

AUDIT OF EVOLVING ROLES OF LAPAROSCOPY IN THE CURRENT SURGICAL PRACTICE AT CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL: A 5 YEAR REVIEW

W Ngwisanyi¹, I Bombil^{*2} & M Nel³

^{1,*2&3}Department of Surgery, University of the Witwatersrand, South Africa

Abstract

Keywords: *Laparoscopic surgery (LS), revolutionized etc.*

Background: Laparoscopic surgery (LS) is gaining momentum and has revolutionised the practice of surgery. Over the past thirty years, LS has been used to manage a wide range of surgical pathologies and has become a recognised and generally accepted standard of care.

Aim: The aim of this study is to describe the evolution of LS in selected procedures..
Methods: Data were collected from theatre registries. Statistical analysis was performed using the software IBM SPSS. The data were analysed using descriptive statistics of mean and standard deviation for age, and percentage and frequencies for categories of variables.

Results: Of the 3745 patients involved in the study, 59.1% were males and 40.9% were females. The mean age of the patients was 35.17±17.30 years. Laparoscopic surgery was represented in 43.2% of the procedures, with laparoscopic appendicectomy (46.73%) and laparoscopic cholecystectomy (32.69%) being the most commonly performed procedures.. Twenty-five adrenalectomies were performed over the study period, and of those 12 (52%) were performed laparoscopically. All the thymectomies (12) were performed thoracoscopically, with one conversion.

Conclusion: The findings of this study suggest that there has been an increase in the overall incidence of laparoscopic surgery in selected procedures at CHBAH

Introduction

Surgery differs from other medical disciplines in that to effect healing, it requires invasion of the body by means of a sharp instrument/instruments (1). For many years open surgery has been the mainstay of surgical intervention. Over centuries, surgical techniques have improved, resulting in better patient outcomes (1).

Since its inception in the late 1980s, laparoscopy has revolutionised the practice of surgery (2, 3). The introduction of laparoscopic cholecystectomy in 1987 led to the rapid development of laparoscopic surgery (LS), that is gaining momentum as the standard of care for a wide range of surgical pathologies (4). The role of minimal access surgery (MAS) in acute care surgery involving abdominal and thoracic pathologies has also increased significantly over the past 30 years (5), both as a diagnostic and as a treatment tool (4). The benefit of MAS over open surgery in selected cases should not be understated; it reduces total hospitalisation costs; shortens postoperative recovery times; in many cases it reduces surgical trauma and post-operative pain, and enables an earlier return to work (4, 6).

Worldwide, the trend of MAS varies from one region to another. In developed nations with abundant resources, the rates of MAS are significantly higher than in low-middle-income nations. The rate of MAS in developed countries has risen exponentially, to the extent that it has significantly replaced open surgery, especially in elective settings. Despite being technically challenging and requiring the use of costly equipment, overall MAS has been shown to reduce hospital costs in countries that have adopted it, especially with improved skills as noted in centres of excellence (6)

Information on the development of MAS in low-middle-income countries (LMIC) is limited. The available literature suggests that the rates of performing MAS in these countries are lower than in developed countries (7), although Alfa-Wali et al report that for various reasons, there has been a sporadic and marginal adoption of MAS in LMICs (7). Barriers to MAS in LMICs is not only attributed to a lack of funding and expertise, but also to inadequate distribution of funds; the hierarchical nature of surgical practices that may block acquisition of new technology and the attitude of surgeons who might be unwilling to innovate (8). However, similar variety of procedures performed in HIC is also achieved in LMICs(7). In South Africa, studies by Koto et al, demonstrates the safety and practicality of MAS on hemodynamically stable patients as well as in the management of stable penetrating thoraco-abdominal injuries (8, 10, 11). Furthermore, in 2015 Bombil et al. reported encouraging results for the use of laparoscopy in selected trauma cases (12).

