Pre-hospital Care Standard Operating Procedure

Thoracotomy

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| RELATED DOCUMENTS: | SOP Penetrating trauma
                   SOP Death on scene |
| THIS DOCUMENT REFERS TO: | PHC Clinical Practice
                           PHC Non-clinical Practice
                           PHC Operational Procedure |

Aims:

- Define the patient population the process aims to save.
- Describe indications for thoracotomy.
- Describe the operative process.
- Describe the contents of the thoracotomy set.
- Describe the procedure for obtaining a replacement thoracotomy set.

Background:

Patients who lose their vital signs on scene through penetrating trauma have a poor prognosis. Transportation to hospital, while administering cardiopulmonary resuscitation is pointless; blood flow through the heart is either obstructed or the heart is simply empty through hypovolaemia.

To maximise the chance of survival, surgical intervention should be immediate. It is vital to understand that pre-hospital thoracotomy does not aim to address all the possible lesions that can lead to cardiac arrest through penetrating chest trauma. Even for A&E departments the provision of an all ‘encompassing cardiothoracic response’ is an impossibility for the majority of departments – most departments do not have a co-located cardiothoracic department on which to draw. It follows that the majority of emergency room thoracotomies are carried out by non-cardiothoracic surgeons and can only reasonably expect to address a limited number of problems.

Pre-hospital thoracotomy aims to address one specific group of patients, those with a simple cardiac wound leading to tamponade and cardiac arrest. It does not aim to address more complicated wounds that have produced hypovolaemic arrest. As the majority of tamponades are clotted, pericardiocentesis is not indicated, formal thoracotomy and pericardotomy is essential. Patients will also require ‘quality massage’ to ensure return of spontaneous cardiac activity.

The type of thoracotomy performed aims to provide maximal exposure to facilitate identification of anatomy. Only a minimal amount of surgical equipment is required; scalpel, Gigli saw, Tuffcutt shears and Spencer Wells forceps.

Each doctor will undertake one to one tuition with a Pre-hospital Care Consultant on the process of opening the chest and the techniques of internal cardiac massage, this includes
one to one discussion, video footage, and use of a dedicated thoracotomy mannequin. Each paramedic will also receive one to one tuition with their mentor and will have to prove competent on their sign-off day. It is recommended that the doctors and paramedics revise the anatomy in standard text books.

This operational guideline should be read in conjunction with the guideline on penetrating trauma.

Policy:

1. Indications

- Penetrating injury to the chest or upper abdomen resulting in cardiac arrest or an agonal state [Dilated pupils, ‘Cheyne Stoke’ breathing, absent or barely palpable central pulse].

2. Process

- The decision to undertake a thoracotomy should be made within 10–15 seconds of arriving on scene and establishing that the patient has no signs of life. This is a clinical diagnosis and should not require monitoring.

- Betadine spray to the chest wall

- Sterile gloves must be worn

- Begin opening the chest immediately while the paramedic undertakes intubation and IV cannulation if required.

- Undertake bilateral thoracostomies in the mid-axillary line 4th intercostal space using a No 22 scalpel and a pair of Spencer Wells.

- Make a broad skin incision along the line of the corresponding rib joining up both thoracostomy wounds. The incision should take the shape of swallow and should aim to get through all skin layers to fat/chest wall.

- Using a pair of Tuffcutt Shears extend the thoracotomy wounds on both sides up to the breast bone. It may be possible to cut through the breast bone with the shears. If not, the sternum must now be breached with a Gigli saw. Pass the Spencer Wells behind the sternum grab the Gigli wire and pull it behind the sternum. Attach the wire to Gigli handles and saw. It should take little more than 2 or 3 pulls.

- Before opening the chest up extend the incision in the intercostal space posteriorly to the posterior axillary line. This will allow you to open the chest fully in a “clamshell” fashion, maximising the exposure and aiding identification of anatomy. If the posterior margin of the intercostal wound is too anterior you will compromise access and find yourself needing a rib spreader to help with access.

- Lift the chest open wide. Use suction if necessary to help clear the field and help identify anatomy.

- Identify the heart; if tamponade is present the pericardium may look tense. The pericardium must be opened even if there is no tamponade in order to inspect the heart. Using two clips raise a tent of pericardium on the anterior surface of the heart and cut a small vertical hole. Extend the hole vertically with scissors; try not to tear it.

- Remove any blood clots with your hands. The heart may fibrillate or beat spontaneously as this happens.
• If the heart makes no spontaneous movement, try flicking it with your finger. If no movement comes about, begin massage. Take great care to do this properly. Do not let anyone else perform the massage at this stage, it is essential to get blood moving through the coronary arteries and for the myocardium to be perfused. Focus on the quality of massage you are providing. Always get an assistant to compress the descending aorta on the spinal column. This will raise aortic root pressure and enhance coronary blood flow. Do not simply end up squeezing the heart while trying to do other things at the same time. Use a two handed technique and ensure the heart is flat in its bed and not kinked on its vascular pedicle (i.e. delivered or partially delivered through the wound to the pericardium).

