

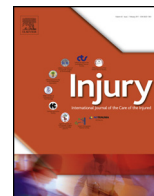


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The pediatric resuscitative thoracotomy during combat operations in Iraq and Afghanistan – A retrospective cohort study

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ABSTRACT

Background: Combat zone trauma poses a unique set of challenges and injury patterns not seen in the civilian setting. The role of the pediatric resuscitative thoracotomy in combat zones remains unclear given a paucity of data regarding procedure outcomes in this setting. We compare outcomes among children in traumatic arrest undergoing resuscitative thoracotomy versus cardiopulmonary (CPR) resuscitation only.

Methods: We queried the Department of Defense Trauma Registry (DODTR) from 2007 to 2016 for all pediatric subjects that underwent a resuscitative thoracotomy or CPR in the prehospital or emergency department setting during operations in Iraq or Afghanistan. We removed CPR subjects with mechanisms of injury not matched in the thoracotomy cohort.

Results: During the study period, there were 3439 pediatric encounters. We identified 13 subjects who underwent a resuscitative thoracotomy and 66 subjects who underwent CPR without thoracotomy with matching mechanisms of injury. When comparing the two cohorts those in the thoracotomy group had higher median thorax body region scores (median 3 versus 0, $p = .001$), but a trend towards higher rates of survival to discharge (31% versus 9%, $p = .108$). The youngest survivor in the thoracotomy cohort was less than 1 year old.

Conclusions: We observed a trend towards higher survival among subjects that underwent a resuscitative thoracotomy survived to hospital discharge compared to subjects undergoing CPR without thoracotomy. The literature will benefit from further data to confirm an association between this procedure and a survival benefit among pediatric subjects in the resource limited setting. Furthermore, improvements in documentation will guide equipping and training providers expected to care for pediatric trauma patients.

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Introduction

Background

Trauma remains the leading cause of death among patients 18 years or younger in the United States (US). The rates of death due to trauma have gradually decreased over the past few years based on data from the Center for Disease Control from 2007 to 2014 [1], however, it remains the most common cause of death in this population. Worldwide, pediatric trauma remains a challenge with motor vehicle collisions and asphyxia cited as the most frequent

causes of death yet very few with access to trauma specialists [2,3]. Multisystem trauma in children is unique from adults due to their differing physiology and increased likelihood of blunt trauma affecting 3 or more body systems [1]. Proportionately larger heads, underdeveloped bodies and musculature, and larger body surface area compared to adults can complicate resuscitative efforts including resuscitative thoracotomy [4–6]. The resource limitations that are a common reality in the settings in which most armed conflicts occur further amplify these resuscitation challenges.

Resuscitative thoracotomy is a potentially lifesaving procedure. Outcomes for this procedure vary widely in adults, with published survival estimates ranging between 0.6% and 37.5% depending on the mechanism of injury and presence of multisystem trauma.

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Blunt trauma victims generally fare worse than those with penetrating trauma [7]. However, there remains a paucity of data for this procedure in the pediatric population. Recent studies show that the pediatric resuscitative thoracotomy can improve survival following traumatic arrest, depending upon the mechanism of injury [8]. Consistent with procedure outcome data from adults, good prognostic indicators for pediatric patients include penetrating injuries to the chest, signs of life upon arrival, and minimal or no multi-system trauma [8,9]. Conversely, poor prognostic indicators include severe blunt trauma, no signs of life on arrival, and 3 or more systems involved [8,10]. Data also suggest significant differences in survival between different age strata within the pediatric population. Prospective, observational data suggest that adolescents (ages 15–18) appear to have more favorable survival than children (<15 years of age): 5% vs 0%, respectively [11]. However, the cited studies are based in the civilian setting in developed countries which limits the ability to extrapolate these findings to the resource-limited, austere setting in which combat operations occur.

Pediatric care comprises a significant proportion of patient volume for military medical providers in the combat zone setting as part of life, limb, and eyesight saving emergency procedures as dictated by the military medical rules of engagement [12,13]. Yet few deployed providers have specific training in pediatric medicine and surgery and it is not included in pre-deployment training. Additionally, data guiding the use of resuscitative thoracotomy in this population remain limited, and there are no data on performance of these procedures in a pediatric population in this resource-limited combat setting. It remains unclear which age groups and injury patterns are most likely to derive benefit from this procedure. Further data regarding outcomes for this procedure when performed in theater will help guide future mission planning, training priorities, and resource allocation.

