Perioperative outcomes of adrenal surgery: Does surgical specialty matter?

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ABSTRACT

Introduction: Management of adrenal disease requires a multidisciplinary approach often involving varied specialists. Surgical management has often overlapped between general surgeons, usually with an interest in surgical endocrinology, or urologists with minimally invasive surgical skills. The objectives of this study were to define perioperative outcomes of contemporary Canadian adrenal surgery, and determine whether those outcomes are impacted by surgical subspecialty. As a secondary outcome, an assessment of the variability in the indications for adrenal surgery was carried out between the two surgical subspecialties.
Methods: A retrospective chart review of all adrenalectomies performed at our center from August 2013 to August 2023 was conducted. The only exclusion criterion was when an adrenalectomy was performed secondary to the main procedure. Data was collected and grouped under four categories: patient characteristics, indications for an adrenalectomy, procedural statistics, and perioperative patient outcomes.
Results: A total of 121 adrenalectomies were performed in a period of just over 10 years. Of these, 103 were included in the analysis. Thirty-seven were performed by general surgery, whereas 66 were performed by urology. There were no significant differences in patients' age and Charlson comorbidity score between the two surgical specialties. The indications for the adrenalectomy were similar between the specialties, and were as follows: 32 (31.1%) for pheochromocytoma, 24 (23.3%) for a cortical functional lesion, 19 (18.4%) for a metastatectomy, 16 (15.5%) for size or growth, and 10 (9.7%) for adrenocortical carcinoma. There were no differences in overall operating room time or type of procedure. Most (89.3%) of the procedures were performed laparoscopically. Patients that were operated on by general

surgeons were more likely to be readmitted within 30 days than those operated on by urologists (five patients [13.5%] vs. one patient [1.5%], respectively, p=0.04), and more likely to require intensive care unit (ICU)/stepdown ICU admission (19 patients [51.4%] vs. 19 [28.8%], respectively, p=0.04). There was no difference in length of stay or postoperative complications. There was, however, one Clavien-Dindo 5 complication after a procedure performed by general surgery.

Conclusions: Most adrenalectomies at this one Canadian center are performed by urology. Indications for adrenalectomy are similar between the specialties. Although postoperative complication rates are similar, rates of 30-day readmission and ICU/stepdown admission were decreased when urologists performed adrenalectomies. Adrenalectomies may be performed safely by either specialty, and factors such as local expertise and surgical volumes are likely important.

INTRODUCTION

Adrenal masses are being diagnosed with increasing frequency, which is partially attributed to the increased utilization of axial cross-sectional imaging (1). Combined with the development of minimally invasive surgical techniques, this has led to an increase in the rate of adrenalectomies performed over the past several decades (2). Adrenalectomies have historically been performed by both general surgeons and urologists, with both specialties having expertise in the surgical anatomy of the retroperitoneum. However, proportionately fewer adrenalectomies have been performed by urologists over time (3), despite the lack of strong evidence to suggest that surgical subspecialty has an impact on patient outcomes following adrenalectomy (3, 4). In a Canadian context, adrenalectomies are performed by both specialties but very little is known about outcomes, trends over time, and patterns of practice.

The role of surgical specialty on patient outcomes has been documented in several other types of operations. Thoracic surgeons had lower operative mortality rates after esophageal cancer resection and lung resection than did other surgeons (5,6). In addition, vascular surgeons were found to have lower in-hospital mortality rates after carotid endarterectomy than did neurosurgeons and general surgeons (7).

Over the last decade, Kingston Health Sciences Centre (KHSC) has been the setting of over 100 adrenalectomies performed by both urologists, and general surgeons. Using a single-centre retrospective chart review, a comparative analysis of differences between specialties was carried out. The parameters examined included patient demographics and comorbidities, perioperative and postoperative outcomes, as well as complications rates. In addition, the indications for adrenalectomies were examined to determine whether any variability exists in practice between specialties.

METHODS

Data collection

This study was conducted as a single-center, retrospective, observational investigation at Kingston Health Science Centre (KHSC). We retrospectively examined the medical records of patients who underwent adrenalectomy between August 8, 2013, and August 8, 2023. The study did not limit participants based on age or other demographic characteristics. However, cases where adrenalectomy was a secondary procedure were excluded.

Comprehensive data were collected from clinical electronic medical records, pathology reports, and laboratory findings of all enrolled patients. Variables collected included patient age, indication for adrenalectomy, type of surgical procedure (open vs. laparoscopic), operating room duration, comorbidities, complications, interventions for complications, ICU admissions, 30-day readmissions, and the medical specialties involved in patient care. Additionally, the Clavien-Dindo classification and Charlson Comorbidity Index scores were determined for each patient.

