1. Key Messages

The Victorian State Trauma System provides support and retrieval services for critically injured patients requiring definitive care, transfer and management. This traumatic cardiac arrest guideline provides evidence-based advice on the management of patients who present to Victorian health services in cardiac arrest or peri-arrest as a result of major trauma.

This guideline is developed for all clinical staff involved in the care of trauma patients in Victoria. It is intended for use by frontline clinical staff that provide early care for major trauma patients; those working directly at the Major Trauma Service (MTS) as well as those working outside of a MTS. These management guidelines provide up-to-date information for frontline healthcare clinicians.

These guidelines provide the user with accessible resources to effectively and confidently provide early care for critically injured patients in cardiac arrest. The guideline has been assessed utilising the AGREEII methodology for guideline development and is under the auspice of the Victoria State Trauma Committee (VSTC).[1]

Clinical Emphasis Points:

- Pre-arrest: stop the bleeding and restore circulating blood volume (IV / IO / fluid volumes / blood).
- Preventable early death in trauma is commonly due to:
  - Haemorrhage.

  - Tension pneumothorax.
  - Airway obstruction.
- Priority should be given to managing the above emergencies before conventional CPR modalities are commenced (external chest compressions / defibrillation).
- Penetrating trauma is more likely to respond to resuscitative thoracotomy (RT) than blunt trauma. It is unlikely to be successful if performed more than 10 minutes after the onset of cardiac arrest.
- In situations where staff and resources are limited, then a rationalised, adapted systematic approach must be utilised.
- Cessation of resuscitation must be actively considered in the patient who is not responding within 10 minutes of correction of reversible causes.
- The principles of damage control resuscitation (DCR) form the core of trauma resuscitation in the treatment of uncontrolled haemorrhage.
- After resuscitation, retrieval of the patient suffering from a traumatic cardiac arrest (TCA) to a MTS gives the patient the best chance of survival. Primary transfer to a proximate facility may be considered when time-critical immediate surgical intervention is required.
- Appropriate access to debriefing after the event for all involved will allow for the sharing of information and processing of the event.

Victorian State Trauma System Guideline

Traumatic Cardiac Arrest

TRAUMA VICTORIA

Life-threatening trauma

Obvious non-reversible cause. E.g. total body disruption; decapitation

Do not attempt resuscitation — Y / N

- Stop Bleeding
- Open airway
- Decompress chest & assist breathing if necessary
- IV or IO access; fluid resuscitation to goal SBP > 90mmHg or consciousness
- Early damage control surgery

Traumatic cardiac arrest

Summon assistance if required. Consider "medical" causes (e.g. myocardial infarction precipitating minor trauma) & if likely, manage according to conventional guidelines with *consideration* of the points below.

* **Open airway and protect cervical spine.**
Consider airway devices e.g. endotracheal intubation; supraglottic airway
Return of Spontaneous Circulation – ROSC?

Y / N

* **IV or IO access**
20mL/kg IV plasma / red blood cells or crystalloid
Further 5-10mL/kg fluid boluses if indicated
ROSC?

* + Control likely sites of haemorrhage (direct pressure; tourniquet)

Y / N

* **Decompress chest: finger or needle thoracostomy followed by insertion of intercostal catheter**
ROSC?

Y / N

* **Ultrasound (if available) to assess pericardial tamponade.** Resuscitative thoracotomy if tamponade identified (or, if ultrasound unavailable, likely given the known mechanism). Consider needle pericardiocentesis only if surgical intervention is not possible.
ROSC?

Y / N

Consider resuscitative thoracotomy to clamp descending aorta, control thoracic haemorrhage, relieve cardiac tamponade, and facilitate internal cardiac compressions and internal defibrillation
ROSC?

Y / N

* **Conventional BLS, ALS or internal cardiac compressions for 10 minutes after all reversible causes have been addressed. BLS/ALS can occur simultaneously with the above interventions if this does not interfere with their application and there are sufficient people available.**
ROSC?

Y / N — Cease resuscitation

Post-resuscitation care, prioritising surgical haemorrhage control and fluid resuscitation to target SBP 90mmHg (110mmHg if there is a head injury) or consciousness until this is achieved.

* *These interventions are prioritised according to the likely aetiology of the cardiac arrest, and if indicated are ideally addressed simultaneously by a multi-member team.

Used with permission from The Australian and New Zealand Committee on Resuscitation (ANZCOR) guideline 11.10.1 – Management of Cardiac Arrest due to Trauma, April 2016.

