RCH Trauma Guideline

Management of Traumatic Cardiac Arrest

Trauma Service, Division of Surgery

Traumatic Cardiac Arrest Guideline

See also

Pelvic Injuries
Chest drain insertion
Massive Transfusion Procedure (MTP)

Purpose

This guideline is to assist staff in the assessment and management of patients who:

- Develop cardiac arrest pre hospital as a result of trauma and are transported to the ED
- Develop cardiac arrest following trauma during their resuscitation in ED
- Are assessed at being at risk of imminent cardiac arrest during trauma resuscitation

It is essential to consider the likely mechanism for the arrest, pre-hospital management and duration of cardiopulmonary resuscitation prior to commencing the suggested interventions. This guideline **excludes** patients with isolated hypoxic events such as **drowning and hanging (in the absence of blunt chest trauma)**, and those with a **non-survivable head injury**.

When using this guideline consideration should be given to the skill-set of the clinicians present and availability of resources within the institution.

It is also important to allocate a specific role to support the parents/ carers, for optimal family centred care and in order to maintain the focus of the team on the patient.

Definitions

Traumatic Cardiac Arrest*:* Cardiac arrest, without signs of life, following a primary traumatic mechanism of injury, that is as a result of energy transfer or traumatic body cavity penetration. Without signs of life is defined as no palpable central pulse and either agonal or absent spontaneous respirations.

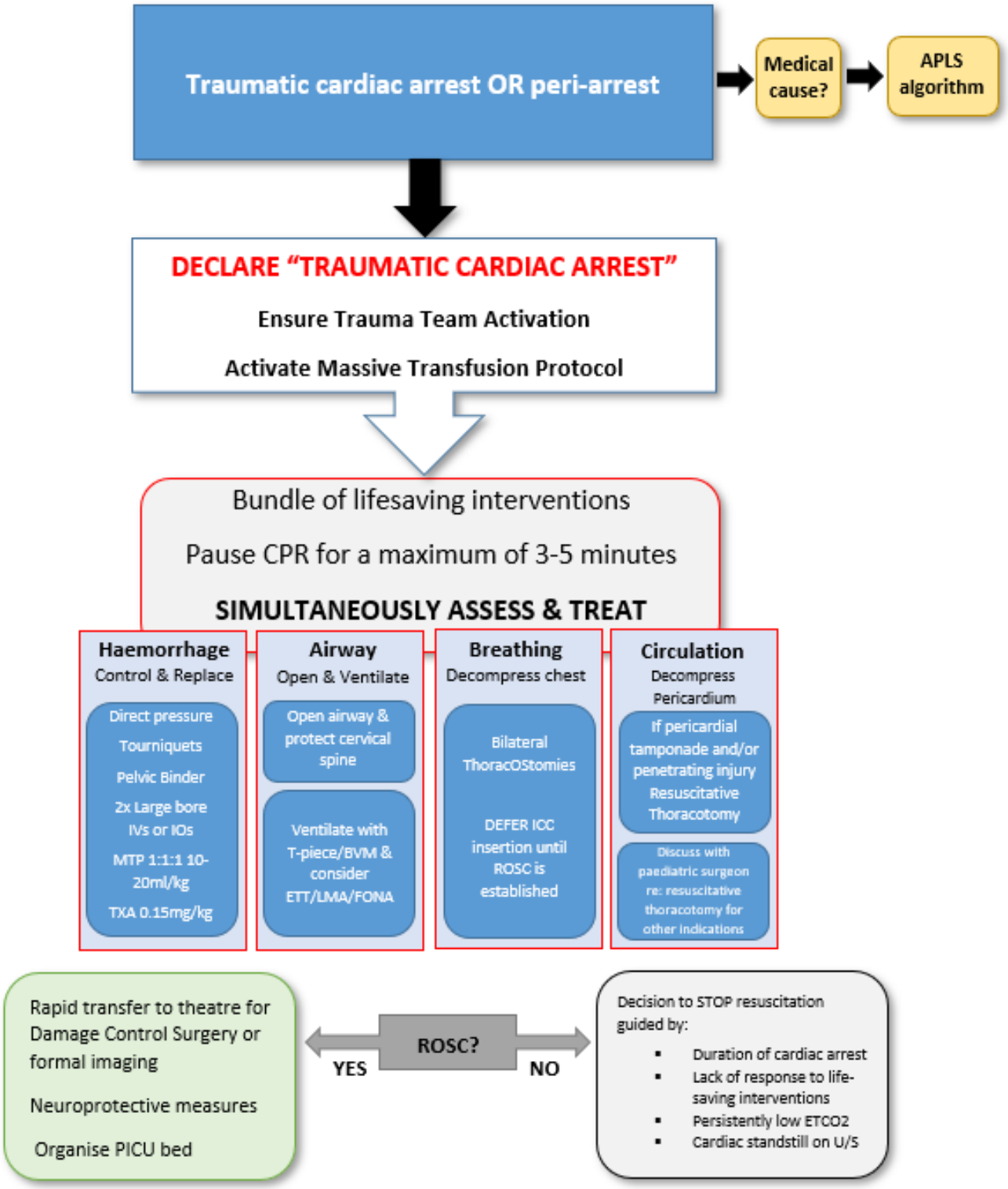
Traumatic Pre - Cardiac Arrest: Hypotension, decreasing conscious state; progression to full cardiac arrest **is imminent**.