The study protocol, amendments, and related documents received approval from the Queen's University Health Sciences & Affiliated Teaching Hospitals Research Ethics Board on July 19, 2023.

Outcomes

The primary objective was to investigate the variation in perioperative patient outcomes and operative metrics based on the surgical subspecialty performing the adrenalectomy. Key perioperative outcomes of interest included mortality, 30-day readmissions, ICU admissions, and post-surgical complications. Operative metrics of interest encompassed the type of surgical procedure (open vs. laparoscopic) and operating room utilization time. A secondary aim was to explore the differences in indications for adrenalectomy between procedures performed by urologists compared to those by general surgeons.

Statistical analysis

Continuous variables were described as means and SD, or as median and range values between patients who received adrenalectomies at KHSC based on surgical subspecialty. Categorical variables were expressed as counts and percentages. Pearson’s Chi-squared test and Welch Two Sample t-test were used to compare patient perioperative outcomes, operative statistics, and indications for adrenalectomy between surgical subspecialties. All statistical analyses were performed using R V.4.2.0 software, with $p<0.05$ considered statistically significant.

RESULTS

Between August 8, 2013, and August 8, 2023, Kingston Health Sciences Centre (KHSC) performed 121 adrenalectomies. Of these, 103 were eligible for inclusion in our study, with 18 excluded due to their designation as secondary procedures. Figure 1 indicates the breakdown of procedures performed by urologists and general surgeons. The demographic and clinical characteristics of the included patients are detailed in Table 1. Statistical analysis indicated no

significant differences in sex (p=0.7), age (p=0.3), tumour size as measured by pre-operative cross-sectional imaging, laterality, or Charlson Comorbidity Index (p=0.7) between the two groups.

Operative room parameters are outlined in Table 2 and were found to be similar between the two groups. 89.3% of the procedures were performed laparoscopically. Operating room times, which reflect surgical, anesthesia, and change-over time, were also similar between the procedures.

Perioperative outcomes, as shown in Table 3, revealed that 6 patients required readmission within 30 days post-operation. A higher likelihood of readmission was observed in patients who underwent surgery by general surgeons (5 patients or 13.5%) compared to those by urologists (1 patient or 1.5%) p=0.04. Additionally, the need for ICU/Step-Down unit admission was significantly higher in the general surgery group (19 patients or 51.4%) than in the urology group (19 patients or 28.8%), p=0.04. No significant differences were noted in the length of hospital stay or in the occurrence of postoperative complications. However, one instance of a Clavien-Dindo Grade 5 complication was reported following a procedure performed by the general surgery department.

The indications for adrenalectomy were broadly consistent across both surgical specialties, including Pheochromocytoma (32 cases or 31.1%), cortical functional lesions (24 cases or 23.3%), metastatectomy (19 cases or 18.4%), size or growth concerns (16 cases or 15.5%), and adrenocortical carcinoma (10 cases or 9.7%). (See Table 4)

DISCUSSION

This is a retrospective report on 103 adrenalectomies performed at one Canadian centre over the last ten years, comparing outcomes between procedures performed by urologists and general surgeons. There was no statistically significant difference between the groups in most outcomes of interest including surgical approach, operative room time, length of stay, and, Clavien-Dindo complication scores. Adrenalectomies may be performed safely by either specialty.

In this Canadian centre, most adrenalectomies are performed by urologists (64%) as opposed to general surgeons (36%). There are differences in the literature regarding the proportion of adrenalectomies performed by Urologists. National trends observed in the USA over 2003-2009, demonstrated that 60% of 23,746 adrenalectomies were performed by Urologists and 40% by General Surgeons, but there was a 15% decrease in the proportion of adrenalectomies performed by urologists over the study period (3). Conversely, a Nationwide Inpatient Sample between 1999-2005 identified that 28% were carried out by Urologists (9). More recent studies have shown figures ranging between 10% and 47% of adrenalectomies being performed by urologists (10,11).

