Impact of gastrectomy procedural complexity on surgical outcomes and hospital comparisons

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Background. *Most risk adjustment approaches adjust for patient comorbidities and the primary procedure. However, procedures done at the same time as the index case may increase operative risk and merit inclusion in adjustment models for fair hospital comparisons. Our objectives were to evaluate the impact of surgical complexity on postoperative outcomes and hospital comparisons in gastric cancer surgery.*

Methods. *Patients who underwent gastric resection for cancer were identified from a large clinical dataset. Procedure complexity was characterized using secondary procedure CPT codes and work relative value units (RVUs). Regression models were developed to evaluate the association between complexity variables and outcomes. The impact of complexity adjustment on model performance and hospital comparisons was examined.*

Results. *Among 3,467 patients who underwent gastrectomy for adenocarcinoma, 2,171 operations were distal and 1,296 total. A secondary procedure was reported for 33% of distal gastrectomies and 59% of total gastrectomies. Six of 10 secondary procedures were associated with adverse outcomes. For example, patients who underwent a synchronous bowel resection had a higher risk of mortality (odds ratio [OR], 2.14; 95% CI, 1.07–4.29) and reoperation (OR, 2.09; 95% CI, 1.26–3.47). Model performance was slightly better for nearly all outcomes with complexity adjustment (mortality c-statistics: standard model, 0.853; secondary procedure model, 0.858; RVU model, 0.855). Hospital ranking did not change substantially after complexity adjustment.*

Conclusion. *Surgical complexity variables are associated with adverse outcomes in gastrectomy, but complexity adjustment does not affect hospital rankings appreciably. (Surgery 2015;158:522-8.)*

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IMPROVING RISK ADJUSTMENT MODELS using clinical data is important for hospital quality benchmarking and new individualized prediction tools such as the American College of Surgeons National Quality Surgical Improvement Program (ACS NSQIP) Surgical Risk Calculator.[1] Assuring the highest accuracy risk adjustment means that hospitals can be compared fairly and that prediction tools provide accurate risk estimates. This is a continually evolving challenge, and one that is particularly relevant in cancer surgery.

Approaches to risk adjustment commonly use patient demographics, comorbidities, the type of index procedure, and, when available, clinical data such as laboratory values. Concern exists that this is not adequate, because this does not account for the technical considerations of complex operations.[2] Recently, researchers have also shown that adjustment for operation complexity is feasible, and that it improves model performance in patients undergoing oncologic resections involving the colon, rectum, pancreas, and liver.[3,4] These approaches incorporate information about

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procedures performed concurrently with the index operation. These secondary procedures are captured in ACS NSQIP, which can code ≤20 procedures, including their Current Procedural Terminology (CPT) codes and associated work relative value units (RVUs), which are collected at the time of the index procedure.

However, it is unknown if complexity adjustment affects individual risk prediction and hospital quality comparisons in patients undergoing gastrectomy for adenocarcinoma. The types of synchronous procedures (eg, feeding tube interventions) performed during a gastrectomy are different than in the prior work, and understanding their effect on outcomes is important. The objectives of this study were to evaluate the impact of complexity adjustment on postoperative outcomes, risk prediction, and hospital quality comparisons in patients undergoing surgery for gastric adenocarcinoma.

METHODS

Data source and patient selection. The history and details of the ACS NSQIP structure, sampling and statistical modeling methodology, variables gathered, and reported outcomes have been described previously.[5-7] Briefly, the ACS NSQIP is a large, prospective database that collects audited, clinical data from >500 hospitals. Data are collected by trained surgical clinical reviewers using standardized definitions on a defined timeline. Variables include patient demographics, a variety of comorbid conditions, preoperative laboratory values, and intraoperative variables such as operative time, anesthesia type, and ≤20 procedures done at the time of the index operation. Patients are followed for 30 days after their index operation for inpatient and outpatient postoperative outcomes. Information is also collected on patients' discharge destination and readmission. Importantly, the ACS NSQIP also allows for the collection of ≤20 procedures that are performed at the same time as the index operation.

Patients undergoing any kind of gastrectomy were first identified based on CPT codes 43620, 43621, 43622, 43632, 43633, 43634, and 43661. Only patients who underwent resections for the indication of gastric adenocarcinoma (ICD-9 151.x) were included. All other histologies, including gastrointestinal stromal tumors and carcinoid tumors, were excluded. Patients were then categorized by the type of gastrectomy they underwent (total or distal).

Surgical complexity. Surgical complexity was characterized using 2 approaches based on recorded secondary procedures. The first approach grouped recorded secondary CPT codes into 10 categories based on CPT codes. These groupings were based on clinical relevance and whether they occurred in ≥1% of patients to avoid issues related to model convergence. We also sought to include a range of procedures that encompassed both the minor and the more extensive and technically complex. The 10 categories included feeding tube interventions, partial hepatectomy, cholecystectomy, enterolysis, omentectomy, distal pancreatectomy, small or large bowel resection, splenectomy, diagnostic laparoscopy, and regional abdominal lymphadenectomy, which included celiac, gastric, portal, and peripancreatic, with or without paraaortic and vena caval nodes. Feeding tube interventions encompassed CPT procedure codes for both laparoscopic and open jejunostomy procedures (CPT codes 44015, 44300, and 44186).

The second approach used work RVUs, which are used by the American Medical Association's Specialty Society Relative Value Update Committee to describe the theoretical time and effort associated with a given procedure.[8] Work RVUs were summed for each patient to generate a single, linear continuous variable that was then treated as a measure of the complexity of the performed procedure. This continuous variable was then grouped into quintiles.

Outcomes. Postoperative outcomes included 30-day mortality, serious morbidity, superficial surgical site infections, deep and organ space infections, prolonged duration of stay, reoperation, and postoperative sepsis or septic shock. Serious morbidity was defined as the occurrence of any of the following: organ or deep space infection, wound dehiscence, myocardial infarction, cardiac arrest, renal insufficiency or failure, sepsis or septic shock, return to the operating room, pneumonia, or ventilator dependence (>48 hours). Prolonged duration of stay was defined as stays beyond the 75th percentile in patients who did not experience a complication.[9] This resulted in defining prolonged duration of stay as >11 days for total gastrectomy and >9 days for distal gastrectomy.

Statistical analysis. After appropriate bivariate statistics, multivariable regression models were developed for each of the 7 outcomes. Variables were selected for inclusion in the regression models using the standard ACS NSQIP approach that uses forward selection (entry criteria