be expanded to include most common paediatric surgical conditions including neonatal conditions such as congenital diaphragmatic hernia, oesophageal atresia, duodenal atresia etc.

Paediatric urology forms a significant proportion of a paediatric surgeon's workload. In most parts of the world, it has emerged as a distinct subspecialty [2]. Plans are being developed to start a separate training program in paediatric urology and in the future, board certified paediatric urologists will be appointed to centres such as LRH and SBH.

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Reinforcing national trauma system development in Sri Lanka

Perspective of a trauma burden in Sri Lanka

Trauma accounts for 11% of the total global burden of disease. Approximately 90% of permanent and temporary disability due to injury occurs in low and middle-income countries [1–3]. Trauma has been the leading cause of hospitalization in Sri Lanka over the last two decades. In 2019, approximately 1,136,000 trauma patients were admitted to government hospitals. It is the 10th cause of hospital deaths in 2019 with reported 2000 cases [2]. High road crash fatality and injury rates on Sri Lanka's roads are undermining the economic growth and progress made over the past decade in reducing poverty and boosting prosperity. Estimated annual road traffic deaths per capita are twice the average rate in high-income countries and five times that of the best performing countries in the world. Available data indicate an average of 38,000 crashes annually which result in approximately 3,000 fatalities and 8,000 serious injuries. [5].

Gaps in existing trauma care

With World Health Organization [WHO] guidance, the Ministry of Health, and Indigenous Medical Services [MoH] embarked on several major trauma system improvement projects. These measures include, accident and emergency policy [March, 2015], identifying emergency medicine as a post graduate specialist program [2012], establishing 1990 Suwasariya as field Emergency Medical System [2016], establishing disaster management center under disaster management council [2005] and implementation of national injury surveillance system [2017] [6–10]. The College of surgeons of Sri Lanka [CSSL] has been the main provider of trauma training in Sri Lanka with established courses including Primary Trauma Care [PTC], National Trauma Management Course [NTMC], Advanced Trauma Life Support [ATLS][11]. Aforementioned policy and governance structure has guided the existing comprehensive hospital network, with highly qualified health care staff towards reasonably sound trauma service in Sri Lanka . At the same time there is a recently established emergency ambulance service [Suwaseriya] providing prehospital care. The disaster management center coordinated by the National Council for Disaster management has a comprehensive network that incorporates a regional administrative system. However there is a significant coordination and communication gap between these three services .

CSSL endeavours to fill the gaps

In 2021 under the leadership of Prof Srinath Chandrasekera, CSSL established a trauma committee with 6 pillars [policy and governance, prevention, pre-hospital care, in hospital care, rehabilitation and training] to facilitate MoH, in congregating all stakeholders together with a shared vision of trauma system development. Trauma committee leaders met monthly at CSSL headquarter to develop, implement, and assess the progress in developing nationwide integrated, comprehensive trauma systems. This encompasses prehospital, hospital and rehabilitation care with the goal of minimizing the short- and long-term health impacts on trauma victims. Trauma committee of CSSL had multiple round table meetings with WHO Sri Lanka office, MoH, Sri Lanka Medical Association [SLMA] , Sri Lanka College of Military Medicine [SLCOMM] and disaster management council to develop a policy plan for next 10 years which is summarized in Table 1. The Committee of Trauma CSSL worked on negotiations, collaborations, and if needed providing resources to address existing communication and administrative gaps. The aim was to develop an excellent trauma care system, which few countries with comparable economic status can claim. As the main workforce, which provides essential trauma care services, membership of the college of surgeons could be an invaluable asset to the MoH in particular and to the public of Sri Lanka in general in these endeavours. Traditionally, College of surgeons have been playing a pivotal role in training doctors and nurses through a well-established array of trauma courses and it is the strength and backbone of this endeavour. While PTC, NTMC, ATLS are intended for training necessary skills within the golden hour of trauma as a baseline, decision Making in

Major Trauma [DMMT] course focuses on developing skills for advanced surgical management options for definitive trauma care. Initial trauma care for nurses [ICTN] course is intended to give basic skills in managing initial trauma care for nurses. Further Emergency Sonography for Trauma Care [ESTC] course impart knowledge on ultrasound principles and hands-on experience of performing eFAST. Additionally, CSSL conducts an annual Severe Burns Emergency Management Course [SBEMC] and a Hand surgery workshop.

Above mentioned committees are connected together through the policy and governance committee to spearhead the movement by partnering with MoH,WHO, other colleges, academia and the public. Further, policy and governance committee is entrusted with development of trauma registry and research. Authors are confident that with the dedicated effort of committee members, CSSL will achieve its objectives within a decade by well-structured short and long-term plans.

Acknowledgement
We would like to thank the dedicated effort of all the committee chairs and members in this historical endeavour.

Mihira Banadara, Amila Ratnayake, Bingumal Jayasundara, Mahanama Gunasekera, Nissanka Jayawardane, Hasantha Thambavita.

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Table 1. Trauma sub-committees and their objectives

Sub committee	Actions planned
Policy and governance	Spearhead the effort with connecting other partners in trauma care delivery and development. Additionally, this committee will support the MoH effort in digitizing health records by providing subject matter expertise to identify minimum data sets, data sources and data collection techniques related to trauma care.
Preventive and public health	To create a greater level of awareness & commitment among public and decision-making bodies on injury prevention in automobile, occupational, domestic, and other trauma. To integrate stakeholders of the prevention of trauma network which include the Ministry of Health, World Health Organization, Sri Lanka Medical Association, Police department, Judiciary and other interested parties to develop and implement strategies.
Prehospital care	CSSL has already signed an MOU with SUWASERIYA foundation to get involved in training of ambulance crew, integration of prehospital care system with hospital care system, providing subject matter expertise required for developing protocols for patient care and improving efficiency of patient handing over process and research work.
In hospital care	To improve in hospital treatment by suggesting necessary resource allocations and adjusting hospital protocols and designs. Development of trauma manuals for doctors working in emergency units has already been undertaken. Introducing a cluster system among regional hospitals for trauma care will be considered together with a policy and governance subcommittee. The college believes the quality of trauma care can be improved by such a cluster system.
Rehabilitation	The college envisages to establish a full -fledged rehabilitation unit per each province. Since it is a major financial and logistic undertaking, it needs government blessings and support from well-wishers. The rehabilitation subcommittee will be working along with the MOH to reach this goal.
Training	The college will be expanding its training activities with an aim of providing mandatory training to all doctors involved in trauma care, especially those in primary care units, emergency treatment units, accident, and emergency units, surgical SHOs. Further expansion of training nurses, training of SUWASERIYA paramedical staff, training of three wheel and taxi drivers and bystander training for "stop the bleed" and team training in trauma care would be undertaken by college of surgeon in near future

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The future of Urological surgery in Sri Lanka

The specialty of urological surgery in Sri Lanka commenced as a single unit at the then Colombo General Hospital in 1954. Now it has made vast strides serving needs of the population and currently is in a state of progressive flux with an evolving repertoire of endoscopic, laparoscopic, and open surgical techniques.

The change of demographics across the world and in Sri Lanka, and changing socio-economic trends have caused a rising demand for urological services for illnesses such as malignancies and urinary stone diseases and changes in health-seeking behaviour.

Towards further expansion of expertise

By the year 2025, Sri Lanka is likely to have 1 urologist per 500,000 population. However, there are restrictions to expansion in the current specialist placement system of the state health sector. Innovative approaches are needed to surmount these limitations and challenges. The concept of sub-specialization according to patient cohorts [e.g. paediatric urology, onco-urology] or types of surgical expertise [e.g. reconstructive urology, robotic/laparoscopic urology], is one of them.

Towards expansion of structure

The traditional approach of stand-alone urology departments needs to change to cater to the national needs. There should change and evolve towards the next level of service expansion with well-equipped centres of excellence. TAll established key university teaching hospitals need to develop as centres of excellence. Each centre needs to be staffed by 5 – 10 urological surgeons with focused sub-specializations and they will be fed by clustered general urology units in the region. The centres of excellence need to be equipped with adequate and excellent infrastructure facilities. General urology cases should shared by consultants in the centre or referred to feeding general urology units in a given cluster. Feeder units would refer the complicated patients to the centre and also carry out basic urology care including the common urological procedures.

The College of Surgeons of Sri Lanka [CSSL] and the Sri Lanka Association of Urological Surgeons [SLAUS] are currently working on a programme where urological surgeons in the state sector who lack facilities for specialized stone surgery can bring in patients for such surgery to a dedicated centre.

Going parallel with the described centres in the state sector, the development of private sector urological services too will be encouraged.

Taking training in urology to the next level

An overhaul of the current post-MD sub-specialization to urological surgery is long overdue. While this debate is ongoing in the postgraduate programme, the CSSL and the SLAUS have initiated an internationally acceptable exit certification of specialist training in urology. This is bound to elevate the international standing of Sri Lankan urology. Reaching out to international urology associations both regionally and internationally will help to make Sri Lanka an important player in global urology fraternity.

Home grown scientific research, publications and presentations will be facilitated. As a surgical field which is advancing rapidly a reliable centrally held data set by regular national audit has come to the fore. SLAUS has taken the initiative to collect the national urological cancer audit at and plans to roll it out to other urological conditions. Research across all levels of urological practice is encouraged with subsequent presentation and publication.

Dr Suren De Zylva [President] and Dr Kalana Parana Palliya Guruge [Secretary] of Sri Lanka Association of Urological Surgeons

Progress and Future of Vascular Surgery in Sri Lanka

Vascular surgery as a standalone specialty has developed in Sri Lanka since the beginning of this millennium. The epidemic of diabetes mellitus and increasing life expectancy in Sri Lanka has resulted in a significant increase in vascular workload in general, and extremity occlusive arterial disease in particular.

Interestingly the bulk of vascular disease presents as lower extremity ulceration in patients with diabetes mellitus and varicose veins. Traditionally, the bulk of this work has been

dealt with by the general surgeons, but a lack of appreciation of the contribution of ischaemia in the fight against infection in the diabetic foot and the transition to endovenous ablation for varicose veins has resulted in the need for vascular specialists to take over this workload as far as possible. Revascularization of the diabetic foot has radically improved limb salvage and healing and provision of bypass surgery1 and balloon angioplasty2 on a regular basis is our goal. The paucity of catheter laboratory facilities in operating theatres is a major hinderance to the provision of endovascular care in Sri Lanka. We propose to transform vascular theatres into hybrid [open-endo] theatres in the near future. Nevertheless, the role of endovascular aneurysm repair [EVAR], balloons, atherectomy devices and stents are costly and less durable alternatives to open surgery that need careful evaluation with clear guidelines for use in Sri Lanka.

We plan to introduce Resuscitative Endovascular Balloon Occlusion of the Aorta [REBOA] 3 in the case of major trauma which is expected to reduce mortality from massive haemorrhage.

There is also a need to develop at least one centre of excellence in each province to deal with difficult, complex, and recurrent vascular surgical problems to offer the best care to patients. Further, setting up of multidisciplinary teams that include podiatrists, orthotists and medical specialists in tertiary centres will be pursued to optimize and sustain best outcomes.

With the objective of improving the quality of surgery for vascular disease, Sri Lanka Society for Vascular Surgery [SLSVS] was established in 2017. By providing a platform for sharing latest developments in vascular disease and surgery, the SLSVS hopes to provide its members with the opportunities to learn from experts in the field as well as sharing knowledge and learning from each other's experiences. SLSVS would ensure the provision of new knowledge and coordination of care which ultimately would benefit all those with vascular disease in Sri Lanka. There is paucity in data on the practices, safety, and efficacy of vascular interventions in Sri Lanka at a national level. The need to collect our own data and make the practice of vascular surgery evidence guided cannot be overemphasized. Our current experience with single centre registries will be used to cover the rest of the island in the coming decade. Similarly the SLSVS propose to setup vascular registries and research collaborations in South Asia.

There is much work to be done in terms of policy making, training, service provision and research in vascular surgery in Sri Lanka. The process has been started and the need is to sustain the effort and move the specialty forward so that vascular surgery in Sri Lanka will be able to match the best practices in the world and provide quality care to all.

Prof S.M. Wijeyaratne SM [President] and Dr M.R.N Cassim [Secretary], Sri Lanka Society for Vascular Surgery

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PERSPECTIVE

3D printing: can it make surgery more accessible?

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Keywords: 3D printing; medical devices; surgical equipment; LMIC; accessible surgery

Abstract
The advancement of 3-Dimensional (3D) printing technology has made the design and production of items increasingly ubiquitous amongst the public. This technology is increasingly being used widely in various medical fields. With its increasing cost efficiency and accessibility, it is the author's perspective that 3D technology can improve accessibility to surgical procedures in low- and medium-income countries (LMIC) by providing proceduralists with the basic equipment required to perform routine operations.

Introduction
Surgical services are increasingly recognised as an important component of public health [1]. These services remain widely accessible in developed countries. However, many fail to appreciate the disparity in low and middle-income countries (LMIC), with only 3.5% of operations performed on the poorest one-third of the world's population[2]. With the advent of accessible and high-quality 3-Dimensional (3D) printing that has been used in various medical fields [3], it is our view that 3D design and printing can help mitigate the shortage and cost of surgical resources in these communities.

3D printing technology
3D printing is a manufacturing method that builds objects by the fusion or deposition of materials. The most common and widely used modality of printing available in medicine is Fused Deposition Modeling (FDM), with the cost of consumer-grade models upwards of USD 300 [4]. FDM printing utilises a heated nozzle to melt and release the plastic filament over a bed, building the object in layers as the plastic cools [5]. Most FDM printer models can print a variety of materials, including but not limited to Polylactic Acid (PLA), Acrylonitrile Butadiene Styrene (ABS) and Polyethylene Terephthalate Glycol (PETG) [all simples] (Table 1).

Material	Cost	Strength	Advantages
PLA	USD 10-40/kg	65MPa	Greatest ultimate strength
ABS	USD 10-40/kg	40MPa	Heat resistant Impact resistant Durable
PETG	USD20-60/kg	53MPa	Water resistant Chemical resistant Durable

Table 1. Characteristics of common materials used for 3D printing [6]

Equipment can be printed at approximately one-tenth the cost of their stainless steel equivalent [4].

The initial process of 3D printing requires the design of a Computer-Aided Design (CAD), a 3D rendered model of the object. There are many open-source and easy-to-use 3D software available for the design of CAD. Furthermore, many pre-made CADs are available for free online and require minimal modifications to fulfil a specific surgical need (e.g smaller retractors for paediatric cases). The CAD models are then uploaded into a printing software where it is reformatted and printed on the 3D printer.

3D design and printing of surgical equipment has already been attempted and utilised on cadaveric inguinal hernia repair with success in 2017 [7]. Construction and modification of instruments, including a scalpel handle, haemostat, needle driver, forceps, self-retaining retractor, and Army-Navy retractors were done in a matter of days.

Requirements
Several key factors will facilitate a conducive 3D printing environment.

(A) Environment
A by-product of 3D printing is the aerosolisation of vapours from the printed material [8]. Fume hoods can be used to extricate the toxic fumes produced [8]. Materials for 3D printing should be kept in an airtight container with silica desiccant packets to prevent moisture absorption and material degradation during long term storage [9].

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(B) Electronic resources
A reliable internet connection, suitable computer hardware and software are necessities. Adjustments can be made easily to existing models to be printed on-demand [6].

Disadvantages of 3D printing
Some disadvantages include:
(A) Sterilisation
Unlike stainless steel, sterilisation methods for plastic filaments remain limited. Currently, standardized autoclave sterilisation is not a feasible option for sterilisation of filament plastics as it might lead to warping and degradation of the material [10]. Limited research in sterilisation of 3D printing materials has shown that low-temperature hydrogen peroxide sterilisation or FDA approved glutaraldehyde protocol are the best methods, with minimal degradation and warping [10, 11]. However, repeated sterilisation and durability of these materials have not been adequately researched, opening the potential for future development in durable materials.

(B) Regulatory concerns
3D printed medical devices are still subjected to regulatory requirements, with manufacturing regulations and the country's legal requirement being a barrier to production [12]. The FDA has guidelines available online regarding the governance of 3D printed equipment that can help mitigate certain barriers of production [13].

Accessibility in LMIC
Surgical equipment can be costly especially for health systems in LMIC. The start-up cost for 3D printing can range from USD 300 upwards for printers alone, with additional resources required for the purchase of a computer, printing materials and trained personnel. This confers the health institution the ability to customise individual equipment for specific operations and needs [14]. Once established, the actual manufacturing of 3D printed surgical equipment can be much cheaper than their stainless-steel counterparts. Given that the haemostat printed by George et al measures 8cm by 4cm by 0.5cm (16cm3) [7], the cost of a 3D printed haemostat with current material prices (PETG at USD60/kg) can be as low as USD1. This is compared to the commercial price of titanium haemostat which can cost USD10 [15], making a 3D printed version 10 times cheaper than their commercial counterpart. Even factoring in additional costs such as electricity and wages, the manufacturing of a 3D printed device can be more cost-efficient than its branded counterpart. Ulmeanu et al manufactured a tracheostomy tube (factoring in parts and labour) for as low as 70 USD (62 Euros) when branded counterparts would normally cost significantly more [16]. However, this advantage may be diminished by a reduced number of times 3D printed instruments can be sterilised.

This technology is not just limited to the manufacturing of surgical equipment, 3D printing can be applied to other aspects of medicine including prosthetic and anatomic modelling. Hand prosthesis has been modelled for war-wounded children for as low as USD 19 [17]. With technological advancement, the ability to customise individual prosthesis for patients can lead to improved postoperative outcomes and reduced complication rates. This can be seen in neurosurgery, where customised cranial plates can be printed to be fitted perfectly for patients who had a craniotomy [18].

Furthermore, the delivery of surgical instruments is a timely affair and can take months to be distributed to rural or remote hospitals. 3D printed instruments are cheaper and can be printed quickly, making them more accessible as compared to standard surgical equipment. Increased accessibility enables the population in these areas to receive appropriate and timely surgical care at a reduced cost.

Conclusion
The advancement of household 3D printing technology has benefited the medical community in various ways. With more research into materials and design, 3D printed surgical equipment has the potential to bridge the gap in low resource communities and make basic surgical procedures more accessible to these communities.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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CASE SERIES

Endoscopic management of Lemmel syndrome: a rare, benign cause of obstructive jaundice

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Keywords: Periampullary; duodenal diverticula; obstructive jaundice; Lemmel syndrome

Introduction

In 1934, the German physician Gerhard Lemmel described a condition where periampullary duodenal diverticuli caused obstructive jaundice in the absence of cholelithiasis, biliary strictures or neoplasms [1]. This entity is still less familiar due to the rarity of the condition and the scarcity of literature.

As it can mimic sinister pathology in the distal biliary or periampullary region, accurate diagnosis is imperative to minimize mismanagement.

Case presentation

Patient 1

An 81-year-old male developed progressive obstructive jaundice, nausea and poor appetite. He denied fever, weight loss and a history of cholelithiasis. Direct hyperbilirubinemia with elevated alkaline phosphatase (ALP) and ɣ glutamyl transferase (ɣ GT) levels was observed. Aspartate aminotransferase (AST) and alanine transferase (ALT) were within the normal range. Ultrasonography revealed dilatation of gallbladder, intra and extrahepatic bile ducts. Contrast-enhanced computed tomography (CECT) abdomen and magnetic resonance cholangiopancreatogram (MRCP) demonstrated a smooth narrowing of the distal bile duct with proximal biliary dilatation and a periampullary diverticulum (Figure 1). The major papilla was located in between two large periampullary diverticula during the endoscopic retrograde cholangiopancreatogram (ERCP) without choledocholithiasis or biliary stricture. A plastic biliary stent was placed following limited selective biliary sphincterotomy. The patient became asymptomatic with improved liver functions. A repeat ERCP was performed after 8 weeks. Biliary sphincterotomy was extended and the stent was removed.

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Patient 2

A 72-year-old female was admitted to the surgical casualty with septic shock due to ascending cholangitis. She denied previous episodes of biliary colic or obstructive jaundice. She had a rising level of direct hyperbilirubinemia, ALP, ɣ GT and marginally elevated AST and ALT. Ultrasonography revealed intra- and extrahepatic duct dilatation, and a stone in the distal common bile duct (CBD). Urgent ERCP demonstrated two periampullary diverticula causing distal CBD narrowing and a stone proximal to it (Figure 2a and 2b). The patient recovered following biliary decompression with a plastic biliary stent. Removal of the stent, a selective biliary sphincterotomy and balloon extraction of CBD stone was performed in 8 weeks (Figure 2c).

Patient 3

An 80-year-old female developed right hypochondrial pain and poor appetite for 3 months in the absence of obstructive jaundice. Her abdominal examination was unremarkable. Total bilirubin, ALP, and ɣ GT were slightly elevated. Ultrasonography demonstrated a distended gallbladder with intra and extrahepatic duct dilatation. MRCP indicated distal biliary stenosis causing proximal dilatation. ERCP demonstrated three periampullary diverticula causing distal biliary obstruction in the absence of a biliary stricture. A plastic biliary stent was placed following a selective biliary sphincterotomy. Repeat ERCP after 8 weeks revealed a proximal stent migration which required an extension of biliary sphincterotomy and strenuous removal using a stone retrieval basket (Figure 3).

