Pre-hospital Trauma Care

Dr Anil Hormis, Sheffield Teaching Hospitals NHS Trust, UK
Dr Neil Sambridge, Sheffield Teaching Hospitals NHS Trust, UK

Email: aphormis@doctors.org.uk

Aim: To provide critical care from the place of injury to the intensive care unit.

Pre-hospital care is a rapidly developing and complex speciality. This article cannot comprehensively cover all areas in detail, but we hope that it will provide a framework and background on which to build knowledge and skills. We shall concentrate on the early, simple, well-conducted interventions that contribute most to improve survival and outcome. Safety is of paramount concern and we include discussion and detail on this topic.

Consider the following case example:
You are working in the local Emergency Department and receive a request from the local ambulance service to attend a road traffic collision (RTC). Little information is given at this stage, but a car has lost control on a bend and hit a tree. The driver (single occupant) is trapped, unresponsive and will require extrication by the fire service. The police have closed the road.

Arrival at the scene
Your vehicle should be positioned to protect the scene from other traffic and to provide a visual warning of the presence of an incident (with the use of appropriate beacons/lights where available). Ensure a safe exit from your vehicle with due regard to other traffic

Safety / hazards
- Personal safety
- Scene safety – identify any obvious hazards
- Patient's safety

Personal safety and protection from hazards at the scene is of paramount importance and takes precedence over other concerns. The scene should not be approached until you, as the rescuer, are safe from actual and potential hazards. Medical personnel who attend these types of incidents frequently will have their own personal kit and equipment. Personal protective equipment should include:
- Fire retardant, high visibility overalls
- Boots (with reinforced toecaps)
- Gloves
- Helmet
- Eye protection

Having ensured your own personal safety, thought should be given to the safety of the scene (for the rescuer) and that of the patient(s) involved. Liaison with the fire service may be required to render the scene safe for the ongoing rescue; until this is achieved there may be limited or no patient contact.

Initial Scene Assessment

Case example (continued)
On arrival at the scene, you note the following:
- The driver is trapped in the vehicle by the dashboard.
- There is significant frontal vehicle damage and driver compartment intrusion.
- The windscreen has been shattered.
- The vehicle roof is damaged and may have rolled over before collision with the tree.
- It is dark and has been raining.

What injuries are likely in this patient from your initial view of the scene?

'Reading the wreckage' and identifying the mechanism of the incident can help to predict the likely pattern of injury sustained by the patient(s). Treatment should be based on expected injury until a particular injury can be confidently excluded.

Case example (continued)
The damage to the vehicle suggests that:
- This was a high speed collision.
- There is a high likelihood that entrapment within the driver compartment has caused:
    - lower limb injuries/fractures of the pelvis and/or long bones)
    - soft tissue disruption and/ crush injury.
- Consider head and cervical spine injury as the windscreen shattered, possibly by the driver.
- There could be a number of other injuries if the car has rolled over.

Communication
Early communication means that resources are more likely to arrive on scene rapidly and to facilitate a rapid rescue. It is important to liaise with the emergency services on scene.

Triage
Where you encounter multiple casualties, it is important to attempt to prioritise the order in which you plan to assess and treat the various patients. The process in referred to as 'triage' This tutorial will not cover triage in detail, but here are various triage 'sorting systems' described (see Further reading).

Access to patient
This may be straightforward, but in a small proportion of cases may be severely limited. Early discussion with the fire service is important to establish a plan for rapid access and subsequent extrication.

Case example (continued)
The primary survey reveals major bleeding coming from the driver's right thigh. The patient's leg is trapped under the dashboard and profuse bleeding continues despite direct pressure with several bandages.

What action should be taken now?

Necessary interventions
Carefully consider which interventions should be performed on scene prior to transport, those that can be reasonably attempted on route to hospital and those which should be delayed (or cannot be achieved in the pre-hospital environment) until arrival at hospital. Interventions that *are* performed should be targeted to improve the patient's clinical state or facilitate safe transfer.

