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## Emergency department thoracotomy in Jamaica: A case controlled study

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### KEYWORDS

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**Abstract** Increasing numbers of severely injured patients have been presenting to Emergency Rooms worldwide due to advances in pre-hospital trauma care. Some of these patients may be candidates for Emergency Department Thoracotomy (EDT). Large advisory bodies have identified selection criteria for EDT in Developed Countries, but there are no regional statistics to guide the selection process in Developing Caribbean Nations. This study evaluates outcomes with EDT at the University Hospital of the West Indies in Jamaica in order to determine factors that could predict survival in this setting.

A retrospective study was performed over 11 years from January 1995 to January 2006 examining patients who had EDT at the University Hospital of the West Indies. There were 13 procedures performed over 11 years, with two early survivors (15%) and one patient surviving to discharge. The factors that have been found to be significant predictors of mortality include gunshot injuries, extra-thoracic injury location, inadequate pre-hospital resuscitation, prolonged transportation time and the absence of signs of life on arrival to hospital.

Several health care limitations have been uncovered in this setting that must be improved if we are to expect improved outcomes. Focused preparation of the Emergency Room is an initial step that can be easily achieved. We also need to define strict management protocols using selection criteria that are tailored to our local environment in order to exclude futile procedures in unsalvageable patients.

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## Introduction

For several decades after its introduction to surgical practice in the early 1900s, Emergency Department Thoracotomy (EDT) yielded poor statistical outcome because it was indiscriminately applied to all moribund trauma patients.<sup>1–3</sup> Reports from Developed Countries have documented improvement over the past three decades after the implementation of strict management protocols with well-defined selection criteria.<sup>1–7</sup> There are no management protocols in place at the University Hospital of the West Indies (UHWI) in Jamaica. And to the best of our knowledge, there are no regional statistics that examine the outcomes from Caribbean Countries that operate under different health care environments. This paper is the first to assess the outcomes with EDT in the English speaking Caribbean.

## Method

The University Hospital of the West Indies (UHWI) is a 500-bed tertiary referral center in Kingston, Jamaica with seven operating theatre suites and two eight-bed multidisciplinary Intensive Care Units (ICU). Trauma victims usually present to the Accident and Emergency (A&E) Department. They are immediately seen by A&E residents, who commence resuscitation following Advanced Trauma Life Support (ATLS®) protocols of the American College of Surgeons (ACS). Surgical consultations are routinely sought for patients with penetrating thoracic injuries.

Patients who require surgery and are stable are transferred to the Operating Theatre. The decision to perform EDT on patients who are in extremis from chest trauma is made by the surgical senior resident on call. Once the patients are stabilized, they are transferred to the Operating Theatre for definitive repair in a controlled setting.

On presentation to A&E, patients were considered to have signs of life if there was a pupillary response, active breathing, palpable carotid pulse, measurable blood pressure, and purposeful extremity movement or cardiac electrical activity. This is the definition used by the ACS' Committee on Trauma.<sup>1</sup>

We retrospectively examined records from the A&E, Operating Theatre and Pathology Department at the UHWI over a period of 11 years from January 1995 to January 2006. The records for patients who had EDT were retrieved. Data were extracted and entered in a Microsoft Excel® (Microsoft Office for Mac OS X) worksheet. The information collected included patient demographics, details of pre-hospital resuscitation, signs of life, injury mechanism, associated injuries and mortality.

The data were sorted into two groups. Patients who were pronounced dead shortly after arrival to hospital were grouped together and labeled an Early Mortality Group. These patients were thought to have unfavourable pathophysiological features that could herald inevitable mortality. It has previously been documented that most trauma deaths in our ICU (55%) occur within 24 h of admission.<sup>8</sup> Therefore, we examined a second group of patients who survived at least 24 h after definitive surgery. We considered these Early Survivors a select group with beneficial

features that predicted better therapeutic outcomes and hence, chance for survival.

Comparisons were performed using the Chi-squared tests and Fisher's exact tests to determine significance. A  $p$ -value  $\leq 0.05$  was considered statistically significant.

## Results

Thirteen procedures were performed over the study period. Hospital records for two patients could not be retrieved to analyze clinical data, but information could still be gleaned from their autopsy reports. The cases are summarized in Table 1.

