

# Emergency department thoracotomy for pericardiac tamponade

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## ABSTRACT

A 31-year-old man with a penetrating chest injury presented acutely with pulseless electrical activity, as a result of a ventricular laceration causing pericardial tamponade. Emergency department thoracotomy was performed to release the tamponade and he was operated on immediately to repair the laceration. He subsequently survived and was discharged to a community hospital for rehabilitation. We present this case of penetrating cardiac injury in which the patient arrived in extremis and for which emergency department thoracotomy was performed, and we discuss the role of emergency thoracotomy, its indications and outcome indicators.

**Keywords:** emergency department thoracotomy, emergency thoracotomy, penetrating cardiac injury, pericardiac tamponade, ventricular laceration

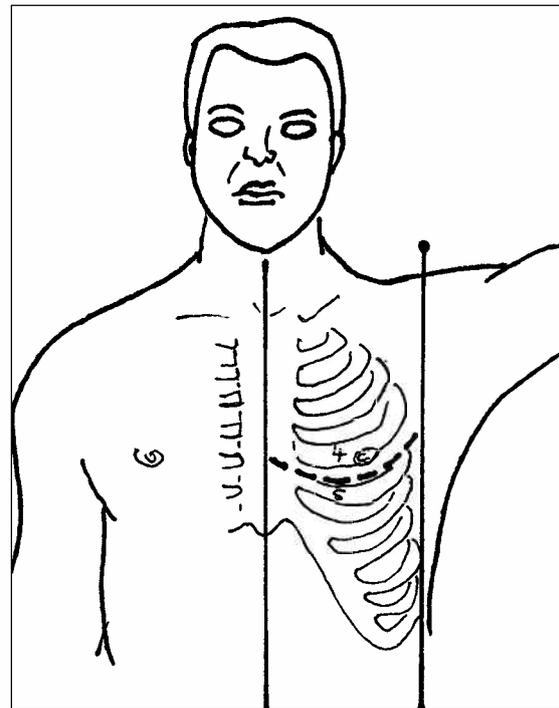
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## INTRODUCTION

Emergency thoracotomy is a lifesaving procedure when performed under the correct indications and approaches. This is one of the dramatic interventions that is used in the emergency department when the patient is deemed to be unlikely to survive his trip to the operating theatre, having suffered a penetrating injury to his chest or heart. The outcome of the patient is often dependent on multiple factors. We report a case whereby emergency thoracotomy was performed and its subsequent results.

## CASE REPORT

A 31-year-old man was driven by his friends to the emergency department at about three o'clock in the morning. He was apparently assaulted and stabbed in the chest. He collapsed at the emergency department driveway and was brought into the resuscitation room immediately. He was pulseless with no spontaneous respiration. He suffered two stab wounds to his chest, a 3-cm laceration over his left fourth intercostal space near the cardiac apex and a 2-cm stab wound over the



**Fig. 1** Diagram shows a left anterior thoracotomy, starting from the costochondral junction to the mid-axillary line.

third intercostal space at the right mid-clavicular line. He was in a state of pulseless electrical activity and the diagnosis of possible cardiac tamponade from the penetrating wounds was made. There was no obvious raised jugular venous pressure. He was intubated and cardiopulmonary resuscitation was started immediately. Intravenous access was obtained with large bore cannula, and fluid resuscitation commenced.

A 5-cm left anterior thoracotomy was made along the upper border of the sixth rib, starting from the costochondral junction to the mid-axillary line (Fig. 1). A scalpel was first used to make an incision on the skin and the subcutaneous tissue. The muscles, periosteum and parietal pleura were then divided in one layer with curved Mayo scissors and blunt dissection was carried out. The pleural cavity was entered and Langenbeck's retractors were used to accomplish further exposure, particularly retracting the lung posteriorly to reveal the phrenic nerve. Inspection of the pericardium was made for any tense appearance of the pericardium and absence of visible pulsation due to the underlying significant

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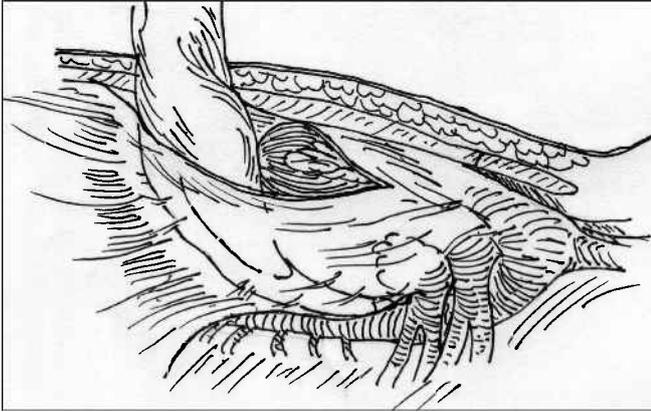
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**Fig. 2** Diagram shows internal cardiac massage performed using the palmar surface of the hand, compressing the heart against the sternum.

cardiac tamponade. A longitudinal incision over the pericardium was made, with care taken to avoid the phrenic nerve that runs anterior to the hilar vessels.

