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Adrenal

Fifteen years of adrenalectomies: impact of specialty training and operative volume

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Background. Previous associations between surgeon volume with adrenalectomy outcomes examined only a sample of procedures. We performed an analysis of all adrenalectomies performed in New York state to assess the effect of surgeon volume and specialty on clinical outcomes.
Methods. Adrenalectomies performed in adults were identified from the New York Statewide Planning and Research Cooperative System from 2000–2014. Surgeon specialty, volume, and patient demographics were assessed. High volume was defined using a significance threshold at ≥4 adrenalectomies per year. Outcome variables included in-hospital mortality, duration of stay, and in-hospital complications.
Results. A total of 6,054 adrenalectomies were included. Median patient age was 56 years; 41.9% were men and 68.3% were white. Urologists (n = 462) performed 46.8% of adrenalectomies, general surgeons (n = 599) performed 35.0%, and endocrine surgeons (n = 23) performed 18.1%. Significantly more endocrine surgeons were high-volume compared with urologists and general surgeons (65.2% vs 10.2% and 6.7%, respectively, P < .001). High-volume surgeons had significantly lower mortality compared with low-volume surgeons (0.56% vs 1.25%, P = .004) and a lower rate of complications (10.2% vs 16.4%, P = < .001). Endocrine surgeons were more likely to perform laparoscopic procedures (34.8% vs 22.4% general surgeons and 27.7% US, P < .001) and had the lowest median hospital duration of stay (2 days vs 4 days general surgeons and 3 days urologists, P < .001). After risk adjustment, low surgeon volume was an independent predictor of inpatient complications (odds ratio = 0.96, P = .002).
Conclusion. Patients with adrenal disease should be referred to surgeons based on adrenalectomy volume regardless of specialty, but most endocrine surgeons that perform adrenalectomy are high-volume for the procedure.

With more widespread use of computed tomography and improved image resolution, adrenal masses are being diagnosed with increasing frequency in the United States.[1] The rising prevalence of adrenal incidentalomas and development of minimally invasive surgical techniques has resulted in an increased adrenalectomy rate throughout the past few decades.[2] Although adrenalectomy is associated with an overall low mortality rate (<1%), studies have shown that complication rates can range anywhere from 8% to 20% and mean hospital lengths of stay (LOS) can stretch to upwards of 8 days.[3,4] These large ranges in complication rate and LOS may in part be due to differences in surgeon volumes. The relationship between surgeon volume and patient outcomes has been examined across a wide variety of procedures including thyroidectomy, pancreaticoduodenectomy, coronary artery bypass grafting, abdominal aortic aneurysm repair, and esophagectomy, and has consistently shown a significant positive association.[5-10]

Prior studies of the relationship between surgeon specialty and patient outcomes for adrenalectomy have demonstrated mixed results likely due to the limitations of the patient databases used in these studies.[11-13] The state of New York created the Statewide Planning and Research Cooperative System (SPARCS) database, which allows analysis of outcomes from all patients in the state. More importantly, this database contains specific individual surgeon identifiers. Therefore, we aimed to determine whether further characterization of surgical subspecialty in addition to surgeon volume influences patient adrenalectomy outcomes.

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Methods

Data source

The New York SPARCS inpatient database was utilized to capture patients undergoing surgery from 2000–2014. SPARCS is a database for the state of New York that captures all patients and payers and collects information on patients, treatments, and providers for every emergency department admission, inpatient admission, hospital discharge, outpatient visit, and ambulatory surgery appointment.

Patient population

Adult patients (≥18 years old) undergoing adrenalectomy were the focus of this analysis. Adrenalectomy procedures were selected based on their *International Classification of Diseases, Ninth Revision, Clinical Modification (*ICD-9*)* procedure code, including partial, unilateral, and bilateral adrenalectomy (ICD-9 codes 07.29, 07.22, 07.3). Patients who underwent adrenalectomy in the setting of trauma, liver transplantation, renal malignancy, or as part of a urologic procedure without a diagnosis of primary adrenal disease were excluded. Patient comorbidities were standardized through calculation of the Charlson Comorbidity Index (CCI).[14]

Surgeon identification and characteristics

Unique surgeon identifiers in SPARCS (NY state physician license number) were utilized to identify surgeons. Surgeon specialty designations were determined as follows: urologists (US) were identified as those surgeons who had performed a prostatectomy, cystectomy, and cystoscopy in a year for ≥2 consecutive years. This narrower definition of identifying urologists in a large dataset was utilized after the method used by Park et al[13] misidentified some general surgeons as urologists. All surgeons in this study population that were registered as active or candidate members in the American Association of Endocrine Surgeons (AAES) database[15] were included in the group of endocrine surgeons (ES). All other surgeons who were not urologists or endocrine surgeons were classified as general surgeons (GS).

