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The impact of major intraoperative adverse events on hospital readmissions

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Abstract

BACKGROUND: Hospital-wide readmission rates recently became a recognized benchmarking quality metric. We sought to study the independent impact of major intraoperative adverse events (iAEs) on 30-day readmission in abdominal surgery.

METHODS: The 2007 to 2012 institutional American College of Surgeons National Surgical Quality Improvement Program and administrative databases for abdominal operations were matched then screened for iAEs using the *International Classification of Diseases, 9th Revision, Clinical Modification*–based Patient Safety Indicator "Accidental Puncture/Laceration". Flagged charts were reviewed to confirm the presence of iAEs. Major iAEs were defined as class 3 or above, as per our recently validated iAE Classification System. The inpatient database was queried for readmission within 30 days from discharge. Univariate and multivariable models were constructed to analyze the independent impact of major iAEs on readmission, controlling for demographics, comorbidities, American Society of Anesthesiology class, and procedure type/approach/complexity (using relative value units as proxy). Reasons for readmission were investigated using the Agency for Healthcare Research and Quality's *International Classification of Diseases, 9th Revision, Clinical Modification*–based Clinical Classification Software.

RESULTS: Of 9,274 surgical procedures; 921 resulted in readmission (9.9%), 183 had confirmed iAEs, 73 of which were major iAEs. Procedures with major iAEs had a higher readmission rate compared with procedures with no iAEs [24.7% vs 9.8%, $P < .001$]. In multivariable analyses, major iAEs were independently associated with a 2-fold increase in readmission rates [OR = 2.17 (95% CI = 1.22 to 3.86); $P = .008$]; 67% of readmissions after major iAEs were caused by "complications of surgical procedures or medical care" as defined by Agency for Healthcare Research and Quality.

CONCLUSIONS: Major iAEs are independently associated with increased rates of 30-day readmission. Preventing iAEs or mitigating their effects can serve as a quality improvement target to decrease surgical readmissions.

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In an increasingly regulated and value-based healthcare environment, the rate of hospital readmissions is currently one of the de facto benchmarking quality indicators.[1] Jencks et al[2] recently estimated that unplanned 30-day readmissions cost Medicare up to $17.4 billion dollars in 2004. In an attempt to improve the quality of care and simultaneously lower costs, the Affordable Care Act established the Hospital Readmissions Reduction Program, which later encouraged the Center for Medicare and Medicaid Services to reduce payments to hospitals with high rates of readmissions. Subsequently, after defining the "hospital-wide readmissions" metric in 2011, Center for Medicare and Medicaid Services began public reporting of all medical and surgical readmissions.[1]

Many studies have since examined the patterns of and risk factors for readmissions after surgery. Using the patient safety indicators (PSIs), Rosen et al[3] suggested that the rate of readmissions is 32% to 61% higher for hospitalizations with one or more postoperative complications such as hemorrhage, deep vein thrombosis, sepsis, or wound dehiscence. The study found that PSI #15 (accidental puncture or laceration) did not independently predict an increase in 30-day readmissions. However, no study has specifically evaluated the impact of intraoperative adverse events (iAEs), which ostensibly represent the most severe cases of PSI #15, on readmissions.[4–10] Our research team has previously described the nature, patterns, predictors, and clinical and financial implications of iAEs in patients undergoing abdominal surgery and has demonstrated that iAEs, in particular "major iAEs", are associated with significantly increased 30-day morbidity and mortality.[11–14] Specifically, major iAEs are independently associated with increased odds of surgical site infection, sepsis, pneumonia, failure to wean-off the ventilator, prolonged hospital stay, and mortality.[14]

In this present study, we sought to evaluate the independent impact of major iAEs on 30-day hospital readmissions. Given their significant impact on 30-day morbidity, we hypothesized that major iAEs would also be associated with increased hospital readmission rates.

Methods

Patient population

All adult patients undergoing abdominal surgery under general anesthesia in a tertiary care academic center from January 2007 to October 2012 were included.

The hospital-wide comprehensive administrative database was linked with our institutional American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP) database, and cases captured by both the databases were selected for additional analyses.

Identification of intraoperative adverse events

The matched database was queried for episodes of "accidental puncture or laceration" (APL) using the *International Classification of Diseases, 9th Revision, Clinical Modification* (ICD-9-CM)–based algorithm for APL, the 15th Agency for Healthcare Research and Quality (AHRQ) PSI. APL has an 8% to 15% false positive rate[15,16] and is not specific to iAEs. Therefore, the operative notes of APL-identified patients were systematically reviewed using a previously published methodology[11,14] to confirm whether an iAE occurred or not.

Defining an intraoperative adverse event

Per the Institute of Medicine recommendation, an "adverse event" was defined as "an injury caused by medical management rather than the underlying disease."[17] For this study, an iAE was defined as an inadvertent injury occurring during the operation. The validated iAE severity classification scheme developed by Kaafarani et al[14] was used to further define iAEs.

Briefly, a class 1 iAE was defined as an injury requiring no repair within the same procedure. A class 2 iAE was defined as an injury requiring surgical repair, without organ removal, or a change in the originally planned procedure. A class 3 iAE was defined as an injury requiring tissue or organ removal with completion of the originally planned procedure. A class 4 iAE was defined as an injury requiring a significant change and/or incompletion of the originally planned procedure. A class 5 iAE was defined as a missed intraoperative injury requiring reoperation within 7 days. Finally, a class 6 iAE was defined as an intraoperative death.

Major iAEs were defined as class 3 or higher, whereas minor iAEs were defined as class 2 or lower.

Defining and identifying readmissions

Readmission was defined as any inpatient admission occurring within 30 days of hospital discharge from the index hospitalization (inpatient operation), or within 30 days of surgery (outpatient operation). To identify readmissions, our ACS-NSQIP database was matched with the institutional Research Patient Data Registry, which contains admission and discharge dates for all patients. In instances where multiple operations occurred during a single inpatient admission, only the last (closest to discharge) surgery was included in our analysis for readmissions.

Cause of readmission

The cause of readmission was also identified through Research Patient Data Registry, which provides an ICD-9-CM code associated with the principle reason for each