Penetrating Craniofacial Injury Management: Clinical Guideline

Scope

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<th>Site</th>
<th>Department, Service or Operational Area</th>
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<td>RPH only</td>
<td>Trauma Service</td>
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Related National Standards

EQuIP National Standard 9: Responding to Clinical Deterioration

Purpose

Standardised process for the initial assessment, identification, investigation and treatment of craniofacial injuries in patients with low velocity penetrating injury to the face.

Rationale

Penetrating craniofacial trauma, although uncommon, has a high potential for death or serious morbidity from injury to important neurovascular structures. In Western Australia the most common causes of craniofacial injuries are motor vehicular accidents and assault. Less common causes include blasts, high energy missiles and low velocity missiles.

A high index of suspicion of cranial involvement in penetrating injuries to the head and neck is required for accurate and early diagnosis. Careful assessment and management of any injuries and their sequelae in consultation with appropriate surgical involvement is required to minimise mortality and morbidity. Cranial involvement can result in immediate injury e.g. brain parenchymal lacerations, vascular injury, etc. However, they can also result in delayed complications including brain abscesses, cavernous sinus thrombosis and seizures, among others. Rarer complications include cerebrospinal fistula and neuroendocrine dysfunction.

Penetrating craniofacial trauma encompasses a wide spectrum of mechanisms of injury and clinical presentations, from mild nonspecific headaches to major neurological disturbances. Neurological examination may show a normal picture in the initial hours even when both intracranial haematoma and foreign body are both present.

Initial management

Patients presenting with possible intracranial extension of facial injuries should be managed through the standard Emergency Management of Severe Trauma (EMST) / Advanced Trauma Life Support (ATLS) algorithms.

Airway and breathing

Penetrating craniofacial injuries may involve the airway structures and cause obstruction of the larynx or trachea, necessitating early intervention for the maintenance of a safe airway.
The nature of these injuries may complicate efforts of endotracheal intubation or other manoeuvres for airway maintenance.

In situations of airway obstruction, or its imminent loss, the most experienced practitioner available should attempt the initial intubation; increasing number of intubation attempts is associated with poorer outcomes. Where endotracheal intubation fails, a surgeon should be at the bedside to establish an immediate surgical airway instead. Occasionally, open injuries to the airway may allow direct intubation through the wound. A local anaesthetic spray may be useful to minimise airway irritation in this direct approach.

In situations where the patient can spontaneously ventilate and maintain an airway, but an airway injury is apparent from the physical examination, a clear, active decision whether to secure the airway in the current emergency department location, or transport to the operating theatre environment is required. This decision should be tailored to the individual patient and injury factors, as well as environmental and resource realities. The risk of airway compromise during transport must be judged by the treating team before considering transfer to a more ideal environment.

Airway compromise may occur from associated aspects of craniofacial injuries, including aspiration of blood, teeth, soft tissues or foreign material, from neurological injuries, or from associated trauma in other anatomical areas. The acute brain injuries associated with these craniofacial injuries may compromise respiratory drive, and depress consciousness, causing airway obstruction of its own accord. Vascular injuries may result in expanding haematomas with associated airway compression. Similarly, subcutaneous emphysema may result in obstruction. In these injuries, anatomical landmarks may become greatly distorted.

The rarity of injuries may distract the trauma team from other injuries. More distal injuries (e.g. a pneumothorax), and other associated traumatic injuries should not be overlooked in this stressful environment.

After successful control of the airway, the primary survey is continued in the standard EMST/ATLS manner. The patient is ventilated, and focus shifts to haemorrhage identification and temporary control.

**Haemorrhage and temporary control**

A thorough examination of the patient is required to identify all penetrating wounds. In addition, the further evaluation should consider the possibility of associated co-incidental blunt force injuries. A systematic evaluation is required, with an assessment of external blood loss, and for the identification of areas of ongoing haemorrhage.

Any wounds should be temporarily secured for haemostasis: a combination of pressure dressings, balloon tamponade, suture ligation etc. may be used. Scalp lacerations should be sutured or stapled early to avoid rapid blood loss that may be associated with the lesions. Bleeding from the nasal passages may respond to packing, but when posterior in origin, it
may also require balloon tamponade. In cases of arterial bleeding from midface, angiographic embolisation may also be of assistance. In cases of neck wounds, active bleeding may require direct manual compression and immediate transfer to the operating theatre.

Finally, with control of both the airway and acute haemorrhage, focus may turn to the possible associated neurological injuries from penetrating craniofacial trauma.

**Further diagnosis and evaluation**

**The brain/nervous system**

Assessment of the neurological status and identification of the clinical signs of neurological injury may be complicated by the priorities of the airway and haemorrhage control. However, every effort should be made to identify early signs and symptoms suggesting intracranial injuries. The early identification of these neurological injuries is important for optimising functional outcome, and minimising mortality. A brief neurological examination (GCS, pupil response and limb movements) is invaluable during further considerations of intracranial injuries. However, where possible, a complete neurological examination is preferable (including in tertiary survey).

