Starship Trauma System

Trauma at Starship hospital is managed by a multidisciplinary team. This includes (but is not limited to) members of the following services; CED, Paediatric Surgery, PICU, Paediatric Orthopaedics, Paediatric Neurosurgery.

Starship Hospital has
- A paediatric trauma service
- A paediatric trauma registry
- Strong links to Safekids NZ (http://www.safekids.org.nz/).

TRAUMA

- **Starship Trauma System**
  - Trauma stat
  - Trauma alert
  - Trauma transfers
- **Initial Trauma Management**
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  - Handover
    - A Airway & Cervical Spine
    - B Breathing
    - C Circulation
    - D Disability
    - E Exposure
- **Further Management**
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  - Analgesia
  - Radiology
  - Tranexamic Acid
  - Abdominal Trauma
  - Secondary Survey
  - Pelvic Fractures
  - **Disposition**
  - **Injury Prevention**
  - **References**

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**Trauma stat**

**Activation Criteria**
- Airway or Respiratory compromise
- Signs of shock
- Penetrating injuries to head, neck, chest, abdomen or pelvis
- Facial or tracheal injury (including burns) with airway compromise (or potential for)
- Altered level of consciousness (as per AVPU) or GCS $\leq 12$ without sedation
- Suspected spinal cord injury i.e. with flaccidity, areflexia or unexplained hypotension
- Amputation proximal to the wrist or ankle
- Any trauma transfer with respiratory and/or haemo-dynamic instability and/or GCS < 8 without sedation or paralytics

Injured children meeting any of the above criteria will have 777 Paediatric Trauma Call activated.

**DIAL 777**

H = Hospital
E = Extension No. of Receiving Room …..
L = Location – Children’s Emergency Dept and Receiving Room No.
P = “PAEDIATRIC TRAUMA CALL” stat or in x minutes
The Trauma Stat team consists of:
- Surgical Registrar
- ED Consultant or fellow (to be contacted by Shift Co-ordinator if after hours)
- PICU Registrar
- Emergency Department Registrar
- Paediatric Registrar
- Emergency Department Nurses x 2
- Radiographer
- Duty Manager
- Paediatric Surgical Consultant on call – to be contacted by Surgical Registrar via cell-phone

**Trauma alert**

- No airway, respiratory or circulatory compromise
- GCS 13 or greater

With any of the following:
- Motor Vehicle Accident
  - Ejection of patient from vehicle
  - Prolonged extrication (>20 mins)
  - Rollover of vehicle
  - Death of an occupant in same vehicle
  - Impact speed > 50kms/hr
- Motor vehicle vs pedestrian
- Motor vehicle vs bicycle
- Significant speed involving bicycle, scooter, skateboard, water skis etc
- Falls > 3 metres
- Bilateral femur fractures or >2 long bone fractures
- Crush injuries proximal to wrist or ankle

Injured children meeting the above criteria will have the Trauma Alert team activated unless the CED consultant in attendance determines otherwise.

**DIAL 777**

H = Hospital
E = Extension No. of Receiving Room
L = Location – Children’s Emergency Dept and Receiving Room No.
P = “PAEDIATRIC TRAUMA ALERT”

The Trauma Alert team includes: ED Consultant or Fellow if available, Emergency Department Registrar, Emergency Department Nurses x 2 and Surgical Registrar Consultation as required with PICU, Orthopaedics, Neurosurgery, Anaesthetics.
TRAUMA

Trauma transfers

- Stable trauma transfers <24 hours post injury

Surgical Registrar to attend and take handover of patient and arrange disposition. CED Registrar or Consultant will attend patient and take handover if Surgical Registrar unavailable. If patient is considered unstable on initial assessment, a Trauma Stat should be activated.

Initial Trauma Management

Preparation

- In general, trauma patients meeting “Trauma Stat” or “Trauma alert” criteria should be managed in resus area of CED.
  - Possible exceptions are patients assessed immediately by CED consultant and regarded as stable enough to be seen in main department and patients attending during a mass casualty event.
- The paediatric surgical service should be involved early in the management of patients with chest or abdominal trauma.
- Staff roles will alter according to the expected clinical situation but it is expected that all patients received into resus will have:
  - Clearly identified team leader
  - Two additional doctors
  - CED ‘medical’ nurse
  - CED ‘surgical’ nurse
- Complex trauma patients will require additional support through additional nursing and medical personnel.
- For further information on resus team roles see Cardiopulmonary Resuscitation Guideline (updated version coming soon to Starship Website)

Handover

- Brief (<1 minute) handover from one pre-hospital provider while trauma team listens.
- Mechanism, time of injury, injuries noted, vitals at scene, interventions provided and response to interventions.
A Airway and Cervical Spine

- Whilst airway management needs to occur in conjunction with cervical spine cares, airway management should take priority.
- If active airway management is required the hard collar should be removed and in-line immobilisation be provided by an assistant.
- Airway management may involve suctioning, foreign body removal, jaw thrust, airway adjuncts, oro-tracheal intubation or surgical airway.
- Suction and other airway clearance manoeuvres should be completed under direct vision where possible.
- **Indications for intubation in trauma patient**
  - Airway or breathing compromise (present or predicted)
  - Unprotected airway
  - GCS < 9
  - Combative or uncooperative patients not able to be managed using analgesia and non-pharmacological techniques
- Examine and investigate for possible C spine injury as indicated
- Rigid immobilisation of the head may increase leverage on the neck in an uncooperative patient - rigid immobilisation should be discontinued and/or senior medical advice sought in this situation.

