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Clinical Science

Mortality after inpatient open ventral hernia repair: developing a risk stratification tool based on 55,760 operations

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Abstract

BACKGROUND: The medical complexity of hernia patients imparts higher risk for complications, and mortality is a distinct reality. No study has stratified patients based on preoperative risk for open ventral hernia repair (VHR) specifically. We utilized the American College of Surgeons National Surgical Quality Improvement Program to create a mortality risk stratification model following VHR.

METHODS: Patients undergoing open VHR were identified from American College of Surgeons National Surgical Quality Improvement Program databases. Baseline variables correlated with mortality risk were entered into stepwise regression and bootstrap analysis. β-Coefficients were used to weigh each factor, yielding the risk assessment tool.

RESULTS: A total of 55,760 patients were included with a mortality of 1.34%. Predictors of mortality included the following: functional status (odds ratio [OR] = 2.87), liver disease (OR = 3.61), malnutrition (OR = 1.43), age greater than 65 years (OR = 2.39), American Society of Anesthesiologists 4 or higher (OR = 2.90), systemic inflammation (OR = 1.99), and contamination (OR = 2.15). Patients were risk stratified into low risk (mortality .33%), moderate risk (mortality 1.86%), high risk (mortality 8.76%), and extreme risk groups (mortality 34.2%). Unplanned reoperations and medical complications increased across risk groups. The model demonstrated high discriminatory ability with a C-statistic value of .86.

CONCLUSIONS: This study provides an accurate model to predict mortality risk specific to open VHR. The strongest predictors were American Society of Anesthesiologists, liver disease, functional status, and older age. This tool may inform clinical decision making to reduce complications.

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A total of 350,000 ventral hernia repairs (VHRs) are performed annually in the United States, with open repairs comprising the majority of cases.[1] The medical complexity of the typical hernia patient imparts higher risk for serious complications, poor quality of life, and higher healthcare-associated costs. Mortality is a distinct reality, particularly with the open approach.[2]

With the rising number of VHRs over the past decade, the use of algorithm-based models for clinical decision making has gained popularity.[3,4] These models aim to facilitate safer, more cost-effective provision of care in the current economically driven healthcare landscape. Given the baseline perioperative risk associated with VHR and the relatively high comorbid burden of patients with ventral hernias, perioperative decision making is increasingly difficult, underscoring the need for procedure-specific risk modeling. The ability to accurately synthesize a wide array of patient risk factors and operative considerations is critical to optimize patient outcomes. While prior institutional studies have identified risk factors for mortality, they have been limited to smaller series lacking generalizability.[5–8] Furthermore, no study has described a risk stratification tool specific to open VHR based on preoperative risk factors alone.

The purpose of this study was to use a widely generalizable dataset (American College of Surgeons National Surgical Quality Improvement Program [ACS-NSQIP])[9] to develop a risk stratification model for mortality after open VHR based solely on preoperative factors, with the hopes of improving decision making, patient guidance, and minimizing perioperative mortality.

Methods

Patient selection

The 2005 to 2012 ACS-NSQIP participant use data files were accessed on December 1, 2013 and queried to identify all patients undergoing open VHR. Current Procedural Terminology codes were used to identify open hernia repairs: 49560, 49561, 49565, and 49566. Both hernia repairs with (49568) and without mesh were included, and the use of acellular dermal matrix was noted as well (15777, 15330, 15331, 15430, 15431). Patients undergoing outpatient surgery were excluded from the analysis (Fig. 1).

Concurrent operative procedures were identified using Current Procedural Terminology codes. These included concurrent panniculectomy (15830 and 15847) and intra-abdominal procedures, defined by enterolysis (44005/44180), exploratory laparotomy (49000), omentectomy (49255), enterectomy (44120), enterorrhaphy (44602), cholecystectomy (47600/47562), appendectomy (44955), closure enterostomy (44620), revision colostomy (44346), total abdominal hysterectomy and oophorectomy (58150), and oophorectomy (58940). Concurrent bowel procedures were identified if enterectomy (44120), enterorrhaphy (44602), closure enterostomy (44620), or revision colostomy (44346) were performed.

Outcomes

The primary outcome of interest was 30-day mortality. Secondary outcomes included surgical or medical complications and unplanned reoperation. Surgical complications were defined as any wound infection, acute wound dehiscence, graft failure, and need for intraoperative blood transfusion. Medical complications included any defined ACS-NSQIP nonsurgical endpoint, such as pneumonia, pulmonary embolism, postoperative renal insufficiency (creatinine $>$ 2 mg/dL), urinary tract infection, stroke, myocardial infarction, symptomatic deep venous thrombosis, or sepsis. Complications were treated as a dichotomous variable (none vs one or more). Information regarding complication severity was not available and all complications were identified within 30 days of the index procedure.

Independent variables

Variables for patient demographics, comorbidities, and operative risk factors were selected. These included baseline health characteristics, past medical and recent

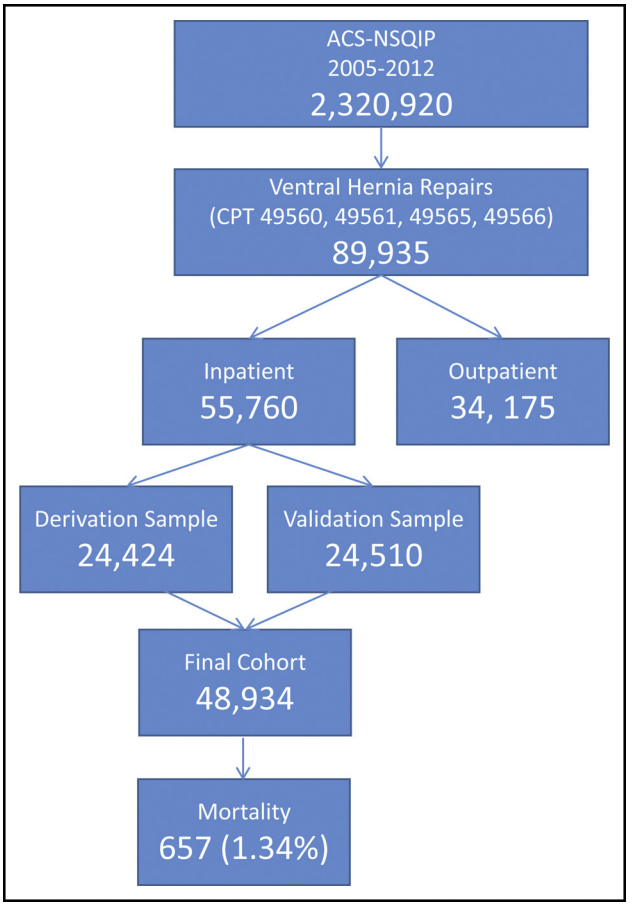

Figure 1 Flow diagram of patients included in the study.