Patient 4

A 74-year-old female presented with progressive jaundice, epigastric pain, poor appetite and intermittent fever without chills for 2 weeks. Her abdominal examination was unremarkable. Direct hyperbilirubinemia and elevated ALP and ɣ GT were noted. Ultrasonography demonstrated a distended gallbladder with intra and extrahepatic duct dilatation, MRCP revealed distal biliary stenosis causing proximal dilatation and few CBD stones. ERCP showed that the major papilla was located in the inner lip of a large duodenal diverticulum. Selective biliary cannulation and placement of a plastic biliary stent were performed with difficulty (Figure 4a and 4b). Sphincterotomy or stone

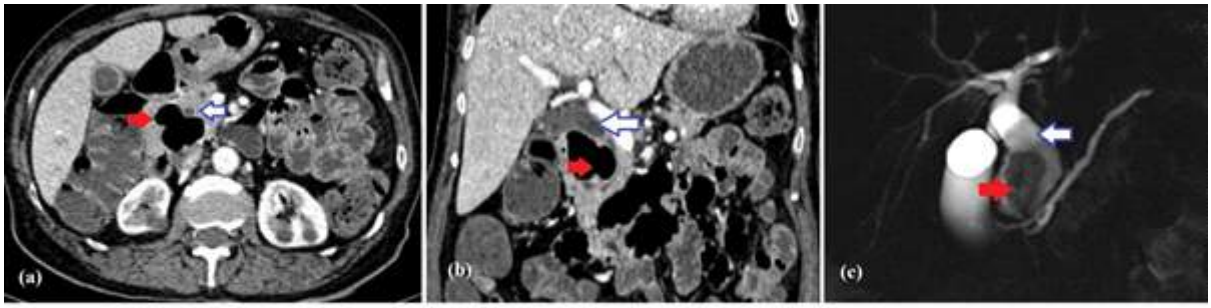

Figure 1: A large periampullary duodenal diverticulum (red arrow) causing dilatation of the proximal biliary ducts (white arrow). (a) Axial view of a computed tomography. (b) Coronal view of a computed tomography. (c) Magnetic resonance cholangiopancreatography.

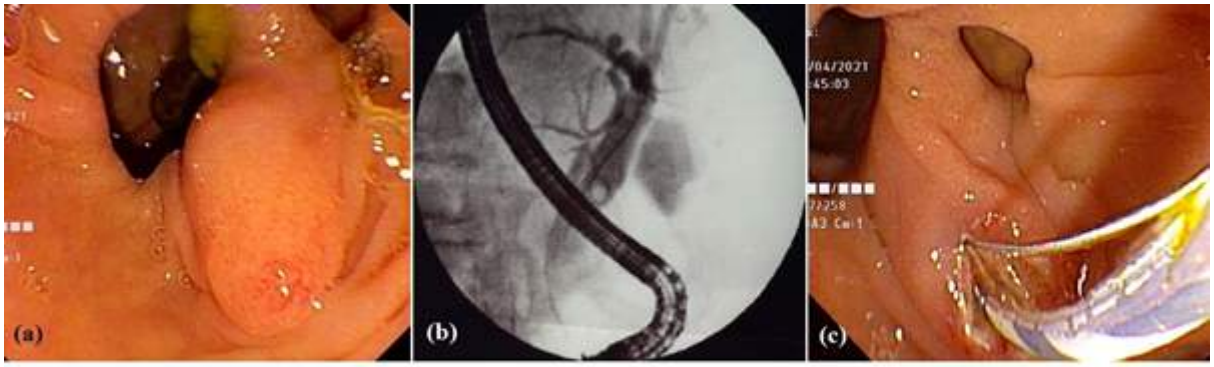

Figure 2: (a) Side viewing endoscopy showed the major papilla lying in between two large periampullary diverticula. (b) Endoscopic retrograde cholangiogram shows dilated intra- and extra hepatic bile ducts with a stone in the common bile duct proximal to the distal stenosis. (c) Selective biliary sphincterotomy.

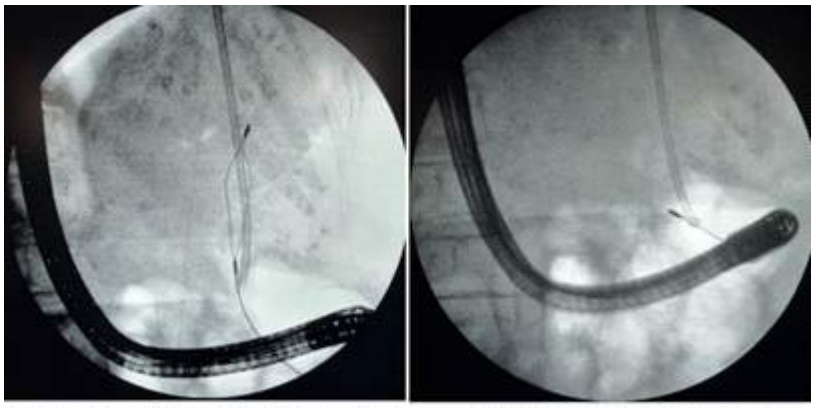

Figure 3: Proximally migrated stent was retrieved using a stone retrieval basket.

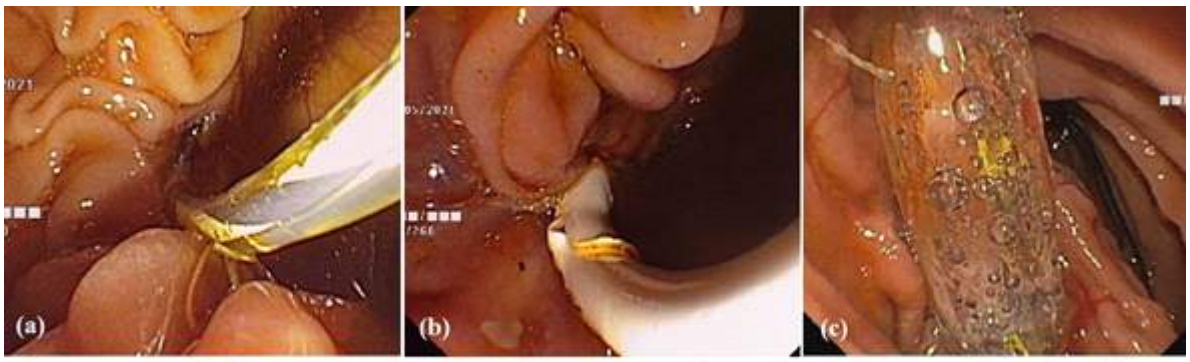

Figure 4: (a) difficult selective biliary cannulation as the major papilla located in the inner lip of a large duodenal diverticulum. (b) Placement of a plastic biliary stent. (c) Sphincteroplasty was performed subsequently to facilitate balloon extraction of common bile duct stones.

extraction was not attempted during the initial ERCP. Sphincteroplasty and balloon extraction of stones was performed during the repeat ERCP (Figure 4c).

Discussion

The duodenum is the commonest location in the small intestine for pulsion type pseudodiverticuli which consist of mucosa, submucosa and serosa protruding through the muscularis propria. Increased intraluminal pressure associated with abnormal intestinal contractions or localized inflammation is presumed to cause the herniation through the weak intestinal wall where blood vessels penetrate [1].

The incidence of duodenal diverticula ranges from 7.5 – 27% based on endoscopic ultrasound and ERCP studies. While many are asymptomatic, some develop complications including haemorrhage, obstruction, inflammation, and perforation. The majority (70%) are in the second part of the duodenum along its medial border and may produce pancreaticobiliary manifestations [1].

The eponym Lemmel syndrome is referred to when a periampullary diverticulum exerts mechanical compression on the common bile duct causing obstructive jaundice. Following endoscopic manometry studies, Tomita et al. suggested that sphincter of Oddi dysfunction also contributes to the condition [2]. Other proposed mechanisms include chronic fibrosis of the papilla (papillitis Chronica fibrosa) and distention of periampullary diverticulum by bezoar or enterolith [3]. However, macroscopic fibrotic changes of the major papilla or significant intraluminal collections causing diverticular distension were not observed in our series [Table 1].

Lemmel syndrome is common among older patients with a female predominance as we observed in this series [3, 4]. Progressive or intermittent jaundice associated with variable symptoms (epigastric pain, abdominal fullness, loss of appetite) has been documented in the previous reports. A subset of patients can present with ascending cholangitis as observed in 'patient 2'. Common biochemical findings include direct hyperbilirubinemia, elevated ALP and ɣ GT with normal or marginally elevated AST and ALT levels. [4]. Normal C-reactive protein and leucocyte levels were observed in the majority in this series except for the patient with ascending cholangitis.

The literature describes the image appearance of periampullary diverticula as rounded sacs containing air, along the medial wall of the second part of the duodenum. However, differentiation of the diverticula from walled-off necrosis, pancreatic pseudocyst or abscess may be challenging [3 - 5]. Frauenfelder et al. recommend the use of CECT with oral contrast to demonstrate communication with the duodenal lumen, estimate its size, and reveal extrinsic compression on the bile duct. Administration of intravenous contrast demonstrates homogeneous enhancement of the diverticular wall in the absence of a mass differentiating from a neoplasm or inflammatory lesions [4]. MRCP has a sensitivity of 81.2% and specificity of 98.6% to detect a single periampullary diverticulum and helps further evaluation of aetiology for the biliary obstruction [5]. In our series, a combination of imaging modalities was performed to exclude malignant pathologies considering the old age at presentation, distended gallbladder with intra- and extrahepatic biliary duct dilatation detected in ultrasonography. Image (CECT or MRCP) evidence of periampullary diverticula was observed only in 'patient 1'. The diagnoses of Lemmel syndrome were made during multidisciplinary team discussions when the imaging failed to show cholelithiasis, masses or strictures as the cause for distal biliary obstruction in the presence of periampullary diverticula observed in the side-viewing endoscopy.

Management of Lemmel syndrome can be conservative, endoscopic, and surgical. Conservative management is suitable for patients who have incidentally detected periampullary diverticula with minimal biliary obstruction in the absence of hyperbilirubinemia. Endoscopic management is commonly described in the literature, whereas surgical management (diverticulectomy or biliodigestive anastomosis) is performed rarely [3, 4].

All patients in this series were managed successfully with endotherapy. Performing selective biliary cannulation and biliary sphincterotomy in the presence of a diverticulum was technically demanding. Plastic biliary stents were inserted following the sphincterotomy. In one patient, stenting was performed without a sphincterotomy as the major papilla was located on the inner lip of a large diverticulum. Two patients had developed common bile duct stones due to distal obstruction. We avoided stone extraction during the first ERCP considering the risk of perforation.

All the patients underwent a second ERCP after 2 months. Balloon extraction of the stones was done with ease as the stones had become soft in the presence of the stent. Once a clear biliary tree was confirmed with an occlusion cholangiogram and the presence of free bile flow, re-stenting was not required in these patients.

The risk of complications related to ERCP including perforation, acute pancreatitis, and cholangitis are higher in these patients [4]. Except for the stent migration, none of our patients developed sinister complications following ERCP. They are being followed up at the surgical clinic 3 monthly with liver functions.

Table 1. Summary of demographic data, clinical presentation, investigations, and treatments

	Patient 1	Patient 2	Patient 3	Patient 4
Age (years)	81	72	80	74
Gender	Male	Female	Female	Female
Comorbidities	Hypertension	Diabetes mellitus	Hypertension	Not evaluated
Presenting complaints	Jaundice Loss of appetite	Jaundice Fever Epigastric pain	Right hypochondrial pain Loss of appetite	Jaundice Epigastric pain
Total bilirubin (µmol/l)	78	153	24	83
Direct bilirubin (µmol/l)	56	81	15	33
ALP (U/l)	332	497	287	304
ɣ GT (U/l)	91	516	43	105
AST	42	87	NA	NA
ALT	34	92	NA	NA
Ultrasonography				
Diameter of CBD (mm)	14	14	16	18
Intrahepatic ducts	Dilated	Dilated	Dilated	Dilated
Gallbladder	Distended	Not distended	Distended	Distended
CECT and MRCP	Distal biliary stenosis, periampullary diverticulum	Not performed	Distal biliary stenosis	Distal biliary stenosis
ERCP				
Findings	2 periampullary diverticula	2 periampullary diverticula, a CBD stone	3 periampullary diverticula, a CBD stone	Single large periampullary diverticulum
Treatments	Biliary sphincterotomy and stenting	Biliary sphincterotomy, stone extraction and stenting	Biliary sphincterotomy and stenting	Biliary sphincterotomy, stone extraction and stenting
Complications			Proximal migration of stent	

ALP, alkaline phosphatase; ɣ GT, gamma glutamyl transferase; AST, aspartate aminotransferase; ALT, alanine transferase; CECT, contrast enhanced computed tomography; MRCP, magnetic resonance cholangiopancreatography; ERCP, endoscopic retrograde cholangiopancreatography; NA, not available

Conclusion

Lemmel syndrome is a rare cause of distal biliary obstruction by periampullary diverticula commonly seen among the elderly. It should be considered in the differential diagnosis of obstructive jaundice in the absence of cholelithiasis, tumour, inflammatory or iatrogenic strictures. Endotherapy with biliary sphincterotomy and stenting is successful in most patients.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- Lemmel syndrome is a rare condition presented with obstructive jaundice caused by periampullary duodenal diverticulum in the absence of cholelithiasis, stricture or neoplasm.
- Lemmel syndrome is usually seen among elderly population.
- Endotherapy with biliary sphincterotomy and stenting is successful in most patients.

CASE REPORT

Free gracilis transfer for elbow flexion for pan brachial plexus injury

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Keywords: Gracilis muscle; free tissue flaps; brachial plexus

Introduction

Global [Pan] Brachial Plexus Injuries [BPI] cause severe compromise of the upper limb functions, hence a significant disability [1]. Reinstating elbow flexion may contribute much towards restoring the function of the upper limb making it a helping hand [2]. Here, we present a case of restoration of elbow flexion in a patient with a global BPI using free functioning gracilis transfer. To our knowledge, this is the first report of a successful free gracilis transfer performed in Sri Lanka for a pan brachial plexus injury.

Case presentation

A 23-year-old male presented with a left-sided global BPI [C5 to T1] following a motorcycle accident. On clinical examination power of his shoulder, elbow and wrist movements were Medical Research Council [MRC] grading M0. Nerve conduction test confirmed severe global BPI [root evulsion type] involving both preganglionic and postganglionic segments. Three years after the initial injury he underwent nerve banking with the phrenic nerve as the donor motor nerve. A 10 cm sural nerve graft was used coaptating with the phrenic nerve to reach the mid-arm at the same time. One year after the nerve banking procedure, he underwent neuroma exploration [Supplementary Figure 1] and free functional gracilis transfer for elbow flexion. During this procedure, free functioning gracilis myocutaneous flap was harvested with its nerve supply [Supplementary Figure 2]. Branches of the brachial artery and brachial vein were anastomosed end-to-side with the recipient's vessels. Nerve end neuroma was taken for biopsy to confirm active axons. Neuroma was excised and was coaptated with the motor nerve to the gracilis. The proximal end of the gracilis was anchored to the coracoid process [Figure 1] and its distal end was attached to the biceps tendon [Figure 2]. Skin defect was closed incorporating the skin island of the gracilis which was used for monitoring of the flap during the postop time. A back slab was applied with elbow flexion of 90 degrees. Gentle active mobilization was started six weeks after the surgery, whereas weight-bearing exercises to strengthen the motor power of the biceps were started in 8 months. Muscle power of M3 was achieved after an 8-months follow-up, and the pain measured on a visual analogue scale was zero.

Discussion

The surgical management of brachial plexus injuries is challenging in developing countries due to the sparsity of resources and expertise. Surgical interventions for BPIs are indicated if [A] there is no spontaneous recovery following the first few weeks of trauma, [B] when discrete nerve injuries are expected/confirmed [eg. penetrating trauma] or [C] associated vascular injury. When feasible, early/immediate surgical repair is recommended over delayed repair since the former allows end-to-end suture or short grafting, which is often difficult when the nerve retracts with time. Nerve transfer procedures with contralateral C7, spinal accessory nerve, phrenic nerve, motor nerves of the cervical plexus and intercostal nerves have been successfully carried out within the first year of the injury [3]. However, the majority of the late presenters of total BPI benefits more by free functioning muscle transfer procedures compared to nerve repair for restoring elbow flexion [3], particularly when the denervation time is more than one year [2]. The phrenic nerve has a very high density of motor nerve fibres per unit area of cross-section, making it a good choice as a donor nerve [4]. Compromising of cardiopulmonary functions can occur as a result of the utilization of the phrenic nerve as a motor neurotizer, however, long-term follow-up data are sparse in the literature. Sacrificing the phrenic nerve is known to reduce vital capacity by approximately 10%, however, this may not lead to clinically significant compromising of the respiratory functions [5]. In our case, we did not observe clinically detectable pulmonary or cardiac complications during one year of follow-up. Nevertheless, the phrenic nerve should be not considered as a donor nerve in infants and children because of the high respiratory demand [3]. Furthermore, obtaining the full length of the phrenic nerve requires thoracoscopic procedures, which may increase the morbidity of patients. Hence only a part of the nerve in the vicinity of the scalenus anterior is mobilized during this procedure. If the donor's nerve fails to innervate the recipient's muscle, it

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Figure 1. Proximal end of the gracilis myocutaneous flap anchored to the coracoid process

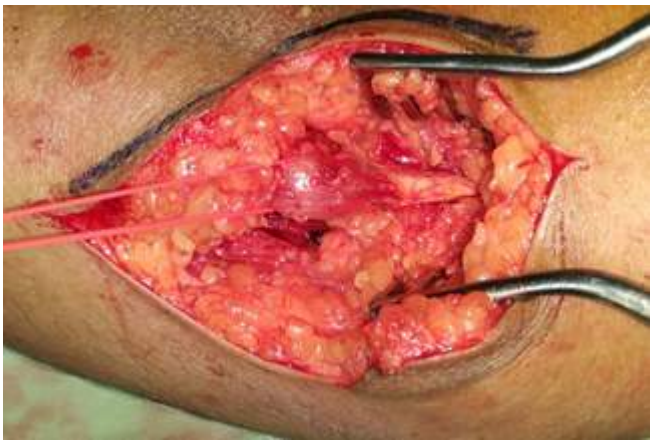

Figure 2. Distal end of the gracilis myocutaneous flap attached to the tendon of the biceps

subsequently undergoes atrophy. The rationale of nerve banking is to ensure the viability of the donor's nerve before initiating muscle transfer procedure and to achieve to appropriate length without tension. As in our case, axonal sprouting of the donor's nerve can be identified preoperatively by the presence of a neuroma which can be palpated subcutaneously with a positive Tinel sign and can be confirmed subsequently by histological examination. Yang et al, analysed 47 cases of functioning gracilis free transfer for global BPI using spinal accessory [n=45] and phrenic [n=2] nerve grafts from 1999 to 2016 [2]. Good elbow flexion, functional recovery and quality of life were observed in most of the participants of this study. In a Chinese clinical trial, less power of elbow flexion was achieved when the phrenic nerve was grafted to the musculocutaneous nerve directly or through a sural nerve graft in comparison to the partial transfer of median or ulnar nerves to the musculocutaneous nerve [6]. In our case, we were able to achieve an MRC grade 3 muscle power within 8 months postoperatively, which is considered as a clinically useful strength of elbow flexion [3].

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- The late presenters of total BPI benefit more by free functioning muscle transfer procedures compared to nerve repair for restoring elbow flexion
- Phrenic nerve has a very high density of motor nerve fibres per unit area of cross-section, making it a good choice as a donor's nerve
- The rationale of nerve banking is to ensure the viability of the donor's nerve before initiating muscle transfer procedure and to achieve to appropriate length without tension

CASE REPORT

A rare case of refeeding syndrome after right hemicolectomy

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Keywords: Refeeding syndrome; right hemicolectomy; parenteral feeding

Introduction

Refeeding syndrome (RFS) is characterized by potentially fatal shifts in fluid and electrolytes, that occur in malnourished patients after commencement of enteral or parenteral feeding [1]. It is an underdiagnosed condition that may result in multi-organ failure. We report on a patient who developed RFS after a right hemicolectomy for intestinal obstruction.

Case presentation

A 53-year-old previously healthy male presented with episodes of abdominal colics, bilious vomiting and progressive anorexia of six months duration. He had been on a low-calorie liquid diet due to his symptoms over the previous two months duration and lost 20 kg in weight during this period. Past surgical history was unremarkable. He was wasted with a body mass index (BMI) of 15.1 kg/m2. The mid-arm circumference was 16.5 cm. The abdomen was scaphoid but otherwise normal except for visible peristalsis. Other systems were normal. Key biochemical parameters from admission to discharge are shown in figure 1.

Oesophago-gastro-duodenoscopy (OGD) showed healed antral ulcers and sequestered bile. Contrast-enhanced CT abdomen revealed an annular growth in the distal jejunum without evidence of loco-regional extension or metastatic disease.

The patient was nutritionally optimized for one week with parenteral nutrition of 30 kcal/kg/day and intravenous thiamine supplementation before surgery. Laparotomy revealed an annular growth in the proximal jejunum and a primary growth at the ileocaecal junction with metastatic omental deposits. A right hemicolectomy with ileocolic anastomosis and a jejunal resection with primary side to side anastomosis was done. Postoperatively parenteral nutrition was continued at 30 kcal/kg/day and oral intake was introduced incrementally.

On the 2nd postoperative day, he developed abdominal distension with sluggish bowel sounds. Paralytic ileus was diagnosed. Over the following two days, he demonstrated extreme fatigue, muscle weakness, resting tremor and paraesthesia in his extremities. In addition, he became disoriented and displayed episodes of aggressive behaviour. This was followed by hypotension and oliguria that did not respond to fluid resuscitation and required noradrenaline infusion. Echocardiography showed an ejection fraction of 50% without segmental hypokinesia. He developed bilateral pleural effusions, ascites, bilateral leg oedema and finally coffee ground vomiting. Ultrasonography excluded deep vein and portal vein thrombosis. He was afebrile and clinical features and inflammatory markers were not in favour of sepsis.

