



Research Article

Emergency Room Thoracotomy (ERT): The Outcomes in a Level One Trauma Unit of a Developing Country

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Abstract

Purpose: An Emergency Room Thoracotomy (ERT) has the most favourable outcomes when performed based on the correct indications in a patient presenting in extremis due to trauma. According to various literature the survival outcomes may reach up to 30% in carefully selected patients. This study aimed to carry out an audit over one year of patients that had an ERT performed and to assess death during admission versus survival to discharge.

Methods: this retrospective observational study review of patients presenting to the level one trauma centre over one year assessing mechanism of injury, injuries sustained and survival to discharge.

Results: it demonstrated higher survival rates of ERT procedures in a developing country, as high as 47% overall with 45% survival shown in penetrating injuries, and 60% survival seen in blunt injuries. Stab injuries had a higher survival of 53% when compared to GSW (38%).

Conclusion: The study showed that these survival rates are approximately two-to-three times higher than the general international standard.

Introduction

The Emergency Room Thoracotomy (ERT) - also referred to as Emergency Department Thoracotomy (EDT) and front room thoracotomy - was formally described in the 1960s [1]. The common predictors of survival are the mechanism of injury, anatomic location of injury, the patient's physiological parameters along with presenting signs of life [2]. However, patients tend to present with or without each of these predictors and, thus, still making it difficult to decide which patients may have the most benefit and best outcome if an ERT is performed [3]. Patients that sustain penetrating intrathoracic injuries with signs of life have more favourable outcomes than those that sustain blunt intrathoracic

injuries when ERT is performed in both groups in comparison, with approximately 21% and 4.6% survival rates, respectively [4]. The patients that had ERT performed that presented without signs of life with penetrating intrathoracic injuries had a survival rate of 8.3%, whilst blunt injuries without signs of life had a 0.7% survival [5]. When analyzing the performance and survival rates of ERT in extra-thoracic penetrating injury with signs of life (15.6% survival) versus extra-thoracic penetrating injury without signs of life (2.9% survival), the mortality rate begins to escalate notably [6]. Hence, it is crucial to select patients carefully in order to provide low morbidity and mortality rates whilst having acceptable quality of life thereafter. The EAST Guidelines provide evidence-based recommendations to assist in this regard [7].

It is understandable that the survival rates of ERT are low since patients present in extremis and it is a life-saving measure that is performed with the aim of temporizing a critical patient until definitive repair is possible in an operating theatre [8]. The ERT allows a surgeon to enter the left anterior-lateral chest in order to 1) decompress cardiac tamponade, 2) cross-clamp the aorta to prevent exsanguination, 3) facilitate direct haemorrhage control of intrathoracic injuries (cardiac or pulmonary), or 4) initiate internal cardiac massage [9]. As evidenced by the retrospective analysis of Velmahos et al, they demonstrated survival rates of 8.3% in stab wound patients, 4.4% in gunshot wound patients, and 0.6% in blunt injury patients [10]. This once again emphasizes the importance of patient selection. Outcomes have been reported retrospectively and analyzing implementation of protocols and their effects thereafter according to the variables of mechanism of injury, location of injury and the presence or absence of signs of life [11]. When all three of these factors are taken into consideration and the most optimal conditions are present - 1) penetrating injury, 2) intrathoracic, and 3) signs of life present, then the outcomes are most favourable reaching to survival rates as high as 27.5% [7,12].

Many of the studies on ERT and outcomes originate from developed countries or well-resourced facilities. Whether the survival rates post-ERT in a developing country at a resource-constrained healthcare facility compare to international standards is not clear. Because of delay of hospital transfers and theatre access delays, the rates of ERT performances may be impacted with possibly a higher proportion of these procedures performed in a specified period. The level one Trauma Emergency Unit (TEU) of this particular hospital serves a large population (approximately 1.9 million people) under the public/government sector and has a heavy burden of trauma. This retrospective audit aims to assess the frequency of ERT performances at this institution and the outcomes of these cases with the intention of encouraging more such articles and studies to be published to assess the morbidity and mortality, indications and the sequelae of ERT cases in other resource-constrained developing nations.