It is important to identify whether the patient is '*time critical'*. A time critical patient is one that has a life threatening problem involving either the airway, breathing, circulation or disability. Rapid identification of a problem is essential to guide extrication and evacuation planning. It is appropriate to wait for a controlled but slower extrication for a trapped but clinically stable patient. However, a patient with airway compromise or severe respiratory difficulties is likely to require an immediate, and relatively uncontrolled, extrication to allow medical intervention.

A newer strategy for performing a Primary Survey is described below (Further reading: Anaesthesia, Trauma and Critical Care (ATACC) Manual 6.2 - see: http://www.atacc.co.uk).

Primary survey

1. Massive haemorrhage control **M**
2. Airway with cervical spine control **A**
3. Respiration (Breathing) **R**
4. Circulation **C**
5. Head injury (Disability) **H**

M/A/R/C/H is intended as both an assessment and intervention framework – problems are managed as they are identified.

Massive Haemorrhage Control
If there is no massive haemorrhage then proceed with A/R/C/H or A/B/C/D as appropriate. If massive haemorrhage exists then apply the following principles

- Direct pressure
- Elevation
- Indirect pressure
- Wound packing
- Tourniquet
- Haemostatic agents

Major haemorrhage caused by trauma may cause death very rapidly and control of haemorrhage should take precedence over other interventions. This is particularly relevant to penetrating injuries, such as gunshot wounds to the extremities. The above steps should be followed in order. If they fail, a tourniquet can be applied proximal to the site of bleeding and tightened to control blood flow. This can be a life-saving intervention. Massive haemorrhage from the chest and/or abdomen requires rapid transfer to hospital.

Case example (continued)
The injury described is time critical and a tourniquet is applied tightly to the right upper thigh proximal to the point of bleeding and the haemorrhage is controlled. The rescuer now moves on to assess the patient's airway.

Case example (continued)
You assess the patient:

Airway	No response, noisy breathing.
Respiration	Respiratory rate 22/minute, decreased air entry on the right, normal percussion both sides, trachea central, SaO_2 90% on air.
Circulation	Pulse rate 125 per minute measured from the radial pulse, no blood pressure able to be recorded, capillary refill time is 4 seconds and he is cold peripherally.
Head Injury	Patient is unresponsive to verbal commands and painful stimuli.

What are your priorities in the immediate management of this patient?

Airway with cervical spine control
- Manual immobilisation of the spine
- Jaw thrust
- Simple adjuncts / supraglottic adjuncts
- Intubation
- Surgical airway

Basic airway manoeuvres such as a jaw thrust may be life-saving. Avoid a chin lift in view of the high risk of cervical spine injury.

The cervical spine should be immobilised as soon as access is possible. This should be the sole responsibility of a selected individual. It is done either manually, in the initial phase, and then using a cervical collar and immobilisation using sandbags and tape.

Simple airway manoeuvres and adjuncts (oral and nasal airways) are often successful in managing the airway. Supraglottic airways (laryngeal mask airway and similar devices) require the patient's conscious level to be very depressed for successful insertion. They are useful for those without the appropriate skills for endotracheal intubation. Patients who can be intubated without drugs have a very poor outcome and it is beyond the scope of this article to discuss roadside drug-assisted intubation.

The surgical airway (trans-cricoid approach) is another useful and life-saving procedure when the airway cannot be maintained by other means. With training it is (relatively) easy to perform with a scalpel, forceps and a cuffed size 6 endotracheal tube. There are many kits available for this purpose and most employ the Seldinger approach (i.e introduction of the cricothyroidotomy tube over a guidewire). The Melker Cricothyrotomy Set by Cook Medical is an example of such a device (www.cookmedical.com/cc/dataSheet.do?id=4016).

