Management of major injuries using the APLS/ATLS system

Before wounds are treated, if there are other injuries, the whole patient must be assessed according to the APLS/ATLS system (see also Section 1.11).

Primary survey and resuscitation
- Assess:
  - Airway and cervical spine control
  - Breathing
  - Circulation and haemorrhage control
  - Disability
  - Exposure.
- Identify and correct life-threatening abnormalities.
- Resuscitate and stabilise vital functions.

Secondary survey and emergency treatments
Remember that if simple resuscitative measures do not stabilise the child, operative intervention may be necessary before a formal secondary survey is done. In the secondary survey, determine the full extent of all injuries to the head, face, neck, chest, abdomen, pelvis, spine and extremities.

Have an emergency treatment plan to give emergency treatments in order of priority.

Definitive care
The definitive care of major injuries, which include wounds, is often carried out by teams that have not been involved in the resuscitation and emergency treatments. Good communication is essential, using:
- legible and detailed notes
- prompt and efficient transfer to a unit which can provide the definitive care (this may be an inter-hospital transfer)
- a clear handover summary.

Wounds
Definition
In a medico-legal context, to wound is to destroy, however superficially or minutely, a bodily surface, be it skin or mucous membrane. A contusion (bruise) is excluded.

Nature of injuries causing wounds
- Kinetic energy (impacts): from any object of any material purposefully or accidentally impacting.
- Heat: from any heated solid, liquid or gas.
- Chemical: acids and alkalis predominate.
- Electrical: can cause significant internal injury.

Types of wounds
- Abrasion: friction injury, also known as graze.
- Laceration: blunt injury.
- Incision: injury from a sharp object.
- Stab: injury from a knife, scissors, screwdriver, poker, etc., usually penetrating in nature.
- Needlestick.
- Bite: human or animal (see Sections 6.2.H and 7.5).
- Firearm: shotgun, rifle, revolver or pistol (see Section 7.3.H).
- Blast (see Section 7.3.G).
- Burn (see Section 7.3.I.a and I.b).

It is important to remember that a variety of types of wounds may coexist following a single incident.

Assessment of minor wounds
Assessment of each wound should include the following:
- nature of the injury causing the wound
- type of wound
- wound site: size, shape, position and depth
- relevant motor function
- relevant sensation
- circulation distal to the wound.

Associated features include the following:
- erythema (redness)
- oedema (swelling)
- contusion (bruise)
- surgical emphysema: this needs urgent specialist care
- tenderness: if this extends beyond the area of the wound, a fracture may be present (see Section 7.2)
- pain.

General assessment includes the following:
- allergies
- immunisation status
- intercurrent illness
- medication
- past medical history
- time of last meal.

General principles
- After assessment of pain, give appropriate analgesia (see Section 1.15).
- If a radiopaque foreign body may be present, arrange an X-ray.
- The most important local treatment for all wounds is vigorous cleaning with sterile saline to remove dirt and possible pathogenic organisms (after analgesia).
Local, regional or general anaesthesia may be needed to achieve optimal cleaning (see Section 1.24).

- Superficial palpable foreign bodies should be removed as soon as possible.
- Removal of deeper foreign bodies may need specialist advice.
- Dead or damaged tissue must be excised. Specialist advice is needed if this involves more than a very small area of skin or mucous membrane.
- If tendons or nerves have been damaged, specialised care is needed.

**Tetanus prevention**

Give tetanus prophylaxis if the patient is not immunised or is not fully immunised (full immunisation is 5 doses of tetanus toxoid: 3 for the primary immunisation in infancy, one before school entry and one before leaving school). Wounds particularly prone to tetanus are those sustained more than six hours prior to presentation, those of puncture type, those with much devitalised tissue, those that appear septic, those associated with a compound fracture or foreign body and those contaminated with soil or dung. These wounds may need human anti-tetanus immunoglobulin (HATI), 250–500 units IM, depending on the patient’s tetanus status and the degree of contamination or devitalisation of the wound.

If the child has received anti-tetanus immunisation in the past, a single extra dose of tetanus toxoid IM (or, if they are due additional immunisation boosters, the relevant combination) should be given.

**TABLE 7.1.1 Need for tetanus immunoglobulin and/or tetanus toxoid after a wound**

<table>
<thead>
<tr>
<th>History of tetanus vaccination</th>
<th>Type of wound</th>
<th>Tetanus vaccine booster (see below)</th>
<th>Tetanus immunoglobulin</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 3 doses</td>
<td>All wounds</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>≥ 3 doses</td>
<td>&lt; 5 years since last dose</td>
<td>All wounds</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>5–10 years since last dose</td>
<td>Clean minor wounds</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>&gt; 10 years since last dose</td>
<td>All other wounds</td>
<td>Yes</td>
</tr>
<tr>
<td>&lt; 3 doses or uncertain</td>
<td>Clean minor wounds</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>All other wounds</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Note: if a patient has not completed the 5 tetanus doses when they are injured, it is likely they have also not completed other immunisation schedules. If possible give a combined immunisation comprising, for example, DTaP, DTP or DTaP – IPV for young children and Td for older children or adults according to local immunisation schedules.

**Antibiotics**

There is no substitute for thorough cleaning of wounds and for careful debridement of any devitalised tissue. However, in addition to cleaning and to tetanus prophylaxis, some wounds will need antibiotics. These will include wounds that have presented late and already are infected. Do not close these wounds but pack with sterile gauze dampened with sterile normal saline and review after antibiotic treatment for possible delayed primary closure after excision of the wound edges if feasible, or secondary closure.

