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Inpatient outcomes after elective *versus* nonelective ventral hernia repair

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ABSTRACT

Background: Patients who present emergently with hernia-related concerns may experience increased morbidity with repair when compared with those repaired electively. We sought to characterize the outcomes of patients who undergo elective and nonelective ventral hernia (VH) repair using a large population-based data set.

Materials and methods: The Nationwide Inpatient Sample was queried for primary International Classification of Diseases, Ninth Revision codes associated with VH repair (years 2008–2011). Outcomes were inhospital mortality and the occurrence of a preidentified complication. Multivariable analysis was performed to determine the risk factors for complications and mortality after both elective and nonelective VH repair.

Results: We identified 74,151 VH repairs performed during the study interval. Of these procedures, 67.3% were elective and 21.6% were performed laparoscopically. Nonelective repair was associated with a significantly higher rate of morbidity (22.5% *versus* 18.8%, $P < 0.01$) and mortality (1.8% *versus* 0.52, $P < 0.01$) than elective repair. Elective repairs were more likely to occur in younger patients, Caucasians, and were more likely to be performed laparoscopically. Logistic modeling revealed that female gender, Caucasian race, elective case status, and laparoscopic approach were independently associated with a lower probability of complications and mortality. Minority status and Medicaid payer status were associated with increased probability of nonelective admission.

Conclusions: Patients undergoing elective VH repair in the United States tend to be younger, Caucasian, and more likely to have a laparoscopic repair. Nonelective VH is associated with a substantial increase in morbidity and mortality. We recommend that patients consider elective repair of VHs because of the increased morbidity and mortality associated with nonelective repair.

1. Introduction

Ventral hernia (VH) repair remains one of the most common general surgery procedures. In a survey of general and plastic surgeons, it was documented that most surgeons do not routinely repair abdominal wall hernias in asymptomatic patients on an elective basis [1]. Patients who present with acute complaints related to their hernia may experience an

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increase in morbidity compared with those who present electively. Patients who undergo emergent surgery may also be different than those who opt to undergo or who are offered elective surgery [2]. We sought to characterize the outcomes of patients who undergo elective and nonelective VH repair using a large population-based data set. We hypothesized that emergent VH repair would be associated with increased morbidity and mortality rates and that patients who undergo elective repair were different from those undergoing emergent surgery.

2. Materials and methods

A retrospective population analysis was performed using the Nationwide Inpatient Sample (NIS) for the years 2008–2011. The NIS is the largest all-payer inpatient care database in the United States, containing data on more than 7 million hospital stays from approximately 1000 hospitals participating in the Healthcare Cost and Utilization Project and maintained by the Agency for Healthcare Research and Quality. This represents approximately 20% of stratified samples of U.S. hospitals in 49 states. The large sample size is ideal for developing national and regional estimates and enables analyses on rare conditions, uncommon treatments, and special populations [3]. As the database is deidentified, the study was exempt from the institutional review board approval process.

Patients were identified for this study according to the International Classification of Diseases, Ninth Revision procedure and diagnosis codes. Elective VH repairs were coded as elective. Urgent and emergent VH repairs were coded as nonelective. The International Classification of Diseases, Ninth Revision codes for VH repair included those for open and laparoscopic repairs and are listed in Table 1. Patients who underwent a primary procedure other than VH repair were excluded and those who underwent any resection of the gastrointestinal tract.

Study variables extracted for analysis included age, race, sex, a weighted Charlson comorbidity index (CCI) score as a marker of their comorbidities, operative intervention (laparoscopic *versus* open procedure type), as well as inhospital morbidity and mortality. The CCI predicts the 10-y mortality for a patient based on 15 conditions (Table 2) [4]. Each condition is assigned a score of 1, 2, 3, or 6 depending on risk of dying for each condition. A summation of all scores is calculated to predict mortality. Adverse outcomes were selected on likely association with time to surgery (Table 1).

Continuous data were reported as mean values, whereas categorical variables were reported as percentages. Bivariate analysis of categorical data was performed using chi-square tests, and for continuous data, two-tailed *t*-tests were used. Multivariable analysis was performed using multiple logistic regression models, adjusting for age, sex, elective *versus* emergent status, race, pretreatment comorbidities and operative approach, to identify risk factors for postoperative morbidity and mortality. A *P* value of <0.05 was considered to be statistically significant. Statistical analysis was conducted using SAS 9.2 (SAS Institute, Cary, NC). All analyses were adjusted for the complex survey design of NIS, using the SurveyFreq and SurveyLogistic procedures for the analyses.

Table 1 – ICD-9-CM procedure and diagnosis codes.

ICD-9-CM code	Description
Inclusion	
Laparoscopic VHR	53.62, 53.63
Open VHR	53.61, 53.69
Exclusion	
GI tract resection	42.4x, 43.5x-43.9x, 44.3x, 45.5x-45.8x, 48.5x-48.6x, 50.3x-50.5x, 52.5x, 52.6, 52.7, 52.8x
Complications	
GI	
997.4	Digestive system complications not elsewhere classified
863	Injury to gastrointestinal tract
Wound	
998.83	Nonhealing surgical would
43.61	Reclosure of postoperative disruption of abdominal wall
998.3	Disruption of wound
998.6	Persistent post-operative fistula
998.12	Hematoma complicating a procedure
998.13	Seroma complicating a procedure
Procedural	
998.9	Unspecified complication of procedure not elsewhere classified
998.89	Other specified complications of procedures not elsewhere classified
998.2	Accidental puncture/laceration complicating procedure
998.4	Foreign body left during a procedure
998.11	Hemorrhage complicating a procedure
868	Injury to other intra-abdominal organs
Infectious	
998.5	Post-operative infection not elsewhere classified
Urinary	
997.5	Urinary complications not elsewhere classified
Pulmonary	
512.1	Iatrogenic pneumothorax
518.4	Acute edema of the lung, unspecified
518.5	Pulmonary insufficiency following trauma and surgery
997.3x	Respiratory complications not otherwise specified
Cardiac	
415.11	Pulmonary embolism and infarction
997.02	Iatrogenic cerebrovascular infarction or hemorrhage
997.1	Cardiac complications not otherwise specified
997.2	Peripheral vascular complications
997.79	Vascular complications of other vessels
Systemic	
998	Postoperative shock not elsewhere classified

GI = gastrointestinal; ICD-9-CM = International Classification of Diseases, Ninth Revision, Clinical Modification.

3. Results

A total of 74,151 patients undergoing VH repair in the study interval were identified. Of these procedures, 67.3% were elective and 21.6% were performed laparoscopically. The