3. Introduction

The Australian Resuscitation Council (ARC) has published a traumatic cardiac arrest (TCA) algorithm in order to prioritise life saving measures and treat reversible causes prior to commencement of chest compressions.[2] The most common cause of traumatic cardiac arrest death is from haemorrhage.[3] External blood loss is usually obvious yet occult bleeding can be challenging for the provider to recognise and manage in its early stages. Time to resuscitation is critical and relies on many factors all working together including advanced prehospital care and onward movement to a specialised trauma centre for definitive care.

The diagnosis of TCA is made clinically, with the patient presenting with coma, agonal or absent spontaneous respiration and the absence of a carotid pulse.

The patient in peri-arrest will be hypotensive, and have a deteriorating conscious state. Progression to full cardiac arrest will be imminent unless resuscitative efforts are commenced immediately.

Resuscitation should be withheld in TCA in the following circumstances:

- No signs of life within the preceding 15 minutes.
- Massive trauma incompatible with survival (e.g. decapitation, incineration).

The termination of resuscitation should be considered if there is:

- No ROSC after reversible causes have been addressed.
- No detectable cardiac activity on ultrasound.

Where cardiac arrest of a non-traumatic origin has led to a secondary traumatic event (i.e. the patient had a cardiac arrest while driving and drove into a tree), this should be recognised early and treated with standard ALS algorithms. In these cases, shockable rhythms are more common (VF/VT). If the history, mechanism of injury and injuries displayed are inconsistent with TCA, then treat the patient using standard Advanced Life Support principles.

4. Pre-hospital considerations

The Australian and New Zealand Committee On Resuscitation (ANZCOR) recommends that in the prehospital setting patients in cardiac arrest from trauma should only be transported to hospital after return of spontaneous circulation.[2] The exception to this is where the hospital is in such close proximity that the patient may have a realistic chance of having access to a resuscitative thoracotomy (RT) within 10 minutes and the patient had signs of life on paramedic arrival.

Treatment of possibly reversible causes such as external haemorrhage, tension pneumothorax and airway obstruction are within the scope of practice of all Ambulance Victoria paramedics. Mobile Intensive Care Flight paramedics also have the capacity to administer a blood transfusion to the patient in hypovolaemic shock.

Patients who have a cardiac arrest en-route to hospital should have the above interventions performed with minimal delay.

Transport to an appropriate hospital for immediate interventions including surgical and operating theatre access and blood bank support is essential.

See Appendix 1: Ambulance Victoria Traumatic Cardiac Arrest Clinical Practice Guideline.

5. Management

Most deaths in trauma occur within the first 5 minutes following the event and most cannot be prevented. There are however the following preventable early deaths in trauma that need to be addressed prior to the conventional teaching of ABCDE.

Haemorrhage

Trauma patients may initially present with an adequate circulating volume but have haemorrhagic injuries that will lead to cardiac arrest if not treated early. Priority must be given to finding the cause and to STOP THE BLEEDING. Only after interventions are performed should consideration be given towards addressing the airway and breathing, unless there are sufficient people to enable this to be done simultaneously.[2] The measures mentioned below to control bleeding are only temporising measures and once established, transfer to a hospital with facilities available to manage the critically ill bleeding patient must be initiated.

The patient in traumatic cardiac arrest may have little active bleeding, but this may resume on restoration of circulating volume. Haemorrhage control techniques as listed below should be initiated as soon as possible in the resuscitation phase. Restoration of circulating blood volume may be the highest priority for patients in cardiac arrest due to trauma.

External bleeding: restrict movement of the patient, immobilise the affected limb (if applicable), advise the patient to remain at complete rest.

Management:

- Direct pressure
  The use of direct pressure is usually the fastest, easiest and most effective way to stop haemorrhage once the bleeding point has been identified. Apply firm, direct pressure using hands or a pad and ensure that the pressure is sufficient and maintained. If bleeding is not controlled then use of a haemostatic dressing if available may be used (i.e. uncontrolled head / trunk wound). Haemostatic dressings act directly on the site to form a clot and reduce active bleeding.
- Tourniquet
  Only to be used for life threatening bleeding from a limb that cannot be controlled by direct pressure. This should be placed 5-7cm above the bleeding point and tight enough to stop all circulation to the injured limb. Once applied it should not be removed until specialist care is available in a controlled environment. Note the time of application.
- Indirect pressure
  Penetrating objects should not be removed as they may be plugging the wound and hence limiting bleeding. Place pads around / above/below the apply pressure over these pads.

Internal bleeding: should be suspected where there are signs and symptoms of shock, particularly with pain, tenderness or swelling over or around an affected area

Management:

- Pelvic splint application
  If pelvic fracture is suspected, application of a pelvic binder may temporarily assist to control bleeding until definitive care can be established but should only be applied after other interventions in undifferentiated trauma.
- Traction
  The use of traction in long bone fractures helps to reduce haemorrhage. Therefore, immobilise the limb as soon as possible after other life-saving interventions.

