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EDITORIAL

When should we stop resuscitation efforts after blunt traumatic arrest?

In a recent issue of *Injury*, Galluccio et al. presented a stimulating case[8] which should provoke us to reconsider the boundaries of what is possible after cardiac arrest secondary to apparent blunt trauma. This report follows a previous study in Injury reporting survival after cardiac arrest after trauma.[24]

Their patient, a 42-year-old male driver, crashed his vehicle at 60 km/h and was found slumped and unresponsive with no obvious external injuries to account for his clinical state. Prolonged prehospital and inhospital resuscitation led to the eventual return of spontaneous circulation.

Apparently, this man was the victim of blunt major trauma; he had been arrested for some time, and then resuscitated successfully in the emergency department (ED) — the reflex reaction must have been to suspect severe internal injuries. But the facts as presented would dispute that assumption: the arrest rhythm was ventricular fibrillation (rare in blunt trauma), and there were few, if any, signs of significant injury.

The distinction is clearly critical, primarily due to the fact that the treatment of the first condition is to stop bleeding, whereas the treatment of the second is to restore coronary blood flow, including systemic anticoagulation and antiplatelet therapy.

So what made the difference in this case? Firstly, he was fortunate to crash close to a competent bystander who was able and willing to provide immediate basic life support (BLS). BLS is considered universally as one of the key steps in the chain of survival for victims of cardiac arrest.[10] However, BLS in trauma is considered by some to be futile, but clearly in the non-trauma situation, there is value in instituting effective BLS at the first opportunity. It is difficult, though, to identify with any certainty which patients may or may not benefit from BLS in those first critical seconds, and this is why the current advice is to provide BLS to all patients with cardiac arrest regardless of aetiology.[10]

Secondly, he had a short period of prehospital advanced life support (ALS). Prehospital ALS is itself controversial. There is little evidence that any interventions, other than rapid defibrillation, make any difference to outcome after sudden cardiac arrest in the prehospital arena. Seminal studies from Scotland suggest that the benefits of paramedics in the treatment of cardiac arrest were overstated.[9,16,17] Recent evidence from Singapore[18] confirms that allegedly advanced interventions such as adrenaline make little difference in the real world.

Prehospital ALS for trauma has also come under close scrutiny. Recent evidence suggests that in trauma, tracheal intubation is of little value in the prehospital setting,[7,22,23] certainly where it is performed without drugs.[13] An ongoing randomised controlled trial in Australia should give valuable information on whether prehospital rapid sequence induction, performed by mobile intensive care ambulance paramedics, makes a difference to outcomes in trauma care (see the following link for details: http://www.med.monash.edu.au/epidemiology/traumaepi/rsistudy.html).

Likewise, there is little evidence to support the administration of intravenous fluids in the prehospital management of trauma.[2] Evidence is urgently required from well designed studies to inform rational therapies for patient care.

Returning to this case, the patient was rapidly transported to a trauma centre. Do trauma services and trauma systems make any difference to outcome? Recent work would suggest that they do. Rainer et al. examined their trauma team performance[19] and found that for a small number of patients, particularly those with a probability of survival of 0.5—0.75, who could be considered borderline patients, did benefit from the attention of a

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trauma team (odds ratio 7.6 for survival with trauma team involvement compared to standard care).

A recent comparison of trauma systems between Hong Kong and Melbourne[3] showed that while Hong Kong had a comparable performance to the United States major trauma outcome study database, Melbourne had better survival figures overall. Reasons for this are undoubtedly multi-factorial, but better availability of intensive care facilities and earlier pre-alerting and earlier assembly of the trauma team appeared to be associated with better outcomes.

The next critical factor in this man's survival was the decision to go directly to the catheter laboratory rather than the operating room or CT scanner. This decision was made by 'senior clinicians', and turned out to be a good judgement call. The presence of senior clinicians has been shown to be associated with improved trauma survival,[1] but has not been demonstrated in cardiac resuscitation.

The resuscitation process took time: return of spontaneous circulation for this patient occurred 40 min from the time of the accident. The chain of survival which contributed to this man's recovery was quite exceptional. Many of us are faced with the situation of when to abandon resuscitation efforts for the victim of an apparently traumatic arrest. What is the evidence?

