Standard Operating Procedures for Trauma

NTEC Trauma Advisory Committee
# Prince of Wales Hospital - Trauma Manual

## Standard operating procedures for trauma in the Emergency Department

### Airway

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic airway and ventilation care</td>
<td>3</td>
</tr>
<tr>
<td>Cervical spine control</td>
<td>4</td>
</tr>
<tr>
<td>Endotracheal intubation</td>
<td>5</td>
</tr>
<tr>
<td>Rapid sequence induction</td>
<td>6</td>
</tr>
<tr>
<td>Surgical airway – cricothyroidotomy</td>
<td>7</td>
</tr>
<tr>
<td>Airway care in children</td>
<td>8</td>
</tr>
</tbody>
</table>

### Breathing

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial resuscitation ventilator settings</td>
<td>9</td>
</tr>
<tr>
<td>Needle decompression</td>
<td>10</td>
</tr>
<tr>
<td>Lateral finger thoracostomy</td>
<td>11</td>
</tr>
<tr>
<td>Tube thoracostomy</td>
<td>12</td>
</tr>
</tbody>
</table>

### Circulation

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical care monitoring</td>
<td>13</td>
</tr>
<tr>
<td>Cardiopulmonary resuscitation in trauma</td>
<td>14</td>
</tr>
<tr>
<td>Intravenous access for trauma patients</td>
<td>15</td>
</tr>
<tr>
<td>Control of massive external bleeding</td>
<td>16</td>
</tr>
<tr>
<td>Emergency surgery – decision making</td>
<td>17</td>
</tr>
<tr>
<td>Fluid resuscitation in trauma</td>
<td>18</td>
</tr>
<tr>
<td>Blood product use in trauma patients</td>
<td>19</td>
</tr>
<tr>
<td>Femoral vein cannulation</td>
<td>20</td>
</tr>
<tr>
<td>Arterial line insertion</td>
<td>21</td>
</tr>
<tr>
<td>Emergency department thoracotomy</td>
<td>22</td>
</tr>
</tbody>
</table>

### Disability

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurological assessment</td>
<td>23</td>
</tr>
<tr>
<td>Pain relief in trauma patients</td>
<td>24</td>
</tr>
</tbody>
</table>

### Other procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disposal of patients</td>
<td>25</td>
</tr>
<tr>
<td>Transfer to operating theatre</td>
<td>26</td>
</tr>
<tr>
<td>Transfer to intensive care unit</td>
<td>27</td>
</tr>
</tbody>
</table>
Introduction

These pages contain the standard operating procedures (SOPs) for trauma patient care in the Emergency Department (ED) of the Prince of Wales Hospital in Shatin, Hong Kong.

They are all one page long to allow them to be used in the acute ‘trauma call’ situation.

All trauma team leaders and members are expected to be aware of the contents of these SOPs: ignorance is not a satisfactory excuse for non-compliance.

As the terms imply, the SOPs are to be used for all trauma patients who are treated in the ED trauma rooms unless there are exceptional reasons to not do so.

Trauma team leaders and members will be asked to justify their non-adherence to these SOPs as a patient’s safety and/or outcome may be compromised as a result.

SOPs are not made simply to be prescriptive about trauma care: they represent an agreed standard of care and clinical practice that maximises patient safety and attempts to gives patients the highest quality of care.

If trauma team leaders and members have suggestions for further improvement of the SOPs, please email suggestions directly to the Trauma Advisory Committee via Janice Yeung, the Trauma Nurse Coordinator in the ED, at yeunghh1@ha.org.hk.

Colin A Graham
Professor, Emergency Medicine
Chinese University of Hong Kong
Prince of Wales Hospital

12 January 2009
**Airway**

**Basic airway and ventilation care**

1. Secure the cervical spine using inline manual immobilisation or mechanical methods (cervical spine collar and head immobiliser) – see cervical spine immobilisation below

2. Assess the airway using look, listen and feel approach
   a. Look for misting of the mask, respiratory rate and effort, etc.
   b. Listen for air movement at the mouth and nose
   c. Feel for evidence of airflow at the mouth and nose

3. If poor or no air flow
   a. Open the airway using a jaw thrust and chin lift technique
   b. Open the mouth and inspect for liquid and solid matter
   c. Use suction (Yankeur) and Magill’s forceps as required to clear airway

4. If breathing still partially obstructed, and patient obtunded, consider using:
   a. Oropharyngeal airway (appropriately sized)
   b. Nasopharyngeal airway(s) (7.0mm for men, 6.0mm for women)
      (Note: **contraindicated** if epistaxis or suspected base of skull fracture or clinical mid face injury)

5. If it is still difficult to maintain clear and patent airway, proceed to advanced techniques without delay (endotracheal intubation/RSI/surgical airway)

6. In the meantime, if spontaneous breathing efforts are adequate, apply a non-rebreathing face mask securely and supply 15l/min of oxygen to the patient

7. If spontaneous breathing is inadequate, or endotracheal intubation is planned, apply a bag-valve-mask device (with 15l/min oxygen flow) tightly to the patient’s face, taking care not to tilt the head or move the cervical spine while making a good seal with the face

8. Gently ventilate the patient at 12-15 breaths per minute, avoiding high tidal volumes (to minimise gastric insufflation), if respiratory effort is inadequate

9. Proceed to endotracheal intubation (usually using RSI) if you have the necessary skills and the patient requires a definitive airway (coma, severe head/facial injuries, severe burns, chest trauma, etc.)