Worldwide, laparoscopic cholecystectomy (LC) has gained popularity to become the standard of care in the surgical management of cholecystitis. Reports from Australia, Canada and the United States of America revealed increased rates of laparoscopic cholecystectomy (6, 13, 14). Even in remote North American settings with limited resources, the success rate of laparoscopic cholecystectomy was noticeable when compared with the results from international centres of excellence (14). A meta-analysis of randomized controlled trials have also described the evolution of MAS| and its preference over open surgery (15). Laparoscopic cholecystectomy has rapidly spread across the globe like a pandemic. Even in Africa where, depending on logistics and expertise, it has also become the standard of care. In South African teaching hospitals, laparoscopy is by default the procedure of choice with a success rate of approximately 90% (16).

Appendicitis ranks among the most common surgical emergencies and affects people of all ages (17). Laparoscopic appendectomy (LA) has now positioned itself as the gold standard of care in the management of appendicitis (17). The incidence of laparoscopic appendectomy is gradually on the rise worldwide, despite regional variations. Although the local literature is limited, there are studies that report the safety and advantages of laparoscopy even in cases of complicated appendicitis (18, 19, 20).

Inguinal hernia represents three-quarters of all abdominal wall hernias, and open hernia repair is performed as a day case in many centres in high-income countries, under local anaesthesia at low cost, with satisfactory results (21). The laparoscopic approach is however, also gaining momentum although at slightly higher cost and with a prolonged operating time. It is also a more difficult technique to master (22).

Laparoscopic anti-reflux procedures have evolved over the past two decades with the acquisition of improved laparoscopic skills (23). Since gastroesophageal reflux disease (GERD) hampers the lifestyle of many sufferers, there will always be cases demanding medical or surgical attention, and the laparoscopic approach is considered the standard of care (24).

There are several other surgical procedures which, although uncommon, have shifted to the minimally invasive approach. Adrenalectomy, thymectomy and splenectomy (4, 3, 6) are some illustrations. Depending on logistics and skills, regional incidence varies. Data on the profile of these procedures in Africa, particularly in sub-Saharan Africa are rare. The scarcity of data on the evolution of MAS at Chris Hani Baragwanath Academic Hospital (CHBAH) and other South African teaching hospitals prompted this study. CHBAH is the largest hospital in South Africa with nearly 3000 inpatient beds.

Methods and materials

Study design

This was a retrospective cross-sectional study to investigate and analyse the frequency of 9 selected procedures (MAS versus open) performed at CHBAH from January 2014 to December 2019.

Inclusion and exclusion criteria

Data were collated on all patients who had undergone any of the selected procedures during the study period in the department of general surgery. Patients who underwent procedures other than those selected for the study, as well as all patients under the age of ten years were excluded. In this particular hospital setting, all patients under the age of 10 years are managed by paediatric surgery. The year 2015 were also excluded from the study due to a lot of missing data.

Statistical analysis

Statistical analysis was performed by means of IBM SPSS 25 software. Use of the Chi-square test revealed that significant changes had occurred over time. The data were summarized using descriptive statistics of mean and standard deviation for continuous variables and proportion by ratio or percentage for categorical variables. Binary logistic regression was used to determine the univariate association between the type of procedure and the year. The results are presented in figures and tables.

Ethical approval was obtained from the Human Ethics Committee of the University of the Witwatersrand (clearance number: M190570) and from the Research Review Board of CHBAH.

Results

The records of 3745 patients were collected during the study period. The mean age of the patients was 35 years, with the majority of patients aged 30 years and younger (see Table 1). In the majority of cases (56.8%), open procedures were performed while 43.2% of the patients underwent MAS. The procedures were further categorized according to the year in which they were performed. All results are depicted in tables (1, 2, 3) and figures (1, 2, 3)

Table 1: Socio-demographic characteristics of the patients involved in the study

Total number of patients	n = 3745 (100%)
Mean age (years), SD	35 (17.3)
Age in category, years (%)	
≤ 20	887(23.7)
21 – 30	848(22.6)
31 – 40	761(20.3)
41 – 50	480(12.8)
51 – 60	392(10.5)
61 – 70	269(7.2)
>70	108(2.9)
Men, n (%)	2332(59.6)
Women, n (%)	1513(40.4)
Men/Women ratio	3:2

Table 2: Summary of the number and percentages of procedures performed the conversion rates from 2014 to 2019

