EMERGENCY DEPARTMENT

MAJOR TRAUMA GUIDELINES

Created April 2002
Revised January 2010
INTRODUCTION

Trauma is a multidisciplinary condition. Pre-hospital care is usually provided by St John Ambulance staff. Upon arrival at hospital it is imperative that the injured patient is cared for by experienced medical and nursing staff with a methodical approach ensuring optimum care whilst minimising delays. This is of paramount importance with severely injured patients.

The following guidelines should not be seen as a substitute for other publications such as the ATLS Manual. They are designed as a resource for medical and nursing staff and have been agreed upon by Senior Clinicians involved in trauma care at Nelson Hospital.
NELSON MARLBOROUGH DISTRICT HEALTH BOARD

TRAUMA TEAM

1. Acute General Surgeon [+ Acute General Surgical Registrar and House Surgeon]
2. Senior Emergency Doctor on duty
3. Anaesthetist
4. ED / ICU / Resource Nursing Staff
5. Radiographer
6. Lab Staff
7. Theatre Nurse in charge (at discretion of Trauma Team Leader)

WHERE APPROPRIATE

- Orthopaedic Surgeon
- Radiologist
- ENT Surgeon
- Ophthalmologist
- Urologist
- O&G Specialist
- Paediatrician Major trauma < 1 yr
  At discretion of Trauma Team for other children
- Physician [Pre-existing severe systemic illness]
- Dentist
- Orderly
TRAUMA CALL

CRITERIA FOR ACTIVATION OF TRAUMA TEAM

MANDATORY

1. Vital Signs:  - GCS < 12
   - RR < 10 or > 30
   - P < 50 or > 130
   - Systolic BP < 90
   - Or age specific abnormal vitals

2. Injuries:     - Airway obstruction
   - Penetrating head, neck, torso injury
   - Fail chest
   - Spinal cord injury
   - Severe crush injury
   - Major pelvic injury
   - > 2 long bone fractures
   - Amputation of limb
   - Significant injury to > 2 body areas
   - Major burn
     | > 10% child | 20% adult |
     | Airway burn     |            |
     | High voltage electrical |

DISCRETIONARY

3. Mechanism of Injury - High energy RTC
   | Speed > 60 kph | Prolonged entrapment |
   | Rollover       | Motorcyclist          |
   | Ejection       | Cyclist               |
   | Fatality       | Pedestrian            |
   - Fall > 5m

4. Other:        - Multiple casualties
   - Significant injury with Age < 5
     Pregnancy
     Pre-existing severe illness
NELSON MARLBOROUGH DISTRICT HEALTH BOARD

ACTIVATION OF TRAUMA TEAM

EMERGENCY DEPARTMENT

All major trauma should be notified in advance by radio, or phone call and the team activated by the senior ED doctor on duty according to the criteria.

All trauma will arrive at the ED.

Patients arriving unannounced will be triaged and the trauma team activated according to the criteria.

HOW TO ACTIVATE TEAM

<table>
<thead>
<tr>
<th>ETA &lt; 10 mins</th>
<th>Activate Trauma Team</th>
</tr>
</thead>
<tbody>
<tr>
<td>ETA &gt; 10 mins</td>
<td>Phone warning of trauma team to standby 'Activate' 10 mins prior to ETA</td>
</tr>
</tbody>
</table>

- Dial 0 and request “activation of Trauma Team”. State relevant details and additional members required.
- Telephonist contacts team members.

PRIOR TO PATIENT ARRIVAL

- Team Notified [attendance mandatory]
- Patient details placed on whiteboard in Resus.
- Team assembles
- Team leader designated
- Roles assigned
- Equipment checked/prepared
- Forms for FBC x-match COAG at trauma team leaders discretion U+E
- Amylase x-rays
- LFT

Note: Additional team members or trauma teams deployed as required
TRAUMA TEAM ROLES

- Trauma roles are flexible
- Roles are allocated at the discretion of the team leader
- Number of Doctors/Nurses depends on available resources and number of casualties
- Additional team members or trauma teams deployed as required
- Below is a guide only

**AIRWAY DOCTOR**
[Anaesthetist or ED Specialist]
- prepare equipment
- airway management
- c-spine
- gastric tube

**AIRWAY NURSE**
[ICU Nurse or Senior ED Nurse]
- assists with airway
- monitoring
- patient transport

**DOCTOR 1**
[R-SIDE]
[Surgical Team Member of ED Doctor]
- 1°+ 2° survey
- IV access
- procedures

**NURSE 1**
- Assists with procedures
- drugs / fluids

**DOCTOR 2**
[L-SIDE]
[Surgical Team Member or ED Doctor]
- IV access
- bloods
- procedures

**NURSE 2**
- clothing removal
- assists with procedures
- records
- vitals
- liaise with family

**TEAM LEADER**
[Surgeon or ED Specialist]
- direct resuscitation
- handover
- documentation
- active involvement at own discretion

**RADIOGRAPHER**
- attends resus [prior to patient arrival if possible]
- portable lat c-spine
  - CXR
  - Pelvis
OVERVIEW

The EMST/ATLS principles form the basis of assessment and treatment guidelines.

Treatment of the seriously injured involves rapid assessment and resuscitation followed by a thorough examination and definitive care. The Systematic EMST approach includes the following:

1. Primary Survey
   ABCDE
   As part of the primary survey, patient monitoring is initiated
   Trauma series of x-rays

2. Resuscitation
   Immediate resuscitation and management of life threatening conditions identified during the primary survey

3. Secondary Survey
   Head to toe examination

4. Definitive care
### PRIMARY SURVEY

<table>
<thead>
<tr>
<th>Airway Assessment</th>
<th>Stridor</th>
<th>Resp pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hoarseness</td>
<td></td>
<td>Conscious level</td>
</tr>
<tr>
<td>FB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facial +/- neck injury</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Airway Maintenance

<table>
<thead>
<tr>
<th>Level</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic</td>
<td>suction</td>
</tr>
<tr>
<td></td>
<td>- FB removal</td>
</tr>
<tr>
<td></td>
<td>- jaw thrust</td>
</tr>
<tr>
<td></td>
<td>- pharyngeal airway</td>
</tr>
<tr>
<td></td>
<td>- bag mask ventilation</td>
</tr>
<tr>
<td>Advanced</td>
<td>rapid sequence induction</td>
</tr>
<tr>
<td></td>
<td>- endotracheal intubation</td>
</tr>
<tr>
<td></td>
<td>- difficult airway techniques</td>
</tr>
<tr>
<td></td>
<td>- oesophageal detector device</td>
</tr>
<tr>
<td></td>
<td>- E+C0₂ monitoring</td>
</tr>
</tbody>
</table>

#### Rescue

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>laryngeal mask</td>
</tr>
<tr>
<td>surgical airway - needle cricothyroidotomy</td>
</tr>
<tr>
<td>- mini track cricothyroidotomy</td>
</tr>
</tbody>
</table>

#### C-Spine Immobilisation

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>neutral position</td>
</tr>
<tr>
<td>semi rigid collar</td>
</tr>
<tr>
<td>sandbags and tape</td>
</tr>
<tr>
<td>inline immobilisation</td>
</tr>
<tr>
<td>until clinical and radiological examination [if indicated] exclude injury</td>
</tr>
</tbody>
</table>
BREATHING

Assessment

0₂ sats
resp rate
tracheal position
chest wall movement
respiratory pattern
percussion
auscultation

Management

0₂ [high flow via mask with reservoir bag]
treat life threatening injury - tension pneumothorax
- open pneumothorax
- massive haemothorax
- flail chest/pulmonary contusion

assisted ventilation
- bag and mask
- consider CPAP
- mechanical
1. Assessment
   - P
   - BP
   - skin colour/temp
   - capillary refill

2. Management
   1. Assess cardiac output and rhythm - commence CPR if required
   2. External haemorrhage control -
      - direct pressure to wound or proximal blood vessel
      - pack peripheral wounds, dress and elevate
      - splint fractures
   3. Fluid Resuscitation
      - insert 2 large bore [≥ 18g] IV cannulae
      - Alternative advanced IV techniques:
        - arrow trauma kit
        - femoral vein
        - cut downs
        - intra osseous canulæ/drill – (adult + paeds)
        - central venous
      - Take blood [through cannula] for
        - CBC
        - U+E
        - LFT
        - Amylase
        - x-match
      - Trauma Team Leader will specify other blood tests (eg coags) and numbers of units for x-match.