To assist the diagnosis of intracranial injuries associated with penetrating craniofacial trauma, an early CT head is ideal. Where this is not precluded by a higher priority for surgery (airway or haemorrhage), the CT head will assist in the identification of foreign body fragments and potential injury tracts. To identify vascular injuries, dedicated angiogram and venogram phases at CT scanning may assist. Alternatively, formal angiography may also assist diagnosis and intervention for select cases.

Injury to the brain occurs by three different methods: 1) direct laceration of the brain and / or its vasculature, 2) shear forces relating to shock waves from a projectile or blow (compounded by reflection within the calvarial vault), and 3) cavitation due to the progress of a missile type injury through the tissue. High velocity missiles are associated with greater injury due to the latter two mechanisms. Overall, prognosis of penetrating head injuries is poor (<20% survival), though such statistics are dependent on local variations in the nature of penetrating mechanisms.

**The face**

Clinical assessment of the maxillofacial bones, airspace cavities, the nasal septum, the dentition, mandible and joints, as well as the ears, is critical during the secondary survey of the patient with penetrating craniofacial injuries.

**The eyes**

Careful clinical assessment and evaluation of potential eye injuries, including globe rupture and intraocular haemorrhage, is vital, and early involvement of Ophthalmology may assist the
accurate evaluation and management of these injuries. On occasion, a retro-orbital haematoma may necessitate an immediate lateral canthotomy to protect vision.

All orbital fractures requiring surgical fixation need to be reviewed by an Ophthalmologist prior to surgery

The neck

The airway assessment and its vital early role has been discussed above. In addition, the assessment for clinical signs of neck injuries should follow.

Spinal clearance

In patients with suspected isolated penetrating craniofacial trauma there is normally no indication for spinal immobilisation. Such precautions are unnecessary in the pure penetrating trauma situation and may, in some cases, worsen an airway obstruction. However in situations where the patient has also experienced blunt forces (e.g. in a blast injury) c-spine immobilisation may be indicated.

Investigations

1. CT scan – ideally early in the clinical course
   - Non-contrast phase for the identification of bone injuries, parenchymal bleeding and foreign bodies.
   - Angiogram and venogram phases for the diagnosis of vascular injuries and complications. CT angiography (CTA) should be performed in most cases of penetrating intracranial injuries.

2. Digital Subtraction Angiography (DSA)
   - In select situations of uncertainty of CTA
   - To facilitate intervention at the same time
   - To establish brain death (though other methods are also available to establish this diagnosis)

3. Endoscopy / Bronchoscopy
   - Upper airway – nasal, laryngeal, pharyngeal
   - Upper oesophagus

If intracranial penetration is confirmed then the patient must be referred to neurosurgery for further management.

Management

Following the initial stabilisation (airway and haemorrhage control as discussed above), further investigation focuses on the early identification of the anatomical injuries. With this information established, clear decisions on the prioritisation and sequencing of treatments may be made. These management decisions are assisted by the early involvement of clinical specialties affected (e.g. Neurosurgery, Maxillofacial Surgery, Otorhinolaryngology and others), coordinated by the attending Trauma Surgeon.
In broad principles, systems likely to be affected include:

1. The brain and associated nervous system
2. The facial bones and associated soft tissues
3. The dental structures
4. The eyes
5. The ears
6. The upper neck:
   - The associated aerodigestive tract
   - The great vessels

The management of the individual injuries to these areas is beyond the scope of this guideline. The point is to establish a coordinated approach, both for the initial diagnosis and subsequent treatment. Careful dialogue between potential clinical stake-holders may serve to optimise outcomes.

Other general considerations include:

1. Antibiotics (managed as open fractures, with potential aerodigestive injury and CNS breech. The need for antibiotics should be discussed with Neurosurgery and Microbiology as appropriate.
2. Tetanus prophylaxis / immunoglobulin as appropriate
3. Involvement of Critical Care
4. Involvement of Anaesthesia
   - Airway management
   - Planning of theatre intervention
5. Early consideration of dietary strategies
   - Percutaneous Endoscopic Gastrostomy (PEG) / Radiology Inserted Gastrostomy (RIG) tube
   - Naso/orogastric tube

Where patients are admitted for observation of potential injuries from penetrating craniofacial injuries, clear plans for the escalation of medical support of these patients are required. Both the thresholds and triggers for failed non-operative management (i.e. what constitutes an indication to intervene), and the plan of action for the type of intervention when the above triggers are reached, should be clearly planned and documented ahead of time.

Authors / Acknowledgements

We acknowledge the following previous site endorsed work and/or contributors used to compile this document.

Dr Amyn Pardhan, Trauma Fellow (January 2014)
Dr Sudhakar Rao, Director, Trauma Services, RPH
Maxine Burrell, Trauma Programme Manager, RPH
Review Authors
RPH Trauma Committee including representation from Trauma Surgery, Orthopaedic Surgery, Neurosurgery, Emergency Medicine, Anaesthesia, Intensive Care, Allied Health and Nursing
Dr Stephen Dunjey, Emergency Department Specialist, RPH
Dr David McCutcheon, Emergency Department Specialist, RPH
Dr Stephen Honeybul, HoD, State Neurosurgery Service
Dr Dieter Weber, Consultant Trauma Surgeon, RPH
Kathy Young, NUM, State Major Trauma Unit

References

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