10. Seek early senior ED and ICU help if definitive airway care is required, ideally before attempting endotracheal intubation
Cervical spine control

1. Initially secure the cervical spine using inline manual immobilisation
   a. Grasp the head from the head of the trolley or below the patient and hold the cervical spine in line with the entire spine
   b. Do not release the manual immobilisation until adequate alternatives are in place (see below)
   c. Do not allow any movement of the cervical spine particularly for intubation attempts

2. Mechanical methods can be used as an alternative:
   a. Apply an appropriately sized cervical spine collar (Stifneck, or preferably, a Philadelphia collar)
   b. Secure the head using:
      i. A head immobiliser unit (on the ambulance service spinal boards) OR
      ii. Sandbags/IV saline bags AND tape to secure the head to the ED trolley

3. If the patient is very agitated and uncooperative, only secure the cervical spine with a cervical spine collar until control of the situation is achieved. Then institute full cervical spine immobilisation as above

4. Do not clear the cervical spine until the cervical spine clearance protocol has been completed

5. Change the Stifneck collar for a Philadelphia collar at the earliest possible opportunity (more comfortable and less pressure sores and more effective)
Endotracheal intubation

1. Secure the cervical spine using inline manual immobilisation
2. Ensure that adequate basic airway care is being performed as well as possible
3. Seek early senior ED and ICU help if definitive airway care is required, ideally before attempting endotracheal intubation
4. Make sure preoxygenation is performed for at least 3 minutes: 15l/min of oxygen is being provided to the patient via a patent airway and a bag-valve-mask device with gentle mask ventilation as necessary
5. Make sure the intubator has adequate personal protective equipment on
6. Draw up drugs for RSI (see RSI SOP)
7. Clearly identify:
   a. One person to perform intubation
   b. One person to assist the person doing the intubation
   c. One person to maintain in line cervical spine immobilisation
   d. One person to provide cricoid pressure
   e. One person to administer the drugs
   f. One person who can go for help and fetch further equipment
8. Brief the trauma team on roles and responsibilities (particularly the persons doing cervical spine immobilisation and cricoid pressure)
9. Decide on a backup plan in case intubation is unsuccessful after three attempts - useful strategies include:
   a. Allow the patient to breath spontaneously and seek more senior help
   b. Insert a laryngeal mask airway and ventilate the patient via the LMA
   c. Perform a surgical airway (see surgical airway – cricothyroidotomy SOP)
10. Wait until help skilled arrives if possible
11. Once RSI drugs have been given, remove the cervical spine collar and wait for full paralysis (30 seconds), then insert laryngoscope and look for epiglottis
12. Suction blood and fluids vigorously under direct vision with Yankeur catheter
13. Elevate epiglottis and visualise posterior vocal cords
14. Insert gum elastic bougie into trachea and railroad endotracheal tube over bougie under direct vision
15. Confirm placement clinically and with capnography and secure tube
16. Sedate, paralyse, and insert oropharyngeal airway and orogastric tube in all patients and replace mechanical cervical spine protection (collar, head blocks, etc)
17. Do not attempt intubation more than three times – this is a failed intubation. Concentrate on maintaining oxygenation and seeking expert help.
Rapid sequence induction

1. Read this SOP in conjunction with the endotracheal intubation SOP above

2. Use RSI for all trauma patients except:
   a. Patients with major burns who are more than 12 hours post burn
   b. Patients with a suspected very difficult airway [includes most of (a)]
   c. Patients who are GCS 3 and peri-arrest (BP unrecordable, no respiratory effort, etc.)