The aim for this retrospective observational audit is to review cases presenting to a state level one Trauma Emergency Unit for one year that underwent a resuscitative emergency room thoracotomy and the survival to discharge.

Methods

A retrospective observational review of all Trauma Emergency Unit (TEU) resuscitation cases with thoracotomies performed from 1 July 2021 to 30 June 2022. These records filled in the trauma statistics files and admission files at the state hospital in this developing nation. The information to be extracted:

- File number (will be anonymized)
- Age
- Gender
- Mechanism of Injury
- Cavity injured and findings
- Transfer to theatre
- Discharge from hospital versus death post-ERT (death during admission)

A comparison of the mechanism of injury, affected cavity and injuries sustained, and the outcome (survival to discharge versus death during admission) are the main assessment tools of this review. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines were used in reporting this observational review.

Ethical and legal considerations

Ethics through the Ethics Committee was obtained: Human Research Ethics Committee (HREC): M220855 (R14/49).

Results

Over a one-year period, a total of 38 Emergency Room Thoracotomies (ERTs) were performed in the front room/resuscitation area. The average age of patients was 33.7years with age range of 17years to 68years old. Overall outcomes demonstrated 21% of patients dying in resus, 21% of patients dying in theatre, 11% of patients dying in the ward, and 47% survival to discharge from the hospital. On arrival to the emergency department, 57% of the patients had an unrecordable (less than 50mmHg systolic) Blood Pressure (BP).

Males made up 95% of the patients, whilst females consisted of 5% of the total ERTs (Figure 1).

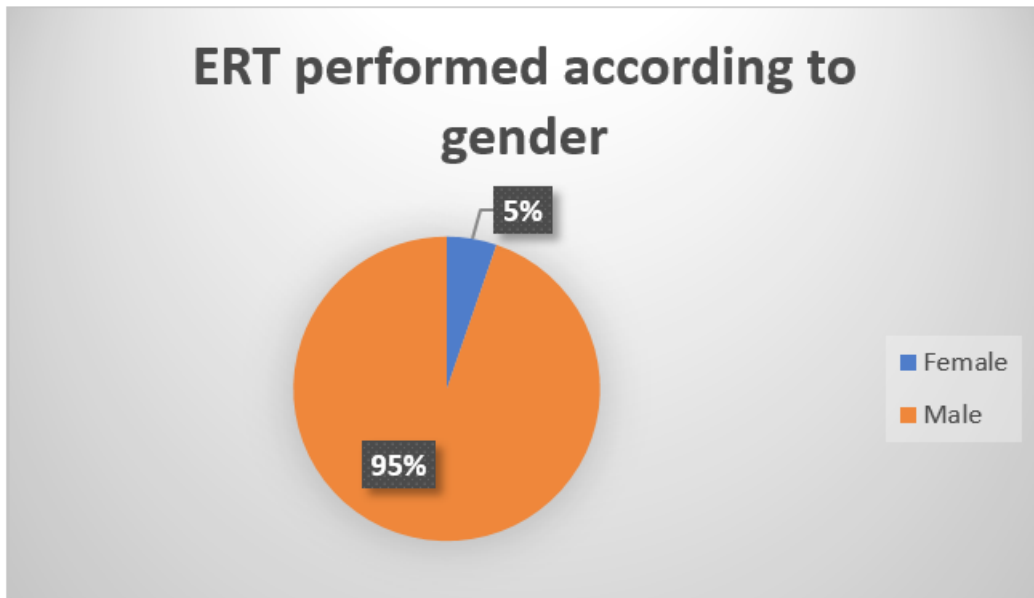


Figure 1: Graph of performed ERTs according to gender.

Penetrating injuries including Gunshot Wounds (GSW) and stabs were the main indication for performing an ERT making up 87% of total ERT indications, and blunt trauma (assault, Pedestrian Vehicle Crash (PVC), Motor Vehicle Crash (MVC)) contributed to 13% of indications to perform an ERT (Figure 2).

