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Laparoscopic subtotal cholecystectomy compared to total cholecystectomy: a matched national analysis



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ABSTRACT

Background: Laparoscopic subtotal cholecystectomy (LSC) is considered a safe alternative to laparoscopic cholecystectomy (LC) if biliary anatomy is obscured by inflammation. While case series studies have observed low morbidity rates with LSC, the impact of operative conversion on patient outcomes is poorly understood.

Methods: A national analysis of all patients who underwent LC or LSC from 2009 to 2013 was performed using the University HealthSystem Consortium database. A 1:1 propensity score match was used to compare procedural outcomes accounting for clinical and demographic factors. Matched samples had <10% standardized differences of each baseline covariate.

Results: A total of 131,082 LC and 487 LSC were performed during the study period. Compared with LC, patients undergoing LSC were more likely to be older (56 versus 48 years), male (54.2% versus 32.3%), and have higher severity of illness scores on admission (9.2% versus 3.5% extreme severity of illness; $P < 0.001$ each). LSC patients had a prolonged hospital length of stay (LOS, 4 versus 3 days), greater total direct cost (\$9053 versus \$6398), higher readmission rates (11.9% versus 7.0%), and higher mortality rates (0.82% versus 0.28%, $P < 0.05$ each). After matching, the difference in total direct cost persisted (\$9053 versus \$7,581, $P < 0.001$), but there were no differences in hospital LOS, readmission rates, or overall mortality.

Conclusions: LSC is an important alternative to LC for the difficult gallbladder. Conversion to LSC is associated with increased patient morbidity and resource utilization leading to perceived poor outcomes, but this is due to patient factors at initial presentation. Health care providers should consider LSC if the patient may be at risk for iatrogenic injury to the biliary tract.

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Introduction

Diseases of the gallbladder constitute a significant public health burden in developed countries. Over 20 million people suffer from gallbladder-related afflictions in the United States alone,¹ and approximately, 750,000 cholecystectomies are performed each year.² As the most common abdominal operation performed in the US, cholecystectomy ranks among the top three emergent surgical procedures contributing to the national health care burden.³ Not surprisingly, advocates for surgical quality improvement have identified cholecystectomy as a key target for health care cost reduction efforts.

A major focus of these efforts is the prevention of surgical complications.^{4,5} Nearly 2% of cholecystectomy procedures develop complications,⁶ amounting to an additional \$6.5 billion of health care spending for this procedure alone.⁷ The most feared complication of cholecystectomy is injury to the common bile duct (CBD). With misidentification of biliary anatomy as the leading risk factor for CBD injury,^{8,9} surgeons are faced with a unique challenge in gallbladders obscured by inflammatory changes. Thus, to prevent iatrogenic injury, one may convert to an open procedure for improved surgical exposure, or a laparoscopic subtotal cholecystectomy (LSC) may be performed instead. Although LSC has the advantage of obviating the need for a laparotomy,¹⁰ the impact of conversion to LSC on hospital and patient outcomes is unclear.

Different methods of performing an LSC have been described in the literature, but the general operative technique can be summarized in four steps.¹¹ First, the free portion of the gallbladder is excised in a top-down manner, leaving a lip for protection against violating the hepatocystic triangle. Second, the posterior remnant of the gallbladder is left in situ, and its mucosa is ablated. Third, the cystic duct orifice is identified and closed from the luminal side using a purse-string suture. Finally, a drain is left in place for detection of biliary leakage. Several case series studies have observed low rates of complications after LSC, including biliary leakage, CBD injury, and retained choleliths, but these studies have been limited by small sample sizes.¹²⁻¹⁴

In the present study, we performed a national-level analysis of outcomes between laparoscopic cholecystectomy (LC) and LSC. Propensity score matching was used to compare outcomes while accounting for patient factors. Primary end points were in-hospital mortality, 30-day readmission rates, hospital length of stay (LOS), and total direct cost.

Methods

Study population

A retrospective cohort analysis was performed using the University HealthSystem Consortium (UHC) database. All patients who underwent LC and LSC from January 1, 2009 to December 31, 2013 were identified via International Classification of Diseases, Ninth Revision (ICD-9) codes 51.23 and 51.24, respectively. For separate analysis, open cholecystectomy procedures performed during the study period were identified via ICD-9 code 51.22. The UHC is an alliance of 98

academic medical centers across the US, along with 143 medical institutions affiliated with these centers. Thus, the UHC clinical data set represents the national experience and has been validated with providing reliable patient-level and intervention-specific data for health service research.¹⁵

Variables defined

The following patient characteristics were collected for all included patients: age (years), sex, race, severity of illness (SOI) scores, and primary payer. Hospital outcomes collected include in-hospital mortality, 30-day readmission rates, discharge destination, hospital LOS, and total direct cost (from admission to discharge).

Statistical analysis

Patient demographics and outcomes were compared between LC and LSC. Categorical variables were analyzed using Pearson's chi-squared test and expressed as *n* (%), whereas continuous variables were analyzed using the Wilcoxon rank-sum test and expressed as median (interquartile range). A *P*-value of less than 0.05 was used to determine statistical significance. A 1:1 matched pair analysis using propensity scores was done between 487 LSC patients and corresponding LC patients during the same period. Propensity scores were created using logistic regression. The predicted probabilities from this model served as propensity scores, which were then used in an SAS macro to form matched pairs between LSC patients group and LC patients. The balance in the baseline characteristics between the two groups was assessed by testing for within-pair differences in baseline covariates. The McNemar's test was used to assess within-pair differences in the matched samples for binary outcomes, whereas the Wilcoxon signed rank test was used for continuous outcomes.

To determine whether LSC or open cholecystectomy was a safer alternative procedure, a multivariate analysis was performed accounting for the following patient factors: age, sex, race, SOI scores, and primary payer. Outcomes after LSC and open cholecystectomy were compared to LC as a reference. Gamma regression techniques were used to identify predictors of perioperative cost; logistic regression techniques for 30-day readmission; and Poisson regression techniques for hospital LOS. The data were analyzed using the statistical package SAS 9.4 and JMP Pro 11 (SAS Institute, Cary, NC). All patient data used in the study were deidentified before acquisition and analysis. Informed consent was waived because data were blinded across multiple institutions. This study was approved by the University of Cincinnati Institutional Review Board, and conducted in accordance with their criteria.

Results

A total of 131,082 patients underwent LC, and 487 underwent LSC during the study period. Patient characteristics are detailed in [Table 1](#). Compared with LC patients, those converted to LSC were more commonly male (54.2% versus 32.3%),

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