Oral antibiotics to choose include flu/cloxacillin 25–50mg/kg four times a day or co-amoxiclav 125/31 mg three times a day for 1–6 years or 250/62 mg three times a day for 6–12 years. Co-amoxiclav is effective in bite injuries. A five day course is usually sufficient.

**Specific injuries**

**Abrasions**

- After thorough cleaning and debridement, leave abrasions exposed or cover them for 5 days with vaseline gauze.
- If debris is left in an abrasion, epithelium will grow over it and ‘tattooing’ will occur.

**Lacerations and incisions**

- Only clean fresh wounds should be closed immediately, preferably only less than 6 hours old, certainly less than 12 hours old.
- Distal-based flap lacerations may need specialist care if the blood supply is poor.
- To close superficial wounds, adhesive strips and tissue glues are excellent, but these must not be used for deeper wounds, in which cavities will be created and healing will not occur.
- Close deeper wounds in layers without tension.
- Close skin with interrupted sutures, ideally using monofilament material.
- If the wound is compound (associated with a fracture), an antibiotic should be given to prevent osteomyelitis (see Section 5.17).
- Arrange for removal of sutures at the times shown in Table 7.1.2.
- Younger patients heal more quickly. Malnourished patients take longer to heal.

**TABLE 7.1.2 Times for removal of sutures**

<table>
<thead>
<tr>
<th>Site</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face</td>
<td>4</td>
</tr>
<tr>
<td>Scalp and neck</td>
<td>5–7</td>
</tr>
<tr>
<td>Hand (flexor surface)</td>
<td>5–7</td>
</tr>
<tr>
<td>Trunk and arms (not extensor surfaces)</td>
<td>5–7</td>
</tr>
<tr>
<td>Legs (not extensor surfaces)</td>
<td>7–10</td>
</tr>
<tr>
<td>Hands (extensor surfaces)</td>
<td>7–10</td>
</tr>
<tr>
<td>Elbows and knees</td>
<td>10–14</td>
</tr>
</tbody>
</table>

**Fingertip injuries**

- Preserve maximum length.
- If the tip is amputated distal to the bone, regeneration will occur if the wound is kept clean and moist under paraffin gauze dressings changed weekly.
Other principles of treatment are the same as for lacerations and incised wounds.

**Tongue lacerations**
- Most stop bleeding spontaneously and do not need sutures.
- Repair under general anaesthesia if there is profuse bleeding or the full thickness of tongue is involved.
- Use absorbable sutures.

**Stab wounds**
- Stabbing may cause serious penetrating injuries to deep structures, which may lead to rapid death from haemorrhage or air embolus.
- The external dimensions of a stab wound may be deceptively small compared with the damage to underlying structures.
- Superficial stab wounds are treated in the same way as lacerations and incised wounds.
- Patients with penetrating wounds need resuscitation and emergency exploration under general anaesthesia.
- Never remove the penetrating object until the patient has been resuscitated and is in a secure surgical environment with cross-matched blood available.

**Needlestick injuries**
- If there is skin puncture, encourage bleeding and wash the wound thoroughly with plenty of soap and water. Dry the wound and apply a dry dressing if appropriate.
- If there is only skin contact, wash the wound with plenty of soap and water but do not scrub it. Scrubbing may damage the skin.
- If there is splashing into the mouth, rinse with plenty of water.
- If there is splashing into the eye, rinse with plenty of water. Obtain the help of a colleague to do this.
- If the identity of the donor (the person whose blood is on the needle) is known, try to find out whether that person has hepatitis B and/or HIV infection.
- Consider immunisation for hepatitis B and triple therapy for HIV if these are available.

**Complications of wounds**

**Retained foreign body**
- This will cause swelling beneath the wound.
- Secondary infection is more likely if there is a retained foreign body. If the foreign body is superficial, it must be removed by a competent surgeon under local anaesthetic. A general anaesthetic will be required if the foreign body is deeply placed and/or in an area with important structures, such as the hand or face.

**Infection**
- Tetanus: this is most likely to occur if the wound has been contaminated with soil and/or manure and the child is not fully immunised (see above).
- Bacterial. Prophylactic antibiotics such as flu/cloxacillin or co-amoxiclav should be considered in cases where wounds have been contaminated, but this does not lessen the need for thorough cleaning of such wounds.
- Antibiotic doses: flu/cloxacillin 25–50 mg/kg four times a day or co-amoxiclav 125/31 mg three times a day for 1–6 years or 250/62 mg three times a day for 6–12 years. Co-amoxiclav is effective in bite injuries. A five day course is usually sufficient.

**Delayed healing**
- This may be due to poor apposition of the edges, malnutrition and/or infection.
- Excision of the edges of the wound and secondary suture may be helpful, except in malnutrition.

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**7.2 Fractures in children**

**BOX 7.2.1 Minimum standards**
- X-rays.
- Splints.
- Plaster of Paris bandages.
- Traction.
- External and internal fixation.
- Physiotherapy.

**Introduction**
As any parent knows, all children are susceptible to injury. However, children in resource-limited countries are probably more at risk than their developed-world counterparts, as they often live in less regulated and protective environments. Once injured, there may be a considerable delay in their presentation to a healthcare facility, a situation that can complicate and restrict treatment options.

Scarc X-ray resources and a limited range of treatment modalities can then further complicate treatment of paediatric fractures.

However, on a more optimistic note it can be said that paediatric fractures are often more ‘forgiving’ when compared to those of the adult; they are often easier to reduce, less requiring of internal fixation, are quicker to unite and, due to the potential for remodelling with continued skeletal growth greater degrees of mal-union can be tolerated.

**Diagnosis**
Certain features of the history and examination may suggest the presence of a fracture: