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Outcomes of abdominal surgery in patients receiving mechanical ventilation for more than 48 hours

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Abstract

BACKGROUND: Abdominal surgery in critically ill patients has high mortality, contributing to high US healthcare costs. This study sought to identify specific predictors of mortality in this population.

METHODS: Using the National Surgical Quality Improvement Program database 2006 to 2012, we identified 4,901 patients who were intubated for more than 48 hours before undergoing common abdominal procedures. Mortality and predictors of mortality were determined using chi-square and/or regression analysis.

RESULTS: Overall 30-day mortality was 44.2% with increasing mortality for additional procedures performed. Ventilated patients with the following preoperative risk factors were 2 to 3 times as likely to die within 30 days of surgery: age greater than 65-years old, coma, preoperative international normalized ratio greater than 3.0, esophageal varices, and disseminated cancer.

CONCLUSIONS: Mortality is significant in ventilated patients who undergo abdominal surgery and is especially high with advanced age, disseminated cancer, and complications of liver disease. Physicians should carefully discuss this with patients and/or family and consider palliative options when appropriate.

Critical care is expensive and has high mortality with 20% of all deaths in the United States occurring during or shortly after an intensive care unit (ICU) admission.[1] In 2000, critical care medicine accounted for 13.3% of hospital costs and .56% of the gross national domestic product in the United States.[2] Of the $585.7 billion Medicare spent in 2013, 25% to 30% was used toward the 5% of Medicare beneficiaries who died, which was 6 times the cost of Medicare spending for a survivor.[3–5] The first 2 days of ICU admission accounted for the highest costs, with mechanical ventilation resulting in higher daily costs and increasing the cost 2.5 fold compared with nonventilated patients.[6]

Admission to the ICU may be considered a therapeutic trial, whereby initial aggressive measures are transitioned to palliative once it is clear that meaningful outcomes cannot be achieved.[7] Although there is no formal definition for "futile care," it is generally understood as care that cannot achieve a patient's quality of life goals. Futile care is often scrutinized for using much of healthcare resources with little return. In 1995, the Study to Understand Prognosis and Preferences for Outcomes and Risk of Treatment[8,9] attempted to identify patients with poor survival prognoses and intervene so as to reduce futile care and

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interventions in these patients. Despite the availability of prognostic information and physician efforts to communicate this to patients and their families, there was no reduction of futile care.[8,9] Although there is no objective means of prospectively identifying patients whose care will be futile, physicians should consider palliative care options and be sensitive to cost and utilization of resources.

Abdominal surgery is particularly risky in critically ill patients. These operations may contribute to the length of ICU admission, length of hospital stay, and high cost of healthcare, but may have limited impact on survival or quality of life. A few studies have addressed mortality after exploratory laparotomy in critically ill patients, but these were small samples, single center, and before the era of evidence-based medicine in large databases such as the American College of Surgeons' National Surgical Quality Improvement Program (NSQIP).[10] Surgical risk calculators have been developed and are useful in estimating an individual mortality based on procedure and risk factors.[11–13] This study attempts to provide evidence-based data that can be more broadly generalized on mortality rates and predictors of mortality in critically ill patients compared with prior single-center studies. It also hopes to supplement the current NSQIP calculator by providing additional data on preoperative risk factors and postoperative mortality that will provide physicians with prognostic values that can be used on a daily basis to help patients and their families make difficult management decisions regarding their care in the ICU.

Methods

This study is a retrospective review of the prospectively collected NSQIP database from 2006 to 2012. The database is compiled from 373 hospitals nationwide and provides information on 30-day, risk-adjusted surgical outcomes, which allows hospitals across the nation to compare outcomes. Preoperative through 30-day postoperative variables are collected on randomly assigned patients, including patient demographics, surgical profile, preoperative risk assessment, laboratory values, operative information, and 30-day morbidity and mortality rates. A highly trained Surgical Clinical Reviewer collects the data. All reviewers receive extensive initial training before starting data collection and ongoing training via continuing education. NSQIP monitors accrual rates and data sampling methodologies and conducts audits on a random basis, ensuring highly reliable data.

Patients

Common Procedural Terminology (CPT) codes[14] for frequently performed emergent abdominal procedures were used to identify patients from the NSQIP database: 49000, 43632, 43635, 43621, 47600, 47562, 44120, 44125, 44950, 44960, 44970, 44143, 44320, 44140, 44150, and 44204. During the time period from January 1, 2006 to December 31, 2012, NSQIP collected data on 2,320,898 patients. Increasing numbers of patients were identified annually with 152,468 patients recorded in 2006, the year of NSQIP's inception and 543,885 patients added in 2012. Note that the 2006 NSQIP database did include a small number of cases that underwent a surgical procedure in 2005 but data from the entirety of 2005 is not represented in this file. Because NSQIP does not identify whether patients are located in an ICU or on a general ward at the time of surgery, we used the parameter of "ventilated for the last 48 hours" as a surrogate for being located in an ICU. We thus identified 17,679 (.7%) patients who were on the ventilator for at least 48 hours and 4,901 of these patients underwent abdominal surgery as defined by the CPT codes. This was the cohort used in the study and our definition of a critically ill patient undergoing abdominal surgery. This analysis would potentially exclude patients who were critically ill but not intubated, and those who were intubated for less than 48 hours before surgery. Trauma patients are also excluded from the NSQIP database. For this study, we identified patients who had one of the primary CPT codes for abdominal surgery and categorized them by organ system: cholecystectomy, appendectomy, gastric, colon, or small bowel procedures. We then looked at the subsequent 3 additional CPT codes to determine if other abdominal procedures were performed at this surgery. Patients were categorized as to having received exploratory laparotomy alone, 1 abdominal procedure, 2 abdominal procedures, or 3 or more abdominal procedures.

NSQIP data[10] included demographics: age, sex, ethnicity, height, weight, and body mass index (BMI). Comorbidities included diabetes, smoking, alcohol use, chronic obstructive pulmonary disease, concurrent pneumonia, ascites, congestive heart failure, esophageal varices, myocardial infarction within 6 months, previous percutaneous coronary intervention, angina, hypertension requiring medications, peripheral vascular disease, renal failure, dialysis, coma, cerebrovascular accident, paralysis, wound infection, disseminated cancer, steroid use, significant weight loss (10%) in the previous 6 months, bleeding disorder, prior chemotherapy, radiation, previous sepsis, systemic inflammatory response syndrome, or septic shock.

Preoperative laboratory values were divided into categorical variables as defined by: abnormal serum sodium (less than or equal to 130 or greater than or equal to 150 mmol/L), serum creatinine greater than or equal to 2.0 mg/dL, albumin less than or equal to 3.0 gm/dL, serum bilirubin greater than or equal to 2.0 mg/dL, aspartate aminotransferase greater than 200 IU/L, alkaline phosphatase greater than 150 IU/L, abnormal white blood count (less than 3 or $>12 \times 10^9$/L), hematocrit less than 30%, platelet count less than 100×10^9/L, and international normalized ration (INR) greater than 3.

Postoperative complications included superficial or deep wound infection, wound dehiscence, pneumonia, reintubation, pulmonary embolism, failure to wean from ventilator