



THE INJURED CHILD

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GENERAL PRINCIPLES

Successful management of the injured child requires:

- An organised team approach
- A designated team leader
- Frequent review of the response to treatment
- Adherence to APLS principles

The injured child differs from an adult in 3 main respects:

1. TYPES and PATTERNS of injury sustained
 - Predominantly blunt trauma.
 - Multiple and multi-system injury is common.
 - Severe injuries more often concealed than revealed.
 - Beware non-accidental injury (medico-legal, social implications).
2. ANATOMICAL features
 - Small size - requires appropriate resuscitation equipment and techniques (venous access)
 - Fluid volumes and drug dosages calculated according to weight
 - Relatively large head - frequently injured.
 - Thin integument + relatively large surface area - risk of rapid heat loss and increased O₂ demands.
 - Immature upper respiratory tract - obligate nose-breathing under 6 months of age.
 - Soft bones - poor protection of viscera.
 - Open physis - high incidence of growth-
 - Plate injuries until adolescence.
3. PHYSIOLOGICAL responses

- Ventilation - high oxygen consumption, low FRC, therefore increased right to left shunting.
- Circulation - increased physiological reserve, so vital signs (BP, Pulse) often normal despite significant fluid loss.
- Shock preterminal event.
- Most paediatric trauma deaths are immediate. Survival in hospital depends on vigorous, adequate resuscitation and diligent assessment of injuries performed simultaneously by the trauma team.

INITIAL ASSESSMENT AND RESUSCITATION

Adapt- "ABCD" approach to specific needs of children

Airway

- Give supplemental oxygen early by nasal prongs (over 6 months) or facemask, head box (less than 6 months)
- Stridor or central cyanosis - ? inhaled FB - head down, slap on back, Heimlich manoeuvre in older children.
- Avoid over-extension of neck (kinking of trachea, ?possible C-Spine injury) and pressure on floor of mouth (tongue falls back).
- Jaw thrust preferred in small children
- Oral airway only if gag reflex absent.
- Endotracheal intubation - straight-blade laryngoscope under 1 year; uncuffed ET tube of size to allow small air leak.

- Needle cricothyroidotomy (16G cannula) if upper airway compromised.

Breathing

- Attach oxygen saturation monitor.
- Assess clinically (respiratory rate, colour, capillary perfusion, auscultation), on blood gases and pulse oximetry (oxygen saturation should be over 95%)
- Inadequate ventilation - exclude aspiration (vomitus, FB), ET tube in oesophagus, tension pneumothorax (Clinical diagnosis), pulmonary contusion, rupture or splinting of diaphragm (gastric dilatation).
- Pass nasogastric tube.
- Commonest cause of respiratory failure is depressed level of consciousness from head injury
- Place prophylactic intercostal chest drains on side of injury if patient requires ventilation or general anaesthetic.
- Rib fractures rare and often not seen on chest x-ray.
- Pulmonary contusion frequent without fractures

Circulation

- Control haemorrhage early where possible (splint fractures, direct pressure over external bleeding).
- Heart rate is usually first to increase with fluid loss.
- Normal systolic BP = 80mmHg + (2x age)
- Attach ECG monitor leads.
- Asystole - External cardiac massage.
- ER thoracotomy not indicated in blunt trauma.
- Assess fluid loss according to peripheral colour, temperature, capillary refill and sensorium.

- Blood pressure and haemoglobin are poor guides as to degree of blood loss
- Do not delay IV fluid replacement until vital signs deteriorate.
- IV Access - peripheral cannula, femoral vein push-in, saphenous vein cut-down (ankle), Intra-osseus (tibial) infusion.
- Avoid central venous catheterisation - high morbidity until/unless CVP measurement required (Int. jugular, never subclavian V.)
- Draw blood for X-match, FBC, CEUG, ABG and serum amylase if abdominal trauma suspected.
- Commence IV replacement with 20-40ml/kg balanced salt solution (PLASMALYTE B or Ringer's lactate) - follow with packed RBC; Immediate O negative blood seldom necessary.

Failure to respond to fluid resuscitation

- Consider pneumothorax, cardiac contusion and exsanguinating intra-abdominal bleeding requiring urgent laparotomy.
- Monitor response to resuscitation - Hb, HR, BP and urine output (+CVP if 40%+ blood loss). Pass urinary catheter. Ideal urine output more than 1ml/kg/hr.