Procedures	Laparoscopic (N = 1617)		Open (N = 2128)		Total N (%)	Conversion n/N (%)
	N	%	N	%		
Appendectomy	849	52.5	1149	54.0	1998(53.4)	87/849 (10.3)

Cholecystectomy	594	36.7	33	1.6	627(16.7)	19/594 (3.2)
CBD exploration	45	2.8	11	0.5	56(1.5)	8/45 (17.8)
Inguinal hernia repair	40	2.5	453	21.3	493 (13.2)	2/40 (5.0)
Perforated peptic ulcer repair	22	1.4	204	9.6	226 (6.0)	0(0.0)
Laparoscopic anti-reflux procedure	21	1.3	0	0.0	21(0.6)	3/21(14.3)
VATS* (chest trauma)	17	1.1	210	9.9	227 (6.1)	1/17 (5.9)
Adrenalectomy	13	0.8	12	0.6	25(0.7)	6/13 (46.2)
Thoracoscopic thymectomy	12	0.8	0	0.0	12 (0.3)	1/12 (8.3)
Whipple's procedure	6	0.4	54	2.5	60 (1.6)	1/6 (16.7)

Table 3: Percentages of common and uncommon procedures per year*

Laparoscopic procedure n (%)	2014 (n=184)	2016 (n=268)	2017 (n=452)	2018 (n=400)	2019 (n=313)
Laparoscopic cholecystectomy	91 (49.5)	80 (29.9)	156 (34.5)	142 (35.5)	125 (39.9)
Laparoscopic adrenalectomy*	2 (1.1)	0 (0)	1 (0.2)	3 (0.8)	7 (2.2)
Laparoscopic appendectomy	76 (41.3)	169 (63.1)	246 (54.4)	221 (55.3)	137 (43.8)
Laparoscopic CBD exploration*	1 (0.5)	2 (0.7)	16 (3.5)	7 (1.8)	19 (6.1)
Laparoscopic inguinal hernia repair	5 (2.7)	7 (2.6)	14 (3.1)	8 (2)	6 (1.9)
Laparoscopic perforated peptic ulcer repair	4 (2.2)	3 (1.1)	5 (1.1)	3 (0.8)	7 (2.2)
Thoracoscopic thymectomy*	0 (0)	3 (1.1)	4 (0.9)	2 (0.5)	3 (0.4)
Laparoscopic Whipple's procedure*	0 (0)	0 (0)	2 (0.4)	3 (0.8)	1 (0.3)
Laparoscopic anti-reflux procedure*	1 (0.5)	2 (0.7)	5 (1.1)	8 (2)	5 (1.6)
Video-assisted thoracoscopy*	4 (2.2)	2 (0.7)	3 (0.7)	3 (0.8)	5 (1.6)