The findings were that of a massive haemopericardium, likely from a lacerated ventricle, causing the pericardial tamponade. A large amount of blood clot was evacuated with Yankauer suction manually. Exploration of the heart using fingers was performed. Internal cardiac massage was also carried out by using the palmar surface of the hand, to compress the heart against the sternum (Fig. 2). Adrenaline was given and the patient regained cardiac contraction and pulse. He was then transferred to the operating theatre. In the operating room, a median sternotomy was performed. Findings were a 1.5-cm anterior right ventricle laceration, a 2-cm anterior pericardial laceration and a 3-cm right upper lobe laceration. The lacerations were repaired, and two mediastinal chest tubes and a right and left pleural chest tubes were left *in situ*. The patient was transferred to the intensive care unit for monitoring.

He continued to be haemodynamically stable and was found to have hypoxic encephalopathy from prolonged brain ischaemia. Tracheostomy was done one week later for prolonged ventilation. Patient underwent physiotherapy, occupational and speech therapy, and was discharged with a nasogastric tube to a community hospital for further rehabilitation. He continued to be followed-up as an outpatient by a cardiothoracic surgeon and a neurologist.

## DISCUSSION

Trauma remains a leading cause of death in all age groups. Accidents, poisoning and violence as a group is listed as the fifth leading cause of death in Singapore in 2006, accounting for 6.3% of total deaths.<sup>(1)</sup> It is also the leading condition for hospitalisation, accounting for

9.1% of total discharges.<sup>(2)</sup> Improvements in prehospital care have increased the number of patients arriving at hospital in extremis following a major trauma, and emergency thoracotomy remains an important life-saving procedure in the management of thoracic trauma in certain instances.

In a review article by Hunt et al, emergency thoracotomy is defined as that occurring either immediately at the site of injury, in the emergency department or in the operating room, as an integral part of initial resuscitation.<sup>(3)</sup> Advantages of emergency thoracotomy include evacuation of the pericardial tamponade, direct control of intrathoracic haemorrhage, open cardiac massage, and cross clamping of the descending thoracic aorta, to redistribute blood flow and limit subdiaphragmatic haemorrhage. Risks of the procedure include infection, bleeding post-procedure and iatrogenic injury. The equipment (thoracotomy set), facilities, as well as expertise required, further limit the use of this procedure.

According to Advanced Trauma Life Support (ATLS) guidelines, emergency thoracotomy should be considered in patients with penetrating thoracic injuries and who arrive pulseless with myocardial electrical activity, but not for blunt trauma. Other indications, such as penetrating abdominal trauma, are not addressed. A study on current opinion found that there was a lack of agreement among clinicians regarding the indications of emergency department thoracotomy, and practice patterns of clinicians performing emergency department thoracotomy differ from existing ATLS guidelines.<sup>(4)</sup> American College of Surgeons Committee on Trauma carried out a major review of the literature from 1966 to 1999, where a strict selection was carried out and 63 articles were referenced. The review recommended the following: emergency department thoracotomy is best applied to patients who sustain penetrating cardiac injuries and arrive at trauma centres after a short scene and transport time with witnessed physiological parameters. Witnessed physiological parameters include: pupillary response, spontaneous ventilation, presence of carotid pulse, measurable or palpable blood pressure, extremity movement and cardiac electrical activity. It also recommended that emergency department thoracotomy should be performed in patients sustaining penetrating non-cardiac thoracic injuries and also in patients sustaining exsanguinating abdominal vascular injuries, but it is noted that both groups generally experience a low survival rate even after the procedure.<sup>(5)</sup>

In the same review, they also reported that of 7,055 emergency thoracotomies, there were a total of 551

survivors, giving a survival rate of 7.8%. Stratification by mechanism of injury revealed a survival rate of 11.2% for penetrating trauma and 1.6% for blunt trauma.<sup>(5)</sup> The poor outcome from blunt trauma is consistent with their recommendation that emergency thoracotomy should rarely be performed in patients sustaining cardiopulmonary arrest from blunt trauma. Of 15 series reporting on neurological outcomes, 4,520 patients underwent emergency thoracotomy with a survival rate of 226 (5%), and of these, 34 (15%) survived with neurological impairment.<sup>(5)</sup> Asensio et al found that the Glasgow coma score (GCS), revised trauma score and the cardiovascular respiratory score were all highly predictive of survival in penetrating cardiac injuries. In that study, for patients with GCS < 8, the mortality was 83.7%, as compared with patients with GCS scores > 8, in whom mortality was 27.3%, demonstrating the inverse relationship between GCS score and mortality rate. Mechanism of injury was also a significant predictor of outcome, the mortality from gunshot wound injuries to the heart was 83.8%, significantly higher than the mortality from stab wounds, which was 35.1%.<sup>(6)</sup> A review of 24 studies by Rhee et al also found that factors reported as influencing outcome in emergency thoracotomy were the mechanism of injury, location of major injury and signs of life.<sup>(7)</sup>

Our patient arrived with pulseless electrical activity, and was witnessed to have collapsed at the driveway. Immediate thoracotomy was performed, with release of cardiac tamponade and internal cardiac massage,

followed by rapid transfer to the operating theatre to repair the ventricular injury. All these contributed to his survival; however, the short downtime still resulted in brain damage from ischaemia and this patient required some degree of inpatient rehabilitation. In conclusion, emergency thoracotomy, when carried out in penetrating chest injury, can occasionally save lives in a subset of people for whom mortality approaches 100% without intervention. Prognosis remains poor in patients with blunt trauma. Further guidelines based on prospective data need to be established. Emergency physicians and surgeons should be familiar with this procedure, its indications and prognostic indicators.

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