Biochemical assays demonstrated a progressive reduction in serum ionized calcium, magnesium and phosphate levels after commencing therapeutic feeding with the lowest values noted between the 3rd and 5th postoperative day.

Thrombocytopenia was observed with values as low as 10,000 / mm3 that coincided with the upper gastrointestinal bleeding.

The evolving clinical presentation resulted in the lack of a diagnosis until the 5th postoperative day when refeeding syndrome was diagnosed. The caloric intake was immediately reduced to 10 kcal/kg/day over the next 4 days and gradually increased to 15 kcal/kg/day. Enteral feeding was established by the 7th postoperative day after the paralytic ileus settled. Intravenous calcium gluconate, magnesium sulphate, thiamine and oral phosphate supplementation were initiated. These resulted in the gradual resolution of clinical parameters and biochemical derangements. He was discharged on the 14th postoperative day on a solid high protein, normal calorie diet.

Histology revealed an adenocarcinoma of the caecum with likely small bowel and omental metastatic disease. He was referred to the oncology unit for adjuvant systemic therapy.

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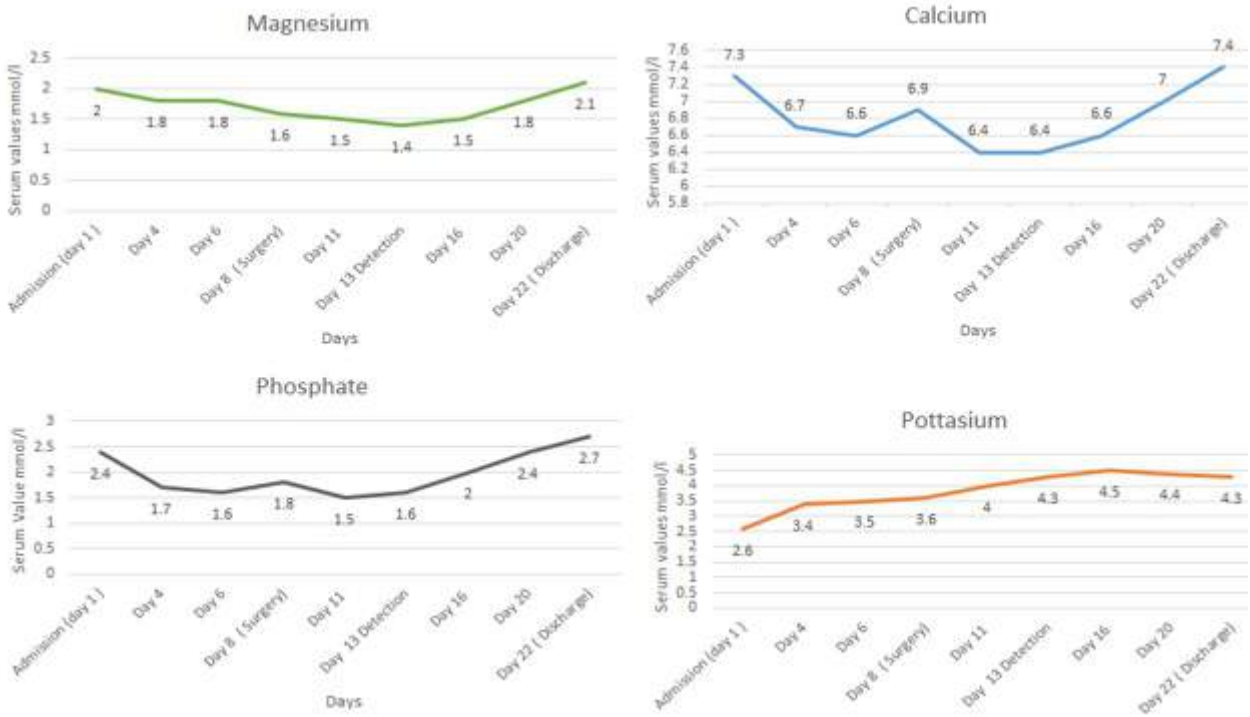

Figure 1. Demonstrate the electrolyte shifts of this patient. From the day of admission serum electrolyte levels were gradually decreasing until identification of RFS (Day 13). Symptoms appear around day 11 . Lowest values are seen around day 13. With reduction in calorie intake and intravenous electrolyte supplementation gradual correction of electrolytes is seen

He is on a normal diet and engaged in daily activities while on chemotherapy.

Discussion

RFS is a potentially fatal condition that occurs due to metabolic and hormonal shifts in high-risk patients after the commencement of supplemental feeding. As in this patient, early clinical features are often non-specific [2] leading to missed and late diagnoses and treatment [3].

Early identification of high-risk patients and a high index of suspicion and are important in the management of RFS. The National Institute for Health and Clinical Excellence (NICE-2006) guidelines to identify high-risk patients are indicated in Table 1. Based on these guidelines the patient was at high risk with a BMI less than 16 kg/m2, weight loss of 37.7% over six months, minimal nutrition intake for more than 10 days and initial low potassium and phosphate levels.

RFS is characterised by fluid retention, hypocalcaemia, hypomagnesaemia, hypokalaemia and hypophosphataemia. Starvation leads to chronic depletion of electrolytes, fluid and energy followed by glycogenolysis and later gluconeogenesis. During refeeding, there is a shift to carbohydrate metabolism and ingested glucose induces insulin secretion. This provokes glucose uptake and increased cellular metabolism with intracellular uptake of calcium, potassium, magnesium and phosphate resulting in further reduction in serum levels. Furthermore, the shift to carbohydrate metabolism reduces sodium and water excretion resulting in extracellular fluid accumulation and fluid overload [3].

In retrospect, the clinical course of this patient is explained by the mechanism described above. The hypokalaemia resulted in reduced cardiac contractility, hypotension, fatigue,

Table 1. National Institute for Health and Clinical Excellence guidelines for identifying patients at high risk of refeeding problems [5].

One or more of the following:
Body mass index (kg/m2) <16
Unintentional weight loss >15% in the past three to six months
Little or no nutritional intake for >10 days
Low levels of potassium, phosphate, or magnesium before feeding
Two or more of the following:
Body mass index <18.5
Unintentional weight loss >10% in the past three to six months
Little or no nutritional intake for >5 days
History of alcohol misuse or drugs, including insulin, chemotherapy, antacids, or diuretics

weakness and ileus. The hypophosphataemia and hypomagnesaemia caused altered mental status, seizures and paraesthesia and finally thrombocytopenia. His altered sensorium was likely further compounded by thiamine deficiency.

The management of RFS includes nutritional assessment and identification of high-risk patients, close monitoring and replacement of electrolytes, fluids and calorie intake. The feeding regimen should be individualized to each high-risk patient. Feeding is started at no more than 50% of the daily requirement, usually at 10 kcal/kg/day for high-risk patients and gradually increased [1]. Before refeeding, phosphate, magnesium and potassium assays must be done. Early correction of vitamin deficiency, especially thiamine, is done before the commencement of feeding and continued for at least 10 days [1].

Correction of hypophosphataemia and hypomagnesaemia is necessary if serum levels are < 0.30 mmol/L or < 0.50 mmol/l respectively or if symptomatic as was observed in this case [4]. The correction of electrolytes can be done concurrently with feeding. Monitoring for arrhythmias, fluid overload and frequent monitoring of serum and urinary electrolytes are mandatory [1].

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- RFS is a potentially fatal condition
- Clinical assessment and biochemical screening will identify those at high risk of RFS
- Measured caloric supplementation with electrolyte and vitamin replacement will minimise occurrence and sequelae of RFS

CASE REPORT

A rare case of acute scrotum presenting as intraoperative surprise

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Keywords: Acute scrotum; leiomyoadenomatoid tumour; epididymis; paratesticular tumours; benign urological tumours

Introduction

Leiomyomas are benign tumours that can arise from the smooth muscle component of any tissue. Adenomatoid(tumours arise from the mesothelial elements. But the origin of the leiomyoadenomatoid tumour is not yet clear. We present a case of acute left testicular pain presenting to the surgical emergency department with a surprising outcome. Torsion testis was considered the first provisional diagnosis, but the irregular shape and contour of the testis aroused the suspicion of a tumour [1].

Case presentation

A 29-year-old male patient presented to a forward military surgical centre located in a conflict zone with acute onset left testicular pain for 3 hrs. The onset and progression of pain were rapid and severe. Since the patient was not comfortable with clinical examination, the only inspection could be conducted. The left hemiscrotum was swollen with an irregular contour. The right-sided testis and hernial sites were normal.

Imaging and transferring to a higher centre was impossible due to ongoing conflict in the region. The patient was taken up for emergency exploration. A high inguinal approach was adopted for suspicion of testicular tumours. But testis could not be delivered out through a high inguinal incision due to adhesion to scrotal skin. Hence, a scrotal incision was given for mobilisation. Intra-op there was a palpable hard tumour in the head of the left epididymis and the testis was irregular in shape and firm to hard inconsistency. Testis along with the spermatic cord was completely removed till the deep ring [Fig 1]. All margins were meticulously excised and specimens were sent for histopathological examination. The external surface of the specimen appeared distorted, but there was no ulceration. Cut surface revealed the presence of a well-defined, firm, white nodule in the head of the epididymis with no grossly apparent extension into the testicular parenchyma. The testicular parenchyma appeared congested. Sections of the nodule showed a well-circumscribed tumour composed of cystic tubules lined by flattened to cuboidal epithelium with intervening fibrous stroma. The presence of prominent smooth muscle was noted in the stroma. No nuclear atypia, mitosis or necrosis was seen. Sections of the testis showed parenchymal haemorrhages with neutrophilic micro-abscesses suggestive of acute changes. All the margins were free of tumours. Immuno-histochemistry showed lining epithelial cells of epididymal tumour to be positive for Creatinine-Kinase (CK), Epithelial-Membrane-Antigen (EMA) and negative for CD-34. Smooth muscle component was positive for Smooth-Muscle-Antigen (SMA). Post-op recovery was normal. Abdominal radiology and tumour marker assay for Non-seminomatous Germ Cell tumours were normal.

Discussion

Primary solid epididymal tumours are rare. They constitute only 5 % of intra-scrotal tumours; 75% of which are benign. Of the epididymal tumours, 73% are adenomatoid tumours; 11% are leiomyomas and 9% are papillary cystadenomas. Differential diagnoses of epididymal swelling include epididymitis, sperm granuloma, sarcoidosis, tuberculosis or neoplasia. As a rule, solid intra-testicular lesions have a high likelihood of malignancy; extra-testicular lesions are usually benign[2,3].

Adenomatoid tumours are benign and originate from the mesothelial cell. They constitute 30% of paratesticular tumours and frequently occur in epididymis & fallopian tubes. Major microscopic features are a glandular pattern with fibrous stroma and cytoplasmic vacuole. Local invasive behaviour is seen rarely. Leiomyoadenomatoid tumour is an extremely rare variety, the histogenesis of which is largely unknown. Some authorities consider this as a subtype of adenomatoid tumour.

The theory of collision neoplasia is the second postulate. Another opinion is that it is an adneomatoid tumour with reactive smooth muscle hyperplasia. Microscopically there are two components; first, the gland-like spaces lined with

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Figure 1.
A. Irregular contour of left hemiscrotum
B. Testis firmly adherent to the scrotal skin
C. Separate scrotal incision
D. Left testis and cord mobilized till deep ring

flattened or cuboidal cells as seen in this case, and secondly, the smooth muscle component with palisades of smooth muscle cells [4,5,6].

Radical orchidectomy was done in this case for suspicion of an underlying tumour of the testis. Otherwise in a diagnosed case of an epididymal tumour, if the frozen section suggests benignity, simple excision of the lesion would suffice.

Conclusion

Adenomatoid leiomyoma is an extremely rare variety of intra-scrotal tumours with very few reported cases in the literature. In a case of an acute scrotum with enlarged and distorted testis, a medical surprise in the form of a tumour must be kept in the back of our mind.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- Benign scrotal tumours can present with acute severe symptoms.
- An underlying tumour must always be kept in mind when dealing with acute scrotal cases.
- Leiomyoadenomatoid tumour is a rare benign tumour in the genitourinary tract, more so in the epididymis.

CASE REPORT

Gallstone-ileus: an uncommon presentation of cholelithiasis

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Keywords: Cholelithiasis; cholecysto-enteric fistula; gallstone ileus; intestinal obstruction

Introduction

Cholelithiasis is the commonest biliary pathology seen in surgical practice. The majority of patients remain asymptomatic while others present with biliary colics, acute cholecystitis and gallstone pancreatitis. Gallstone ileus is one such uncommon presentation, in which there is a mechanical obstruction of the intestines by an impacted gallstone that has migrated through a bilio-enteric fistula. This condition is seen in elderly patients who have a history of neglected gallstones disease and it carries high morbidity and mortality.

Case presentation

An 82-year-old female patient presented with a history of feculent vomiting, constipation, progressive abdominal distention and peri-umbilical colicky pain for five days. These symptoms were preceded by bouts of vomiting, nausea and peri-umbilical colicky abdominal pain for 2 months. Furthermore, she had symptoms suggestive of biliary colics for over 20 years for which she hadn't sought medical advice. She was on treatment for hypertension and dyslipidemia.

On admission, she was haemodynamically stable, anicteric and had abdominal distension without signs of peritonitis. Initial conservative management of suspected intestinal obstruction was employed with intravenous fluid resuscitation, intravenous antibiotics and nasogastric decompression. Her blood investigations revealed a neutrophil leucocytosis and an elevated CRP level of 96 mg/dl. In addition, she had elevated serum creatinine levels suggestive of an acute kidney injury. Imaging with a plain X-ray abdomen showed evidence of small intestinal obstruction without an apparent cause. Contrast-enhanced Computed Tomography (CECT) scan was not done due to concerns of renal impairment. Due to progressive worsening of haemodynamic parameters and feculent nasogastric effluent, an exploratory laparotomy was performed with a clinical suspicion of an obstructive lower gastrointestinal malignancy. During laparotomy, small intestinal loops were found to be dilated up to the mid ileum with collapsed distal ileum and large intestines. After adhesiolysis, a cholecysto-duodenal fistula and an impacted gallstone measuring 5x3x2cm were found at 10 cm from the ileocaecal junction causing a distal small intestinal obstruction (Figure 1). The impacted stone was then milked proximally and removed via an enterotomy. No other impacted gallstones were detected. Due to advanced age, co-morbidities and the deteriorated pre-operative general condition of the patient, an intra-operative decision was taken to defer cholecystectomy and repair of the cholecysto-duodenal fistula. The patient had an uneventful recovery following the surgery and was discharged on postoperative day five. The follow-up visit at one month revealed a completely asymptomatic patient. The patient refused further surgery to undergo cholecystectomy and cholecysto-duodenal fistula repair.

Discussion

Gallstone ileus is a rare complication of cholelithiasis accounting for 1%-3% of mechanical bowel obstruction. It is seen mostly in elderly women in the seventh to eighth decades of life. This has higher morbidity and mortality owing to other associated co-morbid conditions in these patients [1]. The presence of longstanding gallstones in the gallbladder with resultant chronic inflammation and pressure necrosis may lead to cholecysto-enteric fistulae formation through which gallstones can pass into the gastrointestinal tract. Cholecysto-duodenal fistulae are the commonest of these accounting for 75-88%, followed by cholecysto-colonic fistulae [2]. The less common types are cholecysto-gastric, choledocho-duodenal and cholecysto-jejunal fistulae. Stones larger than 2cm in diameter can get impacted in the gastro-intestinal tract [1], with ileum being the commonest site of impaction followed by jejunum and duodenum. A stone can get impacted in the sigmoid colon and give rise to large bowel obstruction very rarely. Gallstone ileus may manifest with acute, intermittent or chronic episodes of intestinal obstruction. This patient's history is suggestive of intermittent partial obstruction with waxing and waning of symptoms until the gallstone got fully impacted and produced complete intestinal obstruction. Spontaneous passage of the stones is uncommon once the patient develops symptoms. Pneumobilia dilated small bowel

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Figure 1. Retrieved Gallstone after enterolithotomy

loops with air-fluid levels and aberrant location of large calcified gallstones are the radiological features seen in the plain X-ray abdomen described as "Rigler's triad". However, only 10% of the gallstones are sufficiently calcified to be radio-opaque and only 20-35 % of patients with gallstone ileus show the classic triad describe above [1]. CECT would be the best imaging modality with high sensitivity of 93 % to diagnose the condition pre-operatively [3]. However pre-operative diagnosis could not be made in this patient due to the absence of pneumobilia in the X-Ray abdomen and the relative contraindication to perform a CECT.

The management of gallstone ileus involves entero-lithotomy to relieve the intestinal obstruction, which is the mainstay of treatment, and subsequent cholecysto-enteric fistula repair and cholecystectomy to prevent recurrences. Latter two steps can be performed at the index laparotomy (one-stage) or a later date (two-stage). Decision on open versus laparoscopic exploration and one-stage versus two-stage procedure is a challenge.

Reisner and Cohen reported a higher mortality rate in the one-stage procedure (16.9%) compared to entero-lithotomy alone (11.7%) [4]. Marko Doko and colleagues who also compared the two surgical pathways found that although mortality rates were similar, patients who underwent the one-stage procedure had a higher rate of complications [3]. The presence of extensive inflammation and adhesions in and around the right hypochondrium renders it technically difficult to attempt the one-stage procedure leading to longer operative time. Thus enterolithotomy alone is considered the safer option. However, it poses a risk of recurrent gallstone ileus, acute cholecystitis and acute cholangitis while awaiting the next stage of surgery.

Conclusion

Gallstone ileus is an infrequent entity that is potentially fatal. This should be considered in the differential diagnosis of an elderly patient presenting with intestinal obstruction and a history of neglected gallstones disease. This high degree of clinical suspicion not only enables surgeons to equip themselves with pre-operative imaging but also to plan and stage the surgical intervention. Enterolithotomy alone is the best option for most patients with gallstone ileus. One stage procedure is only justified when the patient's general condition is optimum and intraoperative findings are permissible.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- Gall stone ileus should be considered in the differential diagnosis of elderly patients presenting with intestinal obstruction and a history of neglected gallstone disease
- High degree of clinical suspicion enables the surgeon to be better befitting surgical intervention.

CASE REPORT

Whitmore's disease: an uncommon urological infectious disease

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Keywords: Melioidosis; prostate abscess; Burkholderia Pseudomallei

Introduction

Melioidosis is one of the rare infectious diseases in humans, and it is caused by a gram-negative bacteria called Burkholderia pseudomallei [1]. This infectious disease is common in Australia and Southeast Asia; however, the number of newly reported cases in Sri Lanka has increased over recent years [2]. The spectrum of disease can affect any organ in the body, and it can be range from pure benign skin and soft tissue infections to fatal septicemia. Isolated prostate abscess due to melioidosis is uncommon. This case scenario aims to share our experience in the identification and management of primary melioidotic prostatic abscesses.

Case presentation

A 40-year-old Sri Lankan male presented at the ward with complaints of fever, dysuria, increased frequency, mild hematuria, and suprapubic pain. He had been diabetes for five years with poor compliance with medication. Other than that, there was no history suggestive of urethral instrumentation, trauma, and similar recurrent presentation. Examination revealed that he was fabrile and had a tender bogginess in the right lobe of the prostate during the digital rectal examination. The full urine report showed the presence of pus and red blood cells, and the inflammatory markers were elevated in the serum (White blood cells 20.5 × 109/ L, C- Reactive protein 234 mg/L, ESR- 70mm/hr). Initial ultrasound imaging of the pelvis revealed an enlarged prostate with possible abscess formation. Subsequently, magnetic resonance imaging (MRI) was requested, and it showed the large prostate abscess (3cm x 4cm x5cm) in the right lobe, which also extends into the left lobe (Figure 1).

After that, he underwent transrectal ultrasound-guided aspiration of the prostate abscess, which was positive for the pseudomonas species. At meanwhile, the sample was screened for melioidosis, and the test result was positive. The microbiology team reviewed him, and the intravenous cefotaxime 1g eight hourly was started for melioidosis. It had been continued for four weeks of duration, according to the microbiologist's opinion. The contrast-enhanced computed tomogram (CECT) of the chest, abdomen, and pelvis was arranged to exclude the rest of the organ involvement, and the study revealed no other foci of infection. Therefore, the diagnosis concluded as isolated primary prostatic melioidosis.

He was discharged after one month with oral augmentin 625 mg for another six weeks of duration. Follow-up ultrasound scans showed a significant reduction in the abscess cavity size at six weeks and no evidence of recurrence for one year.

Discussion

The etiologic agent of Whitmore's disease is a gram-negative anaerobic bacillus which was classified as pseudomonas group previously. Initially, Captain A Whitmore found this bacteria, and the term melioidosis was derived later by Stanton and Fletcher in 1921 [2].

B Pseudomallei is usually found in the environmental saprophytes and enters the human body by various methods such as inhalation, skin penetration, and laboratory acquisition. Therefore, it mainly affects the people who have regular contact with water and soil [3]. The main risk factors for this infection include male sex, diabetes mellitus, liver diseases, chronic kidney disease, and long-term lung diseases [4].

Melioidosis has a broad spectrum of clinical presentation as it can affect any part of the body. The lung is the most affected organ in the body and presents as pneumonia or lung abscess. It can also affect the organs of the genitourinary system, and they may present as pyelonephritis, renal abscess, prostatitis, epididymo-orchitis, and scrotal abscess [3]. However, an isolated prostate infection is a rare form of presentation, and it can present as benign prostatic hyperplasia or prostatitis. The affected patients may have high spike fever with lower urinary tract symptoms like in our case scenario. Rectal examination guides us to the prostatic involvement by the marked pelvic tenderness and prostatic bogginess.