Background

Paediatric TCA is a high acuity, low occurrence event with a high mortality. However, if the reversible causes of hypoxia, hypovolaemia, tension pneumothorax and cardiac tamponade can be treated effectively then return of spontaneous circulation (ROSC) can be achieved in

some cases. Addressing these reversible causes should occur simultaneously and take priority over conventional CPR.

It is important that a non-traumatic cause of cardiac arrest is not misdiagnosed as TCA. A primary cardiac or neurological event may cause a secondary traumatic event.



Key priorities of treatment

The key priorities in a TCA are rapid identification and management of reversible causes common to TCA. .

- **Implement haemorrhage control and address hypovolaemia:** Stop the bleeding and restore circulation with blood and blood products
- **Reverse hypoxaemia:** Open the airway and assist the breathing
- **Decompress the chest with bilateral thoracostomies:** This is to relieve any obstructive shock from a tension pneumothorax
- **Assess for pericardial tamponade on ultrasound and decompress the pericardium if present**

CPR should not interfere with urgently addressing these reversible causes, and it is appropriate to pause CPR for 3-5 minutes to allow these to be managed in the setting of traumatic cardiac arrest.

Haemorrhage Control and Hypovolaemia

Rapid assessment and treatment of external bleeding sources including compression, splinting and tourniquet if necessary. It is important that haemorrhage is reassessed if ROSC is achieved as haemorrhage may only become apparent once cardiac output is restored.

- **Direct Pressure –** The fastest and most effective way to stop bleeding is to apply firm pressure using hands or gauze. Embedded objects should not be removed.
- **Tourniquet –** Can be used in life threatening bleeding from a limb which cannot be controlled with direct pressure. Apply the CAT tourniquet 5cm above the bleeding point and tighten until bleeding has stopped. Note the time of the application.
- **Intravenous / Intraosseous access –** Two large bore IVs should be established as quickly as possible in order to commence damage control resuscitation. If this is not possible intraosseous access should be obtained. The humeral head is the preferred site.
- **Volume resuscitation –** Blood loss is one of the leading causes of traumatic cardiac arrest. Activate the Massive Transfusion Protocol (MTP). Initial fluid resuscitation of 20mls/kg should be with warmed packed red blood cells and/or blood products at a 1:1:1 ratio. In the rare circumstance where blood or blood products are not immediately available, it is reasonable to give 10-20ml/kg of warm crystalloid, whilst acknowledging that this may worsen acidosis and traumatic coagulopathy. There is limited evidence to support the use of vasopressors before

ROSC. They can be considered following ROSC in children with isolated traumatic brain injury.

- **Splints & Pelvic Binder** – If there is suspicion of pelvic injury, a pelvic binder should be applied at the level of the greater trochanters in order to reduce the potential space for haemorrhage. Femoral shaft fractures should be reduced and splinted with the CT6 traction splint (this is a lower priority than fitting a pelvic binder). The CT6 traction splint is applied after a pelvic binder is placed.
- **Emergency Laparotomy** – Significant intra-abdominal haemorrhage should be considered. Rapid transit to theatre for emergency laparotomy to provide direct pressure on the distal aorta and damage control surgery may be warranted in the patient who achieves ROSC but remains unstable. There is no role for performing a laparotomy in the patient who remains in cardiac arrest.

