
Societal Costs of Inappropriate Emergency Department Thoracotomy

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- BACKGROUND:** Emergency department (ED) thoracotomy can be lifesaving. It can also lead to resource waste and exposure to blood-borne infections. We investigated the frequency with which ED thoracotomy was performed for inappropriate indications and the resulting societal costs.
- STUDY DESIGN:** This retrospective cohort study examined all trauma patients admitted directly from the scene of injury from 1992 to 2009 who underwent ED thoracotomy. The main outcomes included inappropriate ED thoracotomy. Secondary outcomes included resource use and societal costs for performing ED thoracotomy for improper indications. Specifically, we analyzed for operating room use, blood transfusions, ICU and hospital stay, needlestick injuries, survivor rate, and neurological outcomes in this group.
- RESULTS:** One hundred and twenty-three patients underwent ED thoracotomy during the study period. Of those, 63 (51%) were considered inappropriate. In this group, we observed no survivors, none became organ donors, 3 cases of needlestick injuries to health care providers occurred, and 335 U of blood products were used in their care. Also, 4 patients of 63 survived to the operating room and required a total of 6 separate operating room visits. Three of these patients had an ICU stay of 1 day and 1 died on day 5.
- CONCLUSIONS:** ED thoracotomy should be reserved for potentially salvageable patients, but discouraged for other indications. From the societal point of view, inappropriate use of the procedure resulted in substantial costs and waste of resources, exposure of health care providers to possible blood-borne infections, and offered no survival benefit. (J Am Coll Surg 2012;214:18–26. © 2012 by the American College of Surgeons)
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Emergency department (ED) thoracotomy can be a dramatic lifesaving procedure if performed on the appropriate patient.¹ For this procedure, an anterolateral left-sided thoracotomy^{1,2} is performed in the ED because the patient is deemed too unstable for transport to the operating room for a formal thoracotomy. The ED thoracotomy can be performed by a surgeon or an emergency room physician, and the limited goals of the ED thoracotomy are to relieve cardiac tamponade; control hemorrhage from the heart, lung, or great vessels; and perform open cardiac massage. This procedure is also performed to provide proximal vas-

cular control of the aorta for major intra-abdominal bleeding; however, the ischemia reperfusion injury from this procedure is considerable and the benefits of performing ED thoracotomy for this indication are questionable.³⁻⁷

Many studies have been published during the last 3 decades that tried to identify the subgroup of patients who would have the best outcomes from this procedure.⁸ Rhee and Acosta⁹ published a comprehensive review in 2000 and found that mechanism and location of injury and signs of life are critical determinants for survival post-ED thoracotomy.

One of the strongest predictors of survival post-ED thoracotomy is mechanism of injury.¹⁰ Many authors, including Rhee and Acosta,⁹ have found that patients who have suffered penetrating injury have better outcomes after ED thoracotomy than patients who have suffered blunt injury mechanisms.^{2,11-15} In addition, there is a biological rationale and some evidence in the literature that suggests that better outcomes are observed in those patients who undergo ED thoracotomy within 30 minutes of injury compared with those who wait longer for the procedure.^{15,16} Even so, patients undergoing ED thoracotomy are criti-

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Abbreviations and Acronyms

ED = emergency department
EMS = emergency medical services
GOS = Glasgow Outcome Scale
OR = operating room

cally injured and some authors have reported a prehospital mortality rate of up to 86% for cardiac injuries and 92% for those suffering great vessel injuries.⁵

From a patient's point of view, ED thoracotomy can only be beneficial. Patients requiring ED thoracotomy are in cardiac arrest and, left untreated, have a 100% mortality rate; performing an ED thoracotomy has only the potential to save their lives. However, from a societal point of view, there can be a downside to performing ED thoracotomies. If an ED thoracotomy is performed on a poorly selected group of patients, it has the potential to waste resources; result in inadvertent injury and disease transmission to health care providers; and prolong life in patients with no hope for a meaningful neurological recovery.^{11,14} We performed a retrospective cohort study to examine the frequency with which ED thoracotomies were performed on patients without appropriate indications, and we attempted to quantify the societal costs and resources expended on this group of unsalvageable patients.

METHODS

The trauma registry at Sunnybrook Health Sciences Centre, an urban Level I trauma center in Toronto, was used to identify all trauma patients evaluated from April 1, 1992 to March 31, 2009.

Study group

All patients who underwent a thoracotomy in the ED during their hospital admission and who arrived directly from the scene of injury were selected for additional analysis. Patients referred from other hospitals or who sustained burns were excluded.

Main outcomes

One of the main outcomes for this study was inappropriate ED thoracotomy. Health care interventions are appropriate if performed properly for accepted indications. Conversely, inappropriate care occurs when an intervention is misused (improperly performed), overused (performed for an improper indication), or underused (not performed despite proper indications).¹⁷ In this study, our focus was on overuse—determining if ED thoracotomy was done for improper indications.

There are 2 different methods for determining the appropriateness of medical interventions. One method is a structured implicit review by panels of experts to assess appropriateness.¹⁸ This method is sensitive to nuances of care, but can be reviewer-dependent and biased by the reviewer's experience, attention to detail, and harshness of judgment.¹⁹ In addition, the composition of the panel can affect agreement within the panel.²⁰ In explicit review, a reviewer compares the processes of care with explicit criteria. Explicit review is insensitive to nuances of care, but shows very high inter-rater reliability. In explicit review, the burden of accuracy falls on the criteria, not the reviewer.^{21,22} In this study, we used explicit review to determine whether or not an ED thoracotomy was done for inappropriate indications.

Trauma guidelines suggest that the best outcomes are expected if ED thoracotomy is performed on patients suffering penetrating torso injury, if they arrive shortly after injury (15 minutes), and still show signs of life.¹⁵ Some authors believe that ED thoracotomy can still be done for blunt trauma patients if they suffer cardiac arrest in or just outside the trauma room.^{14,15,23-25} Although this contention is controversial, we incorporated this into our criteria for appropriate ED thoracotomy. Therefore, for this study, our a priori definition for an inappropriate ED thoracotomy was blunt trauma ED thoracotomy with prehospital arrest >5 minutes and penetrating ED thoracotomy on patients with prehospital arrest >15 minutes and no signs of life (Glasgow Coma Scale score = 3, ie, pupils fixed and dilated, no organized electrical activity, no pulse, and no spontaneous respiratory efforts).^{14,25}

To determine duration of prehospital cardiac arrest, we performed electronic and paper chart review. We looked at the prehospital paramedic sheet and identified the first set of vital signs obtained by the paramedic. If the patient was listed as having no blood pressure or heart rate equal to 0, the patient was deemed to be in cardiac arrest. We then examined the patient's prehospital transport time to determine the duration of the cardiac arrest. Otherwise, the time that the patient suffered cardiac arrest was recorded, and the duration of the cardiac arrest was the time interval from cardiac arrest to arrival in the trauma room. Many times, the exact time of cardiac arrest was not documented. Paramedics would only document the location where patients lost vital signs, with relation to the hospital. As 5 minutes and 15 minutes were important time thresholds in determining appropriateness, we came up with an operational definition of cardiac arrest based on location of cardiac arrest. If the patient lost vital signs after being unloaded from the ambulance and when being transported to the trauma bay, we deemed the prehospital arrest time to be <5

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