Restoration of Circulating Blood Volume

Restoration of circulating blood volume may be the highest priority for patients in cardiac arrest.

- IV or IO access

  Should be established as rapidly as possible. Insertion of a peripheral IV cannula may be extremely difficult, especially in the patient who has exsanguinated. Femoral or CVC insertion should be attempted if staff are trained in the procedure. IO access may be more rapidly and reliably achieved, with the humeral head IO achieving more rapid fluid administration than the tibial IO.
- Fluid therapy

  An initial fluid bolus of 20ml/kg of crystalloid fluid, ideally warmed, should be rapidly administered to the patient where hypovolaemia is the likely cause of traumatic cardiac arrest. In exsanguinating haemorrhage there should be a 1:1:1 ratio of thawed fresh frozen plasma: packed red blood cells: platelets.[4] Prehospital administration of blood products may be available and should be initiated in accordance with Ambulance Victoria CPG's.[5] Use of other products such as Transexamic acid (TXA), cryoprecipitate and platelets should be guided by each facility's Massive Transfusion Protocol. Further fluid boluses of 5-10 ml/kg should be given if hypotension is suspected as the primary cause of cardiac arrest.

  Once there is spontaneous restoration of cardiac output and prior to surgical haemorrhage control and at least for the first hour, fluid should be titrated to a SBP of 90mmHg (permissive hypotension) or to consciousness (as long as there is no traumatic brain injury).[6]

Tension pneumothorax

Tension pneumothorax is the progressive build-up of air within the pleural space, usually due to a lung laceration which allows air to escape but not to return. All patients in cardiac arrest with suspected chest trauma who are not responding to airway opening and restoration of circulating blood volume should have their chest decompressed. Bilateral finger thoracostomy can be quickly performed in the resuscitation phase followed by insertion of an intercostal catheter at a later stage (follow link for insertion technique). An alternative that may allow rapid chest expansion is needle decompression, the insertion of a long, wide bore cannula into the pleural cavity to reinflate the collapsed lung and allow air to escape (follow link for insertion technique). This technique must always be followed by insertion of an intercostal catheter.

Airway obstruction

In the trauma patient with the severely compromised airway, it is important to establish and maintain effective oxygenation. Basic airway manoeuvres and supraglottic airway (SGA) devices should be used to maintain oxygenation if tracheal intubation cannot be established immediately. Oxygen should be applied using gentle ventilation as positive pressure ventilation may worsen a tension pneumothorax. ETC02 monitoring using waveform capnography should be established and ventilation adjusted to achieve low or normal ETCO2. Consideration to cervical spine injury should also be taken into account if there is evidence of head trauma.

6. Conventional BLS / ALS considerations

Priority should be given to managing the above emergencies before conventional CPR modalities (external chest compressions / defibrillation) are commenced as correcting the cause of the cardiac arrest will give the patient the best chance at survival. This will only change where there is enough resources available to allow these interventions to happen simultaneously. In out of hospital traumatic cardiac arrest, the patient can have pulseless electrical activity (PEA) where pathophysiological events such as hypovolaemia or cardiac tamponade restrict the ability of the cardiovascular system to generate a palpable output. Therefore, addressing these reversible causes is the key to enhancing survival.[7]

External chest compressions & ventilation

In traumatic cardiac arrest, cardiac compressions are unlikely to be as effective as in normovolaemic cardiac arrest. Therefore, commencement of external chest compressions takes less of a priority than treatment of reversible causes. The patient in cardiac arrest from a haemorrhaghic cause receives little benefit until a sufficient circulating volume of blood is returned.

Once an attempt has been made to restore circulating volume and other reversible causes corrected, commence external chest compressions at the following ratio:

No ETT/SGA

- 30 compressions / 2 breaths.
- Aim for 100-120 compressions per minute.
- Depth of 5cm with full recoil of the chest.
- Pause for ventilations.

ETT / SGA

- 15 compressions to 1 ventilation.
- Aim for 100-120 compressions per minute.
- Depth of 5cm with full recoil of the chest.
- No pause for ventilations.
- 6-8 ventilations per minute.

Adrenaline

The use of adrenaline in TCA has little evidence for or against it. It is recommended that its use only be considered once haemorrhage control, restoration of circulating volume, airway

opening and decompression (if appropriate) have been addressed. The recommended dose is 10mL of adrenaline 1:10,000 (1mg) IV/IO repeated every two cycles (4 minutely) until ROSC. In the post cardiac arrest phase, consideration may be given to the use of adrenaline or other vasoactive infusions to maintain adequate blood pressure.