Airway & Oxygenation

In the trauma patient with a compromised airway, it is important to establish and maintain effective oxygenation. Basic airway maneuvers and ventilation with a t-piece or bag valve mask (BVM) should be used initially. Supraglottic airway (SGA) devices should be used to maintain oxygenation if tracheal intubation cannot be established immediately. Cervical spine motion restriction should be maintained if there is suspicion of cervical spine injury.

Breathing

In TCA with chest trauma, the chest should be decompressed by performing immediate bilateral thoracostomies in the 4th or 5th intercostal space between the anterior and mid axillary lines. This should not be delayed by awaiting confirmation of tension pneumothorax on POCUS or plain radiograph imaging. ***There is no urgency to insert intercostal catheters (ICCs) until ROSC has been established*** as the patient is receiving positive pressure ventilation. Thoracostomy should be followed with ICC insertion as soon as is practical in the resuscitation. (Thoracostomy and chest drain insertion in children). In a ***spontaneously breathing*** patient thoracostomies can act like a sucking chest wound and further worsen respiratory function.

Circulation

Precordial ultrasound should be performed to identify pericardial tamponade or cardiac standstill. Sonographers must have formal training and be accredited or enrolled in an ultrasound training programme. The scans should be recorded for real time review and retrospective audit, with any findings from point-of-care ultrasound (POCUS) documented in the patient record on EPIC.