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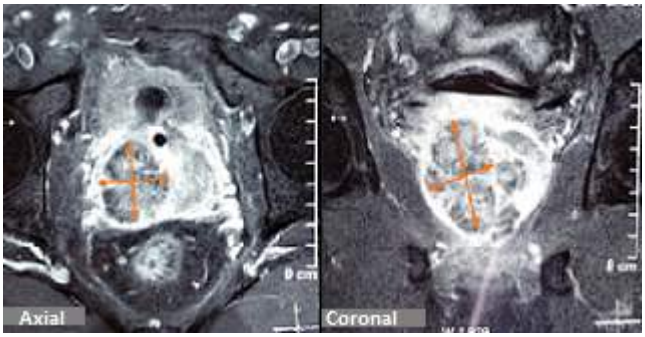

Figure 1. MRI prostate (Axial and Coronal views) showed the multiloculated prostate abscess in the right lobe which was marked by orange arrows.

The transrectal ultrasound is indicated in suspected cases to support the diagnosis. It shows the affected site, number and size of the lesions, and abscess formation. Computed tomography or magnetic resonance imaging is also helpful in defining the anatomy of the lesion, and it can exclude the rest of the organ involvement [5]. Definitive diagnosis requires the isolation of B. pseudomallei in culture from clinical specimens.

Small abscess cavities (< 1cm) can be resolved entirely with antibiotic treatment, but large abscesses need some form of drainage procedures such as needle aspiration or open techniques (transurethral, transrectal, transperineal). Among those, needle aspiration is a safe and straightforward technique, and it can be reproducible if indicated. Usually, B.Pseudomallei is sensitive to ceftazidime, amoxicillin-clavulanic acid, doxycycline, co-trimoxazole, and meropenem. The entire course of antibiotic treatment is recommended for 12-20 weeks despite drainage procedures [4].

There were few studies documented in the literature related to prostate melioidosis. Morse et al. published a 19 years study in melioidosis cases in Australia and found 81 were associated with prostate abscess. Seventy-five cases had clinical evidence of prostate infection, all treated with antibiotics, and 57 abscesses drained [1].

Conclusion

Urologists and primary care physicians should have a clinical suspicion of this infection in patients with prostate abscesses. The microbiology team should see and screen if the prostate abscess has an abnormal resolution course with usual treatment options.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- All primary care physicians and urologists should be aware of the melioidosis infection in patients with pyogenic infection.
- The prostate abscess should be screened for melioidosis if it has a poor response to the usual antibiotics.
- Patient compliance and microbiology team involvement are mandatory to resolve abscesses and prevent a recurrence.

CASE REPORT

Diffuse colonic lipomatosis presenting as acute abdomen with intraoperative resemblance of colonic carcinoma and concealed perforation

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Keywords: Colonic lipomatosis; carcinoma colon; concealed perforation

Introduction

Diffuse colonic lipomatosis is a rare condition characterized by the presence of lobules of adipose tissue in the submucosa of the whole colon affected[1]. Though rare, colonic lipomatosis can present with features of obstruction, perforation and intussusception[2]. They can also mimic colonic carcinoma intraoperatively[3]. There have been reports of five cases of diffuse colonic lipomatosis in literature before[2][3]. Herein we report the sixth case of diffuse colonic lipomatosis resembling colonic carcinoma and concealed perforation.

Case presentation

A 49-year-old female patient presented with intermittent abdominal pain for the one-month duration with pain increasing in severity for 2 days duration. She also complained of abdominal distention and vomiting. She has not opened her bowel for 2 days but was passing flatus. There was no history of fever. She was a diagnosed patient with chronic pancreatitis. On examination, there was severe tenderness and guarding of the right lower abdomen. The initial WBC count was 12.22×109, Hb was 9.5g/dl and S.amylase was 105U/L. Initial ultrasound scan of abdomen suggested inflammatory bowel mass in the right iliac fossa region with suspicion of an appendicular mass. Contrast-enhanced CT abdomen and pelvis showed a thickened terminal ileum with mural oedema of the ascending colon. The inflamed terminal ileal loops were seemed to form an inflammatory mass which made the bowel loops difficult to be traced. There were multiple air pockets within the mass and it was difficult to comment whether they were intraluminal or extraluminal. The appearance was suggestive of "terminal ileitis forming into an infective mass."

The patient underwent an exploratory laparotomy. There was blood stained peritoneal fluid entering into the peritoneal cavity. There was firm to hard irregular mass extending from the distal ileum, caecum to the proximal part of ascending colon. There was no mesenteric lymph node enlargement. On the caecum, there was suspicion of a concealed perforation. Right hemicolectomy was done with side to side anastomosis of distal ileum to the proximal transverse colon. Postoperatively patient recovered uneventfully.

In the histopathology report, gross examination revealed adhered ileum, caecum with appendix and a segment of colon with the hemorrhagic and congested serosal surface. The caecum and terminal ileum were dilated. There was an area with a suspicion of a rupture through the serosa of the caecum. The cut surface showed a thick yellow tissue throughout the submucosa with overlying flattened mucosa. The serosa of the appendix appeared inflamed. There was no diverticula, tumour polyps or caseous necrosis on extensive sectioning.

On microscopic examination, sections of the colon showed intact but diffusely flattened mucosa. The submucosa showed extensive infiltration of mature fat cells causing thinning of the muscularis propria. The serosa showed dilated, congested blood vessels and a moderate amount of inflammatory cell infiltrate. The mucosa of the caecum and ileum showed ulceration with a heavy mixture of inflammatory cell infiltrate, extending from mucosa to serosa, which showed many dilated congested blood vessels. The appendix showed normal histology except for moderate serosal inflammation.

There was no evidence of granulomata or malignancy. Terminal ileum and ascending colon up to transverse colon features were compatible with diffuse colonic lipomatosis with serositis involving the ileum, caecum and colon with evidence of perforation in the caecum adjacent to the appendix.

Discussion

Lipomas of the colon are the second most common benign tumour of the colon after adenomas[3]. Incidence is high in the fifth and sixth decades of life with a slight female preponderance[5]. Colonic lipomas are commonly submucosal [90%], the rest being serosal [4]. Lipomas are usually single[3]. In colonic lipomatosis, multiple benign lipomas are present throughout the colon. If lobules of adipose

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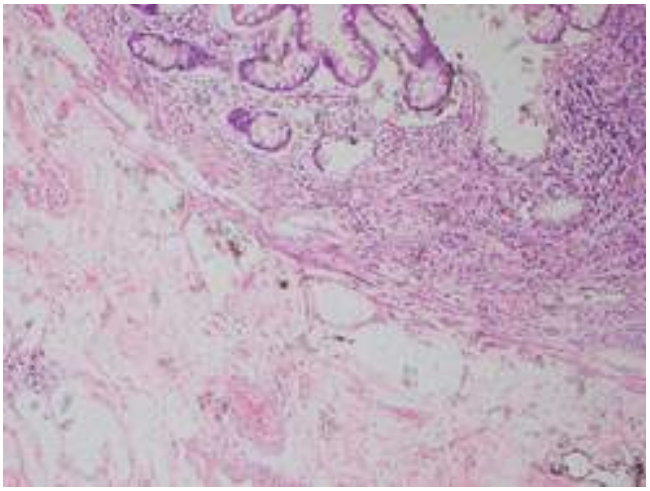

Figure 1. Infiltration of fat in the submucosa

tissue are present only in one segment of the colon it is known as segmental colonic lipomatosis and if lobules of adipose tissue affect the whole colon it's known as diffuse colonic lipomatosis [3].

The majority of patients with colonic lipomatosis are asymptomatic. In most patients, colonic lipomas are detected incidentally during investigation for symptoms associated with the gastrointestinal system. On rare occasions, patients can present with obstruction, perforation or intussusception[1].

Another important clinical significance is that it can resemble carcinoma colon. In this patient gross appearance intraoperatively was similar to carcinoma colon with a concealed perforation.

Colonic lipomatosis can be diagnosed by histopathology. CT abdomen, Barium studies may be helpful but they are not conclusive of the disease.

Common indications for surgical intervention in colonic lipomatosis are the complications associated with it, such as intestinal obstruction, intussusception, perforation and bleeding.

Conclusion

Colonic lipomatosis is a very rare occurrence in clinical practice. Sometimes it can present as acute abdomen. Intraoperatively on gross examination, it can resemble carcinoma colon.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- Colonic lipomatosis is a rare condition that can present as acute abdomen.
- Intraoperatively findings of colonic lipomatosis can be confused with carcinoma colon.

CASE REPORT

Thoracoscopic resection of neurogenic tumours in two children

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Keywords: VATS; thoracoscopy; children; neuroblastoma; neurogenic tumour

Introduction

Neurogenic tumours in children account for one-third of all thoracic tumours in children. Out of all the neurogenic tumours, 60% are malignant, predominantly neuroblastoma[1]. Thoracic neuroblastoma is biologically less aggressive than abdominal neuroblastoma, having excellent long term outcomes.

Conventionally thoracic neurogenic tumours are resected through open thoracotomy but with the availability of miniature endoscopic instruments and improved laparoscopic skills, Video-Assisted Thoracoscopic Surgery(VATS) is increasingly being accomplished with similar long term results[2,3]. Here we report two children who underwent thoracoscopic resection of thoracic neuroblastoma and neurofibroma.

Case presentation 1

The eight-month-old baby boy was presented with a right supraclavicular soft tissue mass of 3cm diameter which was found to be a lymph node mass in computerized tomography (CT) scan. On the CT of the chest, a separate posterior mediastinal mass was noted on the right side. The two masses were not in continuity. An excision biopsy of the neck mass revealed a metastatic deposit of the mediastinal neuroblastoma. The thoracic tumour measured 5X4X4cm which was extending up to the hilum of the right lung. He underwent 3 cycles of neoadjuvant chemotherapy and the tumour was downstaged remarkably. After chemotherapy, the tumour was in a favourable location in the apex of the posterior mediastinum with a size of 3X2cm.

He underwent thoracoscopic resection of neuroblastoma with a successful outcome. The surgery was done with mainstem left bronchial intubation which enabled complete right lung collapse.

The thoracic cavity was accessed through 5mmX 3 ports, having an optical port at posterior axillary line 5th intercostal space (ICS) with two working ports at the anterior axillary line and posterior to the tip of the scapula. He was positioned in a semi-prone position to expose the lesion of the lung. The mass was located in the apex of the posterior mediastinum wedging the brachiocephalic and subclavian veins. The parietal pleura was circumferentially divided and the lesion was separated from the posterior thoracic wall. The sympathetic chain was divided above and below the lesion and the mass was dissected off the subclavian vessels. The lesion was resected and retrieved through the most posterior port site which was upgraded to 10mm size for retrieval..

He recovered uneventfully and was given post-operative chemotherapy after 3 weeks of surgery. He didn't have evidence of recurrence up to the last follow up at 10 months postoperatively.

Figure 1. Mediastinal neuroblastoma with the separate neck mass, before chemotherapy.

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Figure 2. Minimally visible port site scars of the right hemithorax

Case presentation 2

A 7-year-old boy with hereditary neurofibromatosis type 11 presented with a left cervical mass that was enlarging progressively. There was no pain or tenderness and the lesion was over the left cervical paraspinal space extending from the hyoid bone up to the posterior mediastinum of the left hemithorax. On the CT and Magnetic Resonance Imaging(MRI), it was having a homogenous appearance with tracheal deviation to the right side and compression of the left upper lobe of the lung. The lesion was measuring 12X 5cm in size.

The cervical lesion was found encircling the left subclavian artery on CT and MRI. The thoracic lesion was 7X5cm in size occupying the apex of the posterior mediastinum towards the left side. Trucut biopsy of the cervical part of the lesion revealed features of a benign neurofibroma. Resection was planned due to enlarging nature and the pressure effects of the tumour.

During surgery, cervical mass was accessed lateral to the scalenus group of muscles and mobilised completely. The subclavian artery was skeletonized and looped off the mass at the root of the neck and the upper part of the thoracic mass was mobilised bluntly. Thoracic mass was accessed thoracoscopically with an optical port just below the tip of the scapula and 2 lateral ports at the axilla and 6th ICS at the posterior axillary line. The pleura was divided circumferentially and the mass was elevated off the lateral thoracic wall. Superiorly the mass was dissected off the subclavian vessels. The thoracic mass was completely mobilised and retrieved through the root of the neck. No

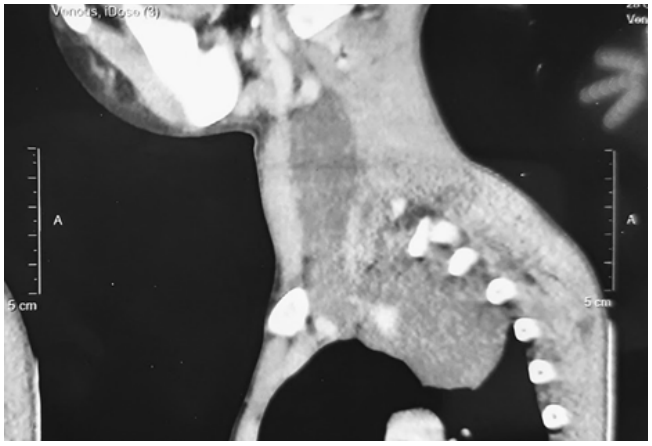

Figure 1. CT scan of the neck and thorax showing the neurofibroma extending from the upper neck up to mediastinum.

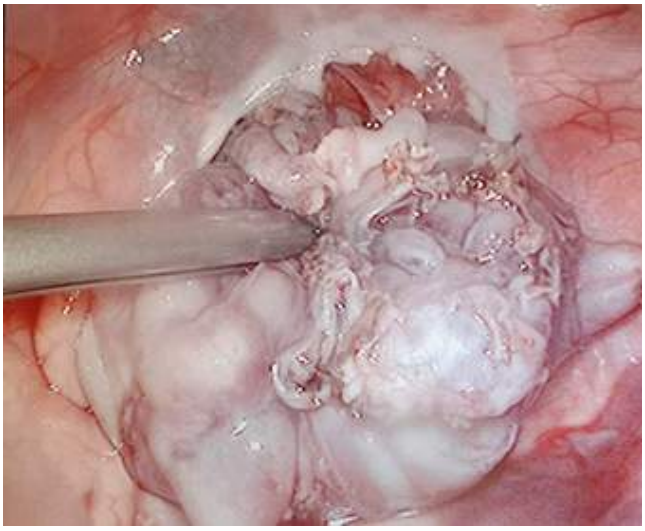

Figure 2. After mobilization of intrathoracic neurofibroma

macroscopic residual lesion was left. The intercostal drain was inserted and removed on day 5.

He was extubated after surgery and was having evidence of partial ptosis which improved on further follow-up. There was transient diaphragmatic paralysis due to phrenic nerve neuropraxia which improved subsequently. Histology confirmed it to be a benign neurofibroma.

Discussion

Thoracic neurogenic tumours were conventionally resected by thoracotomy but thoracoscopic interventions are increasingly being accomplished to reduce the morbidity of thoracotomy. Morbidity of thoracotomy is due to division of latissimus dorsi and rib spreading during the procedure which could produce long term disability in shoulder movements and spinal deformity.[4] In children, 60% of thoracic neurogenic tumours are malignant, hence thoracoscopic

interventions are still controversial due to the feared risk of inadequate resections with positive surgical margins and port site recurrence which has been rarely reported at least in adults.[5] With the availability of miniature instruments and increasing experience in paediatric thoracoscopy, improved outcome and effectiveness has been shown in thoracoscopic resection of these tumours in the literature. [6] In a recent review, it has been stated that the laparoscopic or thoracoscopic approach to neuroblastoma has an equal outcome compared to the open approach, given the adequacy of oncological resection[7] .

Contralateral main stem bronchial intubation has been conventionally used in thoracoscopic procedures but for smaller tumours, tracheal intubation and lung collapse achieved with CO2 insufflation have been successfully used. In the first patient, the lung collapse was achieved with main stem bronchial intubation while the second surgery was done with tracheal intubation and CO2 insufflation with low flow (1l/min) and low pressure (4mmgh) in the pleural cavity. In most thoracoscopic interventions, 3 ports had been used in triangulation with a camera inserted at the convenient port site to improve visualization. Magnification of view in thoracoscopy greatly assists in dissection and achieving hemostasis compared to open surgery, especially when the tumour is in the apical region.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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Learning Points:

- Resection of intrathoracic neurogenic tumours in children is safe and effective with thoracoscopic techniques even in malignant tumours.
- In addition to all advantages of minimal access surgery, thoracoscopic resections have shown less morbidity by avoiding rib spreading thoracotomy and precision in surgical technique due to greater access and magnification.

CASE REPORT

Laparoscopic spleen preserving distal pancreatectomy

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Keywords: Laparoscopy; distal pancreatectomy; spleen preserving

Introduction

Mlaparoscopic distal pancreatectomy is the curative treatment for tumours of the pancreatic body and tail. When performed by laparoscopy the morbidity is reduced [1]. The procedure may be with or without splenectomy. Spleen preservation needs preserving the splenic artery and vein. The alternative is to provide splenic perfusion via short gastric vessels [2]. We present a case of a patient who underwent laparoscopic spleen preserving distal pancreatectomy for a mucinous cystic neoplasm of the pancreatic body. The standard way of dividing the pancreas is by a stapler. If divided by another form the open end is sutured. We have deviated from this by dividing the pancreas by coagulating with bipolar diathermy and transacting with an ultrasonic dissector and leaving the stump unsutured. This is our standard practice for many years.

Case presentation

A 45-year female patient, who had presented with vague upper abdominal pain had a cystic mass of the pancreatic body on ultrasound scan. CECT abdomen revealed mucinous cystic neoplasm measuring 66 mm [Lat] 44mm[AP] 53mm [CC] in size [Figure 1].

After obtaining informed consent a laparoscopic spleen preserving distal pancreatectomy was performed. The patient was positioned in the right lateral position with head-end elevated. Five ports were used including the camera port. The gastrosplenic ligament was divided. Then transverse colon and splenic flexure were reflected down. The pancreas was dissected off the posterior abdomen exposing the splenic vein. The splenic artery was dissected at the superior border of the pancreas. The splenic artery and splenic vein were completely dissected of the pancreas. The splenic vein was cleared up to the confluence with the superior mesenteric vein forming the portal vein [Figure 2].

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The pancreas was divided at the neck using bipolar diathermy and ultrasonic dissector. The divided body and tail was gently freed off and removed using a retrieval bag. The operative time was 210 minutes with a blood loss of less than 100ml. The specimen was removed by minimally enlarging a port site [Figure 3].

Figure 1. White arrow showing the pancreatic cystic neoplasm

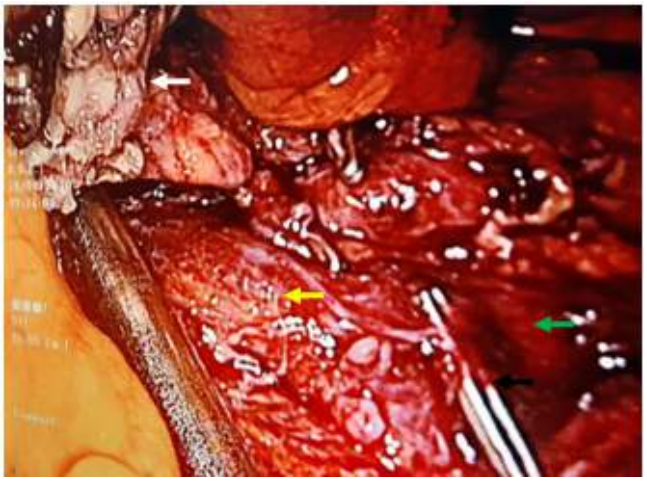

Figure 2.
White arrow - Cut edge of the pancreas
Yellow arrow – Portal vein
Green arrow – Splenic vein
Black arrow – clipped off branch of the portal vein

Figure 3. Port sites and incision for specimen retrieval.

Postoperatively patient received ICU care for one day and was discharged from the ward on postoperative day 6. She had an eventful recovery. The drain amylase was 5020 IU/L on day one which was reduced to 200 IU /L by day three. The histopathology revealed a mucinous cystic neoplasm of the pancreatic body with clear resection margins.

Discussion

Distal pancreatectomy when performed by minimal access is associated with reduced morbidity [3]. The patient presented had a speedy recovery and did not require narcotic analgesics from day one. If the splenic hilum is involved en block splenectomy is required. However, when CECT was analyzed in our patient, it was decided to preserve the spleen which prevents post-splenectomy related problems. However, spleen preserving surgery is more technically demanding. There are two techniques to preserve the spleen with distal pancreatectomy. Either by preserving both the splenic artery and vein [2] or by blood supply from short gastric vessels with splenic artery and vein being divided [3,4].

In our case of distal pancreatectomy, the splenic artery and vein were preserved to perfuse the spleen. The surgery was completed at an acceptable time and with minimum blood loss. There are many ways to divide the pancreas. It is often done using a stapler. Another alternative is to divide and suture the stump [5]. In our unit, over many years we use bipolar diathermy and ultra-sonic dissector and there had been no complications due to pancreatic fistula.

Conclusions

In the patient presented laparoscopic spleen preserving distal pancreatectomy with preserving splenic artery and vein was performed in an acceptable time with minimal blood loss. The standard practice of our unit, dividing the pancreas with bipolar diathermy and ultrasonic dissector and leaving the stump open was well tolerated.

All authors disclose no conflict of interest. The study was conducted in accordance with the ethical standards of the relevant institutional or national ethics committee and the Helsinki Declaration of 1975, as revised in 2000.