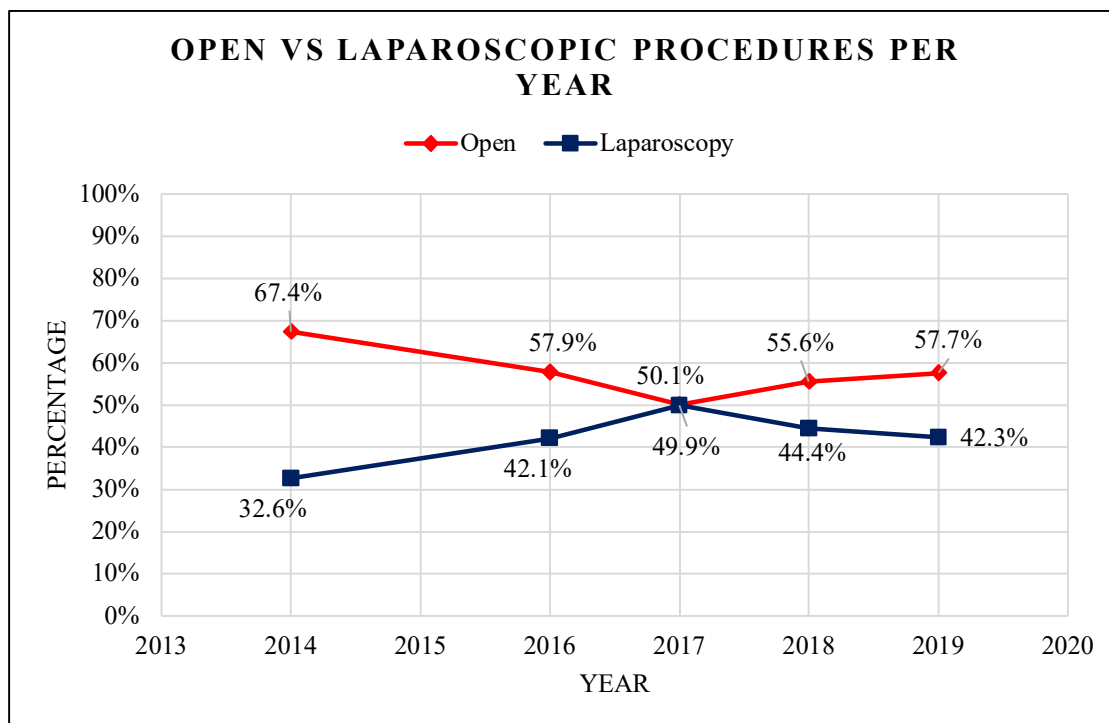


Figure 1: Open versus laparoscopic procedures per year (n=3745)

The figure above represents trends of laparoscopic vs. open surgical procedures during the study period.