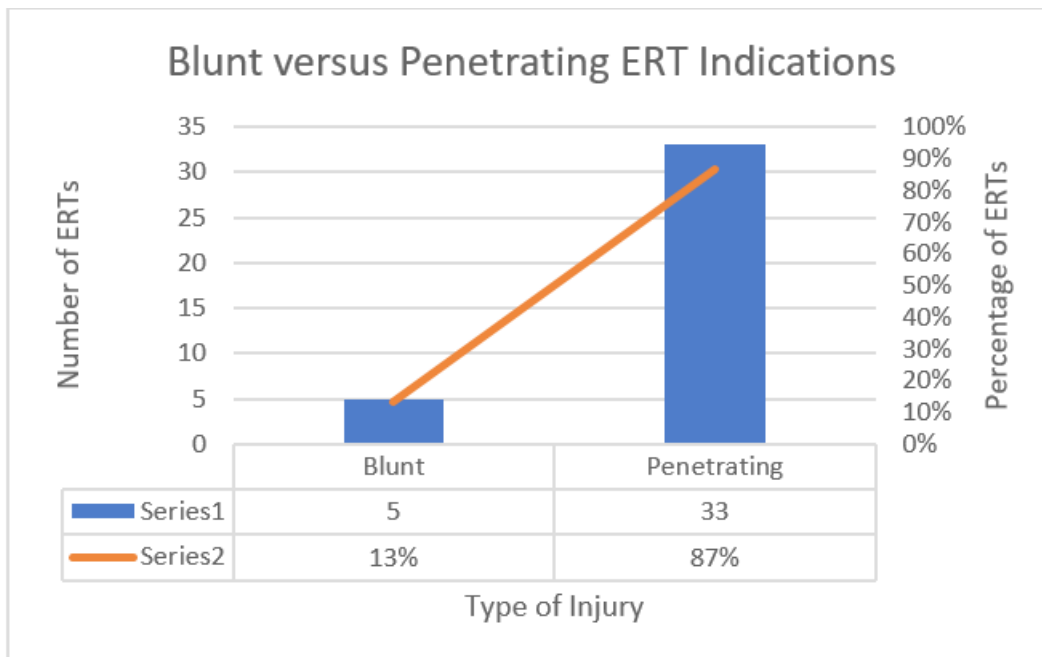


Figure 2: Indications for ERT performance

On reviewing penetrating injuries, majority involved chest trauma (48%), followed by injuries to multiple cavities (24%), then abdominal (21%), neck (3%), and limb (3%) injuries (Figure 3).