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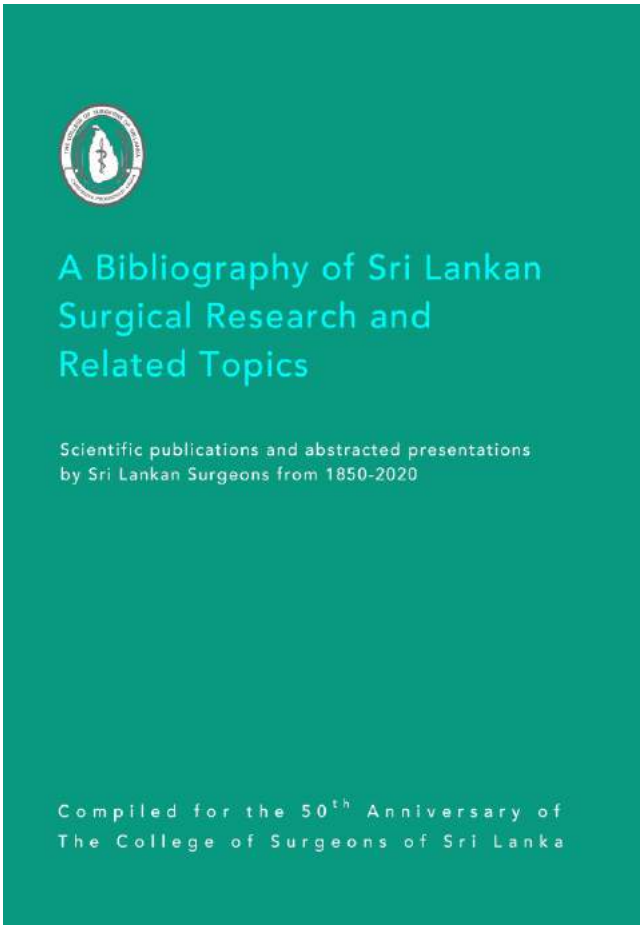
Learning Points:

- Dissecting and preserving splenic artery and vein are key points in spleen preserving distal pancreatectomy.
- As both of these vessels are retroperitoneal laparoscopic visualization is better than open approach due to angle of vision and magnification.
- With better vision, pneumoperitoneum too helps to dissect vessels. Once areolar tissues around vessels are opened gas gets in to dissecting plane facilitating vascular control.

BOOK REVIEW

A bibliography of Sri Lankan surgical research

Edited by Channa Ratnatunga
Published by The College of Surgeons of Sri Lanka



Whenever we want to promote research, we highlight the age-old aphorism *'Publish or Perish'*. However, until recently research was not given its due place in postgraduate medical education of Sri Lanka. Many jokingly said *'Good surgeons operate; bad surgeons do research'!* Fortunately, during the last few years research has become an important component of postgraduate surgical education. Now it is mandatory to conduct research and have publications before becoming eligible for board certification as a specialist surgeon in this country. Sir Isaac Newton said *'If I have been able to see farther than others, it was because I stood on the shoulders of giants'* indicating the importance of the existing knowledge founded by his predecessors. Therefore, it is essential that we read the already done research to plan and conduct better and more advanced research projects rather than repeating the same. Some believe that the advanced knowledge and skills on agriculture, irrigation, architecture and health care we had in ancient Sri Lanka was lost to the future generations as it was not documented and preserved.

It is not difficult to locate research done in the recent past as most articles are available in the internet and can be searched easily. Despite extreme restrictions by certain sources requesting payments, thanks to the hackers and their websites, almost any article that has been published can be accessed free. However, research published a couple of decades ago and beyond are still available only as hard copies in few libraries and searching for their existence is extremely difficult if not impossible.

Professor Channa Ratnatunga (CR) has stepped into fill this void and help us to search old publications by compiling a bibliography of research conducted in Sri Lanka related to surgery and its allied fields. Being a scientific researcher of distinction and a prolific writer of fame himself, CR has done the job with love and care. He has listed every single article written by Sri Lankan surgeons from 1850 to 2021 in any journal and categorised them according to different specialties and sections making search easy. This mammoth task has been completed by CR himself despite his ill health due to a cerebrovascular event sustained few years ago. Professor A. H. Sheriffdeen writing a foreword to the book, marvel at the amount of work and research that has gone into this valuable publication.

The book runs into 354 pages of A4 size and the names of authors of each publication is highlighted in bold for easy perusal. The font size of 12 would help even elderly readers with poor vision like me to refer the contents with ease. Ananda Press who had done the printing should be applauded for the elegant finish. Mr Devendra and his team have shown that they are the best in medical publishing in Sri Lanka. The College of Surgeons of Sri Lanka has taken the initiative to publish this work as part of its golden jubilee celebrations. This kind gesture augurs well with the theme for this year and will be a worthwhile investment in relation to their younger members.

CR has taken the extra burden to include the abstracts of presentations done at various scientific fora of this country too. This must have been a herculean task consuming a considerable time and effort. Many of those proceedings and abstract books may not be

easily accessible to researchers and the contents may not have undergone the rigorous peer review which is the hallmark of quality assurance in research. Whether this extra effort is worth in the long-run would be questionable. Being the modest and unassuming man, CR has not even printed his name in the cover page giving the full credit to the publisher- The College of Surgeons of Sri Lanka which he presided in 2003.This shows his clear intentions of compiling this book - not for personal gain but to perpetuate a research culture among blossoming surgeons. In the prologue, CR emphasises his intention of compiling this book – *'It is envisaged that this will help fuel future research into surgical disease in Sri Lanka, and also become a valuable resource for literature reviews of the same'.* Now it is up to the younger surgeons to pay tribute to CR for this tireless project, by conducting better quality research leading to better patient outcomes. Prof Channa Ratnatunga has given you the opportunity to stand on the shoulders of giants to see far! Please grab the opportunity!!

Reviewd by,

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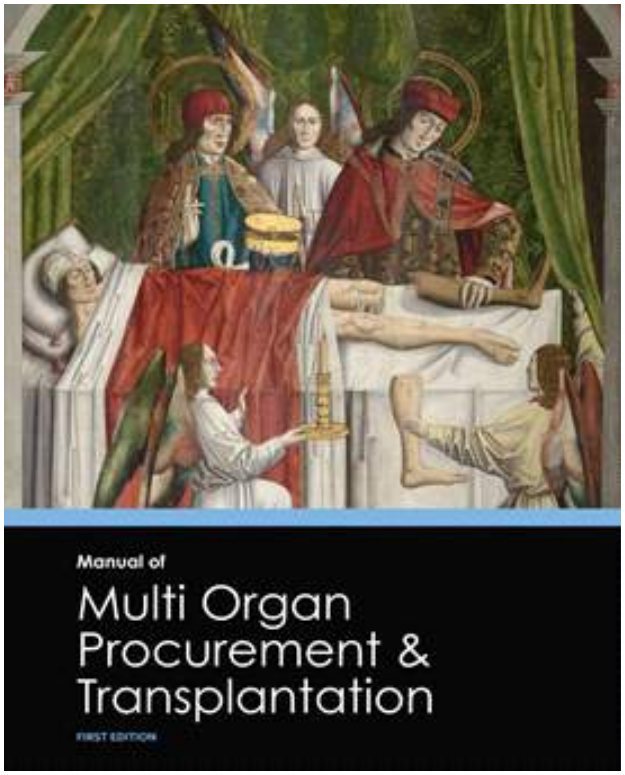
BOOK REVIEW

Manual of multi-organ procurement and transplantation

ISBN 978-624-605900-2

Edited by N Seneviratne, S Edirisinghe, S Udurawana



The Manual of Multi-Organ Procurement and Transplantation certainly fills a long-standing gap in Sri Lankan surgical literature. Compiled by a team of eminent local experts in the field, the editors and authors make an excellent blend of pioneers and the upcoming specialists who are spearheading advances in organ transplantation with the determination to be on par with the rest of the world.

The first chapter brings with it the nostalgia of walking down memory lane, passing the milestones and obstacles of transplant surgery in Sri Lanka, which the pioneers have overcome during the struggle of conquering this new frontier. It holds valuable lessons for the present and future generations of surgeons who pursue the dream of introducing innovative concepts and technology to the existing system.

Reading through this section makes one realize the resistance enforced to the introduction of the mere concept of organ transplantation and establishing it as a legal procedure in our country. It goes on to chronicle the negative attitude towards concepts such as brain death and deceased donor transplantation. These struggles emphasize the sheer power of conviction, dedication and solid team work, enhanced by sharp communication skills and health education, in establishing any new concept in a country with conservative cultural and social norms. This account also elaborates on the expansion of services in the field of organ transplantation starting from the capital and extending to many regional centers driven by the enthusiasm of the younger generations, guided by the senior experts.

The chapter on the structure and process of deceased donor transplantation, written by an expert in medical administration, provides important insights regarding development of the ethical framework and strong legal foundation of the transplant field in Sri Lanka. It also includes useful information regarding the safe and legitimate practice of organ donation.

This book mainly highlights the surgical technical details of commonly performed organ transplants which include kidney, liver, pancreas heart and lungs. Each chapter, which is compiled by local experts specialized in the respective areas, provides the surgical steps of organ retrieval and transplantation in a clear, concise stepwise manner with many tips and tricks that can only come from experienced hands. This format would not only guide a trainee but also immensely assist a specialist consultant at the dawn of his career, providing a quick reference to bolster his confidence before laying the scalpel on the patient.

Chapters on multi-organ retrieval from the deceased donor by itself would provide a valuable hand book for organ retrieval teams not only by emphasizing the essential surgical details but also by way of important information regarding communication and coordination within the transplant team. In the same context, the expertly written chapter on retrieval of abdominal organs draws the main attention to details of commonly performed organ procurements such as the kidney and the liver in Sri Lanka. Details of heart and lung retrieval stimulate the reader to use this knowledge in developing these fields, yet to be firmly established in the developing world.

It is particularly interesting to read the descriptive, yet succinct, account on living donor transplantation of kidney and liver. Here the experts elaborate each step of organ retrieval, deceased organ explantation (in liver), technique of back bench dissection and ultimately implantation. The elements of upcoming minimal access organ retrieval methods, which would be a promising benchmark procedure for live donors, is also a compelling read.

Details of preoperative workup, post-operative care and especially the management of potential complications were not uniformly presented throughout the chapters, probably due to the necessity of constricting the operative chapters to the steps of performing a perfect operative procedure with minimal complications. As hinted in the preface by the eminent editorship, in future editions one can hope to find a chapter sharing the experience of experts handling these problems. This will be extremely useful for more experienced transplant surgeons.

The chapter on organ preservation highlights the importance of this step in achieving a successful outcome. Principles and techniques of organ cannulation and description of material and solutions provides the basic knowledge needed in this aspect of transplantation. It also adds a note on recent advances in organ preservation solutions, future horizons such as ex-vivo preservation and dynamic continuous perfusion methods which hold much promise in future.

The well written final chapter summarizes almost all the anatomical variations which provides an invaluable guide to all budding transplant surgeons to avoid inadvertent misadventures, especially in multi-organ procurement.

In summary, this well written and skillfully edited manual on organ procurement and transplantation will provide an invaluable practical guide for the surgeons involved in organ transplantation on a full or part time basis in their career. It would also provide a concise reference manual for the post-graduate trainees to be successful in local and overseas examinations.

Reviewed by,

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PERSPECTIVE

Sri Lanka Journal of Surgery : chronicles of half a century

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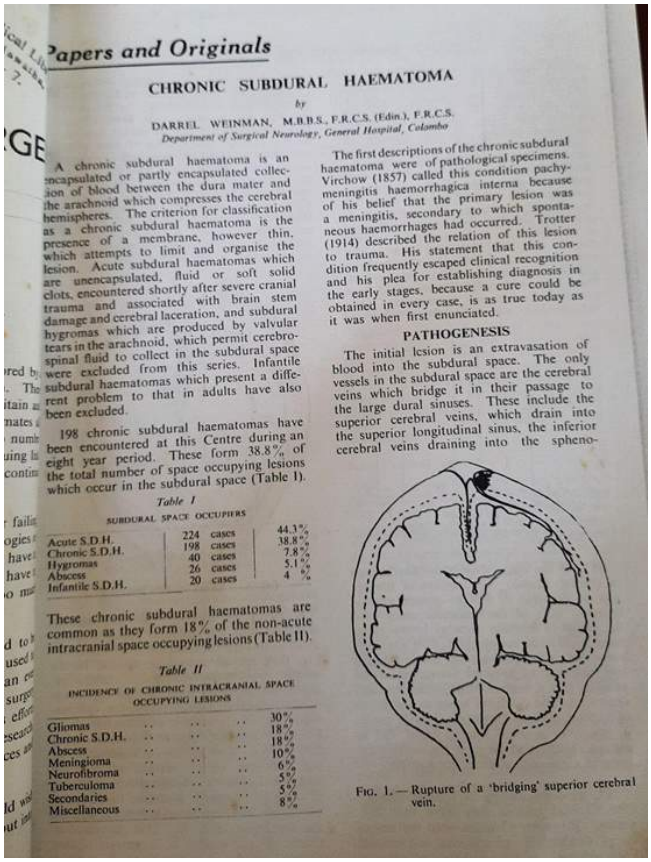
CHIRURGIAE PROGRESSUS CAUSA
" For the progress of surgery"

History is made on pillars of time and perseverance. It's built with hope, knowledge, wisdom and modesty. Such was our beginning, as the Sri Lanka journal of Surgery in 1970. A wonderful mix of all that and more. The College of Surgeons was founded in 1971 in the era of bell-bottoms and disco and also amidst brewing political unrest. It had a rather muted commencement without any assets but the eagerness of the generation of surgeons in that era.

Founding the Sri Lanka Journal of Surgery in 1970, was a fundamental milestone in the evolution of Surgery and surgical education in Sri Lanka. It was called the Ceylon Journal of Surgery at the outset and became the Sri Lanka Journal of Surgery in 1982. It has, in its 51-year history, done a vital, prudent service to the amelioration of surgical research and training.

The first issue was published in 1970, and Dr Chummy S Sinnatamby held the chair as the chief editor with an advisory editorial board of 8 eminent surgeons of that era which included Dr S A Cabraal, Dr A T S Paul, Dr R A Navaratna. The foreword was provided by Sir Thomas Holmes Sellors, the president of the Royal College of Surgeons of England indicating the amicable connection between the two colleges which is still present to this day.

The 1st article of its foremost issue was on subdural haematoma by Dr Darrel Weinman, followed by articles covering paediatric surgery and parenteral nutrition. This issue was mainly focused on the thyroid gland and its benign and malignant pathologies, with a symposium exploring the roots of its epidemiology, surgical management and radiotherapy for thyroid carcinoma. With that debut issue, it embarked on a long journey to enrich and empower surgical education in Sri Lanka. At the outset a single annual issue was published but currently we publish 4 issues per year, one of which coincides with the Annual scientific sessions of the College of Surgeons of Sri Lanka.



Papers and Originals

CHRONIC SUBDURAL HAEMATOMA

by

DARREL WEINMAN, M.B.B.S., F.R.C.S. (Edin.), F.R.C.S.
Department of Surgical Neurology, General Hospital, Colombo

A chronic subdural haematoma is an encapsulated or partly encapsulated collection of blood between the dura mater and the arachnoid which compresses the cerebral hemispheres. The criterion for classification as a chronic subdural haematoma is the presence of a membrane, however thin, which attempts to limit and organise the lesion. Acute subdural haematomas which are unencapsulated, fluid or soft solid clots, encountered shortly after severe cranial trauma and associated with brain stem damage and cerebral laceration, and subdural hygromas which are produced by valvular tears in the arachnoid, which permit cerebro-spinal fluid to collect in the subdural space were excluded from this series. Infantile subdural haematomas which present a different problem to that in adults have also been excluded.

198 chronic subdural haematomas have been encountered at this Centre during an eight year period. These form 38.8% of the total number of space occupying lesions which occur in the subdural space (Table I).

Table I

SUBDURAL SPACE OCCUPIERS

Acute S.D.H.	224 cases	44.3%
Chronic S.D.H.	198 cases	38.8%
Hygromas	40 cases	7.8%
Abscess	26 cases	5.1%
Infantile S.D.H.	20 cases	4 %

These chronic subdural haematomas are common as they form 18% of the non-acute intracranial space occupying lesions (Table II).

Table II

INCIDENCE OF CHRONIC INTRACRANIAL SPACE OCCUPYING LESIONS

Gliomas	30%
Chronic S.D.H.	18%
Abscess	18%
Meningioma	10%
Neurofibroma	6%
Tuberculoma	5%
Secondaries	5%
Miscellaneous	8%

The first descriptions of the chronic subdural haematoma were of pathological specimens. Virchow (1857) called this condition pachymeningitis haemorrhagica interna because of his belief that the primary lesion was a meningitis, secondary to which spontaneous haemorrhages had occurred. Trotter (1914) described the relation of this lesion to trauma. His statement that this condition frequently escaped clinical recognition and his plea for establishing diagnosis in the early stages, because a cure could be obtained in every case, is as true today as it was when first enunciated.

PATHOGENESIS

The initial lesion is an extravasation of blood into the subdural space. The only vessels in the subdural space are the cerebral veins which bridge it in their passage to the large dural sinuses. These include the superior cerebral veins, which drain into the superior longitudinal sinus, the inferior cerebral veins draining into the spheno-

FIG. 1.—Rupture of a 'bridging' superior cerebral vein.

The 1st issue was printed by Kularatne and Company limited at Colombo 10, later for a great number of years the printing courtesy was held by Ananda press, Colombo. Currently it is published online at the Sri Lanka Journals Online platform (https://www.sljol.info/).

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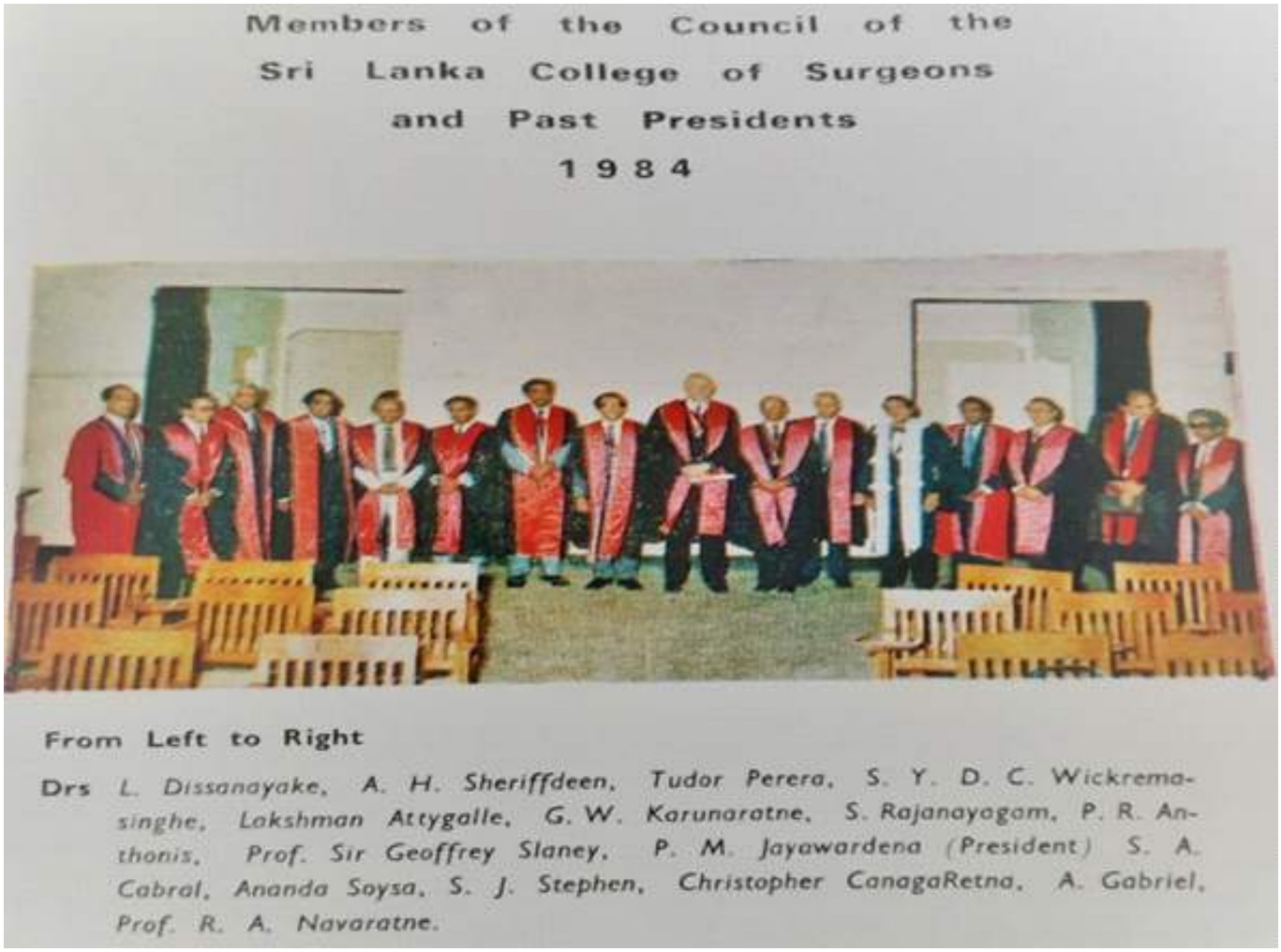


