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Impact of hospital volume on outcomes for laparoscopic adhesiolysis for small bowel obstruction



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ABSTRACT

Background: Volume-to-outcome data have been studied in several complex surgical procedures, demonstrating improved outcomes at higher volume centers. Laparoscopic lysis of adhesions (LLOA) for small bowel obstruction (SBO) may result in better outcomes, but there is no information on the learning curve for this potentially complex case. This study evaluates the effect of institutional procedural volume on length of stay (LOS), outcomes, and costs in LLOA for SBOs.

Materials and methods: The Nationwide Inpatient Sample data set between 2000 and 2013 was queried for discharges for a diagnosis of SBO involving LLOA in adult patients. Patients with intra-abdominal malignancy and evidence of any other major surgical procedure during hospitalization were excluded. The procedural volume per hospital was calculated over the period, and high-volume hospitals were designated as those performing greater than five LLOA per year. Patient characteristics were described by hospital volume status using stratified cluster sampling tabulation and linear regression methods. LOS, total charges, and costs were reported as means with standard deviation and median values. $P < 0.05$ was considered significant.

Results: A total of 9111 discharges were selected, which was representative of 43,567 weighted discharges nationally between 2000 and 2013. Over the study period, there has been a 450% increase in the number of LLOA performed. High-volume hospitals had significantly shorter LOS (mean: $4.92 \pm$ standard error (SE) 0.13 d; median: 3.6) compared to low-volume hospitals (mean: $5.68 \pm$ 0.06 d; median: 4.5). In multivariate analysis, high-volume status was associated with a decreased LOS of 0.72 d ($P < 0.0001$) as compared to low-volume status. Other significant predictors for decreased LOS included decreased age, decreased comorbidity, and the absence of small bowel resection. There was no significant association between volume status and total charges in multivariate or univariate models, but high-volume hospitals were associated with lower costs in multivariate models by approximately \$984 ($P = 0.017$).

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Conclusions: This study demonstrates that high hospital volume was associated with decreased LOS for LLOA in SBO. Although volume was not associated with differences in total charges, there was a small decrease in hospital costs.

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Introduction

Small bowel obstruction (SBO) is one of the most common surgical diagnoses, representing a substantial health care burden accounting for 12%-16% of surgical admissions, over two billion US dollars in expenditures, and 300,000 operations annually.¹ The primary cause of SBO is adhesive disease, with some reporting that up to 70% of SBO diagnoses are due to adhesions from prior surgery. SBO can be managed nonoperatively in some cases; however, others may require operative intervention if there is evidence for prolonged obstruction, peritonitis, ischemia, or clinical instability.²

With the proliferation of the laparoscopic cholecystectomy since the 1980's, there has been an increasing adoption for laparoscopic and minimally invasive surgery when clinically acceptable and technically feasible. There are data to suggest that when indicated, laparoscopic lysis of adhesions (LLOA) has been found to be safe and with significantly lower length of stay (LOS) and fewer postoperative complications, such as wound infection and pneumonia.²⁻⁸ Traditional contraindications for LLOA include significant abdominal and small bowel distension, peritonitis, hemodynamic instability, severe comorbidity; all of which may preclude pneumoperitoneum, and surgeon inexperience.^{2,9} Despite demonstrated benefits, there has yet to be global adoption of LLOA even among clinically appropriate patients with SBO.^{3,6}

Surgeon, and to some extent hospital, volume likely affects outcomes including LOS and cost. This is particularly true of more complex procedures. For example, there is ample literature suggesting that specialized procedures, such as pancreaticoduodenectomy, result in better outcomes when performed by high-volume centers. Similarly, Centers of Excellence designation is reported to improve outcomes for bariatrics and oncology.¹⁰⁻¹⁴ Given the lack of information regarding volume and LLOA outcomes, we sought to examine the effect that increased hospital volume has on outcomes in LLOA.

Methods

Study data set

The Healthcare Cost and Utilization Project (HCUP) Nationwide Inpatient Sample (NIS) data set between 2000 and 2013 was used for this study. The NIS represents the largest publicly available all-payer data set in the United States, containing several millions of discharges.¹⁵ Prior to 2012, the NIS was composed of a 20% stratified sample of US nonfederal short-term and other specialty hospitals, which can be used to make nationally representative estimates of health care utilization, trends, and outcomes.¹⁶ All investigators with access to the data have a signed Data-User Agreement with

HCUP. This study was approved as exempt from review by the Yale Human Investigations Committee.

Patient selection

The NIS includes patient information at the level of an individual hospital admission and discharge, with up to 25 *International Classification of Disease, ninth Revision, Clinical Modification* (ICD-9-CM) diagnosis codes and 15 ICD-9 procedure codes. Discharges of interest were identified by searching for an ICD-9-CM diagnosis code for SBO (ICD-9-CM 560.80, 560.81, 560.89, or 560.8) with a concomitant procedure code for LLOA surgery (ICD-9-CM procedure code 54.51). Patients who underwent concomitant small bowel resection (SBR) (ICD-9-CM procedure codes 45.61, 45.62, 45.90, or 45.91) were identified and included in regression analysis. To facilitate the manipulation of a multiple ICD-9-CM diagnosis or procedure codes simultaneously, HCUP has designed Clinical Classification Software (CCS) codes, which categorize multiple codes into a single diagnosis or procedure group. These were used to identify exclusion diagnoses or procedures. Discharges were excluded if the patient had a diagnostic code for a primary gastrointestinal malignancy (CCS codes 12-18), was aged less than 18 y or greater than 90 y, or was missing information on patient sex, mortality, or routine discharge status. Finally, patients were excluded if they had evidence of any other major operative procedure, which was identified by excluding any major procedure code other than those for LLOA or SBR.

Patient sex, age, and race were organized into categorical variables to facilitate analysis. Age was grouped as age 18-40 y, 41-60 y, 61-80 y, and 81-90 y. Race was grouped using NIS classifications of "white", "black", "Hispanic", "Asian/Pacific Islander", "other", or "missing." Given the high percentage of missing race data in the NIS over the study period, this variable was not used as a predictor variable in the regression models. The Deyo adaptation of the Charlson Comorbidity Index (CCI) was used to capture overall comorbidity.¹⁷ CCI was grouped as none (CCI 0), mild (CCI 1-3), and moderate/severe (CCI \geq 4).

Hospital volume was calculated by first identifying the number of LLOA procedures performed over the study period and calculating the unweighted average frequency of procedures performed by each hospital over the number of years that hospital was sampled. Due to changes in the sampling frame of the NIS in the 2012 and 2013 data sets, these years were excluded from the analysis of hospital volume. We next calculated quartiles of hospital volume and identified hospitals as high volume if they performed in the top quartile of all hospitals studied.

Primary outcomes were LOS, total charge, and total costs. The NIS provides total charges for each hospitalization, representing the amount billed for services. Hospital costs

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