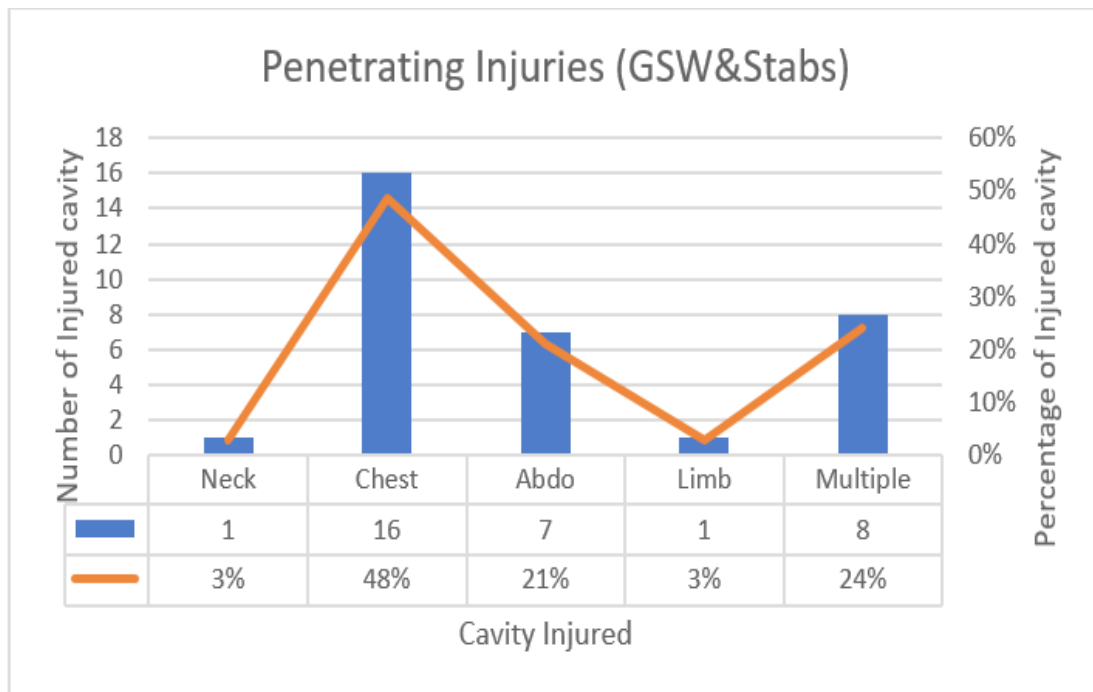


Figure 3: Penetrating injuries according to cavity injured.

Comparing GSW and stabs, stab injuries had a slightly higher incidence at 52% and GSW at 48% of penetrating injuries (Figure 4).

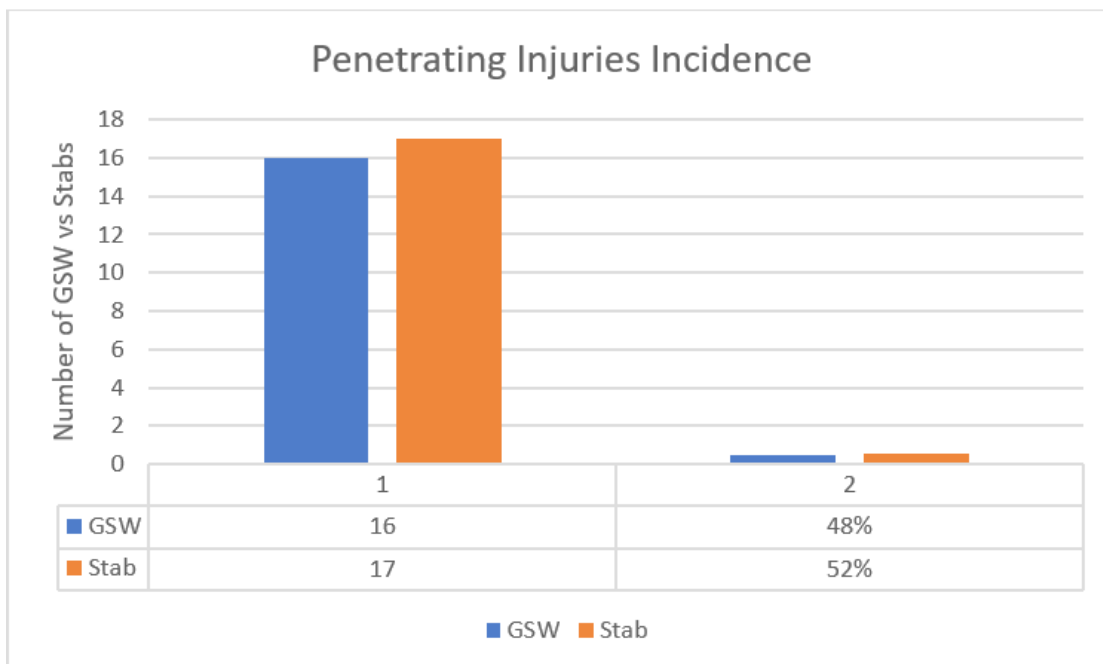


Figure 4: Incidence of GSW versus stab wounds.

Of the penetrating injuries, limb and neck injuries had the highest mortalities (Figure 5).

