The HOTTTT Drill

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The HOTTT Drill provides a systematic approach to identifying and treating the most common, correctable causes of arrest in trauma patients. The response model emphasises predetermined roles for the team members and makes the most of the different strengths of physicians and paramedics.

Arrest in trauma does not have a good prognosis but neither is it hopeless. A recent (2013) observational study of 167 traumatic cardiac arrests from Madrid which uses a two physician response model has found an overall rate of complete neurological recovery of 6.6%. Survival by age group was predictably better in children (23.1%) than in the elderly (3.7%). Complete neurological recovery was achieved in 36.4% of VFs, 7% of PEAs, and 2.7% of those in asystole. The study certainly indicates that even asystole is not completely hopeless.

A systematic review of traumatic arrest survival did find significantly higher rates of survival in physician staffed prehospital services (Zwingmann). Optimistic figures are about 50% ROSC and 5% neurologically intact survival.
Reversible causes in arrest

To the right is the current ARC standard ALS cardiac arrest guideline. In the “consider and correct” section on potentially reversible causes are the classic 4 Hs and 4 Ts.

The HOTTT Drill focuses on the potentially reversible causes that are most likely in the trauma patient and which are rapidly correctable. These are:

- Hypoxia
- Tension pneumothorax
- (Tamponade in knife wounds to the chest)
- Hypovolaemia

Other causes of arrest are either unlikely in a true trauma patient or are not easily correctable.
So what’s HOTTT?

The HOTTT Drill has five basic components then some mechanism specific considerations. The five components are:

**Haemorrhage**  Stop massive external haemorrhage. This has been a major lesson from recent conflicts. Usually this type of bleeding is over by the time EMS arrive as the patient has already exsanguinated. If we however arrive very early then this takes absolute priority. Each ml of the patients own blood is worth 10mls of transfused products. This kind of bleeding is immediately obvious when you approach the patient. Deal with this before you move onto the airway.

**Oxygenate**  This is the paramedics primary responsibility. Intubating the arrested patient without an assistant is in the core skill set of a paramedic and we use it to our advantage here. The patient should then be ventilated on 100% O\(_2\) with no PEEP.

**Tension**  Excluding tension is the doctors primary responsibility. Go straight in with the ultrasound. No definite sliding or B lines means immediate decompression. Use the needle in difficult access situations followed by thoracostomy as soon as feasible. Otherwise go straight in with thoracostomy and insert the drain prior to transport if ROSC is achieved unless the transport time will be very short. If however the lung is clearly up on ultrasound there is no indication for decompression and making a hole can only make a bad situation worse by causing partial collapse and shunting as well as wasting time.

**Tourniquet**  Apply the AAJT unless contraindicated (and if not already done as part of step one). This will cause a dramatic rise in SVR even if the site of haemorrhage is above the tourniquet. This may enable perfusion of heart and brain till surgical control can be achieved.

**Transfuse**  We need to get a lot of volume in very quickly if you are to have any hope of correcting a hypovolaemic arrest. Therefore we recommend a bolus of 7.5% saline (paed 4ml/kg). This approach means you can give the equivalent of 2000mls of crystalloid to an adult in a minute or two. Nothing else gives you this kind of bang for buck in volume expansion. Follow up with packed cells in patients who have either organised electrical rhythm or cardiac motion on echo. Packed cells are a valuable but finite resource. We therefore do not routinely transfuse asystolic patients due to the grim prognosis compared with other rhythms.
Mechanism specific considerations

Depending on the mechanism of injury specific further interventions should be considered:

- Application of a pelvic binder if blunt trauma and AP compression or vertical shear injury is possible
- Crush injury: calcium, bicarbonate, crystalloid (preferably saline) loading, hyperventilation, +/- tourniquets, +/- amputation. See the crush injury chapter in the PHTC course notes for further detail.
- Thoracotomy if:
  - stab wound to anterior chest or epigastrium,
  - arrest < 10 min prior,
  - >5 min transport from a major trauma service
  - and doctor is appropriately trained.
- Consider medical cause, particularly where arrest appears inconsistent with injury mechanism.

**Thoracotomy notes:**
Thoracotomy is not indicated in blunt trauma or gunshot wounds. There are no reported survivors from prehospital thoracotomy in the world literature for these injury mechanisms. We believe this constitutes reasonable evidence of futility.

Also notable is that all but one survivor of prehospital thoracotomy was tamponading. With the advent of small, reliable prehospital ultrasonography it is possible to rapidly exclude tamponade. Absence of tamponade is also adequate reason to withhold thoracotomy even if the other criteria are met.
It’s about the patient

Running HOTTT

This is a time critical situation. Like the pit crew, focused parallel processing is required. The team should call a “HOTTT drill” response when they arrive at an arrested trauma patient so that they are both on the same page about who is doing what. While the paramedic and doctor go about their primary responsibilities, ask one of the scene paramedics to get vascular access so that fluids can commence ASAP.

Standard ALS as per ARC guidelines should continue throughout the process – another use for the ground ambulance crews. Although CPR is unlikely to be of benefit in hypovolaemic arrest, you need to be certain that hypovolaemia is the cause before you discontinue it. As part of standard ALS, remember to check the rhythm – some will have a shockable rhythm. Most patients will be asystolic but in the Madrid paper 6.6% of patients were in VF, a treatable rhythm almost certainly helped by CPR. You do not want to discontinue CPR because it is a trauma arrest, only to get the monitor on and find the patient is in VF. And how sure are you that the traumatic incident did not have a medical cause, even in a younger person?

At conclusion of the case, please complete a HOTTT Drill Carebundle form for all arrested trauma patients.
When to cool it

There are a number of factors which have been shown to be associated with a higher chance of survival from traumatic arrest:

• Age is a strong independent predictor of survival: children >> adults > elderly
• One study (Cera) found that almost all survivors had reactive pupils at hospital admission. This might be the most useful single indicator of whether to persist.
• Survival is greater in VF >> PEA > asystole, although the incidence of these rhythms in traumatic arrest is asystole >> PEA > VF.
• A set of guidelines from the American National Association of EMS Physicians and the American College of Surgeons Committee on Trauma suggested cessation of resuscitation at 15mins. Several services have published survivors with resuscitation times that are longer than this however. We suggest 20 minutes in adults and 30 mins in children.

Mechanisms that do better:
- Single stab wounds
- Asphyxia e.g. isolated laryngeal injury, hangings etc
- Obstructive (tension pneumothorax or massive haemothorax due to isolated chest injury)
- Cardiac tamponade (only if thoracotomy performed promptly after arrest)
- Electrocution

Who can be expected to do badly?
Isolated head injuries with cardiac arrest all die. It is a symptom of complete autonomic failure. Survival from pure hypovolaemic traumatic cardiac arrest is extremely rare.
References