Firstly, we can consider those patients who should not be resuscitated at all.[6] There is consensus that patients with massive tissue destruction, such as massive head trauma or hemicorporectomy, which is incompatible with life, should not be resuscitated at all. Those who have clearly been dead for some time (decomposition, dependent lividity, etc.) also should not be resuscitated.

Patients who have arrested after penetrating injuries to the chest should be rapidly assessed for signs of life within the previous 5 min. If there is any sign of life (pupils reactive, reflexes, pulseless electrical activity on the electrocardiogram), resuscitation should be started without delay and the patient should be transported as rapidly as possible to hospital for ED thoracotomy.[12] This can only succeed if the transport times are very short, and this is therefore only clinically useful in high density urban environments. Time must not be wasted on any procedure that delays transport, and resuscitation must continue on the way. Thoracotomy must be performed by a skilled clinician without delay; however, outcome following thoracotomy in lower volume centres may be dismal.[6,21]

Penetrating trauma victims in cardiac arrest with asystole or without signs of life for more than 5 min have virtually no chance of survival even with the most aggressive resuscitation. Resuscitation should be withheld or terminated in such patients, particularly given the high risks to healthcare staff from blood borne diseases during invasive procedures like ED thoracotomy.

Blunt trauma patients pose a greater dilemma. There is always the chance that the arrest is due to medical causes, as in this case. Successful resuscitation from 'medical' cardiac arrest is more likely if the initial arrest rhythm is not asystole and prompt BLS and defibrillation are provided. One specific cause is 'commotio cordis', occasionally seen in younger patients struck in the chest during sporting events (for example, baseball). Successful resuscitation is not uncommon if prompt action is taken.[14]

Patients who remain in cardiac arrest after 15 min have a very poor chance of neurologically intact survival, regardless of underlying rhythm. However, given its inherent reversibility,[5] persistent ventricular fibrillation should be aggressively treated until a spontaneous circulation is restored or asystole supervenes.

Blunt trauma patients in cardiac arrest should be systemically evaluated to exclude reversible causes. This should include chest examination to identify tension pneumothorax and a FAST scan to specifically look for cardiac tamponade. Ultrasound can help to differentiate tamponade, hypovolaemia and pneumothorax in trained hands.[11] Any suspicion of tension pneumothorax after blunt trauma should lead to decompressive lateral finger thoracostomy[4] followed immediately by tube thoracostomy.

A positive FAST scan for cardiac tamponade should lead to consideration of ED thoracotomy, although results after blunt trauma are dismal. As with penetrating trauma, this procedure should only be performed if the arrest was witnessed and is of short duration — long arrest times (>15 min) and lack of any coordinated electrical cardiac activity should lead to termination of the resuscitation attempt.

A positive FAST scan for abdominal bleeding in the presence of blunt trauma and cardiac arrest almost certainly represents catastrophic haemorrhage. This has been treated in some trauma centres by ED thoracotomy and cross clamping of the descending aorta, followed by damage control surgery. The duration of arrest is again the critical factor, and arrest times in excess of 15 min should lead to abandonment of the resuscitation. Even with this aggressive approach, outcomes are very poor.[6,21]

This leaves us with patients who have arrested after blunt trauma, have pulseless electrical activity or asystole as the underlying rhythm, and have no obvious reversible causes to account for their arrest after physical examination and FAST scanning in the ED. If the arrest time is short (less than 15 min) and

the reported mechanism of injury is not severe, it would seem reasonable to continue resuscitation efforts.

Once resuscitation has been in progress for more than 15 min with no immediately reversible cause, the likelihood of a good outcome is extremely low[15] and the attempt should be terminated. The situation will not improve if the cause of the arrest is not reversible. Longer resuscitation attempts cannot be justified in the face of an irreversible clinical situation.

However this case demonstrates that for every guideline, there are exceptions[20]: senior medical staff must be involved in making these very difficult decisions to terminate resuscitation attempts, and to identify the few cases where prolonged resuscitation efforts may be warranted.

Conflict of interest

There is no conflict of interest associated with this editorial.

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