Defibrillation

Once reversible causes have been identified, routine cardiac arrest management principles including a cardiac rhythm check should be applied. The majority of patients in cardiac arrest from a traumatic cause are not in a shockable rhythm, therefore defibrillation is not a priority. Management of the likely cause of TCA must be addressed first prior to consideration of defibrillation. The only exception to this is in Commotio Cordis, where the direct impact to the precordium alters the electrical stability of the myocardium, leading to VF or VT. In this situation, standard ALS principles should be implemented without a delay including early defibrillation.

Reversible causes

Standard ALS principles maintain consideration of the reversible causes as the “Four H’s and Four T’s” in any patient presenting with cardiac arrest. This updated TCA protocol will identify and treat the majority of the standard reversible causes of cardiac arrest:

- Hypoxaemia.
- Hypovolaemia.
- Tension Pneumothorax.
- Tamponade.
- Hyper/hypokalaemia and other metabolic disorders.

The exception is given to hypo/hyperthermia, toxins and thrombosis. These infrequent causes of TCA may be considered where a patient has not responded to other interventions.[2]

7. Resuscitation procedures

Ultrasonography

Ultrasonography should be used in the evaluation of the critically ill patient in cardiac arrest to establish the likely cause of arrest and prioritise life-saving treatments. In the hands of a skilled clinician, a haemo-peritoneum, a haemo or pneumothorax and cardiac tamponade can be reliably diagnosed within minutes. Appropriate interventions post diagnosis can then be established.

Pericardiocentesis

Cardiac tamponade is the underlying cause of approximately 10% of cardiac arrest in trauma. Penetrating injury to the chest or epigastric region is the most common cause of pericardial tamponade and treatment with immediate RT can be life-saving. Where the option to surgically manage the patient is not immediately available then pericardiocentesis can be attempted in the patient who is peri-arrest or in cardiac arrest with a high suspicion of tamponade until definitive care can be arranged. Needle aspiration of tamponade is unreliable, as the pericardium is usually full of clotted blood. However if immediate surgical

option is not available then needle aspiration should be conducted under ultrasound guidance, where available.

Resuscitative Thoracotomy

The success of resuscitative thoracotomy (RT) is time critical. Penetrating trauma is more likely to respond to Resuscitative Thoracotomy than blunt trauma, where survival is poor. RT is unlikely to be successful if performed more than 10 minutes after the onset of cardiac arrest.

A RT can:

- Release tension pneumothorax and cardiac tamponade.
- Allow direct control of intrathoracic haemorrhage.
- Allow cross clamping of the descending aorta which will stop blood loss below the diaphragm, thereby improving brain and cardiac perfusion.
- Permit open cardiac compression and defibrillation.

The decision to proceed with a RT will be based on the mechanism of injury, whether there is likely to be a surgically correctable problem and the duration since the onset of cardiac arrest. In order to give the patient the best chance of survival, the following needs to be in place prior to consideration of RT:

- A highly skilled and trained team led by a competent medical practitioner who are operating under a robust governance framework.
- Adequate equipment to carry out the procedure and deal with the findings.
- Ideally RT should be carried out in an operating theatre environment but may be considered in other suitably resourced environments.
- The time from loss of vital signs to commencing RT should be no longer than 10 minutes.

If any of the four criteria is not met, then RT should not be attempted.

8. Resource Limited Facility

Ideally in the treatment of TCA, there will be enough staff available for interventions to be conducted simultaneously. In situations where staff and resources are limited, then a systematic approach must be utilised to identify the cause of the TCA as well as the need to call for help early. Resources may need to be pulled from other areas of the hospital or from local ambulance services. In a smaller facility, it is unlikely that services and necessary equipment will available 24/7 in order to thoroughly care for the patient in TCA. It is not expected that providers would attempt any interventions that are outside of their skill level or beyond their capability. Priority in that case should be focused on managing the patient according to available resources and calling for skilled help via Adult Retrieval Victoria or Paediatric Infant Perinatal Emergency Retrieval (PIPER). Contact should be made early to initiate urgent critical care response as well as advice regarding management. The use of telehealth in this situation may be of vital assistance to the providers and gives the consultant on the other end a better understanding of the patient's presentation and available resources.

9. Return of Spontaneous Circulation (ROSC)

In the immediate post resuscitation phase, pending transfer to the operating theatre / an appropriate high care area / hospital, the patient should be treated following the principles of the ABCDE approach.

