University Hospitals Sussex
NHS Foundation Trust

Penetrating injuries in Children

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Penetrating injuries

Background

Penetrating injuries in children are rare. They may be accidental, e.g. a fall onto a sharp object; or inflicted with knives or other sharp objects.

'Stabbings' are increasing in the UK, with violent knife-crime-related injuries rising by 25% each year over the past 10 years. Males are more likely to be injured than females, especially during adolescence, when they are three times more likely to die from injury. A recent UK study[1] showed a characteristic geo-temporal pattern in stab injuries: younger children are more likely to be stabbed within 5km of their home after school between 16:00 and 18:00 hours, compared with older adolescents who are more likely to be stabbed after midnight. The data also suggests males from urban, deprived areas are at higher risk. Adolescents were more likely to have multiple stab wounds. The majority of cases were non-critical and overall mortality rate was low (2%), with the mortality rate peaking in younger children.

This guideline focusses specifically on injuries to the chest and abdomen. Please also refer to the other Paediatric Major Trauma guidelines on Microguide (Major haemorrhage, Thoracotomy, Traumatic Cardiac Arrest).

Management

Prior to arrival:

- Activate the Paediatric Trauma Team and ensure that the adult General and Paediatric Surgeons have been informed and attend as soon as possible. Note paediatric surgery are not resident out of hours and may take up to 30 minutes to attend
- +/- Activate the paediatric major haemorrhage protocol based on credible prehospital information
- Consider preparation of age appropriate thoracostomy (and follow on chest drain) or thoracotomy kit
- Ensure a dedicated member of staff is available to provide support for parents / caregivers

On arrival to the ED, assess and deal with catastrophic haemorrhage, airway, breathing, circulation and disability as per APLS guidelines.

Do NOT remove a retained foreign body (e.g. knife) **in the ED**

Catastrophic haemorrhage

If evidence of catastrophic haemorrhage:

- Activate the paediatric major haemorrhage protocol 'Code Red Trauma'
- Early IV or IO access, Bloods & Crossmatch
- Haemorrhage control with direct pressure, haemostatic dressing or tourniquet
- Give tranexamic acid 15mg/kg (max 1g)

Airway (c-spine) and breathing

- C-spine control is only necessary if mechanism of injury suggests the possibility of cervical spine injury. Be aware that unnecessary immobilisation may hinder discovery of hidden wounds.
- If spontaneously breathing, administer high flow oxygen
- Suction blood / vomit / secretions
- Measure oxygen saturations, respiratory rate, and blood gas
- Intubate and ventilate if:
    - Severe respiratory distress, haemodynamic instability or depressed conscious state **but ONLY AFTER addressing potential causes such as hypovolaemia, or tension pneumothorax (see below) or failure of LMA.**
- Anticipate cardiovascular decompensation at induction of anaesthesia. Ideally anaesthetise in theatre with inotropic support available.

Look for tracheal deviation, crepitus, surgical emphysema, respiratory distress, hypoxia

- If evidence of pneumothorax or in circulatory collapse, perform needle decompression or thoracostomy +/- chest drain
- Perform CXR as part of primary survey

Circulation

- Assess and monitor heart rate, blood pressure and capillary return
- Insert large bore intravenous cannula (ideally x 2). If unable, gain I.O access.

- Take blood for FBC / U&Es / LFT / lipase or amylase / clotting screen / cross-match / blood gas

- **If there are signs of shock:**
  1. Consider resuscitating with blood products immediately. If not available, give 10 ml/kg WARMED sodium chloride 0.9%. If ongoing shock, give a further 10 ml/kg WARMED sodium chloride 0.9% if blood products are not available. Assess response after each aliquot
  2. The adult General Surgeon in conjunction with the Paediatric Surgeon must be involved as soon as it is clear that 20 ml/kg has not stabilised the child
  3. Give IV tranexamic acid ASAP if requires fluids or blood. 15 mg/kg (max 1g) over 10 minutes then infusion of 2 mg/kg/hr for eight hours. For children over 12 years, use adult dose regimen of 1g and then an infusion of 1g over 8 hours.
  4. Activate the massive haemorrhage protocol if 40 ml/kg has not stabilised the child

- Identify wounds / sources of bleeding e.g. intra-abdominal, pelvic, retroperitoneal, cardiac tamponade

Disability and Exposure

- Assess and monitor GCS, pupils and blood sugar
- Check core temperature
- Analgesia
- Remove clothing
- Look for other life-threatening injuries
- Perform ‘Stab check’ – knife wounds can be small: check for ‘hidden wounds’ in the axilla, groin, perineum & buttocks.

Management of specific regions

1) Thoracic Penetrating Trauma

With penetrating trauma there is a major risk of airway, oesophageal, vessel or cardiac injury, depending on the site of the injury. Lower chest injuries may involve the diaphragm or peritoneum. Consider cardiac tamponade on clinical assessment.

- If a significant chest injury is suspected a portable **CXR** should be performed rapidly during the primary survey followed by a **CT chest, abdomen and pelvis** once child is stabilised and if remains haemodynamically stable (see section on radiology). Haemodynamic instability despite resuscitative measures necessitates surgery over imaging.
- A **thoracostomy** may have been performed in the pre-hospital environment.
- Significant pneumothorax +/- haemothorax at primary survey should be managed with intercostal chest drain inserted under sedation or anaesthesia.
  - If patient is stable enough, this can follow imaging
  - **Needle decompression** for tension pneumothorax can be performed as per APLS guidelines. Thoracostomy should be performed following decompression.
- When intubating a patient with a potential chest injury the team should be prepped and ready to perform a thoracostomy in the event of tension pneumothorax due to positive pressure ventilation.
- If the patient is peri-arrest or arrests with a penetrating chest injury this is an indication for a **resuscitative thoracotomy** (see guideline on Paediatric traumatic cardiac arrest on Microguide > Paediatrics > Paediatric Major Trauma guidelines).
- Ensure **adequate analgesia** to aid spontaneous ventilation.

Thoracostomy: is a small incision into the chest wall. The opening is maintained for drainage and is most commonly used for the treatment of a traumatic pneumothorax. If the patient deteriorates a gloved finger should be inserted through the thorocostomy and a finger sweep performed to ensure patency and that the lung is up. This rules out tension pneumothorax as a cause of deterioration. A definitive chest drain can be inserted following this.

Thoracotomy: surgical opening of the chest wall. Is indicated in penetrating injury and massive haemorrhage, and/or pulseless electrical activity

2) Abdominal Penetrating Trauma

Have a low index of suspicion for cardiac / thoracic injury in penetrating abdominal trauma. Diaphragmatic injury should also be excluded.

- Children with penetrating abdominal wounds who are haemodynamically stable may undergo **CT chest, abdomen and pelvis** with the trauma team present (see section on radiology).
- Regular clinical assessment is advised even if CT is normal.
- Perform urinalysis for haematuria.
- In the child who is in extremis, **damage-control** procedures are required, with the goal of bleeding control via packing and resuscitation.
- Consider insertion of nasogastric tube +/- urinary catheter

All patients with penetrating injuries must have a surgical review. Depending on the clinical condition and CT findings a decision will be made between the adult General Surgeons and the Paediatric Surgery Team regarding the need for damage control / exploratory surgery.

Indications for Laparotomy

- Evisceration or omental herniation
- Uncontrollable haemodynamic instability
- Presence of abnormal CT such as free air, free fluid, solid organ injury
- Development of peritonitis post injury

Radiology for penetrating injuries in children

Clinicians should consider judicious use of plain radiographs with targeted CT scanning in the setting of paediatric trauma. Exposure to ionising radiation should always be kept to a minimum and “as low as is reasonably achievable.”

Although “lifetime cumulative exposure” is a consideration it should not prevent appropriate and timely investigations. For example **penetrating chest wounds are an RCR indication for a CT chest**.

- It is important to remember seemingly small ‘stab wounds’ may breach different compartments of the body, for example, the trajectory of a chest wound may breach the diaphragm & enter the peritoneal cavity. Consider the need for a **CT chest, abdomen and pelvis** depending on location of injuries.
- Think about anatomy and vasculature, for example the need for a CT angiogram.

Tranexamic acid

There is no specific evidence for paediatric penetrating injuries/stabbings; however, RCPCH guidance suggests that we take note of the 'CRASH-2' study results. This study of 20,000 adults showed that tranexamic acid (TXA) reduces the risk of death from bleeding in major trauma patients. The recommendation is that in unwell children (either actively bleeding or haemodynamically unstable) it is worth giving TXA. It should be given early, and there is no benefit to giving it after three hours (and some indication of potential harm).

Reporting Knife Crimes

The **police** are responsible for assessing the risk posed by members of the public who are armed with knives. They need to consider: the risk of a further attack on the patient, risks to staff, patients and visitors in the hospital, the risk of a further incident at the site of the original incident. For this reason, **the police should be informed whenever a person arrives at hospital with a wound inflicted in a violent attack with a knife or other sharp instrument.** Identifying details, such as the patient's name and address, should not usually be disclosed at the stage of initial contact with the police.

Make the care of your patient your first concern

If the patient's treatment and condition allow them to speak to the police, you should ask the patient whether they are willing to do so. The health care team and police must abide by the patient's decision.

Disclosing personal information without consent

Where it is probable that a crime has been committed, the police will seek further information. If the patient is unable to give consent (e.g. unconscious), or refuses to disclose information, information can still be disclosed if there are grounds for believing that this is justified in the public interest or disclosure is required by law. Disclosures in the public interest are justified where: failure to disclose information may put the patient, or someone else, at risk of death or serious harm. Disclosure would be likely to assist in the

prevention, detection or prosecution of a serious crime and failure to disclose would be prejudicial to those purposes.

If there is any doubt about whether disclosure is justified, the decision to disclose information without consent should be made by the consultant in charge, or the Trust's Caldicott Guardian. The reasons for disclosure should be recorded in the patient's notes

Safeguarding considerations

Refer all stab victims to the BSUH Safeguarding Children Team and social services (See Paediatric Safeguarding guidelines). You may be the only professional this young person ever talks to – make the most of it. Talk to your patient about safety at home, school, friends, and what makes them feel safe.

2016 data suggests only 4% of knife injuries are gang-related so it is much more likely that your patient has 'just got in with a bad crowd' or having trouble at home, rather than being entrenched in a gang. You really could make a difference here.

Consider referral of patients to community-based violence reduction interventions and support such as St Gile's Trust & Redthread (London).

https://www.stgilestrust.org.uk

https://www.redthread.org.uk/

References

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8. www.tarn.ac.uk