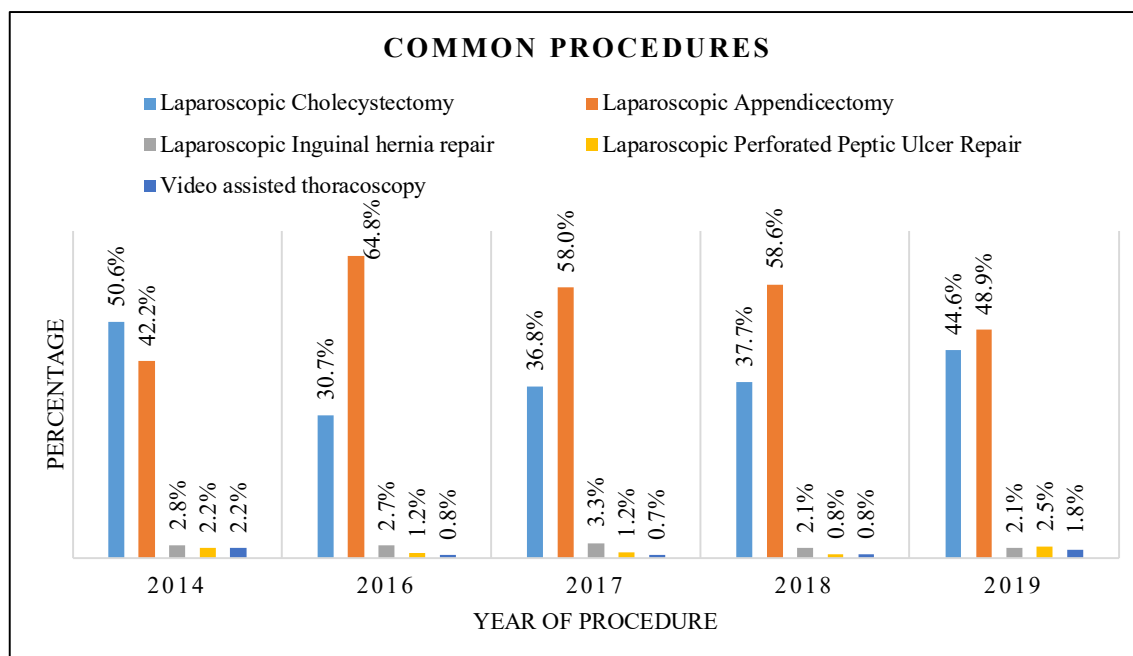


Figure 2: Percentages of common laparoscopic procedures per year

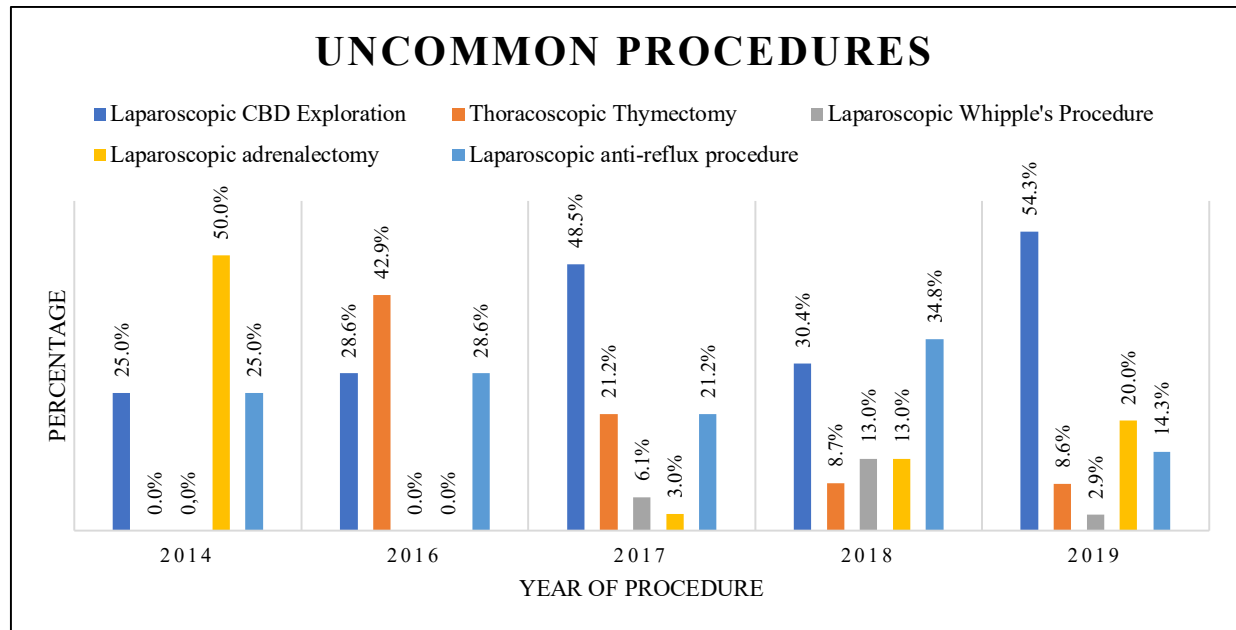


Figure 3: Percentages of uncommon laparoscopic procedures per year

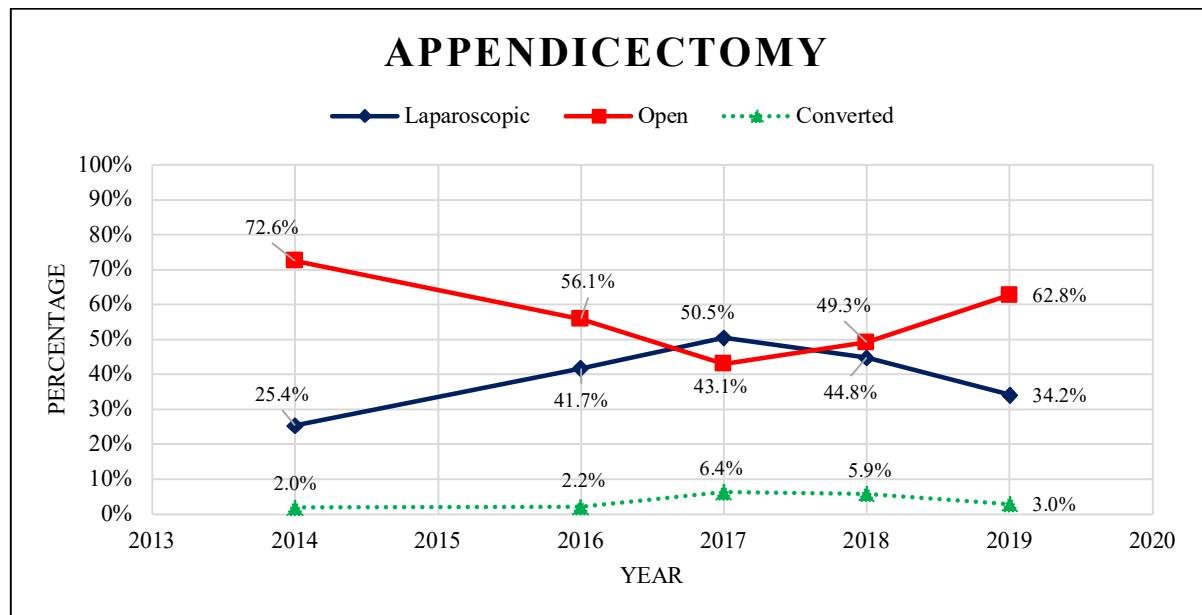


Figure 4: Percentages of open versus laparoscopic appendicectomies

Discussion

To our knowledge, this is the first study to investigate trends of MAS in South Africa.

The highest rate of open procedures occurred in 2014 (67.3%) and the highest rate of laparoscopic procedures was in 2017 (49.8%).

From 2014, there was a gradual increase in the total number of surgical procedures performed, reaching a peak in 2017. This was followed by a small decrease in 2018, and then a sharp decline in 2019. It has not been possible to

explain the aforementioned changes in the total number of patients who underwent surgical procedures. The explanation to this finding is outside the scope of this research.

The predominance of men (59.6%) over female (40.1%) may be due to the fact that the majority of common pathologies (appendicitis, inguinal hernia and chest trauma) affect males (21, 25). The findings of this study are similar to those reported by Nguyen et al. in their review of the use of laparoscopy in general surgical operations at academic centers across the United States of America (2). In our study, more women than men underwent surgical procedures such as anti-reflux surgery and cholecystectomy. This finding is also reported by Nguyen et al. (2). In comparison with 2014, the probability of performing laparoscopic procedures increased significantly from 39% in 2016 to 52% in 2019. Then from 2018 to 2019 it slightly decreased by 6%, but this was not regarded as statistically significant.

Appendectomy was the most frequently performed procedure during the study period, accounting for almost half of all surgical procedures (Table 2). This finding is also mentioned by Dai and Shuai in their meta-analysis of randomized controlled trials comparing laparoscopic and open appendectomy in adults and children (15). However, despite being the