Airway:

- Place an advanced airway if not already insitu.

Breathing:

- Maintain SpO2 94 – 98%.
- Ensure waveform capnography and ventilate lungs to maintain normocapnia.

Circulation:

- If bleeding, then pending transfer to OT maintain a palpable BP if no TBI or aim for maintaining BP>110 if TBI.
- Obtain reliable IV access.
- Blood / fluid replacement – restore normovolaemia and coagulation.
- Obtain 12 lead ECG.
- Continuous cardiac monitoring.

Disability:

- Check pupillary response.
- Maintain sedation.

Exposure and environment:

- Monitor temperature and keep >35C for bleeding patient.
- Look for any previously unidentified sites of possible haemorrhage.

Damage control resuscitation

The principles of damage control resuscitation (DCR) have been adopted into trauma resuscitation for uncontrolled haemorrhage. DCR aims to maintain circulating volume, control haemorrhage and correct the 'lethal triad' of coagulopathy, acidosis and hypothermia until definitive intervention is appropriate. It is based on military trauma experience and uses a systematic approach with the following underlying management principles:

Permissive hypotension:

A conservative approach to IV fluid administration which involves infusion of a sufficient volume in order to maintain a radial pulse in the patient with ROSC. This is usually targeted at a SBP of 80-90mmHg, enough to maintain cerebral perfusion.[6] In the patient with a suspected head injury, this should be targeted at >110.

Early haemostatic resuscitation

Early administration of blood products helps to prevent complications of aggressive crystalloid fluid resuscitation leading to the acute coagulopathy of trauma.

Damage control surgery

Refers to urgent limited surgical interventions in order to control haemorrhage until the patient is able to undergo definitive interventions.

10. Endpoint to resuscitation

Restoration of circulating volume sufficient to sustain spontaneous circulation may take several minutes depending on the equipment and access.

Termination of resuscitation efforts should be considered if there is:

- No ROSC for 10 minutes after reversible causes have been addressed.
- In PEA arrest, no detectable ultrasonographic cardiac activity.

If attempts at obtaining ROSC are unsuccessful the team leader should discuss stopping CPR with the team. The decision to stop should rely upon clinical judgement and careful assessment of the likelihood of achieving ROSC. ARV can assist with advice on making the decision to cease treatment.

11. Debriefing

The circumstances surrounding the traumatic event as well as the physical appearance of the patient may be distressing to all those involved in their care. Appropriate access to debriefing will allow for information sharing and event processing. An immediate post-event debriefing should take place led by the team leader in order to address any immediate issues and concerns.

A delayed facilitated debriefing should be conducted at a later stage. The person conducting the session should have professional skills to guide the process and to identify any individual that may require further assistance. Peer support programs must be available to all providers potentially exposed to any critical incident for psychological and emotional support.

12. Paediatric considerations

The low volume of paediatric traumatic out of hospital cardiac arrests (relative to adults) creates a challenging environment for maintaining skills and institutional preparedness.[8] Traumatic cardiac arrest (TCA) in children is associated with a low probability of survival and poor neurological outcome in survivors.

In Australia, the mechanism of injury in children is usually due to blunt trauma with concealed haemorrhage, and the majority of this is made up from MVA's with falls and non-accidental injury making up the rest. In blunt Paediatric TCA, the primary cause of death in a child is due to brain injury.[9]

Paediatric traumatic cardiac arrest in penetrating trauma should follow the same principles as Adult TCA. The only difference should be towards the volume of fluid replacement (10ml/kg).

In children who have immediate CPR after TCA, then immediate transportation to the ED should be considered. Resuscitative manoeuvres such as airway management, CPR,

intravenous or intraosseous line access should be performed in transit only if safe to do so for both patient and clinician.[10]

Asystole in children following blunt trauma has a poor prognosis, so consideration for ceasing resuscitation efforts early should be given.

Signs of life in the prehospital or emergency department setting that favour a positive outcome with resuscitation efforts include pupillary response as well as organised cardiac activity on ultrasound, even if pulseless.

A child who has RT has only a minimal chance of survival.[11]

See Appendix 2

13. Appendix 1: Ambulance Victoria Cardiac Arrest in Trauma

Cardiac Arrest

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CPG A0201

General Care

- **Medical cardiac arrest**
  - The intent is to prioritise high quality CPR and rapid defibrillation.
  - It is assumed that CPR is commenced immediately and continues with minimal interruptions throughout resuscitation. If any doubt exists to the presence of a pulse, chest compressions must be commenced.
  - Fluid administration in shockable rhythms may be detrimental and should be limited to medication flush/ TKVO only.