There were 11 patients in the Early Mortality Group and two Early Survivors (Table 2). None of them benefited from pre-hospital resuscitation, as they were all transported to hospital by non-medical personnel.

Eleven procedures were performed in the A&E, one in the Radiology Department and the other in a corridor en route to the Operating Theatre. Surgical senior residents performed all the procedures through anterolateral incisions without skin preparation or antibiotics.

Factors that were found to be predictive of early mortality included gunshot wounds, extra-thoracic injuries, prolonged transportation times and absence of signs of life on presentation (Table 2).

There were two patients in the early survivor group. One patient eventually succumbed to his injuries in the ICU 36 h after repair of a right ventricular laceration. Post-operatively he was noted to have a haemoglobin count of 2 g/dl and there were no blood products available for transfusion. He died from decompensated shock due to massive blood loss.

The second patient had EDT performed in a corridor after he had a witnessed arrest during transfer to the operating theatre. Cardiac activity returned after finger occlusion of a right ventricular laceration and one handed internal cardiac massage. After stabilization in the Operating Theatre, the right ventricular laceration was repaired with pledgeted 3/0 polypropylene sutures. Post-operatively he was transfused five units of packed cells and 10 units of plasma to correct haemoglobin of 3 g/dl. He was discharged from hospital 26 days later with persistent neurologic deficits, including reduced mental capacity and incomprehensible slurred speech. There was no significant improvement in function up to three months post-discharge.

## Discussion

Victims of trauma who arrive in the A&E Unit and are unresponsive to resuscitation, in extremis or have a witnessed arrest may be candidates for EDT. This procedure is ideally performed in the Operating Room because of the ready availability of specialized surgical instruments and equipment to deal with any unexpected emergency that may arise.<sup>9–11</sup>

Candidates for this procedure are not stable enough to withstand the delay for transfer and may require EDT to be performed during the initial resuscitation outside of the Operating Room, and not necessarily within the physical confines of the A&E Unit. The EDT may be lifesaving by

**Table 1** Clinical data from patients subjected to EDT

Case no.	Age in years	Gender	Pre-hospital resuscitation	Means of transport to A&E	Estimated transport time in minutes	Mechanism of injury	Extra-thoracic injury	Signs of life on arrival to A&E unit	Attempted pericardiocentesis	Location of EDT	Time of death
1	22	M	No	Bystander	16	Knife	None	None	N/A	A&E	<1 h
2	24	M	No	Bystander	10	GSW	GSW to head and left thigh	BP138/92; PR99; RR28	No	A&E	35 min
3	70	M	N/A	N/A	N/A	GSW	GSW to right flank	File not available	N/A	A&E	N/A
4	26	M	No	Police	20	GSW	GSW to left flank	BP82/60; PR168; RR40; GCS13/15	No	A&E	90 min
5	20	M	No	Bystander	10	GSW	GSW to left thigh	BP80/40; PR178; RR37; GCS13/15	N/A	A&E	<1 h
6	29	M	No	Police	15	GSW	None	BP50/20; PR160; RR46	N/A	A&E	<1 h
7	52	M	No	Bystander	25	GSW	None	BP75/45; PR120; RR26; GCS13	No	A&E	60 min
8	22	M	N/A	N/A	N/A	GSW	None	File not available	Yes	A&E	N/A
9	47	M	No	Bystander	N/A	Knife	None	BP0; PR50; CA <sup>+</sup> ; RRgasp; GCS9/15	Yes	A&E	36 h
10	34	M	No	Police	20	Knife	None	BP84/53; PR129; RR30; GCS13	Yes	X-ray	20 min
11	23	M	No	Bystander	15	Knife	None	None	No	A&E	<1 h
12	31	M	No	Bystander	3	Knife	None	BP56/23; PR49; RR30; GCS14	No	Corridor	Survivor
13	24	M	No	Bystander	10	GSW	None	BP50/20; PR175; RR35; GCS11/15	No	A&E	30 min

Abbreviations: N/A = information not available; BP = blood pressure; PR = pulse rate; RR = respiratory rate; Pup = pupillary response; CA = activity on cardiac monitor; Mov = purposeful extremity movement; GSW = gunshot wound; and GCS = glasgow coma score.

