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Morbidity related to concomitant adhesions in abdominal surgery

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ABSTRACT

Background: We sought to assess the independent effect of concomitant adhesions (CAs) on patient outcome in abdominal surgery.

Materials and methods: Using the American College of Surgeons National Surgical Quality Improvement Program data, we created a uniform data set of all gastrectomies, enterectomies, hepatectomies, and pancreatectomies performed between 2007 and 2012 at our tertiary academic center. American College of Surgeons National Surgical Quality Improvement Program data were supplemented with additional variables (e.g., procedure complexity—relative value unit). The presence of CAs was detected using the Current Procedural Terminology codes for adhesiolysis (44005, 44180, 50715, 58660, and 58740). Cases where adhesiolysis was the primary procedure (e.g., bowel obstruction) were excluded. Multivariable logistic regression analyses were performed to assess the independent effect of CAs on 30-d morbidity and mortality, while controlling for age, comorbidities and the type/complexity/approach/emergency nature of surgery.

Results: Adhesiolysis was performed in 875 of 5940 operations (14.7%). Operations with CAs were longer (median duration 3.2 *versus* 2.7 h, $P < 0.001$), more complex (median relative value unit 37.5 *versus* 33.4, $P < 0.001$), performed in sicker patients (American Society for Anesthesiologists class ≥ 3 in 49.9% *versus* 41.2%, $P < 0.001$), and harbored higher risk for inadvertent enterotomies (3.0% *versus* 0.9%, $P < 0.001$). In multivariable analyses, CAs independently predicted higher morbidity (adjusted odds ratio [OR], 1.35; 95% confidence interval, 1.13–1.61, $P = 0.001$). Specifically, CAs independently correlated with superficial and deep or organ-space surgical site infections (OR = 1.42 (1.02–1.86), $P = 0.036$; OR = 1.47 (1.09–1.99), $P = 0.013$, respectively), and prolonged postoperative hospital stay (≥7 d, OR = 1.34 [1.11–1.61], $P = 0.002$). No difference in 30-d mortality was detected.

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Conclusions: CAs significantly increase morbidity in abdominal surgery. Risk adjusting for the presence of adhesions is crucial in any efforts aimed at quality assessment and/or benchmarking of abdominal surgery.

1. Introduction

Peritoneal adhesions develop following more than 90% of abdominal surgical procedures [1]. The extent of adhesion formation is thought to be variable depending on the type, extent, and site of the abdominal procedure being performed [2,3]. Peritoneal adhesions are occasionally symptomatic, and patients may present with bowel obstruction, chronic abdominal or pelvic pain, or infertility several years after the original operation [4]. A study using the Agency for Healthcare Research and Quality (AHRQ) Healthcare Cost and Utilization Project data estimated that adhesive small bowel obstruction was diagnosed in almost 100,000 discharges every year and was responsible for more than 2000 deaths in the United States in 2005 alone [5].

Concomitant adhesions (CAs) may also affect the clinical outcomes of patients presenting for abdominal procedures other than adhesive bowel obstruction. The performance of additional adhesiolysis in these procedures may increase the risk of intraoperative complications and lead to higher laparoscopic to open conversion rates and a longer operative duration [6–8]. However, the postoperative morbidity attributable to CAs is largely unknown, and limited literature exists that assesses the independent or attributable effect of adhesiolysis on postoperative complications [8–10]. We sought to assess the independent effect of CAs and adhesiolysis on postoperative outcomes in abdominal surgery.

2. Methods

2.1. Patient population

Our prospectively collected institutional National Surgical Quality Improvement Program (ACS-NSQIP) database was queried to identify patients who underwent abdominal surgery under general anesthesia between January 2007 and October 2012. All patients undergoing partial or total stomach resection (Current Procedural Terminology [CPT] codes: 43610–43634, 43644, 43645, 43775, 43820–43865), small or large bowel resection (CPT codes: 44120–44160 and 44187–44661), partial liver resection (CPT codes: 47120–47130), and partial or total pancreatic resection (CPT codes: 48105–48155 and 48520–48548) were included. Cases where adhesiolysis was the primary operation (e.g., for small bowel obstruction) were excluded.

2.2. NSQIP data

The NSQIP methodology has been previously described and validated [11]. In brief, a trained surgical nurse systematically reviews medical records of eligible patients who underwent noncardiac surgery. Sixty preoperative and 18 intraoperative patient variables are systematically collected and recorded. Twenty surgical complications are tracked up to 30 d postoperatively. Mortality is defined as death within 30 d postoperatively, and morbidity is defined as the occurrence of at least one complication within 30 d postoperatively [12,13].

2.3. Concomitant adhesions

The presence of CAs was determined by querying the NSQIP-linked administrative database for all concomitant CPT codes for adhesiolysis (44005, 44180, 50715, 58660, and 58740).

2.4. Operative complexity

Operative complexity was assessed using each procedure's relative value unit (RVU, by the Centers for Medicare and Medicaid Services Resource Based Relative Value Scale) based on the CPT codes. The total RVU of each case was calculated by summing the RVUs of the individual procedures performed within each case, excluding adhesiolysis. Despite their shortcomings, work RVUs have been recently suggested to better predict surgical outcomes when compared with complexity scores established by panels of surgical subspecialists [14,15]. Similarly, they have been shown in multiple ACS-NSQIP studies to independently predict postoperative morbidity in general surgery [16–18].

2.5. Intraoperative enterotomies

The occurrence (or not) of an inadvertent enterotomy was determined by (1) screening all cases using the *International Classification of Diseases, Ninth Revision, Clinical Modification*–based algorithm for "Accidental Puncture or Laceration" (the 15th AHRQ Patient Safety Indicator), followed by (2) systematic review of flagged operative reports by two investigators (M.M. and H.K.) [19]. The false negative rate of Accidental Puncture or Laceration has been estimated to be <5%–7% [20].

2.6. Univariable and multivariable analyses

Univariable analyses were initially performed to compare patients with and without CAs. Multivariable logistic regression models were then developed to assess the independent impact of CAs on postoperative morbidity and mortality, while controlling for the pertinent preoperative and intraoperative variables. All available variables were included in the initial multivariable models; variable selection for the final models was performed in a backward stepwise fashion. The area under the receiver operating curve (AUC) of each logistic regression model was used to assess its performance. Categorical variables were presented as totals and percentages and continuous data as median values and interquartile range