3. Do not proceed with RSI unless you are absolutely sure you can ventilate the patient if intubation proves impossible – if you are not sure, call for senior ED & ICU help, maintain oxygenation as best you can and await the arrival of that help

4. Before embarking on RSI, make sure you have a backup plan and make sure you have briefed your team on what that plan is

5. Make sure intravenous fluids are being infused through at least two 14-16G IV cannulae and try to give at least 500-1000ml of fluid before induction

6. Use only an induction agent and a short acting neuromuscular blocking agent for all trauma RSIs – do not use opioids or other drugs at induction
   a. Induction agents
      i. Etomidate 0.1-0.3mg/kg (low does if hypotensive)
      ii. Thiopentone 2-6mg/kg (tiny doses if hypotensive)
      iii. Ketamine 1-2mg/kg (useful if hypotensive and no major head injury)
   b. Short acting neuromuscular blocking agents
      i. Suxamethonium 1-2mg/kg

7. Note that rocuronium is NOT a short acting neuromuscular blocking agent and should NOT be used for trauma RSIs without exceptionally good reason

8. Once intubation is safely accomplished, administer sedation, analgesia and a medium to long acting neuromuscular blocking agent
   a. Sedation
      i. Midazolam 1-3mg bolus repeated as necessary
      ii. Propofol infusion 5-10ml/hr initially (in isolated head injury only; do not use for hypotensive patients or those with multiple injuries)
   b. Analgesia
      i. Morphine 1-3mg bolus repeated as necessary
      ii. Fentanyl 100-200 microgram bolus repeated as necessary
      iii. Ketamine 0.5-1mg/kg repeated as necessary
   c. Medium to long acting neuromuscular blocking agents
      i. Vecuronium 0.1mg/kg bolus
      ii. Atracurium 0.5mg/kg bolus
      iii. Rocuronium 0.5-1mg/kg bolus
Surgical airway – cricothyroidotomy

1. If there is a failed intubation, and you cannot intubate or ventilate the patient, then you have to establish a surgical airway

2. Immediately call for senior ED, ICU and ENT help if not already requested and tell the attending trauma team that a surgical airway is required

3. ED nurses should:
   a. Open a tracheostomy set
   b. Open a 6-7mm tracheostomy tube
   c. Open a 10ml syringe for the cuff
   d. Open a large suture (2/0 or 3/0 nylon)
   e. Pour povidone iodine solution into the pot for skin cleaning
   f. Place some water based lubricant (KY jelly) on a swab for the tube

   Do not wait for instructions – just go ahead and open the equipment

4. Don appropriate PPE rapidly; maintain manual cervical spine immobilisation

5. Continue attempts to ventilate the patient using an oropharyngeal airway; two nasopharyngeal airways (if no contraindication); suction; an effective mask-to-face seal with two hands and a second operator squeezing the bag with 15l/min oxygen flow

6. Stand on the right side of the patient’s neck and rapidly disinfect the skin of the anterior neck with iodine solution

7. Make a vertical 2cm incision centred over the cricothyroid membrane with your right hand while steadying the larynx with your left hand
   a. For patients with major neck burns, you may need to make a much longer initial incision to identify the cricothyroid membrane accurately
   b. Ignore any bleeding during the initial incision – the priority is to establish an airway; bleeding can be dealt with later

8. Palpate the horizontal cricothyroid membrane through the skin wound and incise the membrane horizontally at its lower border

9. Using your left hand, insert an artery clip or tracheal dilators if available and hold the cricothyroidotomy open while you insert the tracheostomy tube with your right hand and inflate the cuff of the tube

10. Connect the bag-valve device to the tube and hold securely while ventilation is started; confirm placement clinically and with capnography

11. Secure the tracheostomy tube with sutures and tapes and secure haemostasis

12. Sedate, paralyse, and insert orogastric tube in all patients and replace mechanical cervical spine protection (collar, head blocks, etc)
Airway care in children

1. Airway care in children follows the same principles as adults, but with a few important differences
   a. It is rare (<1 case per month in PWH): so no-one is very experienced at performing emergency airway care in injured children
   b. Children have a low functional residual capacity, and therefore become hypoxic rapidly even after good preoxygenation
   c. Remember that oxygenation is the key to success: intubation is not the only objective to be achieved
   d. Shocked children compensate well until they have profound shock: be careful with doses of induction agents and give a fluid bolus (20mL/kg crystalloid) before induction while you are preoxygenating the child
   e. In infants (<1 year), get senior help from paediatric ICU for airway care and use a straight laryngoscope blade for intubation
   f. In older children, most operators are more familiar with a curved (Macintosh) blade and this should be used
   g. After intubation, always pass an orogastric tube in children and empty the stomach, as they usually have acute gastric dilatation which can splint the diaphragm and cause respiratory restriction

2. For a failed intubation in a child:
   a. Surgical cricothyroidotomy is contraindicated in children <12 years old
   b. Use a needle cricothyroidotomy with a 16-18G cannula and jet insufflation
   c. Get senior ENT help to perform an emergency tracheostomy either in the trauma room or in the operating theatre
Breathing

Initial resuscitation ventilator settings

1. FiO₂ 1.0 (100% oxygen; 'no air mix' on Oxylog)
2. Respiratory rate 12-16 per minute
3. Tidal volume 6-7ml/kg (typically 400-600ml per breath)
4. Pmax 40cmH₂O
5. PEEP 5-10cmH₂O as tolerated
6. I:E ratio 1:2 initially