Editors-in-chief of Sri Lanka Journal of Surgery throughout the years

1970 C S Sinnatamby

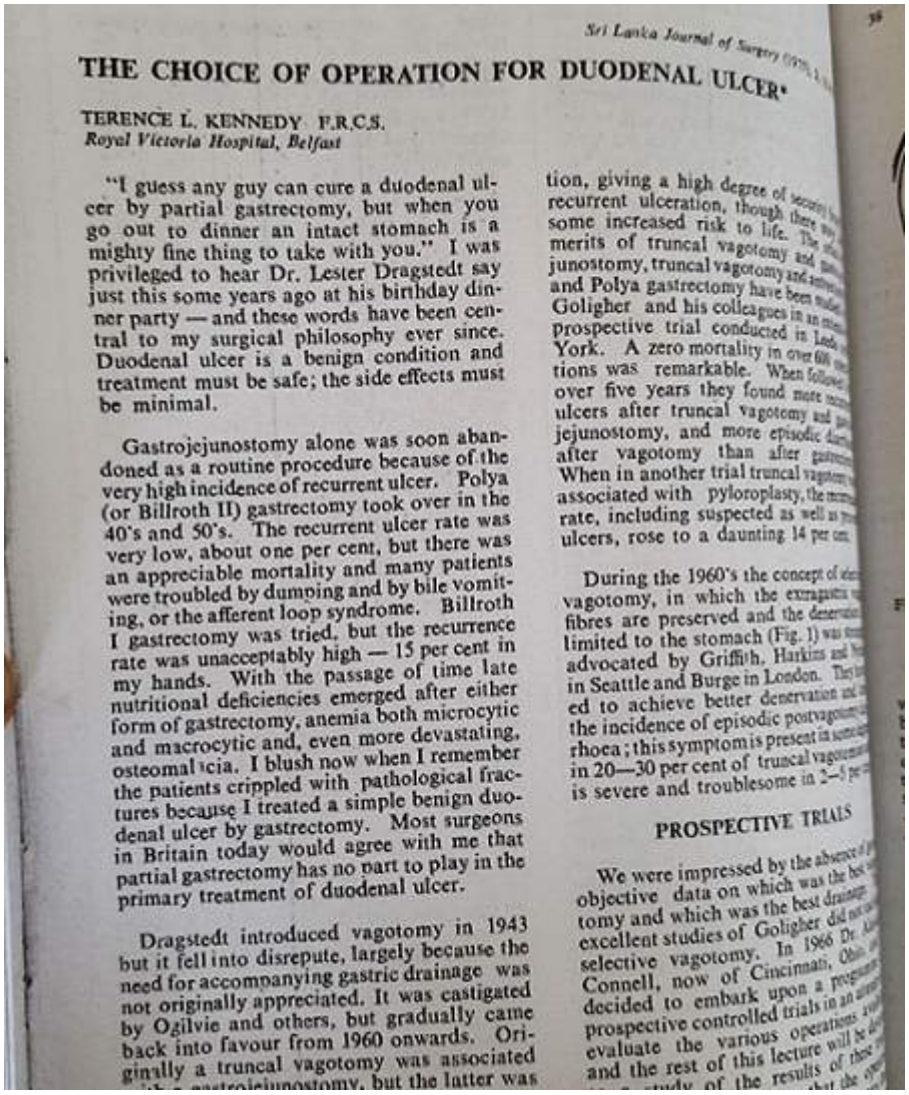
1971-1972 A Gabriel

1973-1983	C S Sinnatamby	
1984	J T Fernado	
1985-1990	Christopher Canagaretne	
1991-1992	A Gabriel	
1993	S J Stephen	
1994-1998	S C Paul	

1999-2000	S A S Goonewardene	
2001-2007	Pradeep Fernando	
2008-2010	Naomal Perera	
2011-2014	Kemal Deen	
2015 to date	Ajith Malalasekera	

Throughout these 50 years, the pages of the journal have made home for audits, debates, advances, innovations, controversies and recognition – all of which makes up a wholesome, dynamic journal on its way to the zenith.

It has covered many topics of surgery and its associated sciences with comprehensive discussions aligned with the prevailing discoveries and advances. It has been a cordial podium to its international contributors and has published articles from renowned personalities such as Norman L. Browse, Terrence L Kennedy, John Gillingham and thus, added more hues of elegance and grace to its pages. It had been a sturdy cornerstone for trainees in surgery which provided them with the broad wisdom to grow and a welcoming platform to brandish their speculations.



Sri Lanka Journal of Surgery

THE CHOICE OF OPERATION FOR DUODENAL ULCER*

TERENCE L. KENNEDY F.R.C.S.
Royal Victoria Hospital, Belfast

"I guess any guy can cure a duodenal ulcer by partial gastrectomy, but when you go out to dinner an intact stomach is a mighty fine thing to take with you." I was privileged to hear Dr. Lester Dragstedt say just this some years ago at his birthday dinner party — and these words have been central to my surgical philosophy ever since. Duodenal ulcer is a benign condition and treatment must be safe; the side effects must be minimal.

Gastrojejunostomy alone was soon abandoned as a routine procedure because of the very high incidence of recurrent ulcer. Polya (or Billroth II) gastrectomy took over in the 40's and 50's. The recurrent ulcer rate was very low, about one per cent, but there was an appreciable mortality and many patients were troubled by dumping and by bile vomiting, or the afferent loop syndrome. Billroth I gastrectomy was tried, but the recurrence rate was unacceptably high — 15 per cent in my hands. With the passage of time late nutritional deficiencies emerged after either form of gastrectomy, anemia both microcytic and macrocytic and, even more devastating, osteomalacia. I blush now when I remember the patients crippled with pathological fractures because I treated a simple benign duodenal ulcer by gastrectomy. Most surgeons in Britain today would agree with me that partial gastrectomy has no part to play in the primary treatment of duodenal ulcer.

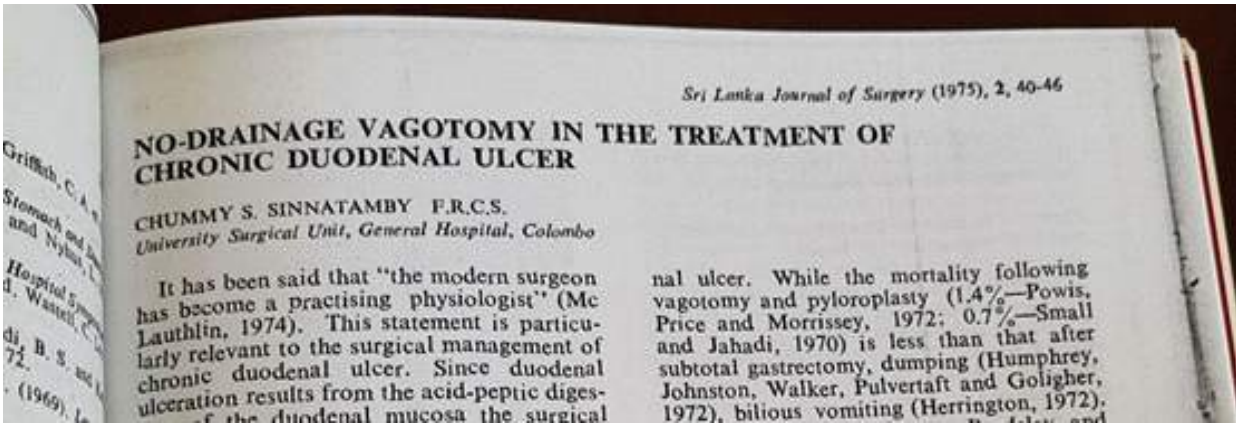
Dragstedt introduced vagotomy in 1943 but it fell into disrepute, largely because the need for accompanying gastric drainage was not originally appreciated. It was castigated by Ogilvie and others, but gradually came back into favour from 1960 onwards. Originally a truncal vagotomy was associated

tion, giving a high degree of
recurrent ulceration, though
some increased risk to life.
merits of truncal vagotomy
junostomy, truncal vagotomy
and Polya gastrectomy have
Goligher and his colleagues
prospective trial conducted
York. A zero mortality
tions was remarkable.
over five years they found
ulcers after truncal vagotomy
jejunostomy, and more
after vagotomy than after
When in another trial truncal
associated with pyloroplasty,
rate, including suspected as
ulcers, rose to a daunting 14 per

During the 1960's the concept
vagotomy, in which the
fibres are preserved and the
limited to the stomach (Fig. 1)
advocated by Griffith, Harkins
in Seattle and Burge in London.
ed to achieve better denervation
the incidence of episodic
rhoea; this symptom is present
in 20—30 per cent of truncal
is severe and troublesome in

PROSPECTIVE TRIALS

We were impressed by the
objective data on which
tomy and which was the
excellent studies of Goligher
selective vagotomy. In 1966
Connell, now of Cincinnati,
decided to embark upon a
prospective controlled trials
evaluate the various
and the rest of this lecture will



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NO-DRAINAGE VAGOTOMY IN THE TREATMENT OF CHRONIC DUODENAL ULCER

CHUMMY S. SINNATAMBY F.R.C.S.
University Surgical Unit, General Hospital, Colombo

It has been said that "the modern surgeon has become a practising physiologist" (Mc Lauthlin, 1974). This statement is particularly relevant to the surgical management of chronic duodenal ulcer. Since duodenal ulceration results from the acid-peptic digesf the duodenal mucosa the surgical

nal ulcer. While the mortality following vagotomy and pyloroplasty (1.4%—Powis, Price and Morrissey, 1972; 0.7%—Small and Jahadi, 1970) is less than that after subtotal gastrectomy, dumping (Humphrey, Johnston, Walker, Pulvertaft and Goligher, 1972), bilious vomiting (Herrington, 1972).

With 50 years behind us…

Half a century later, we are a journal with peer reviewed articles in the form of leading articles, review articles, perspectives, brief reports, case series and reports in the field of surgery and its related surgical sciences - accomplishing its evergreen mission 'to reach the highest standard of scientific surgical practice by dissemination of high quality scientific information and to foster and promote the growth of scientific surgery.

Sri Lanka Journal of Surgery has a benevolent open access policy for its articles elaborating its principle to augment greater global exchange of knowledge. The journal adheres to the publication ethics as portrayed by the Committee on Publication Ethics (COPE) and is a member of this organisation. It is listed as an ICMJE journal which follows its recommendations (ICMJE recommendations) on Conduct, Reporting, Editing and Publication of Scholarly Work in Medical Journals. It is indexed on the Directory of Open Access Journals and Google Scholar. Sri Lanka Journal of Surgery has become a point of reference for aspirations amongst the surgical trainees as well as a motif of surgical excellence in Sri Lanka. It has and will continue to persevere for the betterment of Surgical knowledge not only in Sri Lanka but also at a broader global platform.

Needless to say, it is not an easy task to construct a successful journal to its current level within 50 years. Thus, the esteemed editors-in-chief, editorial boards, the international advisory panels, its multitude of reviewers and authors who have nurtured the journal on its journey with each stride forward with a sense of utmost responsibility and unwavering perseverance are remembered today with unconditional respect and gratitude.

Editorial Board 2021

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EDITORIAL RETRACTION

Puliyath N, Chauhan N, Huda F, Munnamgi S, Mahindrakar B. Gossypiboma presenting as a non-healing post-operative wound: an atypical presentation of a rare surgical complication. Sri Lanka Journal of Surgery. 2021;39(2):74–5.

Ajith P Malalasekera,
Editor in Chief

The above article was submitted to the Sri Lanka Journal of Surgery on 19th December 2020 and published on 31 Jul 2021, following communications with the corresponding author Puliyath N. A senior author Farhanul Huda, has requested for retraction of the article as the case report has been inadvertently published previously in the following journal.

Amrita Gaurav, Juhi Mishra, Om Kumari, Kavita Khoiwal, Farhanul Huda, Jaya Chaturvedi. Transmurally migrated gossypiboma rarely posing as surgical site infection: a case report and review of literature. International Surgery Journal,
[S.l.], v. 7, n. 10, p. 3500-3504, sep. 2020. ISSN 2349-2902.
Available at: <https://www.ijsurgery.com/index.php/isj/article/view/6447>.
doi:http://dx.doi.org/10.18203/2349-2902.isj20204168.

Morphological variations of lung lobes and fissures: A preliminary study

Supplementary Material

Supplementary **Table 1:** A gender-based contingency table of the variations of the major lung fissures and lobes [N = 12 patients]

		Male [N=6]	Female [N=6]
Fissures	Incomplete or absent fissures	2	1
	Accessory Fissures	1	1
Lobes	Accessory lobes	1	3

Supplementary Table 2: Variations of the major lung fissures in different studies.

Study	Sample Size	Right Lung				Left Lung	
		Horizontal Fissure		Oblique Fissure		Oblique Fissure	
		Incomplete	Absent	Incomplete	Absent	Incomplete	Absent
Present Study	12	0%	17%	0%	8%	8%	0%
Bergmann 1988	277	0%	31%	21%	67%	0%	30%
Bhardwaj 2010	28	7%	39%	7%	50%	11%	36%
Devi 2011	22	0%	9%	9%	18%	9%	36%
Dutta 2013	102	39%	34%	65%	12%	64%	8%
Gopalakrishna 2017	100	0%	14%	6%	20%	6%	8%
Lattupalli 2014	50	0%	10%	18%	0%	0%	8%
Mamatha 2016	40	50%	0%	15%	0%	35%	5%
Medlar 1947	1200	5%	26-30%	45%	17%	7%	11%
Meenakshi 2014	30	0%	37%	17%	63%	0%	47%
Nene 2011	100	18%	14%	28%	2%	42%	0%
West 2021	81	67%	11%	36%	0%	16%	2%
Quadros 2014	36	0%	6%	11%	25%	0%	2.5%
Sudikshya 2018	50	48%	13%	30%	0%	52%	0%

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Study Title: Impact of COVID-19 on postgraduate education and mental wellbeing of surgical trainees: a systematic review

Supplementary file

Search Strategy

PubMed, Scopus (Elsevier), LILACS, Ovid MEDLINE, Web of Science, Google Scholar and Cochrane CENTRAL were included in the search strategy. The

Searches were performed from 1 January 2020 to 20 January, 2021.

PubMed

((((education[MeSH Terms]) OR (training)) OR (trainee)) AND (((surgical procedures, operative[MeSH Terms]) OR (Surgery[MeSH Subheading])) OR (general surgery[MeSH Terms]))) AND ((covid-19[MeSH Terms]) OR (sars-cov-2[MeSH Terms]))

Scopus

TITLE-ABS-

KEY (((surgery OR surgical*) AND (training OR trainee OR education)) AND (covid*)) AND PUBYEAR = 2020/2021

Latin American and Caribbean Center on Health Sciences Information (LILACS)

(MH:("education") OR ("training") OR ("trainee")) AND (MH:("surgical procedures, operative") OR ("Surgery") OR ("general surgery ")) AND (MH:("covid-19") OR ("sars-cov-2"))

Ovid MEDLINE

((surgery OR surgical*) AND (training OR trainee OR education)) AND (covid-19* OR Sars-cov-2))

Web of science

((surgery OR surgical*) AND (training OR trainee OR education)) AND (covid-19* OR Sars-cov-2)

Google scholar

("education" OR “training” OR “trainee”) AND ("surgical procedures, operative" OR “surgery” OR “general surgery”) AND (“covid-19” OR “sars-cov-2”)

Cochrane CENTRAL

(MeSH descriptor: [education] explode all trees OR MeSH descriptor: [training] explode all trees OR MeSH descriptor: [trainee] explode all trees) AND (MeSH descriptor: [surgical procedures, operative] explode all trees OR MeSH descriptor: [surgery] explode all trees OR general surgery) AND (MeSH descriptor: [covid-19] explode all trees OR MeSH descriptor: [sars-cov-2] explode all trees)

PRISMA check list

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	1
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	1
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	3
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	3
METHODS			
Protocol and registration	5	Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number.	Not done
Eligibility criteria	6	Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale.	3
Information sources	7	Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched.	3
Search	8	Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated.	3
Study selection	9	State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis).	3

Data collection process	10	Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators.	3
Data items	11	List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made.	4
Risk of bias in individual studies	12	Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.	5
Summary measures	13	State the principal summary measures (e.g., risk ratio, difference in means).	6
Synthesis of results	14	Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., I^2) for each meta-analysis.	NA

Section/topic	#	Checklist item	Reported on page #
Risk of bias across studies	15	Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies).	NA
Additional analyses	16	Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.	NA
RESULTS			
Study selection	17	Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.	5
Study characteristics	18	For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations.	5
Risk of bias within studies	19	Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12).	6
Results of individual studies	20	For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot.	5
Synthesis of results	21	Present results of each meta-analysis done, including confidence intervals and measures of consistency.	NA

Risk of bias across studies	22	Present results of any assessment of risk of bias across studies (see Item 15).	6
Additional analysis	23	Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]).	Not applicable
DISCUSSION			
Summary of evidence	24	Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers).	9
Limitations	25	Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias).	11
Conclusions	26	Provide a general interpretation of the results in the context of other evidence, and implications for future research.	12
FUNDING			
Funding	27	Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review.	12

Table-S1 Quality assessment of included studies (Y-yes, N-no)

	Study	1	2	3	4	5	6	7	8	Total score	Percentage	Quality rating
1.	Ostapenko ,USA(55)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
2.	Cox, Portugal(50)	**Y**	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	3	37.5	**Poor**
3.	Fero, USA(67)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
4.	Hussain, UK((10)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
5.	Collins, USA(11)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**Y**	6	75	**Fair**
6.	Huamanchumo, Peru(12)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**Y**	3	37.5	**Poor**
7.	Williamson, UK(13)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
8.	Cai,USA(8)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	N	5	62.5	**Fair**
9.	Sheridan, Ireland(14)	**Y**	**Y**	**N**	**N**	**Y**	**N**	**Y**	**Y**	5	62.5	**Fair**
10.	Amparore, Italy(15)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
11.	Pertile, Italy(57)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
12.	Zheng, USA(16)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
13.	Munjal, USA(17)	**Y**	**Y**	**N**	**N**	**Y**	**N**	**N**	**N**	3	37.5	**Poor**
14.	Huntley, USA(18)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
15.	Osama, Pakistan(19)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
16.	Khan, UK(20)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**

17.	White, USA(7)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
18.	Sivalingam, USA(21)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
19.	Vallée, France(22)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
20.	Mishra, India(23)	**Y**	**Y**	**N**	**N**	**Y**	**N**	**N**	**N**	3	37.5	**Poor**
21.	Caruana, UK(24)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
22.	Johnson ,USA(53)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
23.	Guo, USA(51)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
24.	Alhaj, Kuwait(25)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
25.	Pelargos, USA(26)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**Y**	3	37.5	**Poor**
26.	Kapila, Belgium(27)	**Y**	**Y**	**N**	**N**	**Y**	**N**	**Y**	**Y**	5	62.5	**Fair**
27.	Cai, USA(48)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
28.	Homer,USA(52)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
29.	Paesano, USA(28)	**Y**	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	3	37.5	**Poor**
30.	Balhareth, Saudi Arabia(29)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
31.	Breukink, USA(30)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
32.	Chang, South Korea(31)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**Y**	3	37.5	**Poor**
33.	Patel,UK(56)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
34.	Henry, USA(32)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
35.	Ferrara,UK (33)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
36.	Zoia, Italy(34)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
37.	Dash, India(35)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
38.	Bandi, Italy(36)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
39.	Kumar, India(37)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
40.	Gonzi, UK(38)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**

41.	Wittayanakorn, Thailand(39)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**Y**	6	75	**Poor**
42.	Megaloikonomos, Greece ,(54)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
43.	Zingaretti, Italy(40)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
44.	Yan, USA(41)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
45.	Ashry,Egypt (47)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
46.	Upadhyaya, India(42)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
47.	Cheriya, India(49)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
48.	Alahmadi, Saudi Arabia(43)	**Y**	**Y**	**N**	**N**	**Y**	**N**	**N**	**Y**	4	50	**Fair**
49.	Adesunkanmi, Nigeria(44)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
50.	Aziz, USA(45)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
51.	Hennessy, Ireland(46)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
52.	Stolarski, USA(58)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
53.	Payne, UK(59)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
54.	Khusid, USA(60)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
55.	Civantos, USA(63)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
56.	Khalafallah , USA (62)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
57.	Aljehani, UK(61)	**Y**	**Y**	**Y**	**Y**	**N**	**N**	**Y**	**N**	5	62.5	**Fair**
58.	Figueroa, Chile(65)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**N**	2	25	**Poor**
59.	Essilfie, USA(66)	**Y**	**Y**	**N**	**N**	**N**	**N**	**N**	**Y**	3	37.5	**Poor**

Table S2- Impact on surgical training

1.	Study period	Authors	Specialty	N	Questionnaire	Level of training	Distribution	Surgery	Clinical exposure
2.	3/March-25/May/2020	Ostapenko ,USA(1)	General Surgery	22	Non-validated, Subjective Operative records	Residency training- all levels	Danbury Hospital.	Reduction in operative volume per resident by 65.7% from 35.0 to 12.0 cases	Reduction in duty hours by 23.9 hours,70% impact on training
3.	11/March-April/23/2020	Cox, Portugal(2)	Ophthalmology	75	28-- item, Pre-tested, Subjective	Residency training- all levels	National level survey - Portugal	Cancellation of all elective procedures	Continued emergency/inpatient care, 63% utilization of Tele heath, 91% impact on training
4.	11/March-28/ April/2020	Fero, USA(3)	Urology	106	27-items, Non-validated, Subjective	Residency training- all levels Majority (67%) junior residents	National level survey- USA	83%-100% reduction in surgical volume	51%Reduced in-person clinic encounters , increased use of tele-health (99%)

5.	14/March/2020–21/March/2020	Hussain, UK(4)	Ophthalmology	111	Non-validated, Subjective	Trainees in ophthalmology	National level survey-UK training programs		Ninety-six Trainees (86%) perceived impact On training
6.	15/March-15/April 2020	Collins, USA(5)	General and plastic surgery	73	30-items, pre-tested, Subjective	All levels-Intern to surgical residents	Department of Surgery at the University of California RR-73.7%	63.3% of operative volume reduction 90% perceived decline in operative exposure	
7.	16/March/2020	Huamanchumo, Peru(6)	General surgery	32	Non-validated, Subjective	Residents with 1-3 year experience	National level survey- 14 Peruvian hospitals	68.8% of loss of surgical Training opportunities No residents had performed > 25 elective, trauma, or laparoscopic surgeries.	
8.	20/March-20/April 2020.	Williamson, UK(7)	Orthopaedic	202	Non-validated, Subjective	Specialist registrars, junior orthopedic teams members	National level survey-UK training programs	91% reported all elective operating had been Cancelled 70% reported disruption to trauma operating.	

