Background

Thoracic trauma is one of the leading causes of death worldwide in all age groups and accounts for 20-50% of all traumatic injuries.\(^1, 2\) Most thoracic injuries can be managed conservatively but a small group will require a thoracotomy as part of their initial resuscitation.

Rapid response times and improved paramedical treatment at the scene have resulted in increasing numbers of patients arriving in the emergency department in extremis.\(^1, 3, 4\) Salvage of this group of patients requires immediate control of haemorrhage and resuscitation.

Survival rates following Emergency Department Thoracotomy (EDT) for penetrating thoracic trauma are 9-12% (up to 38% with signs of life); whereas for blunt trauma survival rates are 1-2% regardless of clinical signs.\(^2, 9\)

Definitions:

Emergency Department Thoracotomy (EDT)

Occurring in the emergency department as an integral part of the initial resuscitation process immediately after presentation.\(^8\)

Urgent Thoracotomy\(^1, 4, 8\)

Thoracotomy performed in the operating theatre.

Signs of Life\(^1, 7, 8, 10, 11\)

- Pupillary response to light
- Respiratory effort
- Cardiac activity on the ECG
- Spontaneous movement
- Palpable pulse
RMH Experience
The Royal Melbourne Hospital has conducted 294 thoracotomies in patients with multiple trauma since 1996, of these 20 were EDT’s (6.8%). The overall death rate for thoracotomies (emergency and urgent) in the major trauma population at RMH is 6%, and for those conducted in the ED the death rate is 61% with only 2 survivors in this small group.

Aims of an Emergency Department Thoracotomy
Resuscitation of a patient in extremis with a penetrating injury by: 1, 3, 7-11, 13

- Release cardiac tamponade
- Control haemorrhage
- Perform open cardiac massage
- Cross clamp the descending thoracic aorta
- Control air embolism

Indications for Emergency Department Thoracotomy

Penetrating trauma
- Presents to ED with no signs of life (SOL) and pre hospital CPR time <10mins 14, 15
- Witnessed cardiac arrest in the ED 1, 3, 7, 8, 10, 13
- Patient in extremis (BP<60 not responding to fluid resuscitation) on arrival in ED 1, 4, 6, 7, 9, 13

Blunt Trauma
- Presents to ED with no SOL and pre hospital CPR time <5mins 14, 15
- Witnessed cardiac arrest in the ED 3-5, 7, 9-11, 14

Patients age and comorbidity needs to be taken into account when making a decision to undertake an EDT 5, 10, 14

It is recommended that all urgent thoracotomies are performed, where possible in the operating theatre by the cardiothoracic team (those patient’s NOT in extremis, who are NOT time critical and can make it to the operating theatre ie Trauma OPSTAT’s).
Methods and Equipment 1, 3

The approach

The EDT incision is determined by the anticipated injury. The left anterolateral approach (see fig 1) is frequently utilised for EDT due to the advantages of

- rapid access with simple instrumentation in the supine patient,
- easy extension to the contra lateral hemi thorax.
- cross-clamping of the aorta
- open cardiac massage

The anterolateral approach is regarded as the initial approach due to its limited access to heart, lungs and great vessels.

The right anterolateral approach may be selected in cases where the injury is to the right side of the chest

How to

Although surgical draping is not essential, large, waterproof, disposable sterile-papered drapes are included in the EDT tray. The patient positioned supine with both arms abducted at right angles, and the left side of the chest and hip partly elevated (folded towels, pillow or sandbags).

The skin incision should be below the nipple, in the infra-mammary fold and should target the fifth intercostal space (see figure 1.0), extending through the soft tissues of the chest wall. Entry into pleural cavity should be on the superior margin of the sixth rib to avoid the intercostal neurovascular bundle. Muscle, periosteum and parietal pleura are divided in one layer with scissors and blunt dissection. Chest wall bleeding is generally minimal.

Once the incision is completed and the pleural cavity exposed a suitable retractor should be inserted with the handle pointing towards the axilla. The superior and inferior costal cartilages of the opened interspaces may be incised in order to achieve additional exposure.

Once cardiac output has returned the patient requires rapid transport to the operating theatre for definitive care. Hypotensive resuscitation principles systolic ~ 90mmhg should be employed to maintain perfusion but minimise haemorrhage (see TRM 08.01 Massive Blood Transfusion in Trauma Guidelines).

Procedures

<table>
<thead>
<tr>
<th>Pericardotomy</th>
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</thead>
</table>

The pericardiotomy should be made with scissors at least 1cm anterior to, and parallel to the phrenic nerve. Any blood and clot should be evacuated.

In the beating heart, digital pressure on bleeding sites should be maintained until the patient is resuscitated.