These should be adjusted after around 15 minutes after arterial blood gas analysis has been performed (there is an ABG analyser in ED Resuscitation Room 4).
Needle decompression

1. Indicated when the clinical diagnosis of a tension pneumothorax is made
   a. No air entry of one (or both) hemithorax
   b. Tracheal deviation away from the affected side (pre-terminal sign)
   c. Hyper-resonance (difficult to elicit in noisy trauma room)
   d. If ventilated: high inflation pressures, and low tidal volumes

2. Do NOT do a chest Xray to confirm or exclude the diagnosis

3. Identify the second intercostal space (below the second rib) on the affected side and identify the mid-clavicular line; find the intersection of these lines, which is the insertion site for the needle

4. Clean the skin rapidly with alcohol

5. Insert a 14 G cannula vertically into the chest above the third rib in the selected insertion site

6. Remove the needle from the cannula: a gush of air under pressure and a rapid improvement in haemodynamic and respiratory status will confirm the diagnosis

7. If no improvement, reconsider the diagnosis: if tension pneumothorax still likely, proceed with lateral finger thoracostomy without delay

8. Perform tube thoracostomy immediately
Lateral finger thoracostomy

1. Indicated when the clinical diagnosis of a tension pneumothorax is made
   a. No air entry of one (or both) hemithorax
   b. Tracheal deviation away from the affected side (pre-terminal sign)
   c. Hyper-resonance (difficult to elicit in noisy trauma room)
   d. If ventilated: high inflation pressures, and low tidal volumes

2. Do NOT do a chest Xray to confirm or exclude the diagnosis

3. Identify the fifth intercostal space (below the fifth rib) on the affected side and identify the anterior axillary line; find the intersection of these lines, which is the incision site for thoracostomy

4. Don sterile gloves and gown

5. Clean the skin rapidly with povidone iodine solution and drape the area

6. If the patient is conscious, infiltrate 15mL of 0.5% lignocaine into the skin and subcutaneous tissues of the incision site; infiltrate a further 5mL into the pleura now or once the skin incision is made

7. Incise the skin and subcutaneous fat at the selected site, parallel to and at the superior border of the sixth rib, for 2-3cm, ignoring superficial skin bleeding

8. Take an artery clip (or Robert's forceps) and bluntly dissect down to the pleura

9. Use the index finger to develop the track rapidly and pierce the pleura using the artery clip/forceps without delay

10. Once the pleura is pierced, insert the index finger and develop the track, releasing air and blood under tension in the process

11. If there was a tension pneumothorax, a rapid improvement in haemodynamic and respiratory status will confirm the diagnosis

12. If there is no improvement, immediately consider cardiac tamponade as a differential diagnosis and perform a FAST examination

13. Proceed as for tube thoracostomy
Tube thoracostomy

1. Identify the fifth intercostal space (below the fifth rib) on the affected side and identify the anterior axillary line; find the intersection of these lines, which is the incision site for thoracostomy.

2. Don sterile gloves and gown.

3. Clean the skin rapidly with povidone iodine solution and drape the area.

4. If the patient is conscious, infiltrate 15mL of 0.5% lignocaine into the skin and subcutaneous tissues of the incision site; infiltrate a further 5mL into the pleura now or once the skin incision is made.

5. Consider adequate IV analgesia prior to tube thoracostomy as this is a very painful procedure.

6. Incise the skin and subcutaneous fat at the selected site, parallel to and at the superior border of the sixth rib, for 2-3cm, ignoring superficial skin bleeding.

7. Take an artery clip (or Robert's forceps) and bluntly dissect down to the pleura.

8. Use the index finger to develop the track rapidly and pierce the pleura using the artery clip/forceps without delay.

9. Once the pleura is pierced, insert your index finger and open the track; make sure there is no adherent lung and make sure you are above the diaphragm.

10. Mount the chest tube (28F-36F) on an artery clip/Robert's forceps and insert it into the chest, parallel to the finger, so the track is not lost: direct the tube apically and posteriorly (blood will still drain adequately as the lung re-expands).

11. Insert the tube until 2-3cm from the final side hole is within the thorax.

12. Ask an assistant to hand you the tube from the underwater seal drain and connect it without delay: ensure the tube is draining blood and/or bubbling and ‘swinging’ with respiration.

13. Ask your assistant to hold the tube steady and use a 2/0 nylon or silk suture to close the skin wound and secure the tube carefully with the suture.

14. Do not insert a suture for tube removal at this time.

15. Clean the skin with sterile saline; dry the skin with swabs; and secure the tube with a transparent Tegaderm or Opsite dressing: do not use layers of ‘Sleek’.