9.	23/March-29/March/2020	Cai,USA(8)	Otolaryngology	82	Non-validated, Subjective	Residency training- all levels .	81 residency programs-USA RR-63%	Decreased resident staffing of surgeries (70% of programs)	Reduced Resident call/on- call rotation
10	27/March-27/April/2020	Sheridan, Ireland(9)	Orthopaedic	40	Non-validated subjective experience assessment Objective training assessment	Orthopedic trainees	National level survey-Ireland	Total procedures per trainee per month 36.8 in 2018, 40.6 in 2019, and 18.3 in 2020. No reduction of trauma procedures	
11	27/March/2020	Amparore, Italy(10)	Urology	351	25-items Non-validated, Subjective	Italian Residency training- all levels	National level survey- Italy RR-60.80%	62.1% reduction in surgical activities	41.1% -81.2% Reduction in clinical activities
12	31/March-6/April/2020	Pertile, Italy(11)	General and other specialties	756	12- item, Non-validated, Subjective	Residency training- all levels	National level survey- Italy	Reduction (61.3%) or a complete interruption (34.6%) of surgical activities	27% complete interruption of clinical activities,12.5% redeployed

13	31/March-7/April/2020	Zheng, USA(12)	General surgery	24	Non-validated, Subjective	Senior residents	Regional-6 academic medical centers in Boston, Massachusetts RR-61.5%	Trainee reported loss of the operative Experience	
14	March/2020.	Munjal, USA(13)	Pediatric otolaryngology	96	Non-validated, Subjective Multiple languages	Residency training- all levels	22-Multiple countries USA, Africa, Asia, Australia, Europe	91.7% reported cancellation of all Elective cases	
15	1/April-1/May/2020.	Huntley, USA(14)	Oral and Maxillofacial Surgery	160	51-items, Non-validated, Subjective	Residency training- all levels	National level survey- USA	97.7% reported cancellation of all Elective cases	68% reported modifications to their rotations, 14% assigned to an off-training activities
16	April/2020	Osama, Pakistan(15)	General Surgery and other specialties	112	40-items, pre-tested, Subjective	Residency training- all levels	Tertiary care hospital in Pakistan	86.6% reported surgical hands-on duration is adversely affected	82.1% responded their clinical exposure has also reduced

17	5/ April - 19/April/2020	Khan, UK(16)	General surgery	28	Non-validated, Subjective	All Core Surgical Training (CT1& CT2) and Improving Surgical Training (ST1 & ST2)	Regional-West of Scotland	71.4% reported less opportunity to operate as The primary surgeon	75.0% reported nonattendance to any outpatient clinics
18	7/April-21/April/ 2020.	White, USA(17)	General surgery	84	31-items, Non-validated, Subjective	Residency training- all levels	Eighty-four residency programs-USA RR-33.6%	64.35% were performing semi elective cases 97.6% were performing urgent and emergent cases	Reduced number of residents on rounds, Increased tele-health clinics (90.5%)
19	7/April-16/April/2020	Sivalingam, USA(18)	Ophthal mology	62	Non-validated, Subjective	Second-year vitreo-retinal surgery fellow	National level survey- USA RR-71.2%	98.4% expected a reduction in surgical case volume	
20	10/ April-7/ May/2020	Vallée, France(19)	General surgery	1001	Non-validated, Subjective	Junior residents (36·4%), senior residents (33·2%), fellowship (30·5%)	National level survey-France		93·5% estimated that COVID-19 outbreak had a negative impact on their training.

21	12/ April – 14/ April/ 2020	Mishra, India(20)	Ophthalmology	716	Non-validated, Subjective	MD/MS programs, Diploma, Fellowship programs, Senior residency	National level survey- India	50% or more reduction in their surgical cases perceived by 62.4%	
22	12/ April -15/ April/2020	Caruana, UK(21)	Cardiothoracic surgery	76	31-item, pre-tested, Subjective	Residency training- all levels Nationally	National level survey-UK	78% reduction of time spent in operating theaters	Time spent in outpatient clinics (44%reduction), multidisciplinary team meetings (79% reduction)
23	12/April–24/April/2020	Johnson ,USA(22)	Vascular Surgery	145	Generalized Anxiety Disorder 7-item (GAD-7), Brief Coping Orientation to Problems Experienced inventory	Residency training- all levels and fellows	National level survey - USA RR-23%	91% reported cancellation of elective procedures, and 82% schedule changes	24% redeployed, 24% outpatient care delivery only

24	14/April-21/April/2020	Guo, USA(23)	Otolaryngology	175	45- item, Non-validated, Subjective	Residency training- all levels and fellows	National level survey – USA and Canada RR-83%	68% reported reduction in surgical training	Reduction in clinical activities (98.3%), Utilization of telemedicine (25%),reduction in inpatient and on-call duties (54.3%)
25	14/ April-28/April/2020	Alhaj, Kuwait(24)	Neurosurgery	52	27 –item, Non-validated, Subjective	Residency training- all levels	Multiple countries- Canada, USA, Kuwait, Saudi Arabia, European	98.1% perceived that Training at the hospital was affected	80.8% perceived that studying hours were affected
26	17/April-30/April/2020	Pelargos, USA(25)	Neurosurgery	197	31 –item, Non-validated, Subjective	Residency training- all levels	National level survey- USA and Canada.	99% reported limits on elective cases, 99.5% reported that reduced volume of operations performed at their institution	82% reported that reduced inpatient and outpatient volumes

27	19/April- 26/ April/2020	Kapila, Belgium(26)	Plastic surgery	86	20 –item, Non-validated, Subjective	Residents with 4 years of training experience	10 multiple countries (India, Romania, Israel, Italy, Colombia, United Kingdom, France ,Netherlands, Slovakia)	>75% Decreased surgical activity was reported by 73-86%	26-40% reduction in consultations
28	20/April-2/May/2020	Cai, USA(27)	Otolaryngology	219	35-item, Non-validated, Subjective	Residency training- all levels	National level survey - USA RR-55%	60% reported reduced surgical education, 56% reduced time in theater	50% reported reduced clinical education, 77% utilized Tele-health
29	20/April-7/May/2020	Homer,USA(28)	Ophthalmic Plastic and Reconstructive Surgery	40	Non-validated, Subjective	Fellowship training	National level survey - USA RR-70.2%	100% continued surgical cases with reduced volume	84.6% emergency room and 76.9% in patient care continued with reduced volume

30	23/ April- 29/ April/2020	Paesano, USA(29)	Urology	148	10 –item, pre-tested, Subjective	Residency training- all levels Majority (23.6%) third year	18 multiple countries - Latin America and Spain		82% reported reduction in urology department activity 15 % reported that, the urology activity has been closed completely
31	23/April-6/May/2020	Balhareth, Saudi Arabia(30)	General surgery	99	Non-validated, Subjective	Residency training- all levels And fellows	National level survey- Saudi Arabia RR-60%	97.0%) responded as reduction in surgical exposure	
32	24/April-29/May/ 2020 and 4/May-26/June/2020	Breukink, USA(31)	General surgery and other specialties	472	37-item, Non-validated, Subjective	Residency training- all levels And Fellows	USA-general surgery and other surgical specialty training programs RR-21%	73-98% reductions in non-emergency operations 8-34% reduction in emergency operations	Reductions were reported in outpatient experience (83%), in in-hospital experience (70%), and outside rotations (57%)
33	27/ April-2/May/2020	Chang, South Korea(32)	Orthopaedic	229	58-item, Non-validated, Subjective	Residency training- all levels	National level survey- South Korea	62.4% perceived of 50% or more reduction in their surgical activities	Reduced working hours from 72.7 to 65.6 hours/week ($p < 0.001$)

34	27/April-11/May/2020	Patel,UK(33)	Dental surgery	150	21- item, Non-validated, Subjective	Dental Core Trainees	National level survey-UK RR-22%		34% redeployed, 23.8% stopped patient contact
35	April/2020	Henry, USA(34)	Orthopaedic	121	Non-validated, Subjective	Residency training- all levels	USA - orthopedic residency programs RR-82%	All programs have discontinued elective orthopedic cases	Most have shifted schedules to periods of active clinical duty followed by periods of remote work and self-isolation.
36	2/May-11/May/2020	Ferrara,UK (35)	Ophthalmology	504	Non-validated, Subjective	Residency training- all levels (82.1%) and fellows(17.9 %)	32 multiple countries including UK	74.6% reported >75% of reduction in surgical activity	Decrease ≥50% of clinical activity (76.4%), Decrease didactic teaching has been experienced by (55.4%)
37	3/May-11/May/2020	Zoia, Italy(36)	Neurosurgery	192	18-item, Non-validated, Subjective	Residents with 5 years of training experience	National level survey- Italy RR-58%		72.4% reported in reduction of time spent in neurosurgical departments, unchanged in 20.8%

38	7/May-16/ May/2020	Dash, India(37)	Neurosurgery	118	Pre-tested, Subjective	Residency training- all levels	National level survey- India	Decrease of 67.50% surgeries performed/assisted per month (from 39.86 to 12.31 surgeries performed/assisted per month)	Academic sessions have fallen from a median of 5 per week to 2 per week.
39	11/May-15/May/2020	Bandi, Italy(38)	Otolaryngology	15	Non-validated, Subjective	Residency training- all levels	Italy- University of Insubria	Reduction of surgical training clinical activity	
40	15/May-21/ May/ 2020	Kumar, India(39)	Plastic surgery	107	Non-validated, Subjective	Residency training- all levels	National level survey- India	86% reported that 75%. Reduction in number of elective surgeries	75% reduction in outpatient cases
41	18/May-11/June/2020	Gonzi, UK(40)	Orthopaedic	101	42-item, Non-validated, Subjective	Residency training- all levels ST1 to ST8 and post-Certificate of Completion of Training	UK -all training programs	73% of trainees did not feel they advanced their operative skills	42.9% reported cancellation of clinics, 76.1% did not feel they advanced the clinical skills
42	22/May-31/May/2020	Wittayanakorn, Thailand(41)	Neurosurgery	298	33-item Non-validated, Subjective Objective record assessment	Residency training- all levels	Multiple countries- Indonesia, Malaysia, Philippines, Singapore, Thailand RR-63%	Decrease in elective neurosurgical operations in Indonesia and in the Philippines (100%) 50-80% reduction in emergency operations	74% believed that the COVID-19 crisis will have a negative impact on their neurosurgical training overall

43	28/May-11/June/2020	Megaloikonomos, Greece ,(42)	Orthopaedic	327	24- item, Non-validated, Subjective 2.2%. Covid +	Residency training- all levels and fellows	23 -Multiple European countries	46-58.6% reduction in pre-operative planning, execution of operations, and post-operative care	Redeployed 20.9%,reduced education52.1%, 58.6% reported impact on surgical training, clinical activities 59.8%
44	May/2020	Zingaretti, Italy(43)	Plastic surgery	115	Non-validated, Subjective	Residency training- all levels	National level survey- Italy RR-72%	Around 60% reported that 50-75% reduction in elective surgery activities	
45	May-June/2020	Yan, USA(44)	Plastic surgery	22	Non-validated, Subjective	Residency training- all levels	Mayo Clinic USA		33.1% of participants agreed that COVID-19 impacted their training 57.1% reported successful tele-health encounters.
46	1/June-15/June/2020	Ashry,Egypt (45)	Neurosurgery	50	27- item, Non-validated, Subjective ,4 residents (8%	Residency training- all levels	National level survey - Egypt	56% reported reduction in surgical activities	Reduced inpatient services, and working hours,Research hours (p= < 0.001)post-pandemic

47	11/June-15/June/2020	Upadhyaya, India(46)	Orthopaedic	138	29-item, Non-validated, Subjective	Post-graduate students pursuing higher orthopedics degree	Delhi-Region, India	92% reported a decreased load in the surgical cases	65.1% stated that no clinical classes, less number of OPD cases (83%), difficulty in clinical case presentation (78%),
48	21/June-11/July/2020	Cheriya, India(47)	Urology	286	38-item, Non-validated, Subjective	Residency training- all levels-final year 55.9%	National level survey - India	80% reported lack of surgical exposure,reduction in case-load 90%.	Workforce restructuring and social distancing at work (43.8%)
49	7/ July-14/ July/2020.	Alahmadi, Saudi Arabia(48)	Ophthalmology	142	50-item, Non-validated, Subjective	Residency training- all levels	National level survey - Saudi Arabia RR-77.6%	Overall score suggested a significant reduction of 45.7% compared to the pre-pandemic	Significant decline in exposure to surgical and office-based procedures compared to emergency eye consultations (P <0.001)
50	27/July-14/August/ 2020	Adesunkanmi, Nigeria(49)	General surgery, and other specialties	207	42-item, Non-validated, Subjective	Registrar to residency- all levels	National level survey - Nigeria RR-82.8%	Reduction in the number of emergency and elective operations (58.5% and 90.8% respectively)	83.6% reported Seeing fewer patients in the outpatient clinics ,reduction (79.2%) or cancellation (5.3%) of postgraduate

									programs in their institutions
51	July/2020	Aziz, USA(50)	General surgery	1102	23-item, Non-validated, Subjective	Residency training- all levels	National level survey - USA	40.6% reported that they were not allowed in the operating room and significant decline in the number of cases performed	80.67% attended no clinic during the pandemic
52	July/2020	Hennessy, Ireland(51)	General surgery	98	Non-validated, Subjective	Core Surgical Trainees (CST) -54% and Higher Surgical Training (HST) pathway (46%)	National level survey- Ireland RR- 29%	83.7% reported lack of access to elective cases and significant reduction in elective major, day case, and endoscopy	

Table S3- Mental health assessment of surgical trainees

Study period	Authors	Surgical specialty	N	Questionnaire	Level of training	Distribution	Anxiety depression and stress	Other concerns on mental health	Aetiology
11/March-28/April/2020	Fero, USA(3)	Urology	106	27-items, Non-validated, Subjective	Residency training- all levels Majority (67%) junior residents	National level survey-USA	51% reported anxiety about competency for completion of residency training	54% reported home-life disruption and 39% agreed with increased financial concerns.	Risk of Covid-19 infection-personal (83%), Re-deployment (20%)
12/March-16/March/2020	Stolarski, USA(52)	General Surgery	30	Non-validated, Subjective	Residency training- all levels	Regional- 2 academic medical centers in Boston, Massachusetts		Personal concern related to the health of family [100%]), risk of their transmitting COVID-19 infection to their family members (80%), to patients (63%), anticipated overwork (50%) Risk of their acquiring COVID-19(27%)	Risk of Covid-19 infection-personal, family, friends Overwork
14/March/2020 21/March/2020	Hussain, UK(4)	Ophthalmology	111	Non-validated, Subjective	Trainees in ophthalmology	National level survey-UK training programs		Mental health had been negatively impacted by COVID-19	Redeployment (77%) , Delay in log book completion 55%, Cancellation exams52%

15/March-15/April/2020	Collins, USA(5)	General and integrated plastic surgery	73	30-items, Pre-tested, Subjective Generalized Anxiety Disorder 7-Item Scale (GAD-7), objective	All levels- Intern to surgical residents	Department of Surgery at the University of California RR-73.7%	Residents have high GAD-7 scores than interns (p = 0.014)	More work load on senior residents	Risk of Covid-19 infection-personal, family, friends
20/March-20/April 2020.	Williamson, UK(7)	Orthopaedic	202	Non-validated, Subjective	Specialist registrars, junior orthopedic teams members	National level survey-UK training programs		69% of registrars felt the pandemic would result in a delay of their certificate of completion date	Cancellation of examinations and key courses 35%, teaching and study leave 67%
23/March-29/March/2020	Cai, USA(8)	Otolaryngology	82	Non-validated, Subjective	Residency training- all levels .	81 residency programs-USA RR-63%	52% of residents expressed concern about anxiety or burnout for themselves.		Limited access to PPE (93%), Risk of Covid-19 infection- family, friends (90%).
27/March-27/April/2020	Sheridan, Ireland(9)	Orthopaedic	40	Non-validated Objective training assessment Subjective	Orthopedic trainees	National level survey-Ireland		37.5%; felt that negative impact on mental health	Risk of Covid-19 infection-personal, family, friends, examination cancellation (82.5%)

				experience assessment					
31/March-7/April/2020	Zheng, USA(12)	General surgery	24	Non-validated, Subjective	Senior residents	Regional-6 academic medical centers in Boston, Massachusetts RR-61.5%		Most significant concern was potential delay in the date of board examinations	Reduced surgical exposure/clinical material
March/2020	Munjal, USA(13)	Pediatric otolaryngology	96	Non-validated, Subjective Multiple languages	Residency training- all levels	22-Multiple countries USA, Africa, Asia, Australia, Europe		Major concern was redeployment and 68.8% (66) of all respondents reported that reallocation is either planned or underway.	Reduced surgical exposure/clinical material, redeployment
March - May 2020	Payne, UK(53)	General surgery and other specialties	32	23 -items, Non-validated, Subjective	Postgraduates with 2 to 4 years of experience.	London hospital-UK		53% felt the redeployment had a negative impact on their mental health	Redeployment, Reduced surgical exposure/clinical material

1/April-1/May/2020.	Huntley, USA(14)	Oral and Maxillofacial Surgery	160	51-items, Non-validated, Subjective	Residency training- all levels	National level survey-USA		60% concerned with the completion of the graduation requirements and with decreased operative experience. 17% reported that contract negotiations or discussions regarding future employment	Reduced surgical exposure/clinical material; Risk of Covid-19 infection-personal, family, friends; limited access to PPE and viral/serological testing
April/2020	Henry, USA(34)	Orthopaedic	121	Non-validated, Subjective	Residency training- all levels	USA - orthopedic residency programs RR-82%		20% of residents are using mental health resources to support their well-being.	Limited access to PPE
5/April-19/April/2020	Khan, UK(16)	General surgery	28	Non-validated, Subjective	All Core Surgical Training (CT1& CT2) and Improving Surgical Training (ST1 & ST2)	Regional-West of Scotland	28.6% trainees felt slightly or significantly more stressed. 7.1% felt definitely burned out.	64.3% trainees were either slightly or significantly more concerned about their career progression	Redeployment, Reduced surgical exposure/clinical material
7/April-21/April/2020.	White, USA(17)	General surgery	84	31-items, Non-validated, Subjective	Residency training- all levels	Eighty-four residency programs-USA RR-33.6%		Re deployment-25% of respondents stated it was likely to happen, and 8.3% stated it was already occurring	Redeployment, Reduced surgical exposure/clinical material

7/April-11/April/2020.	Khusid, USA(54)	Urology	356	47--items, Non-validated, Subjective	Residency training- all levels	National level survey-USA All urology programs in USA RR-20%	Perceived severity of anxiety and depression was observed	Concerns regarding ability to reach graduation case requirements	PPE shortage, local COVID-19 severity, Risk of Covid-19 infection-personal, family, friends ,redeployment
12/April–24/April/2020	Johnson , USA(22)	Vascular Surgery	145	Generalized Anxiety Disorder 7-item (GAD-7), Brief Coping Orientation to Problems Experienced inventory	Residency training- all levels and fellows	National level survey -USA RR-23%	Overall, mild - severe anxiety was noted in 31.7%, and 5.8%, 50.4% had no anxiety (GAD-7 score < 5)	Concerns about professional development	Risk of Covid-19 infection-personal, family, friends, Surgical exposure/clinical material
14/April-21/April/2020	Theresa Guo,(23)	Otolaryngology	175	45- item, Non-validated, Subjective	Residency training- all levels and fellows	National level survey -usa and Canada RR-83%		54.7% reported concerned of ability to secure job/fellowship,89.7% impact on surgical education, Risk of to the virus (70%)	Reduced surgical exposure/clinical material, Risk of Covid-19 infection-personal
19/April-26/April/2020	Kapila, Belgium(26)	Plastic Surgery	86	20 -items, Non-validated, Subjective	Last 4 years of training	Belgium, 9 other countries	Anxiety regarding the pandemic was present in 54%- 69%		Redeployment, Reduced surgical exposure/clinical material