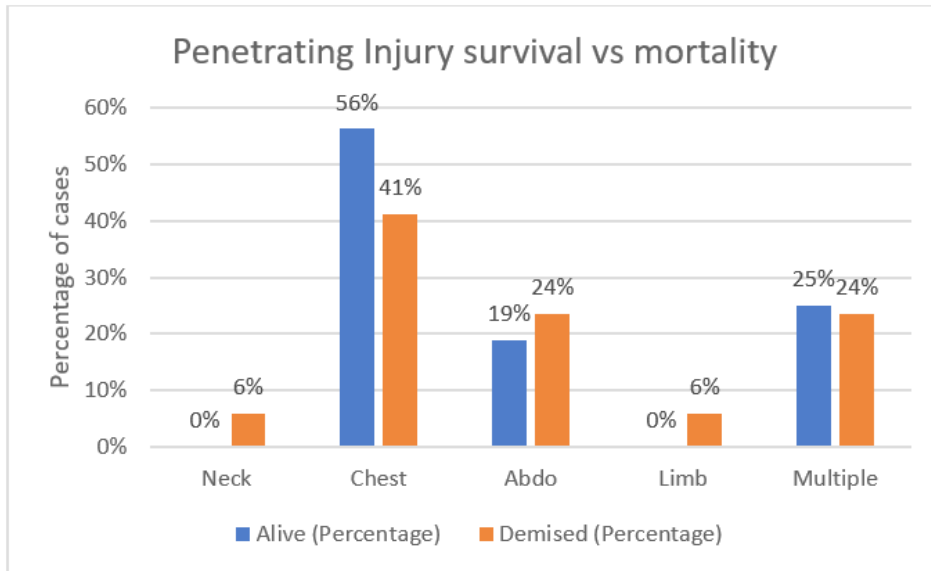


Figure 5: Survival and mortality rates of penetrating injuries.

Of the blunt ERTs performed, a survival rate of 60% was seen, and 45% survival in penetrating injuries (Figure 6).

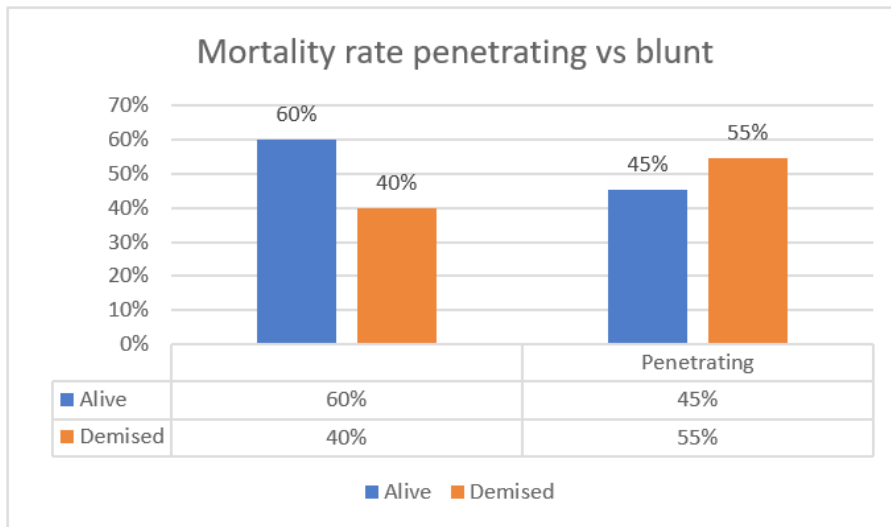


Figure 6: Comparative mortality rates of penetrating versus blunt injuries.

The comparison of GSW versus stab mortalities, a 38% survival was seen in the GSW whilst a survival of 53% of stab injuries was observed. GSW had a mortality of 63%, and 47% in stab injuries. Thus, stab wounds had a higher survival and lower mortality when compared with GSW injuries. Blunt injures showed a 40% mortality with a 60% survival rate (Table 1).

| Blunt | Number | Percentage | Total Penetrating | GSW | Number | Percentage | Stab | Number | Percentage |
|---------|--------|------------|-------------------|-----|--------|------------|---------|--------|------------|
| Alive | 3 | 60% | 15 | 45% | 6 | 38% | Alive | 9 | 53% |
| Demised | 2 | 40% | 18 | 55% | 10 | 63% | Demised | 8 | 47% |

Table 1: Mortality rates of penetrating injuries.