16. Secure the connection of the chest tube with tape and tape the connection to the patient’s abdomen.

17. Take a CXR to confirm the tube position and resolution or otherwise of the haemo/pneumothorax.
Circulation

Critical care monitoring

1. All patients with suspected major trauma should be admitted to the trauma room and monitoring should be instituted as soon as possible.

2. Parameters to be monitored in all patients include:
   a. Electrocardiogram (ECG)
   b. Non-invasive blood pressure (NIBP)
   c. Oxygen saturation by pulse oximetry (SpO2)
   d. Tympanic temperature, measured every 30 minutes
   e. Respiratory rate

3. The initial observations (particularly including the respiratory rate) must be recorded on the ED card and the trauma resuscitation sheet.

4. The following capillary (or venous) blood tests should be done as soon as possible on arrival; the results should be announced to the trauma team leader:
   a. Glucose
   b. Haemoglobin

5. All patients who are intubated must have the tube position confirmed using a capnograph and capnography must be continuously performed thereafter.

6. It is strongly recommended that a radial arterial cannula be inserted into all patients who are intubated and ventilated for continuous invasive blood pressure monitoring.

7. All monitoring should be performed using one integrated critical care monitor; a defibrillator monitor should only be used if the patient is in cardiac arrest. This allows all the relevant information to be displayed on one screen.
Cardiopulmonary resuscitation in trauma

1. Patients who are found to be pulseless on arrival to the trauma room should have cardiopulmonary resuscitation performed as soon as possible.

2. A rapid assessment by a senior doctor should allow a decision to be made on continuing resuscitation or stopping resuscitation.

3. Patients with a history of blunt major trauma who have no clinical signs of life should not have continuing resuscitation efforts and the patient should be pronounced dead.

4. Patients with (a) penetrating injury or injuries to the chest who present in cardiac arrest and have had signs of life since the arrival of ambulance personnel should have an emergency room thoracotomy.

5. In some patients, a brief but comprehensive attempt at resuscitation may be warranted (loss of vital signs just before ED arrival, trauma very close to the hospital, etc.). For trauma patients, cardiopulmonary resuscitation should include the following:
   a. Bag-valve-mask ventilation followed by endotracheal intubation at the earliest opportunity.
   b. External chest compressions, according to AHA guidelines.
   c. 2 x 14-16G intravenous cannulae and a rapid (<10 minutes) infusion of 2000ml normal saline solution.
   d. Bilateral chest drain insertion (28-32F) to drain any possible haemopneumothoraces.
   e. FAST scan to identify any abdominal or pericardial bleeding.

This procedure should take no more than 15 minutes: if there is no clinical response by that point, or it becomes clear from new information (from ambulance personnel, police, family, or CMS/clinical notes) that continued resuscitation would be futile, then resuscitation should stop and the patient should be pronounced dead.

6. Relatives and the relevant authorities (police, coroner) should be informed of the death as soon as possible.
Intravenous access for trauma patients

1. All patients admitted to the trauma room with suspected or established major trauma should have a **minimum** of two 14G (orange) or 16G (grey) cannulae inserted into veins of the upper limbs at the earliest opportunity.

2. Suitable veins include:
   a. The cephalic vein at the wrist
   b. The cephalic vein at the antecubital fossa
   c. The basilic vein at the antecubital fossa
   d. The median cubital vein at the antecubital fossa
   e. The veins of the dorsum of the hand

3. Cannulae should be well secured using tegaderm dressings and micropore tape, particularly if the patient is restless or combative.

4. If both upper limbs are injured, cannulation of the lower limbs can be performed. Suitable veins include those of the dorsum of the foot or the long saphenous veins at the ankle.

5. The femoral vein can be cannulated below the inguinal ligament in cases of severe hypovolaemia or difficulty in securing any other venous access.

6. Both cannulae can be inserted into one upper limb if the contralateral limb is injured.

7. In children, the largest cannulae that can comfortably fit into the veins should be used. At least two cannulae should be inserted in the same manner as adults.

8. If intravenous access is difficult or impossible, use intraosseous cannulation in children under the age of 7 years.

9. Central venous lines are unnecessary and can be dangerous in the early stages of trauma resuscitation:
   a. They should not be routinely used in the trauma room
   b. If necessary, infraclavicular subclavian cannulation using a triple or quad lumen cannula with full aseptic technique should be performed.
   c. If there is a thoracic injury, the side with the injury (and especially, the side with a chest drain) should be cannulated.
Control of massive external bleeding

1. Massive external bleeding is usually due to major arterial bleeding

2. Make sure you have appropriate PPE in place

3. A wound pack or pack of swabs should be placed over the bleeding point and sustained external pressure should be applied using a hand or fist for at least 10 minutes