most commonly performed procedure, laparoscopic appendectomy did not constitute the highest percentage of laparoscopic procedures at CHBAH. The reasons for this might be that laparoscopic appendectomy is an emerging surgical option for the management of acute appendicitis, and many doctors, especially junior surgical trainees may not be sufficiently competent to perform it unsupervised. Furthermore, acute appendicitis can present with complications that require an emergency appendectomy at any time, including late at night, when there is least supervision. Additionally, in their mandate to train medical officers and interns, surgical registrars may opt to perform open surgical procedures.

Laparoscopic cholecystectomies accounted for 94.7% of the total number of cholecystectomies performed, which represents the highest percentage of laparoscopic procedures. This may be due to the fact that laparoscopic cholecystectomy is usually performed as an elective procedure mainly by specialists during working hours. These findings are consistent with global trends and mirror reports by other authors (4, 2, 14). Laparoscopic cholecystectomy was introduced more than three decades ago, and over time the skill required to perform this procedure has improved universally (4, 2, 14).

Thymectomy and adrenalectomy were the least performed surgical procedures (Table 2). Thymectomy is a relatively uncommon procedure, and according to the National Comprehensive Cancer Network (NCCN), the incidence of thymectomy in the United States of America is 0.15 cases per 100,000 persons (26). Adrenalectomy is limited to functional and large tumour. According to Mansmann et al., adrenal tumours are not uncommon, affecting 3% to 10% of the human population, but the majority consists of small benign non-functional adrenocortical neoplasm which do not require surgical intervention (27). This report may explain the small numbers (0.35%) of adrenalectomies performed at CHBAH. Moreover, we speculate that the suboptimal screening for adrenal tumour may be an additional factor contributing to the rarity of this procedure.

