Evaluating cumulative and annual surgeon volume in laparoscopic cholecystectomy

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Background. *Although there is a large body of published data demonstrating improved outcomes for complex operations when performed by high-volume surgeons at high-volume hospitals, the literature is mixed regarding whether this same relationship applies in less complex and more common surgeries such as laparoscopic cholecystectomy.*

Methods. *This study utilized the New York State Department of Health Statewide Planning and Research Cooperative System database to identify patients undergoing laparoscopic cholecystectomy for acute and chronic biliary pathology. Rates of perioperative outcomes were compared among 4 distinct categories of surgeons based on surgeon annual and cumulative volume: low cumulative/low annual, low cumulative/high annual, high cumulative/low annual, and high cumulative/high annual.*

Results. *A total of 150,938 patients undergoing operation by 3,306 surgeons at 250 hospitals across New York state were included for analysis from 2000–2014. There was no difference in adjusted 30-day in-hospital mortality, major events, procedural complications, bile duct injury, or reintervention rates between the 4 groups of surgeons. However, patients undergoing operation by high cumulative/high annual volume surgeons were less likely to experience 30-day readmission, prolonged duration of stay, and high charges when compared with low cumulative/low annual volume surgeons.*

Conclusion. *In New York state, increased surgeon annual and cumulative volume predicts lower rates of 30-day readmission, prolonged duration of stay, and high charges in laparoscopic cholecystectomy, but has no effect on in-hospital mortality, major events, bile duct injury, procedural complications, or reintervention. There is no evidence to support regionalization of this procedure as operative outcomes are comparable even in less experienced hands. (Surgery 2016;■:■-■.)*

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Gallbladder disease affects up to 25 million Americans and costs the US health care system approximately $6.2 billion annually.[1] In fact, >1 million laparoscopic cholecystectomies are performed annually, making it the most common elective abdominal procedure performed in the United States.[2]

Although there is a large body of published data demonstrating improved outcomes for complex operations, such as rectal or esophageal cancer resection, when performed by high-volume surgeons at high-volume hospitals,[3-5] the literature is mixed regarding whether this same relationship applies in less complex and more common operations such as laparoscopic cholecystectomy.[6-19] Studies investigating these issues have focused largely on either inpatient or outpatient settings as well as hospital or surgeon annual volume; no large database studies have evaluated both inpatient and outpatient settings, and few have evaluated the role of surgeon cumulative volume.[17-19] In fact, no study has investigated the relationship of the effect of annual and cumulative surgeon volume on outcomes for laparoscopic cholecystectomy.

Accordingly, we sought to evaluate the role of individual surgeon annual and cumulative volumes on perioperative outcomes after laparoscopic cholecystectomy.

METHODS

Data source. This study utilized the New York State Department of Health Statewide Planning

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and Research Cooperative System (SPARCS) database. The SPARCS database assigns each patient and surgeon a unique identifier and collects patient demographics, diagnoses and procedures as well as hospital measures, such as charges and duration of stay from every inpatient, outpatient, ambulatory operation, and emergency department admission in New York state, regardless of patient age or insurance status. This allows for longitudinal analyses.

Study population. To capture both inpatient and outpatient procedures, patients were identified based on International Classification of Diseases (ICD)-9 diagnosis and procedure codes as well as Current Procedural Terminology (CPT) codes from both inpatient and ambulatory operation databases. Patients were selected if they had a diagnosis of acute (acute calculous cholecystitis, gallstone pancreatitis, cholangitis) or chronic biliary pathology (cholelithiasis, chronic cholecystitis) as done in prior studies[20] (online only Supplementary Table I) and if they also underwent 1 of the following procedures: laparoscopic cholecystectomy (ICD-9 51.23, 51.24 or CPT 47562), intraoperative cholangiogram (ICD9 87.53), or laparoscopic cholecystectomy with cholangiography (CPT 47563). Patients who underwent operation with a diagnosis code of both acute and chronic biliary pathology were considered to have acute on chronic biliary pathology. All cases of malignant biliary pathology were excluded from analysis.

Patient demographics collected included sex, insurance status (Medicare, Medicaid, commercial, other), comorbidities, diagnosis, elective versus emergent procedure, and procedure type. Hospital volume also was analyzed and was categorized as the average number of laparoscopic cholecystectomies performed per year broken into tertiles (low-volume hospitals 1–212 cases; medium-volume hospitals 213–333 cases; and high-volume hospitals ≥334 cases). Hospitals were further classified as urban (location population of >10,000) or rural (<10,000) or academic medical (teaching hospital versus non-teaching hospital versus missing) centers by linking to American Hospital Association hospital database.

Surgeon volume. Surgeon data was compiled through the SPARCS system using a unique identifier for surgeons active from 1995–2014. Surgeons were analyzed based on their cumulative volume and their annual volume in New York state, which was defined as a time frame of 5 years and 1 year, respectively, prior to the index case of laparoscopic cholecystectomy being analyzed. Surgeons must be present in the state for at least 4 years during this 5-year time period to be included for the cumulative volume analysis. Surgeons were delineated into 2 categories (high versus low) for both cumulative and annual volumes based on whether their volume was above or below the median number for the entire cohort, respectively. Low cumulative (LC) and high cumulative (HC) surgeons were defined as surgeons who performed 1–103 procedures and ≥103 procedures, respectively. Additionally, low annual (LA) and high annual (HA) surgeons were defined as surgeons who performed 1–19 procedures and ≥19 procedures, respectively. This model of analysis has been used in previous outcomes assessments[3] and allows for comparison among 4 different groups of surgeons: LC/LA, LC/HA, HC/LA, and HC/HA.

Outcomes and variable definitions. Outcomes of this study included in-hospital mortality, major events (acute myocardial infarction, stroke, pulmonary embolism, and shock), conversion to open (V64.4, V64.41), procedural complications and bile duct injury (online only Supplementary Table I), 30-day reintervention, 30-day readmission, total hospital charges, and duration of stay. As there is no ICD-9 diagnosis code to capture bile duct injury, we used a methodology similar to that reported by Csikesz et al[7] consisting of a ICD-9 procedure codes for repair of bile duct (51.7x), choledochoenterostomy (51.36), and other bile duct anastomosis (51.39). These methods capture all of the procedures that would need to be performed to repair a bile duct injury and are coded routinely.

Duration of stay for ambulatory procedures was included for analysis and was calculated as the difference between discharge date and admission date. High charges and prolonged duration of stay were both defined as being above the 75th quartile for the entire cohort. Reintervention was defined as procedures performed within 30 days of the index procedure. Readmission was defined as admission to an inpatient setting within 30 days of the index admission. In addition, 30-day readmission and reintervention rate calculations excluded patients who underwent operation in December 2014 because we do not have data from 2015 and therefore would not know if they experienced a readmission within 30 days in January 2015.

Statistical analyses. Trends in overall number of procedures and percentage of biliary admissions undergoing operation over time were assessed using Poisson regression. The trend in number of procedures performed by surgeons of different