4. Do not remove the pack every few minutes ‘just to check’

5. Call for surgical/orthopaedic/neurosurgical help as appropriate and alert the operating theatre

6. If the scalp is bleeding heavily, and the skin can be approximated, rapidly close the scalp with hand held sutures (2/0 nylon or silk) or staples using the stapler in the trauma room – this does not need the skills of a neurosurgeon, it needs the skills of anyone who can suture or staple rapidly (ED doctor, surgeons, orthopaedic surgeons, neurosurgeons, anyone…)

7. Do not further explore the scalp wound in the trauma room, even if a haematoma develops beneath the scalp – take the patient to the operating theatre to do this

8. Simultaneously make sure that adequate intravenous access has been secured, fluid resuscitation has been started and blood has been taken for crossmatching and other routine tests

9. Do not raise the systolic blood pressure to more than 100mmHg if major external bleeding continues – you will just encourage further bleeding

10. Go to the operating room as rapidly as possible to secure haemostasis

11. Do not go to CT for any reason until haemostasis has been achieved – portable Xrays can be done in theatre and CT can be done afterwards
Emergency surgery – decision making

1. A senior surgeon (usually 2\textsuperscript{nd} call or 3\textsuperscript{rd} call) should make the decision to proceed to emergency surgery in conjunction with the trauma team leader

2. Indications for emergency general surgery include:
   a. Unresponsive hypotension (systolic BP < 90 mmHg) despite initial fluid resuscitation regardless of FAST scan result
   b. Positive FAST scan in an adult with hypotension
   c. Diaphragmatic rupture with intrathoracic stomach or gut (in conjunction with cardiothoracic surgeons)
   d. Penetrating injury to the abdomen or groin with hypotension
   e. Massive external bleeding (any body site until specific help is available)

3. Indications for emergency orthopaedic surgery include:
   a. Unresponsive hypotension (systolic BP < 90 mmHg) despite initial fluid resuscitation with pelvic fracture
   b. Penetrating injury to a limb with hypotension
   c. Massive external bleeding in the limbs

4. Indications for emergency cardiothoracic surgery include:
   a. Positive pericardial FAST scan
   b. Penetrating injury to the chest with hypotension
   c. Massive bleeding from chest tubes (>1.5 litres on insertion of >200 ml/hr for 4 hours or more)

5. Indications for emergency neurosurgery include:
   a. Positive CT scan for extradural or subdural haematoma, for craniotomy
   b. Positive CT scan, for burr hole for intracranial pressure monitoring

6. Once the decision to operate is made, all efforts must focus on transferring the patient safely to theatre \textbf{with minimum delay}
Fluid resuscitation in trauma

1. The initial fluid resuscitation of a patient with major trauma and shock in the ED should be 1000-2000mL of warmed intravenous 0.9% saline

2. This initial bolus should not take more than 15 minutes through wide bore (14-16G) IV cannulae

3. If the patient does not respond to this at all:
   a. Start transfusing unmatched blood (6 units of O Pos available in ED)
   b. Go directly to the operating room for laparotomy +/- other exploration

4. If the patient transiently responds, consider further investigation (FAST +/- CT) if the patient becomes and remains stable (systolic BP >90mmHg) and early operation for any bleeding

5. If the patient responds and becomes and remains stable, consider further investigation (FAST +/- CT)

6. Do not give more than 3000mL of 0.9% saline without senior input. Consider giving blood and order FFP and platelets too.

7. If you have to give 3000mL of fluid, you need to go to the operating room now for haemostasis

8. There is no convincing evidence showing the superiority of colloids over crystalloids or vice versa in trauma patients, but crystalloids are cheaper, and less likely to induce anaphylaxis than colloids, which is why they are recommended for ED use
Blood product use in trauma patients

1. **Do not give more than 3000mL of 0.9% saline without senior input.**
   Consider giving blood and order FFP and platelets too

2. If you have to give 3000mL of fluid, you need to go to the operating room now for haemostasis

3. Ensure that FFP and platelets have been ordered as they take time for the blood bank to prepare

4. Transfuse O Positive blood in the trauma room if hypovolaemic patients show no response to initial fluid resuscitation and go to the operating theatre

5. O Negative blood (in very limited quantities) is available for emergency transfusion of women of child-bearing age instead of O Positive

6. Do not transfuse more than 4 units of blood in the trauma room – transfer immediately to the operating theatre for surgery and haemostasis

7. Once FFP and platelets are available, give packed cells, FFP and platelets in a ratio of 1:1:1: this is best done in the operating room (or angiography suite) simultaneously with surgery (or embolisation) to achieve haemostasis