Goal of this study

Our objective was to compare survival among pediatric subjects experiencing pre-hospital or emergency department (ED)

traumatic arrest during combat operations in Iraq and Afghanistan undergoing cardiopulmonary resuscitation (CPR) only versus resuscitative thoracotomy. We hypothesized that subjects undergoing thoracotomy would experience a survival benefit compared to subjects undergoing CPR only.

Methods

Data acquisition

We identified subjects as part of a study seeking to evaluate prehospital and ED interventions for pediatric trauma patients. This study met US Army Institute of Surgical Research regulatory requirements (USAISR protocol H-16-014). We obtained only de-identified data.

Subjects and setting

We queried the Department of Defense Trauma Registry (DODTR) from January 2007 to January 2016. All medical care occurred in Iraq or Afghanistan. We searched for all subjects that had a documented thoracotomy in the prehospital or the ED setting based on International Classification of Disease 9th Edition (ICD-9) procedure codes. For the comparator cohort, based on the clinical indications for resuscitative thoracotomy, we searched for all subjects undergoing CPR [14]. We placed all subjects with documentation of both a thoracotomy and CPR into the thoracotomy group. Of the remaining subjects, we placed subjects with documentation of a thoracotomy or CPR in both their prehospital and ED records into the pH category. We removed subjects in the CPR cohort without a matching mechanism of injury (MOI) in the thoracotomy group to improve comparability between the cohorts.

Department of defense trauma registry (DODTR) description

The DODTR, formerly known as the Joint Theater Trauma Registry (JTTR), is the data repository for DoD trauma-related injuries. The DODTR includes documentation regarding

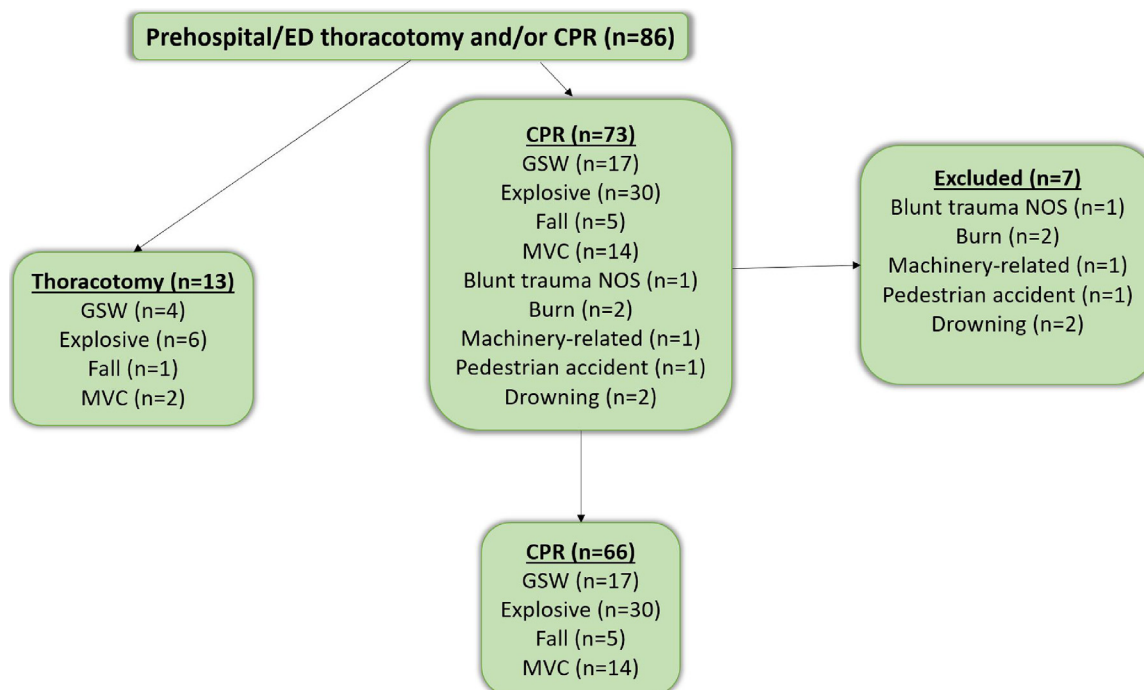


Fig. 1. Inclusion/exclusion flow diagram.

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