Conversion

As the most commonly performed procedure reported over the entire study period, laparoscopic appendectomy had an average conversion rate of 10.3% (Table 3). This conversion rate is higher compared to the 8.6% and 2.4% conversion rates reported by Switzer et al. (28) and Nguyen et al. (2) respectively. It is possible that the same reasons mentioned in the introduction might also explain the high conversion rate in laparoscopic appendectomy. Our study shows a conversion rate of 3.20% for laparoscopic cholecystectomy. Numerous sources report different outcomes in the conversion rates of laparoscopic cholecystectomy. Nguyen et al. analysed the use of laparoscopy in general surgical procedures performed at several academic medical centers in the United States of America over a five-year period and found a conversion rate of 14.6% for laparoscopic cholecystectomy (2). In northern Canada, Verdolin et al reviewed laparoscopic cholecystectomy in 290 patients over 7 years and reported a conversion rate of 1.37% (14). The specific reasons for the conversion of various procedures were not analyzed, although we suspect the trainee level of expertise and the timing of the procedure to be responsible for conversion. For example, a junior surgical registrar working at night is likely to convert. It is also speculated that difficult cholecystectomies may be performed by junior consultants who may more readily opt to convert compared to experienced surgeons.

Among the uncommon procedures, laparoscopic adrenalectomy had the highest conversion rate, with almost half the number of procedures (46.15%) being converted. It is possible that the larger size, extra-adrenal location (paraganglioma) with its unpredictable vascularity and malignant invasion of major vessels might be reasons. Conzo et al. reported a single case (0.79%) of adrenalectomy conversion out of 126 patients over a 12-year period. The reason for the conversion was suspected infiltration of the renal vessels (29).

Limitations of the study

The retrospective nature of the study with expected missing data is recognized as limiting factor. Another shortcoming is that the expertise of the surgeon performing the procedure and other circumstances associated with it were not evaluated. Such information would have helped to determine the basis of decision-making.

Conclusions

Overall, there was an increase in the incidence of MAS for the selected procedures at CHBAH from 2014 to 2019. In the common procedures group, cholecystectomy achieved the highest laparoscopy rate, whereas laparoscopic appendicectomies seemed to plateau around 40% of all appendicectomies. In the uncommon procedure group, the rate of thoroscopic thymectomy fares very well, whereas laparoscopic adrenalectomy shows an upward trend after an initial lag period. Furthermore, Other uncommon procedures (VAT, laparoscopic Whipples) are still in their infancy.

Recommendation

We suggest that similar studies be conducted in various teaching hospitals across South Africa to establish national trends in the performance of minimal access surgery.

References

- Gawande A. Two hundred years of surgery. *N Engl J Med.* 2012;366(18):1716-1723.
- Nguyen NT, Nguyen B, Shih A, Smith B, Hohmann S. Use of laparoscopy in general surgical operations at academic centers. *Surgery for Obesity and Related Diseases : Official Journal of the American Society for Bariatric Surgery.* 2013 Jan-Feb;9(1):15-20.
- Gyedu A, Fugar S, Price R, Bingener J. Patient perceptions about laparoscopy at Komfo Anokye Teaching Hospital, Ghana. *Pan Afr Med J.* 2015;20:422.
- Julianov A, Karashmalakov A, Stoyanov H, Georgiev Y. LAPAROSCOPIC SURGERY IN GENERAL SURGERY CLINIC – WHERE WE ARE?. *Trakia Journal of Sciences.* 2010;8:214-216.
- Negoi I et al. The laparoscopic approach in emergency surgery: A review of the literature. *J Acute Dis* 2018;7(1):15-19.
- Hirsch N, Hailey D. The evolution of laparoscopic surgery in routine health care. *Int J Technol Assess Health Care.* 1995;11(4):779-785.
- Alfa-Wali M, Osaghae S. Practice, training and safety of laparoscopic surgery in low and middle-income countries. *World J Gastrointest Surg.* 2017;9(1):13-18.
- Fouogue JT, Fouelifack FY, Fouedjio JH, Tchounzou R, Sando Z, Mboudou ET. First steps of laparoscopic surgery in a sub-Saharan African setting: a nine-month review at the Douala Gynaeco-Obstetric and Pediatric Hospital (Cameroon). *Facts Views Vis Obgyn.* 2017;9(2):105-110.
- Koto MZ, Matsevych OY, Mosai F, Balabyeki M, Aldous C. Laparoscopic management of retroperitoneal injuries from penetrating abdominal trauma in haemodynamically stable patients. *J Minim Access Surg.* 2019;15(1):25-30.
- Koto MZ, Matsevych OY, Motilall SR. The Role of Laparoscopy in Penetrating Abdominal Trauma: Our Initial Experience. *J Laparoendosc Adv Surg Tech A.* 2015;25(9):730-736.
- Koto MZ, Matsevych OY, Mosai F, Patel S, Aldous C, Balabyeki M. Laparoscopy for blunt abdominal trauma: a challenging endeavor. *Scand J Surg.* 2019;108(4):273-279.
- Bombil I, Maraj A, Lunda WS, Thomson J. Laparoscopy at Sebokeng Hospital with Emphasis on Trauma. *Global Journal of Medical Research.* 2014;14(4):1-7.
- Marshall D, Clark E, Hailey D. The impact of laparoscopic cholecystectomy in Canada and Australia. *Health Policy.* 1994;26(3):221-230.

