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| Contact details for further information:<br>Midlands Critical Care, Trauma and Burns Networks<br>15 Frederick Road<br>Birmingham<br>B15 1JD<br>Website: www.mcctn.org.uk |
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Version control/amendments

| **Date changed** | | **Section/Para** |
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| September 2022 | | Addition of 2021 ERC guidelines for thoracotomy in blunt trauma. Addition of principles that all sites must consider in their local guidelines. |

## Purpose

This guideline describes the immediate management of patients presenting to the Emergency Department with penetrating chest trauma who are in cardiac arrest.

## Scope of document

It is intended for use by Major Trauma Centres, Trauma Units and Local Emergency Hospitals in the West Midlands trauma network.

## Introduction

This guideline is intended for the immediate management of patients presenting to the Emergency Department (ED) with penetrating chest trauma who are in cardiac arrest. It defines the

indications, contra-indications and practical procedure for performing an emergency thoracotomy in the Emergency Department for both cardiac arrest and patients who are peri-arrest.

The primary objectives of ED thoracotomy are to (a) release pericardial tamponade; (b) control cardiac haemorrhage; (c) control intra-thoracic bleeding; (d) perform open cardiac massage; and (f) temporarily occlude the descending thoracic aorta.

It is expected that a thoracotomy will rarely be performed in the ED as the majority of patients will have been in cardiac arrest for too long for the procedure to be effective and patients with signs of life will go to theatre (or if very well may be transferred out of a TU/LEH).

The prerequisites for a successful resuscitative thoracotomy (RT) can be summarized as the “four E rule”:

- Expertise: teams that perform RT must be led by a highly trained and competent healthcare practitioner. These teams must operate under a robust governance framework.
- Equipment: adequate equipment to carry out RT and to deal with the intrathoracic findings is mandatory.
- Environment: ideally RT should be carried out in an operating theatre but may need to be performed in the Emergency Department if the patient has lost vital signs.
- Elapsed time: the time from loss of vital signs to commencing a RT should not be longer than 15 minutes.

**Principles**

Patients may self-present to any hospital or may be too unwell for bypass to a MTC. Each hospital must therefore have considered and defined the following in their local guidelines/pathways:

- Which Surgical Specialty will provide support to the Emergency Department for a patient who requires emergency thoracotomy or damage control surgery?
- What training will ED senior doctors or surgical specialties undertake to maintain competency in resuscitative thoracotomy?
- What equipment is ready to use for an Emergency Department resuscitative thoracotomy to be undertaken?
- What is the ongoing chain of survival for patients who require definitive or specialist surgery? Options include:
    - the local general surgical team performing damage control surgery locally.
    - transfer of the patient from TU/LEH to MTC with support of a WMAS tasked critical care team
    - transfer of a cardio-thoracic surgeon from the MTC to the local hospital.
    - appropriately resourced and trained immediate transfer of the ventilated patient with an open chest to the MTC by the local hospital team.

**Recommendations**

## Indications for ED thoracotomy

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| Penetrating trauma to thorax or upper abdomen<br><br>AND<br><br>Patient is in cardiac arrest<br><br>AND<br><br>Patient has had cardiac output within the last 15 minutes eg signs of life, palpable carotid pulse or cardiac activity seen on ultrasound |

**Blunt chest trauma** is unlikely to produce an isolated single system injury that will respond to the interventions performed at thoracotomy. ED thoracotomy for traumatic cardiac arrest following blunt trauma has a very poor prognosis. It should therefore only be considered if pericardial tamponade has been confirmed by ultrasound or CT scan; the patient has been witnessed to arrest by the trauma team; and there are no other obvious irreversible causes of cardiac arrest. The ERC 2021 guidelines also document that thoracotomy for the purpose of immediate aortic occlusion (cross-clamping the descending aorta) is recommended as a last resort measure in patients with exsanguinating and uncontrollable infra-diaphragmatic torso haemorrhage.

### Contraindications to performing ED thoracotomy

- Patient has signs of life and is not about to arrest – patient should be considered for rapid CT or be moved immediately to theatre. However if patient loses cardiac output in the Emergency Department then the patient should not be moved and an immediate thoracotomy should be performed in the resuscitation room.

- Patient has had loss of cardiac output for greater than 15 minutes – evidence in the literature points to the procedure being unsalvageable after this time. This information may be obtained from the ambulance crew in the time of 999 call or time of arrival at scene. Where doubt exists regarding the exact time but it is thought to be around 15 minutes it may be in the patients best interests to perform an Emergency Department thoracotomy.