Independent variables

Surgeon specialty and surgeon volume were the 2 primary independent variables in this study and were treated as categorical variables. High volume surgeons were defined as those who perform ≥4 adrenalectomies per year as described by Park et al.[13] Adrenalectomies were further categorized as unilateral, bilateral, or partial; and technique was classified as minimally invasive (laparoscopic or robotic) or open. Although there are no specific codes for laparoscopic adrenalectomy, previously published methodology[13] was utilized to combine the code for laparoscopy or robotic-assisted laparoscopy of the abdomen with the code for adrenalectomy to identify these procedures.

Patient demographic variables included age, race, ethnicity, payer status. Hospital level variables included teaching hospital status (i.e., affiliated with a general surgery residency program) and whether the hospital was in New York City.

Outcome variables

The primary outcome variable was in-hospital complication. Complications were categorized as postoperative shock, hemorrhagic, infectious/wound, cardiovascular, respiratory/ventilator-associated complications, enteric fistula/leak, adrenal insufficiency, urinary, and other (including retained foreign body; Appendix A). Secondary outcome variables were LOS and in-hospital mortality.

Statistical analysis

Bivariate analysis of the independent variables with the outcomes of interest were performed using the χ^2 test for categorical variables and analysis of variance for continuous variables. Multivariable logistic regression was utilized for adjusted analysis of complications and mortality. Multivariable linear regression was used for LOS. Data analysis and management were performed using a statistical software program (Stata, version 13.0, StataCorp, College Station, TX). The Institutional Review Board deemed this study exempt from review.

Results

Patient and provider characteristics

Between January 1, 2000, and December 31, 2014, 9,385 adult patients were identified in the SPARCS database as having a procedure code for adrenalectomy. One hundred thirty patients were excluded based on the likelihood that adrenalectomy was performed in the setting of trauma. Four patients were excluded on the likelihood that adrenalectomy was performed in the setting of liver transplantation. Patients were also excluded based on the likelihood that the adrenalectomy was performed as part of a primary urological procedure ($n = 3,197$).

A total of 6,054 adrenalectomies were included in the analysis. Overall, 671 (11.1%) of patients experienced at least 1 complication after adrenalectomy, and 51 patients died (0.84%). Median LOS was 3 days (interquartile range [IQR] 2–6) with a mean and standard deviation of 5.3 ± 8.6 days. Hemorrhage accounted for 34.1% of all complications, followed by pulmonary (23.5%), cardiac (18.9%), infectious (11.3%), adrenal insufficiency (10.3%), urinary (9.8%), and wound disruption (1.9%) events (see Appendix A for a list of the ICD-9 codes for each complication).

The majority of patients were female, white, insured by a private insurance carrier, underwent adrenalectomy for a benign neoplasm, had a unilateral adrenalectomy, and had an open operation. Most adrenalectomies were performed at teaching hospitals and in NYC. The distribution of patient demographics and other comorbidities is shown in Table I.

There were 2,839 adrenalectomies performed by 462 US (46.9%), 1,098 by 23 ES (18.1%), and 2,117 by 599 GS (35.0%; Table II). The majority of patients were white and female among all surgeon groups. Endocrine surgeons tended to operate on patients with private insurance, low preoperative comorbidities, and with primary endocrine disorders of the adrenal gland significantly more often than general or urologic surgeons. General surgeons were more likely than ES or US to operate on nonwhite patients, and US also were more likely than GS or ES to operate on patients with high CCI or nonprivate insurance. Endocrine surgeons also operated more frequently at teaching hospitals, in New York City, and used minimally invasive techniques more often.

Surgeon volume

Median annual surgeon volume was 1 case (IQR 1–2) with a mean of 2.1 cases, and a range of 1 to 29 cases. Approximately 65.2% of ES were high volume surgeons compared with 10.2% of US and 6.7% of GS ($P < .001$). Additionally, ES performed a significantly higher median number of adrenalectomies/year (5 [range 1–29, IQR 6–18] ES versus 1 US [range 1–21, IQR 1–5] versus 1 GS [range 1–14, IQR 1–4], $P \leq .001$). Within surgeon subspecialty, there was a greater proportion of high volume ES performing adrenalectomies (97.8%) compared with GS (44.4%) and US (54.9%; $P < .001$).

A significantly greater number of high volume surgeons practice in teaching hospitals (77.6% vs 22.5%, $P < .001$) or in New York