Discussion

The majority of patients that had an ERT performed were male patients at 95% and the average age of patients of 33.7 years. Most indications for ERT were due to penetrating injuries and 13% of ERT indications were from blunt injuries. The overall survival rate of patients with ERTs performed was 47%, with 21% of patients having died in the resuscitation area, 21% dying in theatre, and 11% dying in the ward some days-to-weeks post ERT. Blunt injuries demonstrated a 60% survival whilst penetrating injuries had a 45% survival. Since its first formal description in 1967 [1], the ERT has seen survival rates most optimal in penetrating intra-thoracic injuries in patients presenting with signs of life of up to 21%-28% [4] which dramatically decreases to 8.3% in penetrating intra-thoracic injuries without signs of life on presentation [5]. As demonstrated in this study, patients with penetrating intra-thoracic injuries have a survival rate of up to 56% - approximately double the international rate.

Extra-thoracic penetrating injuries had survival rates ranging from 0% (Neck and limb) to 19% - 25% for abdominal and multi-cavity injuries, respectively. Internationally, however, this survival rate declines with extra-thoracic injuries with and without signs of life to as low as 15.6% and 2.9%, respectively [6]. Once again, this study demonstrates a slightly higher survival rate for penetrating extra-thoracic injuries. Blunt injuries proved to have the worst outcomes with a survival rate ranging from 0.7% to 4% [5]. Our study showed a survival of up to 60% on blunt injuries (predominantly abdominal and pelvic injuries). GSW injuries had a lower survival rate of 38% when compared to stab injuries which had a 53% survival rate.

The 11% of patients that died in the ward were due to hypoxic brain injury, multi-organ failure, or sepsis.

As evidenced by numerous studies, the outcomes of an ERT depend on the mechanism of injury, cavity/location of injury, and whether the patient presents with signs of life. Across the board in this study the ERT outcomes were more favourable with higher survival rates for both blunt and penetrating trauma, as well as intra- and extra- thoracic injuries.

Limitations

This was a small study with a small pool of patient numbers, and hence, the results are not significant. Not all signs of life were documented if present or absent - only whether a blood pressure was recordable or not (less than 50mmHg) was clearly documented. The time from occurrence of injury to transport from scene to hospital is not clear. The length of time spent in resuscitation prior to performance of an ERT was not clearly recorded. Due to resource constraints such as time lapse from occurrence of injury to arrival to hospital, and emergency blood availability not always being readily available, the resuscitation outcomes may be negatively

affected. At times the delay of more than thirty minutes in blood acquisition was encountered. Physiological parameters measured on arrival were not clearly documented such as percentage of Hydrogen (pH), Base Excess (BE), lactate, haemoglobin (Hb), and the time between ERT performance and transfer to theatre for definitive management and repair.

Recommendations

Larger study with a patient sample that may yield significant results is needed. Assessing the presenting signs of life in more detail, and outcomes according to functionality of the patient, morbidities or complications during admission, may be of use. Including parameters such as percentage of Hydrogen (pH), base excess (BE), lactate, haemoglobin, and time spent in the emergency department before the ERT is performed, may assist in fully evaluating whether the indication and outcomes of the ERT are accurate.

Conclusion

The indication of ERT together with the presenting physiology of the patient influence the outcomes and success thereof, of such a procedure. This study demonstrated the potential higher survival rate of ERTs in a level one trauma centre despite certain resource-constraints. The ERT survival was as high as 47% overall with 45% survival shown in penetrating injuries, and 60% survival seen in blunt injuries. Stab injuries had a higher survival of 53% when compared to GSW (38%). Intra-thoracic penetrating injuries showed the best survival of 56% when compared to extra-thoracic penetrating injuries. These survival rates are approximately two-to-three times higher than the general international standard.

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