**Table 2** Factors affecting the therapeutic outcome from EDT

Factor	N	Early survivor, N (%)	Early mortality, N (%)	p-Value
Total number of patients	13	2 (15%)	11 (85%)	—
Gunshot wounds	8	0 (0)	8 (100%)	—
Stab wounds	5	2 (40%)	3 (60%)	0.66
Signs of life on arrival	9	2 (22.22%)	7 (77.77%)	0.04
Absent signs of life on arrival	2	0 (0%)	2 (100%)	—
No pre-hospital resuscitation	13	2 (15.38%)	11 (84.62%)	0.01
Mean estimated transportation time	—	3 min	15.9 min	0.05
Isolated chest injury	9	2 (22.22%)	7 (77.77%)	0.04
Extra-thoracic injury	4	0 (0)	4 (100%)	—
Cardiac tamponade from stabs	5	2 (40%)	3 (60%)	0.66

providing immediate access to release cardiac tamponade, control exsanguinating hemorrhage and perform internal cardiac massage. Secondary aims include clamping the descending thoracic aorta to isolate circulation to the upper torso and allow for damage control surgery.

Several reports from Developed Countries have documented improved outcomes once strict management protocols with well-defined selection criteria are implemented.<sup>1–7</sup> But these results are not easily reproducible in Developing Countries where support services and facilities are not readily available.<sup>8</sup>

It is significant to note that none of the patients had pre-hospital resuscitation by specialized Emergency Response Teams, despite the proven benefits of this.<sup>12,13</sup> Although local police transported three patients to the A&E, they were not trained in advanced resuscitation skills.<sup>14,15</sup>

Without adequate pre-hospital resuscitation, it is expected that longer transport times will herald worse outcomes. This was the case in our series where the mean estimated transportation time was significantly longer in non-survivors (15.9 vs 3 min,  $p = 0.05$ ). The lack of universal availability of pre-hospital Emergency Response Services is an obvious limitation for the care to trauma patients in Jamaica today.<sup>13–16</sup> This is a reflection of the health care environment that is present in many Caribbean Countries.

Despite these limitations, the early survival at the UHWI (15%) is comparable to that in larger reports from Developing Countries. The ACS' Committee on Trauma reported 11.16% survival in their meta-analysis of 4482 patients who had EDT for penetrating chest trauma.<sup>1</sup>

Some patients in this series have been offered EDT despite the presence of poor prognosticators. Several reports have identified the absence of signs of life on arrival to hospital as a herald of mortality.<sup>1–4,6</sup> Similarly, this was noted to be predictive of early mortality in our series. Despite this, two patients without signs of life on arrival were subjected to EDT and they both succumbed to their injuries. Perhaps EDT should not have been extended to these patients.

Gunshot wounds<sup>4,7,13,17</sup> and extra-thoracic injury location<sup>1,3,7,17</sup> have also been identified in several reports as reliable predictors of poor therapeutic outcomes. These factors were also noted to be highly predictive of mortality in this series. The implementation of institutional protocols at the UHWI may have prevented futile EDT in these patients.

Patients with thoracic stab wounds and resultant cardiac tamponade had the best results in our series, accounting

for both early survivors. This is similar to reports in the literature where these patients have particularly impressive survival ranging from 32%<sup>18</sup> to 68%<sup>19</sup> after EDT. The three patients with precordial stab wounds in the early mortality group had other factors contributing to their demise – two presented without signs of life and the other had EDT delayed because instruments were unavailable. This is a major obstacle because when equipment is unavailable in the A&E, patient salvage suffers as a consequence. This barrier can easily be eliminated by ensuring that instruments are available in the form of a special EDT kit that is always present in the A&E Unit. Our recommendations for the contents of such a kit are outlined in Table 3.

The fact that EDT is one of the last maneuvers that may preserve life cannot justify its indiscriminate use because there are several complications. The trauma team is at high risk for percutaneous injuries, blood exposure and disease transmission.<sup>1,2,6</sup> Additionally, the financial demands cannot be underscored, especially in Caribbean Countries where resources are scarce with the health care systems being under-funded.<sup>8,20</sup> The quality of life in survivors is also of valid concern in the survivors. The ACS' meta-analysis identified 226 survivors of EDT who had 15% incidence of significant neurologic deficits.<sup>1</sup> The sole survivor in our series also required constant home supervision due to his neurologic impairment, much to the distress of his caregivers.

## Conclusions

It is time to implement strict protocols to exclude futile operations in unsalvageable patients and we must tailor the indications to suit our local health care environments.