Breathing
- Oxygen
- Control of ventilation
- Seal open / sucking chest wounds
- Chest decompression

High flow oxygen should be provided at the earliest opportunity, provided it is safe to do so (wait for the fire service to extinguish any fires). Ventilation can be assisted with a bag-valve-mask to provide adequate oxygenation and control of carbon dioxide. Open chest wounds

should be covered with a three sided dressing (to prevent the development of a tension pneumothorax). Tension pneumothorax should be actively sought and excluded, or treated by chest decompression (with a needle or open/tube thoracostomy). Frequent reassessment is crucial after any intervention.

Case example (continued)
The cervical spine is immobilised manually by a fireman.
The patient's airway is obstructed - but suction, a jaw thrust and an oropharyngeal airway clears it.
High flow oxygen is delivered via a face mask.
The right chest wall expands poorly and has reduced air entry on auscultation. However, there is no evidence of a tension pneumothorax. (There is no hyper resonance on the right chest and the trachea is central).

You are able to get a large bore cannula into the patients left antecubital fossa.

Does this patient require any intravenous fluid?
Which fluid and how much do you give?

Circulation
- Intravenous and intraosseous access
- Limited fluid resuscitation
- Access to urgent surgery

Venous access is often difficult, but transfer should not be delayed by attempts to gain intravenous access. Intraosseous access may be appropriate for both paediatric and adult patients where intravenous access is difficult. Rapid transfer for surgery is paramount for those patients with uncontrollable bleeding, particularly bleeding into a body cavity.

The choice of fluid is a matter of ongoing debate. Isotonic sodium chloride in 250ml aliquots titrated to the presence (or absence) of a radial pulse is the preferred option. In patients with a penetrating chest injury, the presence a carotid pulse is a suitable endpoint. In patients with head injuries higher blood pressures may be targeted to maintain cerebral perfusion. Frequent reassessment is crucial.

Case example (continued)
The patient has a radial pulse present and so does not require any fluid therapy currently. If the pulse was to disappear then a bolus of 250mls normal saline should be given.

NB – we note that there is a potential head injury and we may consider giving a fluid bolus if any haemorrhage continues to maintain the cerebral perfusion pressure

What further management does this patient require?

Head Injury (Disability)

- Spinal care
- Reversal of hypoxia / hypotension
- Control of agitation
- Prevention of aspiration
- Safe transport
- Access to urgent surgery

All trauma patients should be assumed to have a spinal injury and treated as such, until this can be confidently excluded. There are rare exceptions, when a patient who would otherwise die if spinal care was commenced or continued. Full spinal immobilisation should be employed including a collar, spinal board and blocks. Tape should be used to secure the head to the blocks. This should be done as soon as physically possible and prior to moving the patient to a site of definitive care.

Care of the head injured, agitated or unresponsive patient is challenging. Adherence to simple principles can improve outcome. Rapid reversal of hypoxia, correction of hypotension, airway protection and rapid transport to a neurosurgical centre are paramount.

Other issues

Limb injury

- Splint (box / vacuum / traction)
- Wound dressing
- Realignment

Good care of limb injuries is important to maximise functional recovery post injury. Open wounds should be dressed and realignment attempted to restore peripheral circulation and correct abnormal neurology – worsening of distal neurovascular status after realignment should prompt return of the limb to its original position. Splinting provides a number of benefits:

- Analgesia
- Reduction of blood loss
- Prevention of further (neurovascular and tissue) injury
- Reduction of fat emboli
- Facilitate packaging

Case example (continued)
The casualty is extricated from the car on a spinal board. Blocks and tape are applied immediately to immobilise the cervical spine. The right leg is splinted and the tourniquet is left in situ. The patient is still unresponsive but is maintaining his airway with the oropharyngeal airway in place.
He is covered in a blanket and, in view of his conscious level, no analgesia is given.
On reassessment, you are happy with his ABCD and plan to transport the patient to your hospital as quickly as possible.

How will you travel to hospital?
Who do you need to tell that you are coming?

