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Effect of time to operation on outcomes in adults who underwent emergency general surgery procedure



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ARTICLE INFO

Article history:

Received 9 November 2017

Received in revised form

30 December 2017

Accepted 14 February 2018

Available online 7 April 2018

Keywords:

Emergency general surgery

Acute care surgery

30-Day outcomes

Time to operation

ABSTRACT

Background: Patients who undergo an emergency procedure have an increase in post-operative morbidity and mortality. Emergency procedures constitute 14.2% of all general surgery procedures and account for 53.5% of deaths. Among this population, time to surgery from arrival to the emergency department (ED) has not been evaluated as an independent risk factor for morbidity and mortality.

Material and methods: Patients who underwent an emergency general surgery procedure from 2013 to 2015 were identified using a local American College of Surgeons National Surgical Quality Improvement Project (ACS-NSQIP) database. Outcomes of interest included 30-d mortality, all morbidity, and severe morbidity. Multivariate analyses were conducted using a logistic regression model using clinically relevant covariates to determine predictors of the outcome measures.

Results: A total of 974 patients were included in the final analysis. The prolonged median time from ED presentation to OR was predictive of all morbidity (14.3 h versus 13.3 h, $P = 0.009$) and severe morbidity (13.3 h versus 14.4 h, $P = 0.063$) on univariate analysis. Time from ED presentation to OR was not predictive of mortality (13.5 h versus 13.6 h, $P = 0.474$). Multivariate analysis demonstrated an adjusted increased odd of morbidity of 2.3 (95% CI: 1.01-5.24) for priority level A cases within the fourth quartile compared to that of the first quartile of time ($P = 0.048$).

Conclusions: This study corroborates with known data that morbidity and mortality increases in patients who are older, have multiple comorbidities, and higher ASA class. Furthermore, the time from ED arrival to the OR is associated with an overall increase in morbidity.

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Introduction

Emergency general surgery represents a population that accounts for a large volume of both mortality and morbidity.

American College of Surgeons' National Surgical Quality Improvement Program (ACS-NSQIP) data have shown that a patient who undergoes an emergency procedure has a 1.26-fold increase in major postoperative morbidity and a 1.39-fold

Authors' contribution: All authors contributed equally in the study conception and design, acquisition of data, analysis and interpretation of data, drafting of the manuscript, and critical revision.

Presented at Digestive Disease Week (DDW) Conference 2017.

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<https://doi.org/10.1016/j.jss.2018.02.027>

increase in mortality.^{1,2} Furthermore, while emergency general surgery procedures constitute 14.2% of all general surgery procedures conducted, they account for 53.5% of the deaths.^{1,2} In addition, emergency general surgery has been shown to be a major financial burden to the health-care system with cost estimates of \$28.37 billion in the United States.^{3,4}

There has been much attention around predictors of increased mortality and morbidity among those who undergo an emergency procedure. Specifically, advanced age, ASA classification, and the type of procedure being conducted have been shown to correlate with an increase in mortality.⁵⁻⁸ Furthermore, patients who have experienced specific postoperative complications such as pneumonia, myocardial infarction, or stroke are at higher risk for mortality.⁹ One specific variable that has not been evaluated in a large population of emergency general surgery patients is time to surgery from when the patient arrived in the emergency room.

It is commonly assumed that patients who present to the emergency room with an acute surgical condition should have an expedited route to the operating room to minimize morbidity and mortality. There are multiple reasons for delays including investigation time, time needed for resuscitation, and availability of the operating room and anesthesia.^{10,11} Previous literature has demonstrated that delays in surgery for select trauma patients and patients with perforated peptic ulcer disease may lead to poor outcomes.^{12,13} However, there is a paucity of literature assessing the impact of delays in operative intervention for emergency general surgery patients.

The objective of this study was to assess whether an increase in time from emergency department (ED) to operative intervention results in changes in 30-d mortality and morbidity for emergency general surgery patients. The secondary objective was to determine the adjusted effect of time from ED to operative intervention on length of hospital stay.

Material and Methods

Database

The National Surgical Quality Improvement Program (NSQIP) database generated by the American College of Surgeons was used for this study. The NSQIP database is a highly validated instrument that measures preoperative risk factors, intraoperative variables, and 30-d postoperative outcomes.^{14,15} The organization of this study followed the design outlined by the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) statement.¹⁶

Study sample

The local NSQIP databases were accessed from two tertiary care hospitals in Toronto, Canada. All patients aged 16 y or older who underwent an emergency general surgery procedure between February 2013 and December 2015 were included in the study. An emergency surgery was defined as a surgery that occurred in a patient who entered the hospital via the emergency department. As such, all elective surgeries and

reoperations for elective patients were not included. All patients who waited for more than 36 h for their surgery were excluded from our study. In addition, patients who were classified as C cases by the surgeon, defined as an operation that must occur between 8 and 48 h from time of booking, were also excluded from the study population. These two exclusions were used as they represented a group of patients deemed by the surgeon as having disease that did not require immediate operative intervention and therefore of lowest priority (i.e., can wait between 8 and 48 h before intervention). Furthermore, patients within this group were excluded to eliminate those in whom nonoperative management was initially used (i.e., small-bowel obstructions). A cutoff of 36 h was used as it has been referenced as the time in which a gastrografin challenge fails for a small-bowel obstruction.¹⁷ There were 49 patients in the priority C subgroup, of which the majority had cholecystectomies (53%); there were zero severe morbidity, zero mortality, and only four cases of non-severe morbidity (three SSI's and one UTI). Therefore, patients in priority C classification were excluded to limit the bias they would instill on the outcome measures with respect to time from emergency room presentation to operating intervention. This study was approved by the Institutional Research Ethics Board at the University Health Network (UHN) in Toronto, Canada.

Study measures

For patients meeting the inclusion/exclusion criteria for the study, the following variables were collected using the NSQIP database: patient demographics (age, gender), comorbidities, ASA class, presence of sepsis in the emergency department (ED), time of operation, priority class booking, and indication for surgery. The time at which the patient entered the ED was obtained through a hospital-specific registry. For each case, the indication for operation was categorized into five separate groups based on the organ of origin (appendix, large bowel/rectum, gallbladder, small bowel/gastric, and hernia). Data from patients were divided into four quartiles based on time from ED to OR. At the study institution, because of limited operating room resources for emergency operative interventions, all emergency cases must be booked and triaged by the operating surgeon into one of three categories based on the acuity of the disease pathology. At each institution, the same priority class system was used; specifically, an A case was defined as a surgery that should occur within 2 h of booking, and a B case was defined as a surgery that should occur within 2 to 8 h of booking.

Using the NSQIP database, primary outcomes were defined as 30-d mortality, 30-d all morbidity, and 30-d severe morbidity. Overall morbidity was defined by the documentation of new sepsis, surgical site infection, deep space infection, perioperative ventilator use for more than 48 h, unplanned intubation, venous thromboembolism, neurological, respiratory, cardiovascular, gastrointestinal, and genitourinary complications. To identify severe morbidity, each of the documented complications was investigated and scored according to the Clavien-Dindo classification.¹⁸ Severe morbidity was defined as the presence of new sepsis, perioperative ventilation for more than 48 h, unplanned intubation,

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