- **Traumatic cardiac arrest**
  - The intent is to prioritise haemorrhage control and managing correctable causes prior to other therapies. Priorities include oxygenation and ventilation; exclusion of tension pneumothorax by insertion of bilateral intercostal catheters; and administration of **Normal Saline 20 mL/kg IV/IO** in order of clinical need. This should be followed by routine cardiac arrest management including cardiac rhythm check. Once correctable causes have been addressed, a cardiac rhythm check and other standard cardiac arrest therapies such as compressions and adrenaline should be administered.
  - In cases where the Hx, MOI or injuries are inconsistent with traumatic cardiac arrest, or patient is in VF/VT, consider medical cause. If any doubt exists as to the cause of arrest, treat as per Medical Cardiac Arrest.
  - Control of major haemorrhage is a priority and can be achieved with tourniquets, haemostatic dressings and/ or direct pressure.
  - A pelvic splint should be applied after other interventions in undifferentiated blunt trauma. Where pelvic fracture is clearly contributing to cardiac arrest, a pelvic splint may be applied earlier.

General Care

- **All cardiac arrest**
  - During cardiac arrest, rhythm analyses are required every two minutes but carotid pulse checks are only required if there is no shock advised and QRS complexes are present in what may be a perfusing rhythm. A perfusing rhythm would be expected to be accompanied by a rise in $ETCO_2$.
  - A supraglottic airway is an appropriate option to manage the airway initially and to facilitate continuous compressions. When ETT is attempted, it should not interrupt compressions.
  - $ETCO_2$ can be used as a surrogate marker of cardiac output during cardiac arrest. Where capnography is available, measure $ETCO_2$. A reading greater than 10 mmHg is desirable.
  - Where clear signs of prolonged cardiac arrest are present, or continued resuscitation may be futile, consider **CPG A0203 Withholding or Ceasing Resuscitation**.

- **Ratios of compression to ventilation:**

  No ETT/SGA
  - 30 compressions to 2 ventilations
  - Aim for 100 – 120 compressions per minute
  - Pause for ventilations

  ETT/SGA
  - 15 compressions to 1 ventilation
  - Aim for 100 – 120 compressions per minute
  - 6-8 ventilations per minute
  - No pause for ventilations
  - The required depth of compression is > 5cm and full recoil of the chest should be allowed.
  - Evidence suggests compression rates often differ from recommendations. Consider using metronome if available.
  - CPR operators should rotate every 2 minutes to reduce fatigue and maintain performance. A gradual fall in $ETCO_2$ may suggest fatigue during CPR.

Cardiac Arrest

CPG A0201

Special Notes

- **Mechanical CPR**
  - Where available and where resources allow, a mechanical CPR device may be applied after initial cardiac arrest management.
  - Communication, planning and teamwork should minimise interruptions to compressions to deploy a mechanical CPR device.
  - If ROSC is achieved and a mechanical CPR device is not already in place but immediately available, apply in anticipation of re-arrest.
  - Patients should be transported to the nearest appropriate ED with mechanical CPR (if immediately available) if all of the following:
    - Paramedic witnessed arrest or initial rhythm is VF/VT refractory to initial Mx
    - Likely reversible with medical intervention
    - The patient is ≤ 65 years of age and lives independently
    - The Alfred: collapse to ED time ≤ 60 minutes for patients aged 15 – 35, **OR**
    - Nearest ED with ECMO-CPR or PCI: collapse to ED time ≤ 45 minutes for patients aged 36 – 65.
  - Pulse/rhythm checks, defibrillation every cycle (2 minutely) and **Adrenaline** every 2nd cycle (4 minutely) should be continued as per routine cardiac care.
  - Outside of mechanical CPR, transporting patients in cardiac arrest leads to poorer outcomes and presents a risk to paramedic safety.
  - Where the patient is pregnant with a known or suspected gestation > 20 weeks and mechanical CPR is available, paramedics should transport the patient, with concurrent resuscitation efforts, to the nearest ED for consideration of resuscitative hysterotomy. The uterus should be pushed to the left side during transport to minimise aorto-caval compression, rather than attempting to perform mechanical CPR with the patient tilted to the left.
- **CPR interfering patient**

  Where the patient interferes with CPR, a gag reflex is present or the patient is suspected to be aware during resuscitation consider:
  - ALS: **Fentanyl 25 mcg IV** repeat every 3-5 minutes as required
  - MICA: **Ketamine 20 mg IV/IO** repeat every 3-5 minutes as required.

  Minor movements (e.g. such as eye rolling) in isolation may not require treatment.