## Pre-arrival preparation

If the Emergency Department receives an alert message from the ambulance service of an incoming patient with penetrating trauma who is peri-arrest or in cardiac arrest the following should be prepared:

- Activate a Trauma Alert and register as ‘unknown’
- Activate “Major Haemorrhage Protocol” for blood transfusion
- Fast bleep the locally agreed surgeon for penetrating chest trauma. This may be a Cardiothoracic Registrar/Consultant in a MTC or a General Surgical Registrar/Consultant in a non-MTC hospital. The plan for theatre versus CT versus ED thoracotomy should be discussed before the patient arrives.
- Prepare equipment for emergency thoracotomy including scalpels, spencer wells forceps, sterile paramedic shears, large gauze swabs (and the full surgical thoracotomy pack where available).
- Prepare rapid infuser with blood products (if available).
- Inform theatres of potential emergency case.

## Emergency Department thoracotomy procedure

The decision to perform ED thoracotomy will be led by the Trauma Team Leader and the procedure will be executed without delay. It should be performed by the member of the team with the most experience and training in this procedure. This is normally the ED Consultant and/or Cardiothoracic Surgeon/local surgeon. The ED middle grade may need to take over the role of TTL, if the ED Consultant is involved in performing the thoracotomy, until the procedure is completed.

It is recognized that external chest compressions are not effective for patients in traumatic cardiac arrest due to cardiac tamponade (an obstructed heart) or hypovolaemia (an empty heart) and obstruct access to the chest for emergency procedures.

Unlike a medical arrest, the administration of inotropes and vasopressors (eg adrenaline) is contraindicated in the hypovolaemic patient who is already maximally vasoconstricted. Inotropes may be required after control of haemorrhage and release of tamponade if ROSC is achieved.

Whilst the thoracotomy is being performed the following simultaneous actions will occur:

- intubation and positive pressure ventilation with 100% oxygen.
- wide bore IV or IO access with the infusion of blood products via the Belmont rapid infuser

A clam-shell technique will be used to open the chest to allow full exposure.

Skin preparation will not routinely be undertaken for the patient in cardiac arrest.

Bilateral thoracostomies will be performed in the 5th intercostal space just anterior to the mid-axillary line. The first thoracostomy will be performed on the side of the penetrating injury. If ROSC occurs following thoracostomy there is no need to continue to thoracotomy and it is likely the patient had a tension pneumothorax.

If ROSC does not occur, the thoracostomies will be joined by a scalpel incision through the skin, with scalpel and paramedic shears used to cut through the intercostal muscles. The sternum can be divided with sterile paramedic shears or the gigli saw in the thoracotomy pack.

The pericardium will be opened longitudinally (in an inverted T) on every patient in cardiac arrest to exclude an occult tamponade.

Bimanual internal cardiac compressions should be undertaken on patients with no cardiac activity.

The descending thoracic aorta should be compressed by an assistant to redistribute the reduced circulating volume to the brain and myocardium.

Cardiac wounds should be controlled by gentle digital pressure over a gauze swab (± Celox gauze) until an appropriate senior surgeon is available.

Lung bleeding should be controlled by packing or digital pressure (± Celox gauze) at the pulmonary hilum until an appropriate senior surgeon is available.

## Patients who are peri-arrest with penetrating chest trauma

The following should take place simultaneously:

- Activate MHP
- Intubation by Anaesthetist
- Bilateral thoracostomies to exclude tension pneumothorax
- IV or IO access with immediate rapid infusion of blood products
- Immediate FAST scan to identify presence of free fluid in the abdominal cavity or the presence of pericardial fluid suggesting cardiac tamponade.
- Immediate surgical assessment (Cardiothoracic or designated Surgeon in local trust) to decide on management plan with Trauma Team Leader
- Involvement of Surgical Registrar or Consultant if abdominal injury also suspected

- Rush patient to theatre for thoracotomy ± laparotomy.

- If the patient is about to arrest or actually arrests in the ED, the patient may require Emergency Thoracotomy performed in the Resus room to avoid any delays.

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RCEM Position Statement on Resuscitative Thoracotomy in Trauma Units 2017 https://rcem.ac.uk/wpcontent/uploads/2021/10/Position_Statement_on_Resuscitative_Thoracotomy-in_Trauma_Units_Apr_-2017.pdf