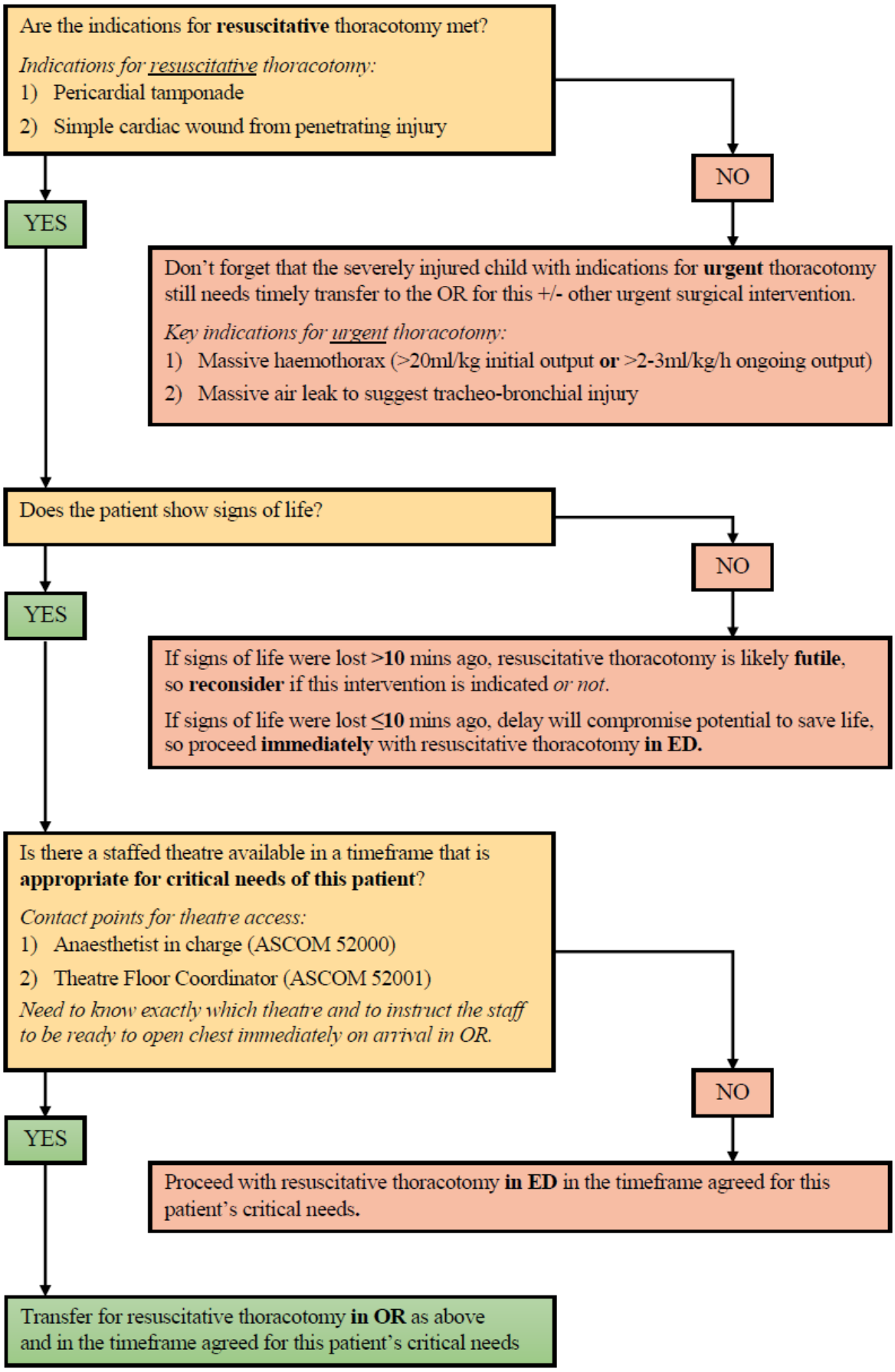
Resuscitative Thoracotomy

Resuscitative thoracotomy is only indicated in a small subsection of patients with a traumatic cardiac arrest. It is used to treat those patients who have cardiac tamponade or a simple cardiac wound from a penetrating injury. There may be a role for ***urgent thoracotomy in theatre*** for other cases of thoracic trauma in the absence of tamponade, but in the presence of massive thoracic bleeding or airway trauma. There is no role for pericardiocentesis in tamponade of trauma as the majority are clotted.

In the paediatric population, survival has recently been reported to be as high as 28% for penetrating thoracic trauma and 11% for blunt trauma, in a selected population of children at risk of imminent arrest but who have maintained cardiac output at the time of thoracotomy [1]. Favourable neurological outcome is more likely if the thoracotomy is performed within 10 minutes [2]. Therefore, it should proceed as a time critical intervention by rapid transit to theatre or in the ED trauma resuscitation room as determined by the team leader and surgeon. Both environments are appropriate locations to perform resuscitative thoracotomy in the select population where this intervention is justified. In this hospital, resuscitative thoracotomy should be performed by the most senior paediatric surgeon present. However in the event that no suitable surgeon is available, and the resuscitative thoracotomy algorithm supports this intervention it can be performed by an accredited emergency physician who is competent and capable in the procedure.

There have been no cases of survival following a resuscitative thoracotomy performed after 43 minutes of CPR, however, futility may be recognised earlier, and resuscitation may be ceased earlier than this (see below).

TRAUMA RESCUCITATIVE THORACOTOMY DECISION GUIDANCE



Ceasing Resuscitation

The decision to cease resuscitation should be made in agreement between senior decision makers present.

Considerations for stopping resuscitation include[4]:

- Prolonged duration of cardiac arrest
- Lack of response to life-saving interventions (including haemorrhage control, intubation and chest decompression)
- Persistently low $ETCO_2$
- Cardiac standstill on POCUS

Disposition and post resuscitative care

- Rapid transfer to theatre for resuscitative thoracotomy if deemed most suitable environment; decision should be made in agreement between senior paediatric surgeon and Team Leader
- Rapid transfer to theatre for damage control surgery if required and/or formal imaging (CT)
- Neuroprotective measures
- Organise PICU bed and transfer

References

1. Prieto JM et al. Nationwide analysis of resuscitative thoracotomy in pediatric trauma: Time to differentiate from adult guidelines? J Trauma Acute Care Surg. 2020 Oct; 89(4):686-690.

2. Davies GE et al. Thirteen survivors of prehospital thoracotomy for penetrating trauma: a prehospital physician-performed resuscitation procedure that can yield good results. J Trauma. 2011 May; 70(5):E75-8.

3. Lockey D et al. Traumatic Cardiac Arrest: Who Are the Survivors? Annals of Emergency Medicine. October 2004; 48(3):240-244.

4. Vassallo J et al. on behalf of PERUKI (Paediatric Emergency Research in the UK and Ireland), et al. Paediatric traumatic cardiac arrest: the development of an algorithm to guide recognition, management and decisions to terminate resuscitation. Emergency Medicine Journal 2018; 35:669-674.