Australian Resuscitation Council - ANZCOR Guidelines 2016. Available from: https://resus.org.au/guidelines/

Special Circumstances

- **Hypothermic Cardiac Arrest**

  ≥30ºC
  - Standard cardiac arrest

  < 30ºC
  - Double the interval for **Adrenaline** and **Amiodarone** doses
  - Greater than 3 shocks is unlikely to be successful while patient remains severely hypothermic. Where resources do not allow for further management e.g. AAV, mechanical CPR, continue DCCS as per standard cardiac arrest.
  - The primary goal of managing moderate to severe hypothermia should be the prevention of further heat loss prior to ROSC or transport. Significant improvement in temperature from prehospital intervention is unlikely.
  - For patients in cardiac arrest where hypothermia is clearly the cause, mechanical CPR to hospital may be appropriate in consultation with the clinician and receiving hospital.
- **PEA Correctable Causes**
  - Hypoxia
  - Exsanguination
  - Asthma
  - Tension pneumothorax
  - Anaphylaxis
  - Upper airway obstruction
- **Tension pneumothorax**

  Where tension pneumothorax is considered to be the cause of cardiac arrest, in either medical or traumatic arrest, decompress chest bilaterally as per **CPG A0802 Chest Injuries**. Chest decompression should not be routine in medical cardiac arrest.
- **TCA overdose or hyperkalaemia**

  Administer **Sodium bicarbonate 8.4% 100 mL IV/IO**. Sodium bicarbonate should not be routinely administered outside of this setting.
- **Hypovolaemia/Anaphylaxis/Asthma**

  In PEA arrest where hypovolaemia, anaphylaxis or asthma is suspected or the patient has a rhythm that may be fluid responsive, administer **Normal Saline 20 mL/kg IV/IO**.
- **Hypoglycaemia**

  Hypoglycaemia in cardiac arrest is rare. However, BGL should be measured and hypoglycaemia treated as per **CPG A0702 Hypoglycaemia**. All other management should be prioritised above the measurement of BGL.

Cardiac Arrest - Trauma

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CPG A0201

Traumatic cardiac arrest

- Hx, MOI or injuries **do not** suggest medical cause of cardiac arrest

Major haemorrhage

Prioritise control of major haemorrhage over all other interventions

Prioritise treatment of correctable causes of cardiac arrest over chest compressions and in order of clinical need

Action

Airway
- Ensure patent airway, oxygenation and ventilation
- **Supraglottic airway**
- **ETT** if required or proceed directly to cricothyroidotomy where trauma prevents other airway Mx

Action

Tension pneumothorax
- Where accredited, decompress chest bilaterally

Action

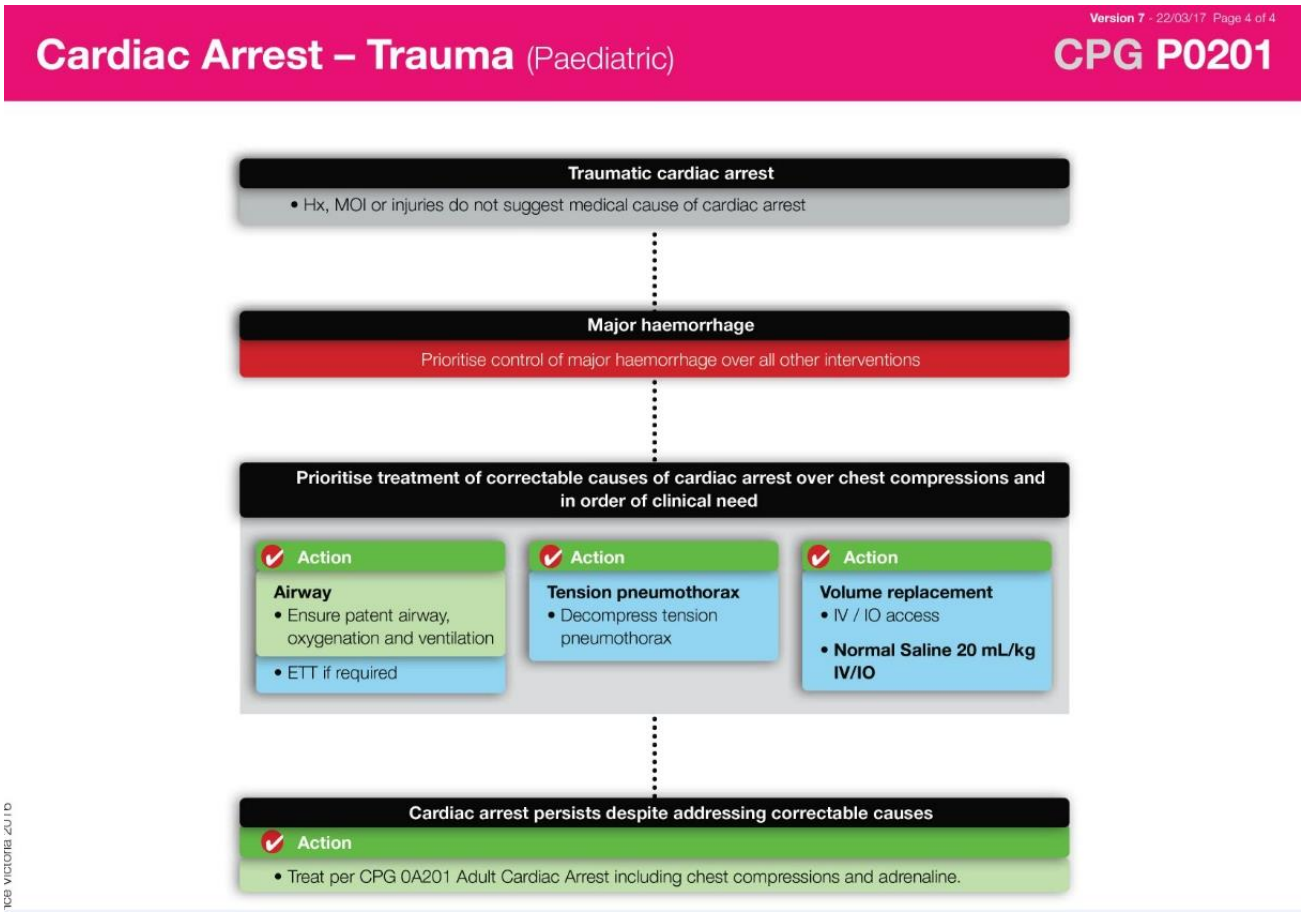
Volume replacement
- IV Access
- **Normal Saline 20 mL/kg IV**
- **Normal Saline 20 mL/kg IV/IO**