14. Verdolin B, Pillay Y. Surgical audit of a single-surgeon experience with laparoscopic cholecystectomy in northern Saskatchewan, Canada. *Clinical Audit*. 2018;10:7-13.
15. Dai L, Shuai J. Laparoscopic versus open appendectomy in adults and children: A meta-analysis of randomized controlled trials. *United European Gastroenterol J*. 2017;5(4):542-553.
16. Mbatha SZ, Anderson F. Outcomes in laparoscopic cholecystectomy in a resource constrained environment. *S Afr J Surg*. 2016;54(3):8-12.
17. Mandrioli M, Inaba K, Piccinini A, et al. Advances in laparoscopy for acute care surgery and trauma. *World J Gastroenterol*. 2016;22(2):668-680.
18. Thomson JE, Kruger D, Jann-Kruger C, et al. Laparoscopic versus open surgery for complicated appendicitis: a randomized controlled trial to prove safety. *Surg Endosc*. 2015;29(7):2027-2032.
19. Bombil I, Lunda WS, Maraj A. Laparoscopic appendicectomy for complicated appendicitis at Sebokeng Hospital. *IOSR Journal of Dental and Medical Sciences*. 2015;14(12):65-69.
20. Bombil I, Lunda W.S, Ndjoze I. Trans-umbilical laparoscopic assisted appendicectomy. *IOSR. Journal of Dental and Medical Sciences vol 14*. 2015;14(4):42-46.
21. Mabula JB, Chalya PL. Surgical management of inguinal hernias at Bugando Medical Centre in northwestern Tanzania: our experiences in a resource-limited setting. *BMC Res Notes*. 2012;5:585.
22. Bhandarkar DS, Shankar M, Udwardia TE. Laparoscopic surgery for inguinal hernia: Current status and controversies. *J Minim Access Surg*. 2006;2(3):178-186.
23. Davis CS, Baldea A, Johns JR, Joehl RJ, Fisichella PM. The evolution and long-term results of laparoscopic antireflux surgery for the treatment of gastroesophageal reflux disease. *JSLs*. 2010;14(3):332-341.
24. Rossetti G, Limongelli P, Cimmino M, et al. Outcome of medical and surgical therapy of GERD: predictive role of quality of life scores and instrumental evaluation. *Int J Surg*. 2014;12 Suppl 1:S112-S116.
25. Ekpe EE, Eyo C. Determinants of mortality in chest trauma patients. *Niger J Surg*. 2014;20(1):30-34.
26. Ettinger DS, Riely GJ, Akerley W, et al. Thymomas and thymic carcinomas: Clinical Practice Guidelines in Oncology. *J Natl Compr Canc Netw*. 2013;11(5):562-576.
27. Mansmann G, Lau J, Balk E, Rothberg M, Miyachi Y, Bornstein SR. The clinically inapparent adrenal mass: update in diagnosis and management. *Endocr Rev*. 2004;25(2):309-340.
28. Switzer NJ, Gill RS, Karmali S. The evolution of the appendectomy: from open to laparoscopic to single incision. *Scientifica (Cairo)*. 2012;2012:895469.
29. Conzo G, Gambardella C, Candela G, et al. Single centre experience with laparoscopic adrenalectomy on a large clinical series. *BMC Surg*. 2018;18(1):2.