If the heart is fibrillating, suture control of the bleeding points should be formed before defibrillation.

A skin-stapling device can be useful for temporary control of bleeding from the myocardium.
Specific operative approaches

**Repair of the heart**

- Digital occlusion of the laceration
- Satinsky clamp for atrial wounds
- Interrupted sutures

**Internal (open) Cardiac Massage**

- 2 cupped hands, opposed at the wrist and avoiding thumb pressure.
- Internal defibrillation for VF requires energies of 15 to 30 Joule.

**Cross Clamp Pulmonary Hilum**

- Air embolism may result from severe lung trauma where air passages, and pulmonary veins are ruptured in continuity, and air embolism to the coronaries may occur.
- Partial or complete rupture of the pulmonary artery or pulmonary vein may also be controlled.

Rationale for clamping the descending thoracic aorta is to reduce sub-diaphragmatic blood loss if that is a problem, and hence retain the limited blood volume to the myocardium and brain.
Cessation of Emergency Department Thoracotomy

Cessation of EDT and resuscitation requires careful consideration and should be terminated if 1, 3, 5, 10, 14:

- Irreparable damage
- Massive head injuries
- Pulseless electrical activity (PEA)
- Systolic BP< 70 after 15-20 mins
- Asystolic arrest
If patient is expected with penetrating/blunt chest trauma in extremis notify cardiothoracic team.

Patient arrives
Commence Primary Survey

Are there any indications for an emergency department thoracotomy (EDT)?

Yes

TRAUMA OPSTAT

Patient assessed as needing an Urgent Thoracotomy conducted in theatre?

No

Notify Cardiothoracics and Commence a EDT

Cessation of treatment
- Irreparable damage
- Unsurvivable head injuries
- Pulseless electrical activity
- Systolic <70 after 15-20 mins
- Asystolic arrest

Downgrade Trauma OPSTAT
Notify theatre # 6312

No

Return of SOL?

Yes

URGENT THEATRE

Signs of Life
- Pupil response
- Respiratory effort
- Cardiac activity
- Spontaneous Movement
- Palpable pulse

Indications for EDT in Penetrating Trauma?
- Extremis (BP <60 not responding to fluid resuscitation)
- No signs of life and prehospital CPR < 10 mins
- Witnessed cardiac arrest in ED

Indications for EDT in Blunt Trauma?
- No signs of life and prehospital CPR < 5 mins
- Witnessed cardiac arrest in ED

Continue primary & secondary survey

No

Notify Theatre # 6312
## Equipment: Emergency Department Thoracotomy Tray

<table>
<thead>
<tr>
<th>IMAGE</th>
<th>No</th>
<th>INSTRUMENT NAME</th>
<th>USE</th>
</tr>
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<tbody>
<tr>
<td><img src="image1.png" alt="Image" /></td>
<td>2</td>
<td>DeBakey dissectors Long 25cm</td>
<td></td>
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<tr>
<td><img src="image2.png" alt="Image" /></td>
<td>2</td>
<td>DeBakey dissectors Long 20cm</td>
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<tr>
<td><img src="image3.png" alt="Image" /></td>
<td>1</td>
<td>Metzenbaum curved Scissor 18cm</td>
<td>Cutting delicate tissue</td>
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<tr>
<td><img src="image4.png" alt="Image" /></td>
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<td>Metzenbaum Scissor 23cm</td>
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<tr>
<td><img src="image5.png" alt="Image" /></td>
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<td>Mayo Scissor-Curved 17.1cm</td>
<td>Cut sutures etc</td>
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<tr>
<td><img src="image6.png" alt="Image" /></td>
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<td>Vascular Needle Holder-Long</td>
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<tr>
<td><img src="image7.png" alt="Image" /></td>
<td>2</td>
<td>Rampley sponge holders</td>
<td>Attach prep foam for skin prep</td>
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<td><img src="image8.png" alt="Image" /></td>
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<td>Curved Artery Forceps</td>
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<tr>
<td><img src="image9.png" alt="Image" /></td>
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<td>Roberts artery forceps</td>
<td>Longer Tissue forceps clamp bleeding vessels</td>
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<tr>
<td><img src="image10.png" alt="Image" /></td>
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<td>Clamp vascular DeBakey aortic large</td>
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<td>Vascular clamp</td>
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<td>Quantity</td>
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<td>Duvals Lung Tissue Forceps large</td>
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<td>Tissue forceps used on lung</td>
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<td>Durham Barr Retractors</td>
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<td>Gigli saw + 2 handles</td>
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<td><strong>Other equipment on EDT trolley</strong></td>
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<tr>
<td>Suture</td>
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<td>Suction</td>
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<td>Large tegader</td>
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References