Analgesia and sedation

- Morphine

- Ketamine
- Entonox
- Midazolam
- Peripheral nerve blocks

Analgesia and sedation should be provided depending on the experience of the rescuer and with considering that the intervention will improve rather than worsen the situation. Sedation of a head injured patient may precipitate the need for formal airway control. Ketamine is a very useful drug in this setting (see Further reading).

Environmental protection
Hypothermia and hyperthermia impact on patient comfort and survival (especially after major blood loss). Early protection from the prevailing weather is important. Simple measures such as shelter to provide shade and/or wind protection will reduce harm to both patient and rescuer. The casualty can be wrapped in warm blankets to confer some protection against heat loss.

Extrication
Once the rescue team are satisfied with casualty's safety and clinical condition, they can commence extrication. This will normally be supervised and conducted by individuals who are trained in this area (such as the Fire Service). Extrication techniques are beyond the scope of this article.

Packaging and evacuation
The casualty needs to be made safe and secure for transport to a site of definitive care (packaging), combining all the facets described above. The preferred method will depend on the mode of transport and the equipment available. Regardless of how packaging is achieved, the rescuer should ensure:
- Access to the airway and chest
- Appropriate monitoring
- Secure intravenous access
- Spinal care where appropriate
- Comfort and protection from the environment

Prior to leaving the scene, the casualty must be re-assessed using the M/A/R/C/H approach and any new problems identified and treated.

Transport
The mode of transport will depend on a number of factors. The rescuer needs to determine the most appropriate form of transport for each patient, the current location and the destination. Local (and regional) knowledge is important to help make these decisions.

Receiving hospital
The receiving hospital should be chosen (where possible and reasonable) with regard to the patient's injury pattern. Thus, an unresponsive head-injured patient could be transferred directly to a centre with neurosurgical capability (which may require the bypassing of a nearer hospital) provided it has the resources for the management of the other injuries. The receiving hospital should be telephoned to give them details of the patient(s) and alert them of your imminent arrival. A handover of the history (mechanism, injuries, vital signs and treatment) should be relayed to the hospital staff. An up-to-date set of observations should be handed over and your estimated time of arrival is always helpful.

Further treatment in hospital
The casualty will be met by a trauma team at the hospital and they will provide ongoing specialist care and investigations. They will also commence the secondary survey to look for other injuries when the patient is more stable.

Summary
The successful management of trauma patients in the pre-hospital environment can be challenging. The most important points to emphasise are the need for safety for the rescuer, a thorough and quick primary survey to identify life-threatening injuries that should be treated prior to evacuation to hospital. Life threatening haemorrhage must be stopped quickly. The rescuer must perform frequent reassessments of the casualty especially after any therapeutic interventions.

Further reading

- Coats TJ, Davies G. Prehospital Care for Road Traffic Casualties. *BMJ* 2002; **324**: 1135-8
- Anaesthesia, Trauma & Critical Care. ATACC Manual (version 6.2)
- NAEMT & American College of Surgeons. Pre-hospital Trauma Life Support Manual (6th Edition) 2007
- Lee C, Porter KM, Hodgetts TJ. Tourniquet use in the civilian prehospital setting. *EMJ* 2007; **24**: 584-7
- National Institute for Clinical Excellence. Pre-hospital initiation of fluid replacement therapy in trauma. Technology Appraisal 74. 2004
- Craven R. Ketamine in anaesthetic practice. *Update in Anaesthesia* 2007; **21**: 16-18. Available at: http://worldanaesthesia.org/component/option,com_docman/task,cat_view/gid,62/dir,DESC/order,name/Itemid,49/limit,10/limitstart,10/

Relevant courses
- Anaesthesia, Trauma & Critical Care (ATACC). See: http://www.atacc.co.uk
- Pre-hospital Trauma Life Support (PHTLS). See http://www.naemt.org/PHTLS/programs/coordsites/international/