• By this time IV access should have been established. Load the heart with volume - you will feel whether it is empty or not.

• If myocardial activity is sluggish despite adequate filling then 1 mg of intracardiac adrenaline should be delivered to the right ventricle.

• Massage and repeated doses should be continued until myocardial activity is good.

• If the procedure is successful the internal mammary arteries may now bleed and require clips.

• Spontaneous ventilation may occur even on scene depending on the degree of cerebral hypoxia.

• Anaesthetise the patient as required.

3. Cardiac Wounds

• Small wounds (approximately 1cm) can be left if there is little blood loss, however if they bleed significantly they should be sutured or occluded with a finger. Be careful not to plug the hole with a finger as this may simply extend the wound.

• Wounds adjacent to coronary arteries should be treated with caution. If the artery is distal then it (and the distal myocardium) can be sacrificed if necessary otherwise either a mattress suture should be used or the wound occluded with a finger. Skin staples should be used primarily for temporary wound closure. Handheld 1/0 silk is also available to insert interrupted sutures if stapling is not successful.

• Consideration can also be given to using a small Foley catheter. Place the tip of the catheter into the relevant ventricular cavity through the cardiac wound. Inflate the bladder on the catheter with a small amount of water. Use as small amount as is needed to prevent bleeding when there is slight traction on the catheter. Do not pull the catheter with force it may extend the wound. Use the Spencer Wells forceps to clamp the catheter under slight tension.

4. Ventricular Fibrillation

• Coarse VF - should this occur, remove rib spreaders, close the chest, apply electrodes to chest wall as normal and defibrillate.

• Fine VF – continue quality internal massage until coarse VF or spontaneous activity starts. Defibrillate for coarse VF as above.

• Ensure there are no blood pools / fluids that may arc.
5. Triage

- All patients who have undergone thoracotomy should be triaged to the nearest cardiothoracic centre.

- Hypothermia may well prevent you from restarting the heart in the pre-hospital setting.

- If despite maximal resuscitation the situation appears hopeless, then life may be pronounced extinct at the scene. It is vital to document on the ambulance crews paperwork that thoracotomy has been performed for the coroners reference. The patient may then be taken to the mortuary as per Death on scene SOP.

6. Blue Call

- Indicate:
  - What surgery has taken place
  - An immediate cardiothoracic response is required
  - Blood needs to be available in the Emergency Department.

7. Associated Hypovolaemia

- If volume loss is associated with tamponade or turns out to be the primary problem on entering the pericardium then the following should be carried out:
  - The aorta should be compressed as low as possible.
  - If the wound is obvious it should be stapled / sutured.
  - For unilateral disease with extensive blood loss and no obvious wound the hilum should be clamped.

8. Key points to success

- Rapid access - < 1 minute to pericardial sac

- Extending the thoracotomy wound to the posterior axillary line to promote clamshell opening

- 2 handed quality massage

- Aortic occlusion against the spinal column (manual compression)

- Extend the opening of the pericardium as far cranially as possible.

9. Common Reasons for Failure

- Anterior location of thoracostomies preventing adequate access.

- Failure to open the pericardium and identify wounds

- Single-handed, poor quality, intermittent massage

- Failure to occlude aorta.

- Kinking of heart anteriorly, delivering it through inadequate pericardial incision / wound, impairing vascular filling
10. Thoracotomy Sets

There are 2 types of thoracotomy set:

- **Personal (small) Thoracotomy set** - carried in individual leg bag:
  - 1 scalpel
  - 1 pair of Spencer Wells forceps
  - 1 set of Tuff cut shears

- **HEMS Thoracotomy pack** – sets are kept in the aircraft and each operational car. Spare sets are kept in the store room. A training pack is available.

  **Contents:**

  **Yellow bag**
  - Gigli saw blade x 2 (sterile)
  - Skin stapler
  - Silk 0 suture on colt (handheld) needle x 2
  - Tuff cut shears (sterile)

  **Sterile CSSD pack**
  - Finochietto rib spreader – adult
  - Finochietto rib spreader – child
  - Mayo curved blunt scissors 14.5cm x 1
  - Artery forceps Spencer Wells straight x 2
  - Artery forceps Mosquito curved x 2
  - Satinski clamp – small x 1
  - Gigli saw handle x 2

Following use the contents should be placed in the green CSSD bin in the store room on the helipad. The CSSD bin is emptied twice a week. If you require an urgent replacement, phone CSSD directly.