Overall, complication rates for adrenalectomy are low at our centre, which may be attributed to its high-volume status, and the fact that 89% of the procedures were performed laparoscopically. A laparaoscopic approach has been found to result in lower complications. (13) However, there have been mixed results regarding the hospital-volume outcome relationship,

with a high volume centre being defined as >10 cases per year (14,15,16). Adrenal disease requires a multidisciplinary approach with the involvement of specialties such as endocrinology, advanced anesthesia, and genetics which are more likely to be available at high volume centres. No differences in complications, operating room time, and length of stay were observed between the specialties. Conversely, post-op ICU/Step Down Unit admission, and 30-day readmission were higher when general surgeons performed the procedure. There have been conflicting reports on this in the literature. Complications and length of stay were found to be higher when urologists performed the procedure in one series (9). However, this effect disappeared on multivariate analysis, and only surgical volume mattered. Conversely, no differences were observed in complications, and, length of stay between specialties in a more contemporary series. (11) A recent survey of Canadian practice indicated that up to 11.5% of practitioners routinely admit pheochromocytoma cases to the ICU as a personal preference or as a result of an institutional practice. (12)

Independent of specialty, surgeon volume has been found to positively impact patient outcomes in adrenal surgery. (9,10,16). With high-volume generally being defined as more than 4 cases per year, high volume surgeons tended to have lower complication rates, decreased length of stay, and lower costs. (16) Some series found that urologists were more likely to be lower volume, and less likely to perform the procedure at academic institutions. (9,10) This is in contrast to our series; where only one surgeon, a urologist, was found to maintain the high-volume definition of more than 4 cases per year over the entire study period.

One unique aspect of this study is that the proportion of adrenalectomies performed laparoscopically is elevated at 89% with no difference between the two specialties. Other reports on this topic found the rate of minimally invasive adrenalectomy to range between 14% and 27% (3,10,16). The rate seems to go up when the procedure is performed by high volume surgical endocrinologists compared to urologists, and general surgeons, but even then, that rate remains low at 34.8%. (10) One report observing trends found that the uptake of minimally invasive adrenalectomy lags behind other extirpative procedures with a 4% increase over a 10-year period (2002-2011). (3) In addition, no increase in the laparoscopic approach was observed for adrenalectomies performed for malignant indications. There is a need for more contemporary series to keep track of this trend of uptake of laparoscopy for adrenalectomy.

In this series, no statistically meaningful differences were observed between urologists and general surgeons in indications for adrenalectomies. It appears the pattern of practice is fairly similar. A previous report found that urologists performed higher proportions of malignant cases than general surgeons (9). In the current series, as opposed to a large national database, we had the ability of eliminating secondary adrenalectomies such as removal of the adrenal gland during a radical nephrectomy. This may partially explain the similar number of adrenalectomies performed for malignant indications observed here.

Being a shared procedure, concerns have been raised that both general surgery and urology residents are under-exposed to adrenalectomies during their training. In 1996, Harness et

al examined the Resident Statistic Summaries (Report C) of the Residency Review Committee for general surgery from 1986 to 1994. They found that the average number of adrenalectomies performed per general surgery resident was 0.98.(17) An updated analysis of the same data source from 1994 to 2004 showed an increase in the average number of adrenalectomies performed per general surgery resident to 1.46.(18) A 2005 survey of 372 residents and 56 program directors in urology throughout the United States showed that only 52% of urology chief residents had performed a laparoscopic adrenalectomy during their training.(19) Another report suggested that the number of minimally invasive adrenalectomies performed by Canadian and American urology residents has increased between 2004 and 2009. (20) However, those numbers remain fairly low on both sides of the border with an increase from 0.68 to 2.53 cases per resident per year for Canadian residents, and 1.65 to 1.79 cases per resident per year for American residents. With such low exposure numbers for both specialties during residency training, adrenalectomy may be best reserved for fellowship trained specialists in surgical treatment of adrenal disease. That expertise can be gained by a general surgeon through a surgical endocrinology fellowship, or a urologist with a minimally invasive fellowship with exposure to adrenal surgery.

The limitations of our findings include those inherent to any retrospective, single centre study. The results of this one academic institution may not be generalizable to other Canadian centres. Local expertise, regardless of surgical specialty, may matter more. Despite this, this report provides interesting and revealing data on a procedure claimed by two surgical specialties, yet not entirely owned by either. Future reports from large Canadian databases or multi-centre studies are needed to provide a fuller picture of the state of contemporary adrenal surgery in Canada.

CONCLUSIONS

Most adrenalectomies at this one Canadian centre are performed by urology. Indications for adrenalectomy are similar between the specialties with a high penetration of minimally invasive surgery. Although postoperative complication rates are similar, rates of 30-day readmission, and ICU/Step down admission were decreased when urologists performed adrenalectomies. Adrenalectomies may be performed safely by either specialty, and factors such as local expertise and surgical volumes are likely more important. Larger, and multi-centre series of surgical management of adrenal disease are needed to draw a more wholesome picture of contemporary Canadian practice.

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FIGURES AND TABLES

Figure 1. Distribution of adrenalectomies between urology and general surgery. KHSC: Kingston Health Sciences Center.