Disability

- Closed head injury is common in children; Obtain early baseline assessment of neurological status.
- Is the patient **A**lert, responding to **V**ocal stimuli, only **P**ainful stimuli, or **U**nresponsive? ("AVPU" scale).
- Assess pupils for size, equality and response to light in order to screen for focal injuries.

Normal Paediatric Values			
	Infants	Pre-school	Scholar
Heart rate/min	120-140	100-120	80-100
BP Systolic	70-90	80-90	90-110
Resp. rate/min	30-40	20-30	15-20
Blood Vol.ml/kg	90	80	80

Secondary survey and management

General Principles

- Remove all clothing to avoid missing injuries but also avoid excessive heat loss (Infants - warming blankets, overhead heaters, children - warmed air (Bair hugger))
- Do not neglect to monitor vital signs while examining for injuries.
- Analgesia -paracetamol, tilidine for axial injuries. Morphine (0,2mg/kg in 20ml 5% Dextrose) by slow infusion for trunk injuries or post-surgery.
- Place naso/oro-gastric tube, indwelling urinary catheter and request X-rays of cervical spine, chest and pelvis.

Head and neck

- Primary injury - irreversible. Secondary injury (brain swelling, cerebral oedema) is common - prevent by early, adequate resuscitation, oxygenation and ventilation (PaCO₂ 4.5-5.5 kPa)
- Raised intracranial pressure - watch for SIADH (low Na⁺, high urinary SG)
- Intra-cranial haematomas -clinical signs subtle compared with adults - watch carefully for changes in level of consciousness, abnormal behaviour.
A restless child is a hypoxic child.
- Basilar skull fractures involving anterior cranial fossa – small but clinically significant risk of bacterial meningitis. Use of prophylactic antibiotics is controversial. Perform CSF culture early if signs of meningeal irritation develop

- CT Scan - indicated as for adults.
- Non-penetrating C-Spine injuries are uncommon, mostly at C1/C2. If doubt - Xray in flexion. Significant cord injury can occur without fractures (Spinal Cord Injury Without Radiological Abnormality). SCIWORA Be familiar with anatomic variants in children.
- Subgaleal haematomas can be large and may cause haemodynamic changes.

Thorax

- Majority of injuries are minor - rib fractures, small pulmonary contusions.
- Most pleural collections are small effusions - drain only if clinically indicated (splinting, dyspnoea, underlying atelectasis)
- Ruptured diaphragm, cardiac contusion – less common, but life-threatening. Diagnose clinically, and X-ray on high index of suspicion.
- Give supplemental oxygen whether symptomatic or not
- IV Morphine (see above) for rib fractures

Abdomen

- Ensure that stomach is deflated with a nasogastric tube before physical examination. Vast majority of distention due to air swallowing.
- Intra-peritoneal haemorrhage (liver, spleen, kidney) - usually self-limiting. Watch vital signs; Circulatory shock will precede abdominal distension. Surgery indicated for massive or ongoing haemorrhage.
- Ruptured viscus and peritonitis – surgery based primarily on clinical impression / deterioration in signs (free air on initial x-ray rare).
- IVP for all children with macroscopic haematuria or loin

mass / tenderness suggesting significant renal injury.

- CT scan with contrast (if available) now often replaces IVP.
- Diagnostic peritoneal lavage - not indicated in vast majority and compromises subsequent clinical examination.
- Role of laparoscopy in selected cases.

Musculo-skeletal

- Physis (cartilagenous growth plate) is the weakest part of musculo-skeletal system - growth plate fractures are common; sprains and ligament injuries are rare before adolescence.
- Beware of compartment syndrome following reduction of supracondylar fractures of the humerus or fractures around the knee joint (pain on passive extension of wrist, or dorsiflexion of the foot). Early (open) fasciotomy of all compartments if suspected.
- ?Vascular injury – on-table angiography followed by exploration and repair if indicated.

Non-accidental injury

Suspect where:

- Delay in seeking medical care
- History is unforthcoming, vague or inconsistent with type or degree of injury.
- Multiple hospital attendances for minor complaints
- Obvious injuries – cigarette burns, bruising away from bony prominences, perianal or genital injury.
- Multiple injuries in various stages of healing or incidentally diagnosed (skeletal survey).
- Diagnostic features such a bucket-handle fractures
- Consult with social worker, Child Protection Unit or child care

agency before confronting parent(s)

- Complete the necessary documentation in order to contribute optimally to the judicial process.
(J88 - Police and DRX 55 - Social Worker)



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