The National Trauma Data Bank story for emergency department thoracotomy: How old is too old?

Lindsay A. Gil, Michael J. Anstadt, Anai N. Kothari, Michael J. Javorski, Richard P. Gonzalez, and Fred A. Luchette

ABSTRACT

Background. The fastest growing segment of the American population is the elderly (>65 years). This change in demographics also is being seen in trauma centers. Emergency department thoracotomy is utilized in an attempt to restore circulation for patients arriving in extremis. The purpose of this study was to investigate the relationship between clinical variables, particularly age, and outcomes for injured patients receiving an emergency department thoracotomy.

Methods. Using the National Trauma Data Bank for years 2008–2012, observations with International Classification of Diseases, Ninth Revision, Clinical Modification procedure codes for exploratory thoracotomy were identified. Emergency department thoracotomy was defined as any observation that occurred at a time to thoracotomy less than the total time spent in the emergency department thoracotomy, and within 15 minutes of arrival. Mechanisms of injury, demographic data, and injuries were analyzed for predictors of survival and mortality rates. Mortality rates were determined for each decade and year of life.

Results. There were 11,380 observations for thoracotomy identified. Of these, 2,519 were emergency department thoracotomy, with the majority (n = 2,026, 80% observations) performed for penetrating wounds. Mortality rates ranged from 80% to 100% for each decade of life. Mortality was 100% for patients >57 years old with either penetrating or blunt mechanisms of injury.

Conclusion. Emergency department thoracotomy offered no survival benefit for patients older than 57 years of age. These data suggest that emergency department thoracotomy performed in elderly patients may be futile.

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Fifty years ago, Beall et al described the use of emergency department thoracotomy (EDT) for resuscitation of the moribund patient presenting with penetrating cardiac wounds. In the late 1970s, the concept was expanded to blunt trauma patients with reportedly high salvage rates. Despite these studies demonstrating restoration of spontaneous circulation after circulatory arrest, many surgeons thought clinical criteria were needed for selecting patients who would benefit from EDT rather than a liberal use of the procedure, which had inherent risk associated with it. During the past 3 decades, several groups have attempted to elucidate clinical guidelines for EDT. Previously identified predictors of survival included mechanism of injury, anatomic location of injury, injury severity, prehospital time, cardiopulmonary resuscitation (CPR), vital signs, cardiac rhythm, Glasgow Coma Scale (GCS) score, and signs of life. This led to the development of guidelines that have somewhat helped to shape the decision-making for selective use of EDT. Guidelines developed by the American College of Surgeons–Committee on Trauma, the Eastern Association for the Surgery of Trauma (EAST), and the Western Trauma Association (WTA) all utilize mechanism of injury, signs of life, CPR, and vital signs as clinically relevant factors in the decision-making process for whether to perform an EDT. Using these guidelines, the majority of single institution studies demonstrate a low survival rate for EDT in patients typically in their third to fifth decade of life. Survivors older than this are rare.

For the past 2 decades, geriatric citizens defined as ≥65 years old have been the most rapidly growing segment of the American population. Additionally, these elderly individuals live very active, independent lives. Not surprisingly, trauma is the fifth most common
cause of death in this segment of the population with falls and motor vehicle collisions accounting for >95% of the injuries. These patients are challenging to care for due to the deterioration in organ function as a result of aging. They also may have several comorbidities. Survival is impacted markedly by these derangements in physiologic reserve.

During this same time, there have been improvements in access to trauma centers. First, there has been a proliferation of new state trauma systems and a maturation of the older established systems. Simultaneously with these changes, prehospital care also has seen many advances that have been beneficial for injured patients. These changes have improved access for elderly injured patients to be cared for at a trauma center. Thus, the trauma surgeon is seeing an increase in geriatric patients presenting to the emergency department in extremis and must interpret mechanistic, physiologic, and clinical data within minutes to identify which of these elderly patients might benefit from an EDT. To date, none of the guidelines has included age as a variable for decision-making.

The purpose of this study was to evaluate the relationship between clinical variables, particularly age, and outcomes for patients receiving an EDT using the National Trauma Data Bank (NTDB).

Methods

Data source

The dataset of the American College of Surgeons (ACS) NTDB for the years 2008–2012 was used for this study. NTDB data are collected from a total of 805 hospitals across all 50 states in the United States that are verified by the American College of Surgeons—Committee on Trauma (ACS-COT). These hospitals include 235 Level I centers and 267 Level II centers; the remainder are either Level III, Level IV, or pediatric-only centers. The NTDB provides deidentified, protected trauma registry data that abide by an exact national trauma registry standard consisting of specific patient inclusion criteria and a uniform set of variables with associated variable definitions. All observations submitted to the NTDB go through a series of edit checks to ensure that the database is both accurate and reliable, and each year, the ACS-COT revises the dictionary of the National Trauma Data Standard data based on suggestions from NTDB participants, researchers, and committee members. All records contained in the NTDB are deidentified as to patient and trauma center identity. Therefore, this study was exempt from the need for approval by the Institutional Review Board.

Patient inclusion

Records for this study were identified using the International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) procedure code for “exploratory thoracotomy” (34.02). Of these observations, we defined a thoracotomy performed in the emergency department as any record with a procedure code time being performed in less than or equal to 15 minutes and time to procedure less than the total time spent in the emergency department. Records also were stratified by penetrating and blunt mechanism of injury using the data field for the mechanism of injury (injury type = 1, blunt; injury type = 2 penetrating). All other mechanisms of injury codes and those with missing data for age were excluded to yield the final study population.

Analytic approach

In terms of baseline characteristics, demographic variables such as age, sex, race, and payer status, as well as preexisting comorbidities and mechanism of injury were utilized to better characterize the patient population who undergo EDT and analyze patient-level factors that are potentially influencing the decision to perform an EDT. Prehospital vital signs and vital signs on arrival to ED also were analyzed to assess the utility of existing guidelines that recommend the use of these variables as indicators to select patients for an EDT. Finally, all-comer, unadjusted mortality, as well as hospital and intensive care unit (ICU) length of stays (LOS) and ventilator days for survivors were analyzed to investigate baseline patient outcomes and assess the success rate of EDTs in the study population. Overall descriptive statistics are reported with arithmetic means (standard deviation) or frequencies (proportions). T tests or χ² tests were used for parametric univariate statistical testing for comparisons between groups.

Age was the primary exposure variable with observations stratified by decade (-10 years, 10–19, 20–29, 30–39, 40–49, 50–59, 60–69, 70–79, 80–89). Survival was the primary outcome of interest. Mortality and survival rates were calculated for each age group for both blunt and penetrating mechanism of injury. To achieve a more granular view of survival and mortality as a function of age, we calculated mortality and survival rates for each single year of age.

Statistical analyses were performed in STATATA MP Version 14 (64-bit).

Results

For the years 2008–2012, a total of 3,659,548 records were submitted to the NTDB. Of these, 11,380 (0.3%) patients underwent thoracotomy, and of these patients, 2,585 (0.001%) met our definition for an EDT. Exclusion of observations that had missing data for age or those who did not have blunt or penetrating mechanisms of injury recorded yielded a final study population of 2,519 patients.

Baseline characteristics of patients undergoing EDT demonstrated that the majority of patients were male (87.5%), of a minority race (67.1%), and self-pay (57.9%). The average age of 32 years old was consistent with other reports. Furthermore, the majority (80.4%) of patients who underwent EDT were injured by a penetrating wound, whereas 19.6% were injured by blunt forces. Not surprisingly, patients with blunt injuries were older and had more comorbidities than the penetrating group. Overall, the study population had low rates of preexisting comorbidities, with hypertension, smoking, and diabetes mellitus having the greatest prevalence (Table 1). These low rates for the co-morbidities most likely reflect underreporting by the trauma centers due to the inability of the health care providers to obtain this information from the family and patient in these patients. The overall survival rate for this study was 7.2%. When considering the mechanism of injury, the survival for blunt patients undergoing an EDT was 5.1%, whereas the survival rate for the penetrating group was 7.7%.

Collectively, the prehospital vital signs for the patients receiving an EDT were consistent with patients presenting in extremis with impending cardiac arrest (Table 2). Comparing the group by blunt versus penetrating injury revealed that those with a penetrating mechanism had a significantly lower systolic blood pressure, lower pulse rate, lower respiratory rate, and lower oxygen saturation, whereas there was no difference in the GCS scores (Table 2). Although these differences in vital signs may not influence clinical decision-making, the vital signs for the patients with penetrating wounds were bradycardia with agonal respirations representing a moribund patient when compared to the blunt mechanism group.

Comparison of admission vital signs by the mechanism of injury revealed similar trends as seen with the prehospital vital signs. The group with penetrating wounds had a significantly lower systolic blood pressure, lower pulse rate, and lower oxygen saturation. The admitting GCS score was similar for both mechanisms of injury (Table 3). Despite this statistical difference, the vital signs for both groups reflected profound shock, bradycardia, and impending asphyxiation with hypothermia; the differences most likely do not have clinical
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