Background

Thoracic trauma is one of the leading causes of death worldwide in all age groups and accounts for 25-50% of all traumatic injuries. 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 prehospital treatment at the scene have resulted in increasing numbers of patients arriving in the emergency department in extremis. Salvage of this group of patients requires immediate control of haemorrhage and resuscitation.

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

Definitions:

Emergency Department Thoracotomy (EDT)

Occurring immediately in the emergency department as an integral part of the initial resuscitation process shortly after presentation.

Urgent Thoracotomy

Thoracotomy performed in the operating theatre.

Signs of Life

- Pupillary response to light
- Respiratory effort
- Cardiac activity on the ECG
- Spontaneous Movement
- Palpable pulse
RMH Experience

The Royal Melbourne Hospital has conducted 235 thoracotomies in patients with multiple trauma since 1997, of these 23 were emergency department thoracotomies.

The overall death rate for thoracotomies in the major trauma population at RMH is 20%, and for those conducted in the ED the death rate is 91% with only 3 survivors in this small group.

Aims of an Emergency Department Thoracotomy

Resuscitation of a patient in extremis with a penetrating injury by:

- Release cardiac tamponade 1,3,7-10
- Control haemorrhage 1,3,7-10
- Perform open cardiac massage 1,3,7-10
- Cross clamp the descending thoracic aorta 1,3,7-10
- Control air embolism 1,2,9

Indications for Emergency Department Thoracotomy

Penetrating trauma

- Patient with < 5 mins of CPR on arrival 3,8,9
- Patient in extremis (BP <60 not responding to fluid resuscitation) on arrival to ED 1,11
- Witnessed cardiac arrest in the ED 1,3,7,9,10

Blunt Trauma

Witnessed cardiac arrest in the ED 2,5,8,9

Patients age and comorbidity needs to be taken into account when making a decision to undertake an EDT 9. It is recommended that all urgent thoracotomies should be performed in the operating theatre by the cardiothoracic team if possible (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, 2, 11

The Approach

The EDT incision is determined by the anticipated injury. The left anterolateral approach (see fig 1) is frequently utilised for EDT. Advantages include rapid access with simple instrumentation in the supine patient, easy extension to the contra lateral hemithorax.

This approaches allow for cross-clamping of the aorta and open cardiac massage, this 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, sterile-papered drapes with an appropriate aperture are readily available and can be deployed in a few seconds.

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 10), 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, peristeum and parietal pleura are divided in one layer with scissors and blunt dissection. Chest wall bleeding is general 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 massive blood transfusion guidelines).

Procedures

Pericardotomy

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

**Cross Clamping the Aorta**

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.

**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.

Cessation of EDT

Cessation of an resuscitation and an emergency department thoracotomy requires careful consideration and should be terminated if 1, 2, 9, 11

- Irreparable damage
- Massive head injuries
- Pulseless electrical activity (PEA)
- Systolic BP< 70 after 15-20 mins
- Asystolic arrest
Emergency Department Thoracotomy

If patient is expected with penetrating/blunt chest trauma in extremis notify cardiothoracic team

Patient arrives in extremis with blunt or penetrating chest trauma

No

Yes

Primary/ Secondary Survey

Signs of life

No

Yes

TRAUMA OPSTAT

Penetrating Chest Trauma
Extremis (BP <60 not responding to fluid resusitation) and/or CPR < 10 mins with signs of life

No

Yes

Call Cardiotoracics and Perform an EDT

Cessation of treatment
Downgrade Trauma OPSTAT
Notify theatre # 6312 or 6311

No

Return of SOL

Yes

URGENT THEATRE

Blunt Torso Trauma
Witness Cardiac Arrest

No

Yes

Patient Requires Urgent Thoracotomy
Call cardiothoracics

No

Yes

Aims of EDT
Release tamponade
Control haemorrhage
Control air embolism
Open cardiac massage
Cross clamp aorta

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

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

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Maxi Bin containing:
3x 4/0 Prolene round needle
3x 2/0 Ticron
5x 1/0 Prolene
1 PKT Teflon felt pledges
Skin stapler
X1 Box disposable sterile No 23 scalpel blades attached to handles
X1 Box disposable sterile No 15 scalpel blades attached to handles
X1 14G Foley catheter

Equipment: Emergency Department Thoracotomy Tray

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<tr>
<th>INSTRUMENT</th>
<th>No</th>
<th>NAME</th>
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<tbody>
<tr>
<td>B.P. Handle No 4 Long</td>
<td></td>
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<td>Deep wounds</td>
</tr>
<tr>
<td>DeBakey dissectors Long</td>
<td>2</td>
<td>25cm</td>
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<tr>
<td>Yankeur sucker</td>
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<td>Cut sutures etc</td>
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<td>Vascular Needle Holder-</td>
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<tr>
<td>2 Rampley sponge holders</td>
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<td>Attach prep foam for skin prep</td>
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<tr>
<td>6 Curved Artery Forceps</td>
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<td>6 Roberts artery forceps</td>
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<td>Longer Tissue forceps clamp bleeding vessels</td>
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</tr>
<tr>
<td>1 Aortic Curved Clamp- Large</td>
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<td>Vascular clamp</td>
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<td>2 Durham Barr Retractors</td>
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<tr>
<td>1 Gigli saw + 2 handles</td>
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<td>Cut through ribs and sternotomy if required</td>
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References