**Table 3** Suggested equipment for emergency department thoracotomy kit

Access	Haemostasis	Repair
Scalpel and 10 blade	Laparotomy packs	DeBakey vascular forceps
Rib spreader	Satinsky vascular clamp	Long needle holder
Mayo scissors	Artery forceps	Teflon pledgets (10)
		3/0 non-absorbable suture on round-bodied needles

Several limitations of the health care system have been uncovered in Jamaica that are likely reflective of most Caribbean Countries. They must be addressed if we are to expect improved outcomes. Importantly, the A&E should stock a special EDT Kit that contains the basic equipment necessary for this procedure.

#### Conflicts of interest

None.

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#### Ethical approval

The manuscript was exempted from ethical committee review as it analyses retrospective data and contains no identifying information about any patients.

#### References

1. Working Group, Ad Hoc Subcommittee on Outcomes, ACS Committee on Trauma. Practice management guidelines for EDT. *J Am Coll Surg* 2001;**193**:303–9.
2. Aihara R, Millham F, Blansfield J, Hirsch E. Emergency room thoracotomy for penetrating chest injury: effect of institutional protocols. *J Trauma* 2001;**50**:1027–30.
3. Rhee P, Acosta J, Bridgeman A. Survival after emergency room thoracotomy: review of published data from the past 25 years. *J Am Coll Surg* 2000;**190**:288–98.
4. Tyburski JG, Astra L, Wilson RF. Factors affecting prognosis with penetrating wounds of the heart. *J Trauma* 2000;**48**:587–90.
5. Lorenz H, Steinmetz B, Lieberman J. Emergency thoracotomy: survival correlates with physiologic status. *J Trauma* 1992;**32**:780–8.
6. Feldman J. Provider risk during medically futile EDT. *Ann Emerg Med* 2001;**38**(3):341.
7. Velmahos G, Degiannis E, Souter I, Allwood A, Saadia R. Outcome of a strict policy on emergency department thoracotomies. *Arch Surg* 1995;**139**:774–7.
8. Scarlett MD, Mitchell VT, Amata AO. Trauma admissions to the ICU of the university hospital of the West Indies, Kingston. *Trauma Care* 2001;**11**(2):86–9.
9. Rao AB, Spencer H, Fletcher P. Penetrating wounds of the thorax. *West Indian Med J* 1979;**28**:80–6.
10. Branday JM, Kumar EB, Spencer H. Intra-pericardial heart and great vessel injuries. *West Indian Med J* 1984;**33**:176–9.
11. McFarlane M, Branday JM. Penetrating injuries of the heart. *West Indian Med J* 1990;**39**:74–9.
12. Barnett A, Segree W, Matthews A. The roles and responsibilities of physicians in pre-hospital emergency medical services: a Caribbean perspective. *West Indian Med J* 2006;**55**(1):52–5.
13. Durham L, Richardson R, Wall M. Emergency center thoracotomy: impact of prehospital resuscitation. *J Trauma* 1992;**32**:775–9.
14. Segree W, Matthews A. Pre-hospital emergency medical services phase I. Role of the department of community health and psychiatry. *West Indian Med J* 1998;**47**(S4):22–4.
15. Richards K. A review of the activities of the emergency medical service of Jamaica. *PAHO/WHO Document Centre* 2002;**35**(W215):R53.
16. McDonald AH, Williams-Johnson J, Williams ER, French S. Emergency medicine in Jamaica. *Can J Emerg Med* 2005;**7**(5):340–3.
17. Branney S, Moore E, Feldhaus K, Wolfe R. Critical analysis of two decades with post injury emergency room thoracotomy in a regional trauma center. *J Trauma* 1998;**45**:87–95.
18. Demetriades D, Vander-Veen BW. Penetrating injuries of the heart: experience over two years in South Africa. *J Trauma* 1983;**23**(12):1034–41.
19. Mattox KL, Limacher MC, Feliciano DV, Colosimo L, O'Meara ME, Beall AC, et al. Cardiac evaluation following heart injury. *J Trauma* 1985;**25**(8):758–65.
20. Ward E, Fox K, Ricketts L, McCaw-Binns AM, Gordon G, Whorms S, et al. A Review of hospital care in Jamaica: morbidity and mortality patterns, resource allocation and cost of care. *West Indian Med J* 2001;**50**(S2):21.