Factors associated with failure-to-rescue in patients undergoing trauma laparotomy

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Introduction. *Quality improvement initiatives have focused primarily on preventing in-hospital complications. Patients developing complications are at a greater risk of mortality; however, factors associated with failure-to-rescue (death after major complication) in trauma patients remain undefined. The aim of this study was to identify risk factors associated with failure-to-rescue in patients undergoing trauma laparotomy.*

Methods. *An -8-year, retrospective analysis of patients undergoing trauma laparotomy was performed. Patients who developed major in-hospital complications were included. Major complications were defined as respiratory, infectious, cardiac, renal, or development of compartment syndrome. Regression analysis was performed to identify independent factors associated with failure-to-rescue after we adjusted for demographics, mechanism of injury, abdominal abbreviated injury scale, initial vital signs, damage control laparotomy, and volume of crystalloids and blood products administered.*

Results. *A total of 1,029 patients were reviewed, of which 21% (*n *= 217) patients who developed major complications were included. The mean age was 39± 18 years, 82% were male, 61% had blunt trauma, and median abdominal abbreviated injury scale was 25 [16–34, interquartile range]. Respiratory complications (*n *= 77) followed by infectious complications (*n *= 75) were the most common complications. The failure-to-rescue rate was 15.7% (*n *= 34/217). Age, blunt trauma, severe head injury, uninsured status, and blood products administered on the second day were independent predictor for failure-to-rescue.*

Conclusion. *When major complications develop, age, uninsured status, severity of head injury, and prolonged resuscitation are associated independently with failure-to-rescue, whereas initial resuscitation, coagulopathy, and acidosis did not predict failure to rescue. Quality-of-care programs focus in patient level should be on improving the patient's insurance status, preventing secondary brain injury, and further development of resuscitation guidelines. (Surgery 2015;158:393-8.)*

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The American College of Surgeons Committee on Trauma has established the Trauma Quality Improvement Program to ensure consistent high-quality care for the injured patients in trauma centers across the United States. This program is focused primarily on identification of the activities and infrastructures to prevent adverse in-hospital and long-term outcomes and reduce complications.[1,2] Studies found that patients with complication are more likely to die[3,4]; however, hospitals with a greater incidence of complications do not necessarily have a greater incidence of patient mortality.[5,6] Recent studies have shown patients were more likely to die after a complication in hospitals with greater rates of mortality but comparable complication rates.[6-10] Taken together, these findings determine the aim of quality improvement initiatives in trauma centers, towards reducing complications and improving the likelihood of patients being "rescued" if they have a complication. "Failure to rescue" (FTR) patients with complications account for a substantial proportion of postoperative mortality and are an emerging indicator of quality of care.[4,11]

Previous studies have examined the impact of FTR in elective surgery and trauma centers[9,10,12-15];

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however, factors associated with FTR in trauma patients undergoing operative intervention remain unknown. The aim of this study was to identify risk factors associated with FTR in patients undergoing trauma laparotomy. We hypothesized that the resuscitative measures in the first 24 hours and the second 24 hours have an independent effect on postoperative rate of FTR.

METHODS

Study settings and patients. After obtaining approval from the Institutional Review Board at the University of Arizona, College of Medicine, we performed an 8-year (2006–2013), retrospective cohort analysis of all trauma patients who underwent laparotomy at our level 1 trauma center. Patients with intra-abdominal injuries who underwent emergent laparotomies and developed major complications postoperatively were included. We excluded the patients who died in the first 24 hours of hospital admission.

Data points and definitions. Patient's medical records were reviewed, and the following data points were recorded: patient demographics (age, sex), mechanism of injury, vitals on presentation (systolic blood pressure, heart rate, and temperature), Glasgow Coma Scale score, crystalloid and blood products transfused during the first 48 hours of admission, and insurance status of the patient (insured or uninsured). Crystalloids and blood products were split into first 24 hours (perioperative) and second 24 hours (postoperative). The injury severity score, abbreviated injury scale scores, revised trauma score, and trauma and injury severity score were obtained from the trauma registry.[16]

Crystalloid resuscitation was defined as the sum of the volumes of normal saline and lactated ringer administered per patient in emergency department, operating room, intensive care unit (ICU), and/or hospital room. The blood product resuscitation was defined as the sum of the volumes of packed red blood cells, fresh-frozen plasma, and platelets administered per patient, in the emergency department, operating room, ICU, and/or hospital room.

Major complications were defined as respiratory complications, infectious (sepsis, wound infection), cardiac failure, renal failure, and compartmental (abdominal compartment syndrome). We defined respiratory complications as acute respiratory distress syndrome, and/or pneumonia based on the patient diagnosis on discharge. All complications for the patients in the study were recorded using the standard definition from National Surgical Quality Improvement Program.[17]

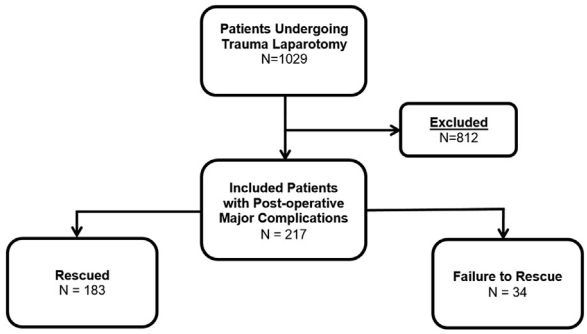

Fig 1. Study population.

Data presentation and statistical analysis. We compared the demographics, injury characteristics, resuscitation, and insurance status between the survived ("rescued") and dead ("failed to rescue") patients. Then, we performed univariate analyses to define the important risk factors in FTR. We considered p-value <0.2 as statistically significant for univariate analysis. Multivariate logistic regression analysis was performed to identify independent factors associated with FTR after we adjusted for demographics, mechanism of injury, abdominal abbreviated injury scale, initial vital signs, damage control laparotomy, and volume of crystalloids and blood products administered. Our primary outcome measure was mortality.

For our statistical analysis, we used Statistical Package for Social Sciences (SPSS, Version 21.0; IBM, Inc., Armonk, NY). Continuous data are presented as the mean and SD. Continuous variables were compared using Student *t* test. Ordinal data are presented as the median and interquartile range. Median test was used to compare the ordinal variables. Categorical data are presented as proportions and percentages. The χ^2 test was used to compare categorical variables.

RESULTS

A total of 1,029 patients were reviewed, of which 21% ($n = 217$) who developed major complications were included. The flow of patients in our study is shown in Fig 1. The mean age was 39 ± 18 years, 82% were male, 61% had blunt trauma, and median abdominal abbreviated injury scale was 25 [16–34]. Trauma and injury severity score (predicted survival probability) was 80.9%, and actual survival rate was 84.3% in our patient cohort. Patient demographics are summarized in Table I.

Respiratory complications ($n = 77$) followed by infectious complications ($n = 75$) were the most common complications. Distribution of the