8. Warn the blood bank early of the likely need for more packed red cells and blood products
Femoral vein cannulation

1. Ensure you have adequate PPE
2. Wash your hands and don sterile gloves
3. Clean the groin skin rapidly with povidone iodine solution and drape the area
4. Identify the insertion point for the needle, 2cm below the inguinal ligament,
   1cm medial to the femoral arterial pulsation
5. Either insert a long 16G cannula over needle or use the Seldinger technique
   to insert a 8.5F PA introducer (better)
   a. 16G cannula over needle
      i. Insert the needle at 30° to the skin, aiming for the umbilicus
      ii. Aspirate continuously once the needle is subcutaneous
      iii. Once blood is aspirated freely, advance another 1-2mm and
           thread the cannula off the needle, keeping the needle steady
      iv. Confirm the cannula is within the vein by aspirating blood, and
          then attach the infusion set
      v. Secure the cannula with sutures and a transparent film
         dressing
   b. 8.5F PA introducer
      i. Insert the needle at 30° to the skin, aiming for the umbilicus
      ii. Aspirate continuously once the needle is subcutaneous
      iii. Once blood is aspirated freely, advance another 1-2mm and
           remove the syringe from the needle, keeping the needle still
      iv. Insert the guidewire through the needle, it should pass freely
      v. Keeping hold of the guidewire, remove the needle
      vi. Keeping hold of the guidewire, pass the cannula and dilator
          over the guidewire and into the vein
      vii. Remove the dilator and guidewire together
      viii. Confirm the cannula is within the vein by aspirating blood, and
          then attach the infusion set
      ix. Secure the cannula with sutures and a transparent film
          dressing
6. Beware of the heightened risk of DVT and line infection with femoral venous
   lines, and try to secure alternative venous access as soon as circumstances
   allow, and remove the femoral venous line at that time
Arterial line insertion

1. Ensure you have adequate PPE
2. Wash your hands and don sterile gloves
3. Ask the nurses to prepare an arterial line set with 0.9% saline and pressurise it to 300mmHg with a pressure bag
4. Clean the skin on the volar aspect of the wrist rapidly with povidone iodine solution and alcohol solution
5. Identify the insertion point for the needle, 1cm distal to the radial arterial pulsation at the wrist
6. Insert a 20G cannula over needle through the skin at 30° to the skin, aiming for the palpable radial artery
7. Once a flashback is seen, advance another 1mm and thread the cannula off the needle into the artery
8. If the artery is not cannulated, withdraw the cannula slowly and try to advance it into the artery once free blood flow is observed
9. If arterial line insertion is proving difficult, do not waste time by trying to cannulate multiple times – get expert help or defer the procedure until the patient is in ICU or the operating theatre
10. For children, use a 22G cannula and consider using the transfixion technique for cannulation
11. Once the arterial cannula is inserted, connect it to the prepared pressure line and secure the cannula carefully using a film dressing (Tegaderm) and tape
12. Zero the line and transduce the invasive arterial pressure using the critical care monitor
Emergency department thoracotomy

1. Only indication is penetrating injury to the chest, cardiac arrest (or profound hypotension, systolic BP<40mmHg) and witnessed signs of life before arrest

2. Call for senior ED and cardiothoracic assistance (24 hours a day) and alert OT

3. Ensure you have adequate PPE (gown, mask, visor/eye protection)

4. Wash your hands and don sterile gloves

5. Ask the nurses to open the ED thoracotomy set and ask one of the nurses to don sterile gloves (and act as a scrub nurse until help arrives)

6. Clean the skin on anterior aspect of the chest rapidly with povidone iodine solution and abduct the left arm widely (ask someone to hold it)

7. Identify the fifth intercostal space by counting down from the second rib at the angle of Louis

8. Make a generous skin incision over the fifth intercostal space starting 5cm lateral to the sternum and extending into the left axilla

9. Deepen the incision into the intercostal muscle and pleura and open the chest

10. Separate the ribs and insert the Finochetti retractor from the thoracotomy set

11. Identify the pericardium (usually bulging and tense due to cardiac tamponade) by retracting the left lung and look carefully for the left phrenic nerve

12. Incise the pericardium using scissors and forceps anterior to the phrenic nerve, making the incision from the superior aspect of the pericardium down to the base. This will release a large amount of clotted and fresh blood

13. Deliver the heart and look for any wounds that are actively bleeding – apply digital pressure to these wounds to stop the bleeding temporarily

14. With surgical assistance, consider closing any cardiac wounds with 3/0 Prolene or another suitable suture

15. Assess the cardiac rhythm and the state of filling of the heart. If the heart is filling and contracting, look for any other sources of bleeding

16. If the heart is in ventricular fibrillation, defibrillate carefully using adhesive external paddles until internal paddles are available (usually from OT)

17. If asystole, consider giving adrenaline 1mg, either intracardiac (under direct vision) or intravenously; start internal cardiac massage

18. If a blood pressure and reasonable cardiac output are restored in the trauma room, transfer the patient immediately to the operating room with the chest open (but covered) for definitive surgery
Disability

Neurological assessment

1. Neurological assessment should be performed in all trauma patients, initially at 5 minute intervals

2. Prehospital assessment includes AVPU, GCS and pupil size

3. In the ED, the GCS should be recorded at the earliest opportunity
   a. Record the three components separately
   b. Best motor response in the upper limbs should be recorded

4. Pupil size and reaction to light should also be recorded

5. Power in each limb should be recorded at the same time as GCS

6. The glucose level should be checked and documented in every trauma patient

7. The scalp should be carefully evaluated for haematoma, lacerations and other evidence of trauma

8. Full neurological assessment must include a logroll to evaluate the spine – this should be done once only in the trauma room by ED or orthopaedic staff
Pain relief in trauma patients

Assess vital signs
Conscious?