Cardiac arrest persists despite addressing correctable causes

Action

- Treat as per **CPG 0A201 Adult Cardiac Arrest** including chest compressions and adrenaline

14. Appendix 2: Ambulance Victoria Cardiac Arrest in Trauma (Paediatric)



15. Appendix 3: AGREEII Score Sheet – Traumatic Cardiac Arrest

AGREE II Score Sheet: Traumatic cardiac arrest guideline

Domain	Item	AGREE II Rating						
		1 *Strongly Disagree*	2	3	4	5	6	7 *Strongly Agree*
Scope and purpose	1. The overall objective(s) of the guideline is (are) specifically described.							X
	2. The health question(s) covered by the guideline is (are) specifically described.							X
	3. The population (patients, public, etc.) to whom the guideline is meant to apply is specifically described.							X
Stakeholder involvement	4. The guideline development group includes individuals from all the relevant professional groups.						X	
	5. The views and preferences of the target population (patients, public, etc.) have been sought.							X
	6. The target users of the guideline are clearly defined.							X
Rigor of development	7. Systematic methods were used to search for evidence.					X		
	8. The criteria for selecting the evidence are clearly described.						X	
	9. The strengths and limitations of the body of evidence are clearly described.						X	
	10. The methods for formulating the recommendations are clearly described.						X	
	11. The health benefits, side effects and risks have been considered in formulating the recommendations.						X	
	12. There is an explicit link between the recommendations and the supporting evidence.							X
	13. The guideline has been externally reviewed by experts prior to its publication.							X
	14. A procedure for updating the guideline is provided.							X
Clarity of presentation	15. The recommendations are specific and unambiguous.						X	
	16. The different options for management of the condition or health issue are clearly presented.							X
	17. Key recommendations are easily identifiable.							X

Domain	Item	AGREE II Rating						
		1 *Strongly Disagree*	2	3	4	5	6	7 *Strongly Agree*
Applicability	18. The guideline describes facilitators and barriers to its application.							X
	19. The guideline provides advice and/or tools on how the recommendations can be put into practice.							X
	20. The potential resource implications of applying the recommendations have been considered.							X
	21. The guideline presents monitoring and/ or auditing criteria.							X
Editorial independence	22. The views of the funding body have not influenced the content of the guideline.							X
	23. Competing interests of guideline development group members have been recorded and addressed.							X
Overall Guideline Assessment	1. Rate the overall quality of this guideline.	1 *Lowest possible quality*	2	3	4	5	6	7 *Highest possible quality*
Overall Guideline Assessment	2. I would recommend this guideline for use.	*Yes*	*Yes, with modifications*		*No*			
		X						

16. References

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