B Breathing

- Administer high flow oxygen
- Assess
  - Effort of breathing
    - Respiratory rate, recession, accessory muscle use, nasal flare, additional sounds.
  - Efficacy of breathing
    - Chest expansion, abdominal excursion, breath sounds, percussion
  - Effects of inadequate respiration
    - Heart rate, skin colour, mental status
- If causing respiratory or cardiovascular compromise the following conditions should be managed as part of the primary survey:
  - tension pneumothorax
  - massive haemothorax
  - flail chest
  - sucking chest wound
  - pericardial tamponade
C Circulation
- Attach cardiac leads, oxygen saturation probe and appropriate sized BP cuff
- Peripheral vs central pulses
- Capillary refill times - peripheral vs central
- HR and rhythm – compared to age appropriate normals
- BP – compared to age appropriate normals
- One IV line is usually sufficient
  - Two IV lines are likely to be required for patients:
    - Requiring intubation
    - Requiring fluid resuscitation
    - With injuries involving > 2 body regions
- Trauma Bloods may be required:
  - FBC, U and E, glucose, LFTs, amylase, coags,
  - Group and hold or cross match
- Direct pressure should be applied to sources of active bleeding
- Fluid resuscitation
  - 0.9% saline is the fluid of choice for initial resuscitation
  - 20ml/kg boluses are recommended (APLS)
  - Blood should be used if patient remains unstable after 40ml/kg of crystalloid has been administered
- If cardiovascular instability consider tranexamic acid use (see Further Trauma Management section)

D Disability
- Assign GCS (assistance with this can be found on nursing documentation sheet)
- Check pupils
- Check ears for haemotympanum
- See Head Injury guideline
- Check blood sugar

E Exposure
- Remove clothing (except underwear) and briefly inspect abdomen and limbs
- Maintain optimal body temperature
- Formal assessment occurs during the secondary survey
Further Trauma Management

History
- **A** Allergies
- **M** Medications (especially anticoagulants, insulin and cardiac medications)
- **P** Previous medical/surgical history
- **L** Last meal (Time)
- **E** Events/Environment surrounding the injury (exactly what happened)

Analgesia
- Analgesia is very important in paediatric trauma. Early use of appropriate analgesia will make assessment of the child more accurate and will reduce distress associated with C-spine immobilisation and other procedures.
- Non-pharmacologic measures are important; this includes caregiver presence, explanation and distraction.
- The most appropriate analgesia in this setting is IV morphine (0.1mg/kg) ([Morphine administration](#)) and/or regional block (e.g. femoral nerve block) ([Local Anaesthetic for Minor Procedures](#))

Radiology
- Radiology is not ‘routinely’ required.
- Lateral cervical spine X-ray if indicated (significant head injury, neck pain or tenderness, significant distracting injury).
- Chest X-ray if respiratory distress, chest contusions, history of impact to chest or other indicators of chest pathology.
- Pelvis X-ray only if history of impact to upper leg/pelvis/lower abdomen.
- C spine series may need completing (AP and open mouth views +/- swimmers) in the Radiology department.
Tranexamic Acid Use

- Anti-fibrinolytic drug which has been shown to reduce overall mortality in cardiovascularly unstable, bleeding adult trauma patients. Its use in paediatric trauma is extrapolated from adult trauma experience and its use in elective paediatric cardiac and spinal surgery.

- It should be given as early as possible and/or within 3 hours of the injury.

- Indications for use:
  - Cardiovascular instability with ongoing active bleeding
  - Massive transfusion requirement

- Dosage:
  - Loading dose: 15mg/kg (max 1g) over 10 minutes
    - Dilute in 0.9% NaCl or 5% Dextrose to 10mg/ml (ie. 1g in 100mls)
  - Maintenance infusion: 2mg/kg/hr for the next 8 hours.
    - Dilute 500mg in 500ml of 0.9%Nacl or 5% Dextrose (ie. 1mg/ml)

- Note:
  1. Its use via an intraosseous route has not been studied, however the pragmatic approach would be to administer via this route if no other access is available.
  2. It may cause hypotension if given rapidly

Abdominal Trauma

- See Blunt Abdominal Trauma algorithm below

- Mechanism of injury is a useful guide as to probable abdominal injury. Abdominal examination is about 50% accurate, but certain signs are very useful e.g. seat belt sign, handlebar sign, peritonism.