Y

1. Document severity of pain
2. Identify source
3. Consider physical methods

1st line analgesia
Give NSAID or Opioids if NOT Contraindicated

If 1st line contraindicated or inadequate, consider
2nd line analgesia
1. Nerve blocks
2. Ketamine
3. Physical methods

Reassess
1. Stable?

N

Reassess
2. Effective?
3. Side effects?

Y

Monitor
Document
Handover

N

Resuscitate
Other procedures

Disposal of patients

1. Patients who are haemodynamically unstable despite initial adequate fluid resuscitation should be transferred without delay to the operating theatre for emergency surgery, then to the intensive care unit post-operatively.

2. Patients who are haemodynamically stable but require urgent life saving surgery (for example, craniotomy for haematoma, ICPM, etc) should be transferred without delay to the operating theatre for emergency surgery, and generally will be admitted to the intensive care unit post-operatively.

3. Patients who are haemodynamically stable and have no need for urgent life saving surgery (for example, craniotomy for haematoma, ICPM, etc) but are intubated and ventilated, require intensive monitoring, or have sustained multiple injuries should generally be admitted to the intensive care unit.

4. Patients who are haemodynamically stable and have single system injury (for example head injuries, or limb trauma) can be admitted to a specialty ward directly.

5. Be wary of sending patients with multi-system injury to the ward, particularly during the night – often a brief admission to ICU is safer if beds allow.

6. Patient disposition should be determined by the trauma team leader in conjunction with staff from the specialties involved in the patient’s care.

7. Patients should not spend more than 60 minutes in the ED under normal circumstances.
Transfer to operating theatre

1. Patients who are haemodynamically unstable despite initial adequate fluid resuscitation should be transferred without delay to the operating theatre for emergency surgery, then to the intensive care unit post-operatively.

2. Patients who are haemodynamically stable but require urgent life saving surgery (for example, craniotomy for haematoma, ICPM, etc) should be transferred without delay to the operating theatre for emergency surgery.

3. Patients should be escorted to the operating theatre by the trauma team leader unless it has been clearly and explicitly agreed that another member of the trauma team can accompany them (for example, intensive care unit staff).

4. The HA NTEC critical care transfer checklist should be used for all patients who need to be transferred to the operating theatre.

5. Full critical care monitoring should continue throughout the transfer.

6. The trauma team leader and the senior ED nurse is responsible for checking that there is sufficient oxygen in the trolley cylinder to get to OT safely.

7. Lifts should be held to facilitate a smooth rapid transfer to OT.

8. Beware of the press, who have the right to take photographs in the public areas of the hospital. Try to shield the identity of the patient as much as possible but do not jeopardise the patient’s clinical safety.
Transfer to intensive care unit

1. Patients who are haemodynamically unstable despite initial adequate fluid resuscitation should be transferred without delay to the operating theatre for emergency surgery, then to the intensive care unit post-operatively.

2. Patients who are haemodynamically stable but require urgent life saving surgery (for example, craniotomy for haematoma, ICPM, etc) should be transferred without delay to the operating theatre for emergency surgery, and generally will be admitted to the intensive care unit post-operatively.

3. Patients who are haemodynamically stable and have no need for urgent life saving surgery (for example, craniotomy for haematoma, ICPM, etc) but are intubated and ventilated, require intensive monitoring, or have sustained multiple injuries should generally be admitted to the intensive care unit.

4. Patients should be escorted to the intensive care unit by the trauma team leader unless it has been clearly and explicitly agreed that another member of the trauma team can accompany them (for example, intensive care unit staff).

5. The HA NTEC critical care transfer checklist should be used for all patients who need to be transferred to the intensive care unit.

6. Full critical care monitoring should continue throughout the transfer.

7. The trauma team leader and the senior ED nurse is responsible for checking that there is sufficient oxygen in the trolley cylinder to get to ICU safely.

8. Lifts should be held to facilitate a smooth rapid transfer to ICU.

9. Beware of the press, who have the right to take photographs in the public areas of the hospital. Try to shield the identity of the patient as much as possible but do not jeopardise the patient’s clinical safety.