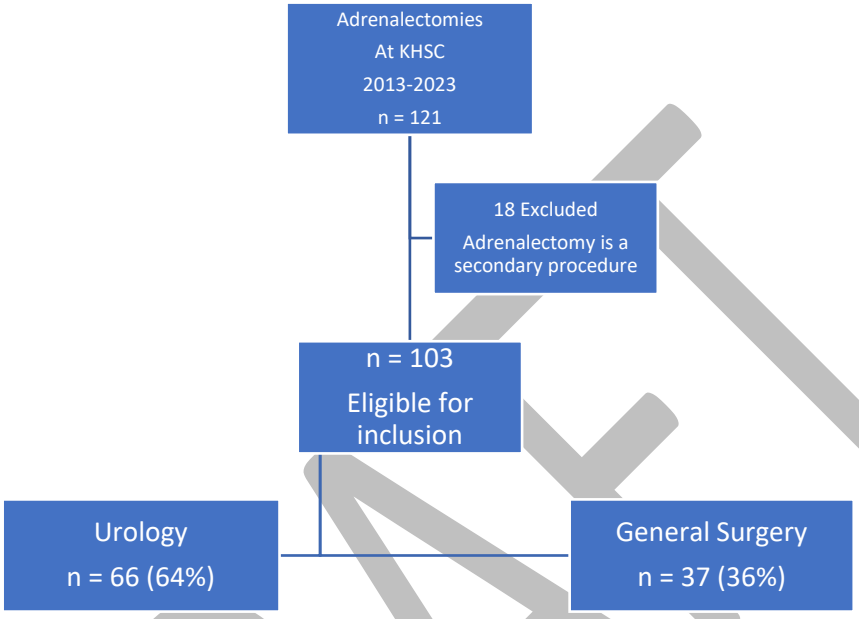

Table 1. Characteristics of patients by surgical subspecialty

Characteristic	General (n=37)	Urology (n=66)	p
Female (%)	59.5%	55.7%	0.7
Age			0.3
Range	13–78	26–79	
Median (IQR)	56 (47, 67)	60 (50.2, 66.8)	
Adrenal mass size (cm)			0.9
Range	0–15	0–14.1	
Median (IQR)	3 (1.7, 5.5)	3.5 (1.7, 5.0)	
Laterality (% right)	40.5%	48.5%	0.8
Charlson comorbidity score			0.7
Range	0–10	2–12	
Median (IQR)	4.0 (3.0, 6.0)	4.5 (3.0, 6.0)	

IQR: interquartile range.

Table 2. Operative outcomes by surgical subspecialty			
Characteristic	**General (n=37)[a]**	**Urology (n=66)[a]**	**p[b]**
Operating room time (minutes)			0.7
Range	158 - 618	123 - 490	
Median (IQR)	235 (206, 296)	256 (211, 302)	
Surgical approach			0.4
Laparoscopic	31 (83.78%)	61 (92.42%)	
Open	5 (13.51%)	4 (6.06%)	
Open/laparoscopic	1 (2.70%)	1 (1.52%)	

[a]n (%). [b]Welch two sample t-test; Pearson's Chi-squared test. IQR: interquartile range.

Table 3. Perioperative outcomes by surgical subspecialty			
Characteristic	**General (n=37)[a]**	**Urology (n=66)[a]**	**p[b]**
30-day readmission	5 (13.5%)	1 (1.5%)	**0.04**
ICU/Stepdown admission			**0.04**
Yes	19 (51.4%)	19 (28.8%)	
No	18 (48.6%)	47 (71.2%)	
Clavien-Dindo score			0.4
0	23 (62.2%)	49 (74.2%)	
1	6 (16.2%)	8 (12.1%)	
2	5 (13.5%)	6 (9.1%)	
3	2 (5.4%)	1 (1.5%)	
4	0 (0.00%)	2 (3.0%)	
5	1 (2.7%)	0 (0.0%)	
Length of stay (days)			0.07
Range	1.00 - 50.00	1.00 - 9.00	
Median (IQR)	3.0 (2.0, 4.0)	2.0 (1.0, 3.0)	

[a]n (%). [b]Pearson's Chi-squared test; Welch two sample t-test. ICU: intensive care unit; IQR: interquartile range.

Table 4. Indications for adrenalectomy by surgical specialty			
Indication	**General (n=37)**	**Urology (n=66)**	**p**
			0.2
Pheochromocytoma	12 (32.4%)	20 (30.3%)	
Functional adrenal lesion	5 (13.5%)	19 (28.8%)	
Metastases	9 (24.3%)	10 (15.2%)	
Size/growth	5 (13.5%)	11 (16.7%)	
Primary adrenocortical carcinoma	4 (10.8%)	6 (9.1%)	
Other	2 (5.4%)	0 (0.0%)	