7/April - 16/April/2020	Sivalingam, USA(18)	Ophthalmology	62	Non-validated, Subjective	Second-year vitreo-retinal surgery fellow	National level survey- USA RR-71.2%		56.5% reported concern about the effect of COVID-19 on their surgical training	Redeployment, Reduced surgical exposure/clinical material ,limited access to PPE
10/ April- 7/ May/ 2020	Vallée, France(19)	General surgery	1001	Non-validated, Subjective PHQ-9, the GAD-7	Junior residents (36·4%), senior residents (33·2%), fellowship (30·5%)	National level survey- France	Anxiety, depression and insomnia were present in 35·9%, 40·8% and 43·1% participants respectively	Feeling alone due to the current situation, about one quarter (32.5%)	Limited access to PPE, Reduced surgical exposure/clinical material
12/ April – 14/ April/ 2020	Mishra, India(20)	Ophthalmology	716	Non-validated, Subjective	MD/MS programs, Diploma, Fellowship programs, Senior residency	National level survey- India	54.8% reported higher than usual stress levels, 46.5% reported as unhappy		Limited access to PPE (59.2%), Impact on personal routines, redeployment(24.6%)
12/ April -15/ April/ 2020	Caruana, UK(21)	Cardiothoracic surgery	76	31-item, Pre-tested, Subjective	Residency training- all levels Nationally	National level survey-UK		63% and 32% were concerned about their physical and mental health	Risk of Covid-19 infection-personal, limited access to PPE, Redeployed, Insufficient communication and clarity from the training bodies and leadership

14/ April-28/April/2020	Alhaj, Kuwait(24)	Neurosurgery	52	27 –item, Non-validated, Subjective	Residency training- all levels	Multiple countries- Canada, USA, Kuwait, Saudi Arabia, European		Perceived impact on mental health of 90% of the participants	Reduced surgical exposure/clinical material
14/April - 25/April/2020	Civantos, USA(55)	Otolaryngology	349	Objective Mini-Z Burnout Assessment, Generalized Anxiety Disorder scalegad-7, Impact of Event Scale Patient Health Questionnaire PHQ-9	Residency training- all levels And fellows	National level survey- USA RR-10.22%	Anxiety, distress, burnout, and depression were reported in 47.9%, 60.2%, 21.8%, and 10.6% respectively		Risk of Covid-19 infection-personal, family, friends
17/April - 30/ April/ 2020	Pelargos, USA(25)	Neurosurgery	197	31 –item, Non-validated, Subjective	Residency training- all levels	National level survey- USA and Canada.		31.6% reported that it had negatively affected their interpersonal relationships by treating Covid patients	Reduced surgical exposure/clinical material

20/April-2/May/2020	Cai, USA (27)	Otolaryngology	219	35-item, Non-validated, Subjective	Residency training- all levels	National level survey -USA RR-55%		14% redeployed,87% PPE reuse, financial future, 36% worse in-hospital well-being ,48% improved well-being outside of the hospital, perceptions of risk for contracting COVID-19 ,required case numbers by graduation	Reduced surgical exposure/clinical material, limited access to PPE, Redeployment
20/April-7/May/2020	Homer, USA(28)	Ophthalmic Plastic and Reconstructive Surgery	40	Non-validated, Subjective	Fellowship training	National level survey -USA RR-70.2%		Mild (72.5%) to moderate (27.5%) impact ,75.0% reported reduced surgical confidence,94.4% effects on graduation case logs	Reduced surgical exposure/clinical material
23/April-6/May/2020	Balhareth, Saudi Arabia(30)	General surgery	99	Non-validated, Subjective	Residency training- all levels And fellows	National level survey- Saudi Arabia RR-60%	45% Anxious or worried ,37.1% reported feel a low mood	Upcoming exam had a significant impact to residents and fellows ($P < 0.001$).	Limited access to PPE, Reduced surgical exposure/clinical material
24/April-29/May/2020 and 4/Ma	Perez, USA(31)	Surgical specialties related to gener	472	37-item, Non-validated, Subjective	Residency training- all levels And Fellows	USA- general surgery and other surgical specialty training		Impact on emotional health (11% -42%)	Reduced surgical exposure/clinical material, physical safety (6% -31%), physical health (7% -17%),

y-26/June/2020		al surgery, all other				programs RR-21%			
27/April - 2/ May/ 2020	Chang, South Korea(32)	Orthopaedic	229	58-item, Non-validated, Subjective	Residency training- all levels	National level survey- South Korea		Reduction in average score for quality of life from 68.9 to 61.7 out of 100 scores	Risk of Covid-19 infection-personal, family, friends, Reduced surgical exposure/clinical material
27/April-11/May/2020	Patel, UK(33)	Dental surgery	150	21- item, Non-validated, Subjective	Dental Core Trainees	National level survey-UK RR-22%		52.6% redeployment 43.9% reported reduced confidence, PPE limited availability 14%	Reduced surgical exposure/clinical material, Limited access to PPE
April/ 2020	Osama, Pakistan(15)	General Surgery, and other specialties	112	40-items, Pre-tested Subjective Modified Maslach Burnout inventory score	Residency training- all levels	Tertiary care hospital in Pakistan	Reduction in Modified Maslach Burnout inventory score ($p < 0.001$) due to reduced number of working hours.	61% concerned about transmitting it to their family members , 38.4% afraid of dying because of their direct exposure	Reduced surgical exposure/clinical material

3/May-11/May/2020	Zoia, Italiy (36)	Neurosurgical	192	18-item, Non-validated, Subjective	Residents with 5 years of training experience	National level survey- Italy RR-58%		Participants expressed concerns of their mental health.	Risk of Covid-19 infection-personal, limited access to PPE, Reduced surgical exposure/clinical material (78.6%)
7/May-16/May/2020	Dash, India(37)	Neurosurgery	118	Pre-tested Subjective	Residency training- all levels	National level survey- India		88.1 % reported mental concerns on operative and clinical skills, 57.6% Fear of rescheduling or deferring of licensing examinations	Reduced surgical exposure/clinical material
15/May-21/May/2020	Kumar, India(39)	Plastic surgery	107	Non-validated, Subjective	Residency training- all levels	National level survey- India	37.50% reported stress due to pandemic	36.46% adverse effect on their mental health	Risk of Covid-19 infection-personal , Reduced surgical exposure/clinical material
22/May-31/May/2020	Wittayanakorn, Thailand(41)	Neurosurgery	298	33-item Non-validated, Subjective	Residency training- all levels	Multiple countries- Indonesia, Malaysia, Philippines, Singapore, Thailand RR-63%		74% concerned about impact on their neurosurgical training overall most concerned about the decrease in hands-on surgical experience, uncertainty in their career advancement, occupational safety in the workplace.	Reduced surgical exposure/clinical material, Occupational safety

28/May-11/June/2020	Megaloikonomos , Greece(42)	Orthopaedic	327	24- item, Non-validated, Subjective 2.2%. Covid +	Residency training- all levels and fellows	23 -Multiple European countries		58.2% reported concerns on annual training goals, fellowship options were suspended 56.6%	Reduced surgical exposure/clinical material
May-20	Khalafallah , USA (56)	Neurosurgery	111	26- item, Non-validated, Subjective , abbreviated Maslach Burnout Inventory (ambi)	Residency training- all levels 63.9% 3-6 years	National level survey -USA RR-12.2%	Burnout was reported in 26.1%	Concerns on future healthcare reform (79.3%),career satisfaction in (73.9%, surgical milestones (65.8%). Alterations in elective rotation/vacation schedules	Reduced surgical exposure/clinical material
May-June/2020	Yan, USA(44)	Plastic surgery	22	Non-validated, Subjective	Residency training- all levels	Mayo Clinic USA		33% reported COVID-19 impacted their training/career and their relationship with family/friends, 76.2% changed their family or travel plans	Reduced surgical exposure/clinical material, Occupational safety
1/June-15/June/2020	Ashry , Egypt (45)	Neurosurgery	50	27- item, Non-validated, Subjective ,4 residents (8%	Residency training- all levels	National level survey -Egypt	68% reported burnout symptoms	10% were redeployed,48% concerned about surgical skills, willingness to extend,74% lack Reduced surgical exposure/clinical material of PPE, 62% financial strains	Reduced surgical exposure/clinical material limited access to PPE, Redeployment
11/June-15/June/20	Upadhyaya, India(46)	Orthopaedic	138	29-item, Non-validated, Subjective	Post-graduate students pursuing	Delhi-Region, India		96% had concerns about mental health, 68% fear of contracting COVID-19, 71.56% were redeployed ,	Reduced surgical exposure/clinical material (83.8%),, Risk of Covid-19

20					higher orthopedics degree			uncertainty about professional life (66.6%), lost confidence in acquiring surgical skills (54.5%)	infection-personal,friends(70.7%)
21/June-11/July/2020	Cheriyan, Indai (47)	Urology	286	38-item, Non-validated, Subjective	Residency training- all levels-final year 55.9%	National level survey -India		35.6% reduced availability of adequate PPE, and lack of job opportunities	Reduced surgical exposure/clinical material, limited access to PPE
7/ July-14/ July/2020.	Alahmadi, Saudi Arabia(48)	Ophthalmology	142	50-item, Non-validated, Subjective Patient health questionnaire (PHQ-9)	Residency training- all levels	National level survey -Saudi Arabia RR-77.6%	Mild and moderate depressive symptoms were observed in 26.1-33.1% .11.3% scored high (severe depressive symptoms) in the PHQ-9 scale	70.5% reported effect on mental health	Reduced surgical exposure/clinical material, Risk of Covid-19 infection-personal
27/July-14/August/2020	Adesunkanmi, Nigeria(49)	General surgery, and other specialties	207	42-item, Non-validated, Subjective	Registrar to residency- all levels	National level survey -Nigeria RR-82.8%		88.4% feared they may contract the coronavirus at work, 90.3% feared they could transmit the virus to their family members.	Risk of Covid-19 infection-personal family, friends, limited access to PPE

July/2020	Aziz, USA(50)	General Surgery	1102	23-item, Non-validated, Subjective	Residency training- all levels	National level survey -USA		33.1% respondents reported more burnout, 72.7% concerned about potential transmission of COVID-19 to family members and friend, 55% concerned about contracting COVID-19	Risk of Covid-19 infection-personal, family, friends (55%)
September/2020	Aljehani, UK(57)	General surgery	234	Non-validated, Subjective GAD-7	Postgraduates with 5 years of training experience	Regional- 2 academic medical centers in Boston, Massachusetts	50% scored positive in the screening tool of generalized anxiety disorder (GAD), 100% reported considerable amount of stress		Redeployment, Reduced surgical exposure/clinical material, Risk of Covid-19 infection-personal,

Table S4- Educational activities assessment of surgical trainees

Study period	Authors	Surgical specialty	N	Questionnaire	Level of training	Distribution	Teaching +/-
3/March - 25/May/ 2020	Ostapenko , USA(1)	General surgery	22	Operative objective with logs, others Non-validated, Subjective	Residency training- all levels	Danbury Hospital.	Independent studying increased by 1.6 hours (26.2%) ,didactics decreased by 2.1 hours (35.6%)
11/March- April/23 /2020	Cox, Portugal (2)	Ophthalmology	75	28-- item, Pre-tested, Subjective	Residency training- all levels	National level survey -Portugal	52% willing for virtual teaching , 60% reported increased time for research
11/March-28/ April/2020	Fero, USA(3)	Urology	106	27- item, Non-validated, Subjective	Residency training- all levels 67%junior residents	National level survey -USA	A transition to virtual educational platforms (95%) and decreased size of inpatient resident teams (90%) were observed.
14/March– 21/March/2020	Hussain, UK(4)	Ophthalmology	111	Non-validated, Subjective	Trainees in ophthalmology	National level survey-UK training programs	Increase use of webinar,88% reported positive opinion
16/March/2020	Huamanchumo, Peru(6)	General surgery	32	Non-validated, Subjective	Residents with 1-3 year experience	National level survey- 14 Peruvian hospitals	40.6% had complementary virtual tutoring or training program
20/March- 20/April 2020.	Williamson, UK(7)	Orthopaedic	202	Non-validated, Subjective	Specialist registrars, junior orthopedic teams members	National level survey-UK training programs	67% reported cancellation of teaching and study leave , 33% reported reduced or changed method of delivery in teaching

27/March-27/April/2020.	Sheridan, Ireland(9)	Orthopaedic	40	Non-validated Objective training assessment Subjective experience assessment	Orthopedic trainees	National level survey-Ireland	92% reported format of virtual core curriculum teaching platform either met or exceeded their expectations.
31/March-6/April/2020	Pertile, Italy (11)	General surgery and other specialties	756	12- item, Non-validated, Subjective	Residency training- all levels	National level survey- Italy	9.5% reported suspension of didactic and,9.6% increased research activities a
March/2020.	Munjal, USA(13)	Pediatric otolaryngology	96	Non-validated, Subjective Multiple languages	Residency training- all levels	22-Multiple countries USA, Africa, Asia, Australia, Europe	87.5% reported that no supplementary operative education, cancellation of seminars(40.6%), all such seminars are virtual-only(41.7%). 71.43% indicated that simulation is useful for all residents
March-May/2020	Payne, UK(53)	General surgery and other specialties	32	23-items, Non-validated, Subjective	Residency training- 1-2 years of experience, foundation year doctors (FY2), clinical fellows	London hospitals. RR- 36%	Redeployment was useful in gaining more confidence in managing critically ill patients in ICU and 97% felt that the experience would be beneficial
1/April-1/May/2020..	Huntley, USA(14)	Oral and Maxillofacial Surgery	160	51-items, Non-validated, Subjective	Residency training- all levels	National level survey- USA	94.2% had moved to web-based didactics, and 47% had found increased value in the didactics.

April/2020	Henry, USA(34)	Orthopaedic	121	Non-validated, Subjective	Residency training- all levels	National level survey- USA RR-82%	Didactic education has continued via videoconferencing to mitigate the effects of Covid 19 on training
5/April-19/aprilapril/ 2020	Khan, UK(16)	General surgery	28	Non-validated, Subjective	All Core Surgical Training (CT1& CT2) and Improving Surgical Training (ST1 & ST2)	Regional- West of Scotland	75.0% trainees have not attended any teaching 35.7% reported more time for research projects
12/ April – 14/ April/ 2020	Mishra, India(20)	Ophthalmology	716	Non-validated, Subjective	MD/MS programs, Diploma, Fellowship programs, Senior residency	National level survey- India	81.2%reported Internet use was productive with ophthalmology training , 75.7% indicated that they found useful ophthalmic webinars
12/ April - 15/ April/2020	Caruana, UK(21)	Cardiothoracic surrgery	76	31-item, Pre-tested, Subjective	Residency training- all levels Nationally	National level survey-UK	66% currently having no participation Covid 19 research, 77% were engaged in national or international collaborative initiatives
13/April /2020.	Figueroa, Chile(58)	Orthopedic	100	Non-validated, Subjective	Residency training-1 to 3 years of training	Regional- Chile 7 training programs	86% stated that their programs are using online education. 86% webinars, 28% online presentations, 27% would continue performing online tests after Covid-19
14/April - 21/April /2020	Guo, USA(23)	Otolaryngology	175	45- item, Non-validated, Subjective	Residency training- all levels and fellows	National level survey –USA and Canada RR-83%	62.3% increase in didactic educational activities, 86.9% reported positive response to web based learning

17/April - 30/April /2020	Pelargos, USA(25)	Neurosurgical	197	31 –item, Non-validated, Subjective	Residency training- all levels	National level survey- USA and Canada.	58.6% of residents spending >4 hours per week on didactics during the pandemic (P < 0.0001), with 19.4% spending >10 hours per week in didactic lectures
19/April - 26/ April/2020	Kapila, Belgium(26)	Plastic Surgery	86	20 –item, Non-validated, Subjective	Residents with 4 years of training experience	10 multiple countries (India, Romania, Israel, Italy, Colombia, United Kingdom, France ,Netherlands, Slovakia)	60% -71% of trainees received continuous education. 77% reported that this was by webinars and/or journal clubs by videoconference. 74% reported increase in research activity, 61% - 91% reported more time to deepen the theoretical aspect of their specialty.
20/April - 2/May/2020	Cai, USA(27)	Otolaryngology	219	35-item, Non-validated, Subjective	Residency training- all levels	National level survey -USA RR- 55%	Reported increase in Clinical work from home (60%), structured didactics (82%), self-study (76%), and research (72%)
20/April - 7/May/2020	Homer, USA (28)	Ophthalmic Plastic and Reconstructive Surgery	40	Non-validated, Subjective	Fellowship training	National level survey –USA RR-70.2%	Increased research activities (85.0%), academic study (77.5%)
23/April -29/ April/2020	Paesano, USA(29)	Urology	148	10 –item, Pre-tested Subjective	Residency training- all levels Majority (23.6%) third year	18 multiple countries - Latin America and Spain	93% receive urological information through web based platforms, 65% reported reduction in academic training
23/April	Balhareth,	General	99	Non-	Residency	National level	84.6% reported a reduction in the training

-6/May/2020	Saudi Arabia(30)	surgery		validated, Subjective	training- all levels And fellows	survey- Saudi Arabia RR-60%	activities , 41.3% reported psychological preparedness to study with increased free time
24/April -29/May/2020 and 4/May-26/June/2020	Perez, USA(31)	Surgical specialties related to general surgery, all other	472	37-item, Non-validated, Subjective	Residency training- all levels And Fellows	USA-general surgery and other surgical specialty training programs RR-21%	Impact on didactic education increased (14% - 46%). Virtual conferences were adopted by 97% across all stages of training.
27/April -2/ May/2020	Chang, South Korea(32)	Orthopaedic	229	58-item, Non-validated, Subjective	Residency training- all levels	National level survey- South Korea	Education times for lecture and clinical case discussion were decreased, Online-based teaching methods was increased-webinar , online symposium, lectures, videos of surgeries. Average satisfaction level for online-based teaching methods was significantly lower
2/May-11/May/2020	Ferrara, UK(35)	Ophthalmology	504	Non-validated, Subjective	Residency training- all levels (82.1%) and fellows (17.9%)	32 multiple countries including UK	91.7% reported value of web-based case-presentations in clinical training, 85.7% on web-based discussion of edited surgical videos and 86.9% on simulation-based practice
3/May-11/May/2020	Zoia, Italy(36)	Neurosurgical	192	18-item, Non-validated, Subjective	Residents with 5 years of training experience	National level survey- Italy RR-58%	Increase of the educational and scientific activities, time spent for studying. 55.7% reported increase in production of scientific papers or research projects,64.6% reported increased theoretic educational activity
7/May-16/ May/20	Dash, India(37)	Neurosurgery	118	Pre-tested Subjective	Residency training- all levels	National level survey- India	44.91% reported less teaching rounds, 40.68% reported that they had stopped. Shift from classroom teaching to online

20							videoconferencing sessions was observed in 61.02%.
11/May-15/May/2020	Bandi, Italy(38)	Otolaryngology	15	Non-validated, Subjective	Residency training- all levels	Italy-University of Insubria	53.4% reported that dissection lab, surgical anatomy were useful, 46.6% has reported online journal clubs/webinars as useful activities.
15/May-21/May/2020	Kumar, India(39)	Plastic Surgery	107	Non-validated, Subjective	Residency training- all levels	National level survey- India	86.9% of residents perceived that the online teaching pattern was useful and should be continued after the pandemic
18/May-11/June/2020	Gonzi, UK(40)	Orthopaedic	101	42-item, Non-validated, Subjective	Residency training- all levels ST1 to ST8 and post-Certificate of Completion of Training	UK -all training programs	93% reported attendance of at least one weekly online webinar, 79% rating these as useful or very useful
May/2020	Zingaretti, Italy(43)	Plastic Surgery	115	Non-validated, Subjective	Residency training- all levels	National level survey- Italy RR-72%	67% reported increase didactical programs following the restrictions due to the pandemic
May-20	Khalafallah , USA (56)	Neurosurgery	111	26- item, Non-validated, Subjective , abbreviated Maslach Burnout Inventory (ambi)	Residency training- all levels 63.9% 3-6 years	National level survey -USA RR-12.2%	66.7% reported increase in research studies

May-June/ 2020	Yan, USA(44)	Plastic Surgery	22	Non-validated, Subjective	Residency training- all levels	Mayo Clinic USA	Attendance at these virtual conferences was higher than normal, with positive reviews from faculty and attendees.
11/June-15/June/ 2020	Upadhyaya, India(46)	Orthopaedic	138	29-item, Non-validated, Subjective	Post-graduate students pursuing higher orthopedics degree	Regional- Delhi, India	16.24% reported lack of regular classes, 89.09% of classes and case presentations are being conducted virtually
21/June-11/July/ 2020	Cheriyan, India (47)	Urology	286	38-item, Non-validated, Subjective	Residency training- all levels-final year 55.9%	National level survey -India	Increased time for research (67.5%),theoretical knowledge (75.2%), >70% used virtual learning activities.
July/2020	Aziz, USA(50)	General Surgery	1102	23-item, Non-validated, Subjective	Residency training- all levels	National level survey -USA	41.3% reported receiving more didactics during the pandemic. 80.6% reported a transition to a completely online platform for didactics
7/ July-14/ July/2020.	Alahmadi, Saudi Arabia(48)	Ophthalmology	142	50-item, Non-validated, Subjective Patient health questionnaire (PHQ-9)	Residency training- all levels	National level survey -Saudi Arabia RR-77.6%	55.4% respondents were satisfied with the virtual method of education

27/July-14/August/ 2020	Adesunkanmi, Nigeria(49)	General surgery, and other surgical specialties	207	42-item, Non-validated, Subjective	Registrar to residency- all levels	National level survey -Nigeria RR-82.8%	Academic seminars (83.1%) and journal club meetings (31.9%) were the most common virtual academic programs.Virtual surgical simulations (2.9%) and telesurgery (1.4%). 57.5% preferred the online platform to physical meetings, and wanted training/academic programs to continue virtually beyond the pandemic
October/ 2020	Essilfie, USA(59)	Orthopedic	168	36- item, Non-validated, Subjective	Residency training- all levels And fellows	National level survey -USA	85.7% of residents have used e-learning platforms, Overall satisfaction with e-learning compared with in-person learning was higher, with 32.2% -51.4% (P = 0.006). More likely to pay attention with in-person learning than e learning (P = 0.89).

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