- Repeated clinical examination is important

- Haematuria is often interpreted as abnormal if >50 RBC are found in the urine (Odd ratio for solid organ injury 4.8). Gross haematuria indicates renal trauma but associated injuries eg to liver or spleen are also likely.

- Microscopic haematuria is more specific for solid organ injury following blunt trauma in children than it is in adults. If a CT scan is not indicated acutely on clinical grounds, microscopic haematuria following trauma is an indication for a renal ultrasound (completed before discharge from hospital).

- CT scanning is currently the modality of choice for children with suspected abdominal trauma. There may be a place for abdominal USS in the investigation of a stable child with blunt abdominal trauma and a low probability of solid organ injury based on clinical assessment.

- LFTs are often interpreted as abnormal if AST>200 U/L and/or ALT>125 U/L (Odds Ratio for liver injury 17.4). LFTs should be interpreted in conjunction with clinical findings.
Blunt Abdominal Trauma

Primary survey completed

Cardiovascularly Unstable

- Signs suggest abdominal source of blood loss
  - Consider FAST scan
  - Laparoscopy or Laparotomy

Cardiovascularly Stable

- Abdominal tenderness
  - Or
  - Unable to reliably assess
    - Consider mechanism
    - Consider CT Abdo/Pelvis
- Normal GCS
  - Normal exam
  - Clinical observation
Secondary Survey

Head to toe examination
- Head: check scalp, face, teeth, mandible, eyes
- Neck: open collar (use in-line immobilisation of neck) and feel for tenderness and steps in the midline
- Upper limbs
  - Inspect and feel clavicles, shoulders and arms for swelling and tenderness.
  - Check joint movement. Check power.
- Repeat examination of chest
- Examine abdomen
- Inspect urethral meatus for blood in male
- Check pelvis stability
- Lower limbs
  - Inspect and feel thighs, lower limbs and feet for swelling and tenderness.
  - Check joint movement. Check power.
- Log roll (whilst maintaining cervical spine immobilization if needed). A minimum of four people are required.
- PR exam is not routine in paediatric trauma patients. Asking a child to squeeze his/her buttocks should suffice.
- Be mindful of hypothermia and cover patient when secondary survey complete
- A urine sample should be collected if concerns about abdominal or pelvic trauma

Pelvic fractures
- Are uncommon in paediatric trauma and have a much lower mortality and morbidity than adults
- Unstable fractures should be immobilised with external compression (this can often be effectively achieved using a sheet)

Disposition
- The paediatric surgical team should always be involved in the care of major trauma patients. It is usual for multi-system trauma to be admitted under the paediatric surgery team with input from other subspecialties as required. It may be appropriate to admit a trauma patient to another service (e.g. neurosurgery or orthopaedics) if they do not have multi-system injuries (this decision should be made in conjunction with the paediatric surgical team).
- PICU should be consulted early in cases with airway difficulties, cardio-respiratory instability or severe head injury.
- Intubated patients requiring CT scan are usually transported by the PICU team.
Injury Prevention

Injury (intentional and unintentional) is the leading cause of paediatric mortality. The mortality and morbidity associated with injury is best avoided by preventing the injury.

### Leading Causes of Death, New Zealand 1994-2000

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<th>Rank</th>
<th>Age (years)</th>
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<th>1 to 4</th>
<th>5 to 9</th>
<th>10 to 14</th>
<th>15 to 24</th>
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<td>1</td>
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<tr>
<td></td>
<td>Unintentional Injury</td>
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<tr>
<td>2</td>
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<tr>
<td></td>
<td>Congenital Injuries</td>
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<td>Infectious</td>
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- Injury prevention should be a consideration when interacting with all caregivers and children in CED. Further information can be found in resources in CED.
- Proven injury prevention interventions that should be strongly advocated for include:
  - Swimming pool fencing
  - Bicycle helmets
  - Reduced vehicle speed limits
  - Motor vehicle restraint systems (seatbelts and airbags)
  - Child car seats and booster seats
  - Child resistant packaging (reducing unintentional poisoning)
  - Smoke alarms
  - Motorbike helmets
  - Playground modification
- Hospital staff involved in the management of trauma patients can be strong advocates for injury prevention. Injury prevention related research can be undertaken in conjunction with Starship’s Children’s Trauma service and Safekids New Zealand.
References

- Royal College of Paediatrics and Child Health. Evidence Statement: Major Trauma and the use of tranexamic acid in children. November 2012
- CRASH-2 trial collaborators. The importance of early treatment with tranexamic acid in bleeding trauma patients: an exploratory analysis of the CRASG-2 randomised controlled trial. The Lancet – published online March 24, 2011
- Napolitano et al. Tranexamic Acid in Trauma: How should we use it? Journal of Trauma and Acute Care Surgery 2013; Vol 74, no 6 pp1575-1586