**NOTE:** 5 potential sources of bleeding
   - External
   - Chest
   - Abdomen
   - Pelvis
   - Longbones
INITIAL FLUID RESUSCITATION

- 2 L warmed crystalloid
  [20 mls/kg] in a child. Consider 2x 10ml/kg increments). Reassess haemodynamic response

- Repeat x 1 and reassess haemodynamic response

- O Negative blood for exsanguinating haemorrhage / severe shock
- Early use of Group specific blood or preferably x-matched blood if required (10mls/kg in a child)

HAEMODYNAMIC INSTABILITY

Consider the patient haemodynamically unstable if despite initial fluid resuscitation the trend indicates:

- HR > 100 } or age specific abnormal vitals.
- Systolic BP < 100 } or age specific abnormal vitals.
- Capillary refill > 3 seconds
- > initial fluid volume required
- > 1 unit blood required
- ongoing significant fluid requirement

NOTE

The most important determinant of outcome in unstable trauma victims is time to definitive surgery. Time should not be wasted with unnecessary monitoring lines such as arterial lines. These can be inserted later.
DISABILITY

1. Level of consciousness - AVPU
   Awake
   Responds to verbal stimuli
   Responds to pain
   Unresponsive
   - GCS (refer to wall charts in Resus / Trauma Sheets

2. Pupillary response and size

EXPOSURE

1. Completely remove all clothing to allow examination
2. Cover patient as soon as possible to prevent hypothermia
3. Rewarm the hypothermic patient. Consider:
   Warm environment
   Warmed humidified 02
   Warmed IV fluids (Hot line or Level 1)
   Warm Blankets
   Bair Hugger Rewarming blanket
   Overhead Radiant Warmer

Note: These principles are important for all trauma patients but particularly those of extremes of age.
RESUSCITATION

Treatment of immediate life threatening injuries or abnormalities detected in the primary survey.

Remember:
- Airway maintenance
- Cardiopulmonary resuscitation
- Life saving treatment

Should be initiated when the problem is identified.

Monitor progress with:
- O$_2$ sats
- RR
- ETCO$_2$ [intubated patient]
- Pulse rate / ECG
- BP
- Capillary refill
- Urine output
- Conscious level

Note: Arterial lines are not resuscitation lines and their insertion should not delay definitive surgery or urgent investigation such as head CT. They can be inserted later (in ICU or OT) for ongoing monitoring or sampling.
The radiographer should be present when the patient arrives in Resus
The CXR plate should be placed in the trolley before patient arrival

In general only three x-rays should be performed in the Resus Room

1. Chest - this will invariably be a supine AP film [but with isolated penetrating trauma may be erect].

2. Pelvis – this may be omitted in some instances when examination of a fully alert patient (with no significant distracting injuries) is negative.

3. Lateral cervical spine - this should be performed with longitudinal traction applied to the upper limbs to minimise the likelihood of the shoulders obscuring the view of the lower cervical spine, unless there is gross neurological deficit [paraplegia, quadriplegia] in which case traction should be avoided. The C-spine x-ray be omitted at the Trauma Team leaders discretion when CT is indicated eg. CT Head required.

Other x-rays may be performed in the Resus Room at the discretion of the Trauma Team Leader. This may occur in the situation when transfer to the General X-ray Room may cause delays unacceptable for the particular patient. Examples may include thoracolumbar spine or isolated limb x-rays.

It is acknowledged that quality of x-rays in this circumstance may need to be compromised in order to optimise patient outcome.
GASTRIC TUBE

Consider gastric decompression with:

- Nasogastric tube
  [unless significant head/facial injury]
  or
- Orogastric tube

URINARY CATHETERISATION

Consider unless contraindicated by:

- blood at Urethral meatus
- perineal haematoma
- high riding/impalpable prostate
SECONDARY SURVEY

Examination "Head to Toe"

Head and Maxillofacial

Inspect and palpate the entire head and face including intraorally.
Check pupillary response, fundi, tympanic membranes

Cervical spine - neck

The cervical spine should be protected until injury is ruled out by clinical and WHERE INDICATED radiological examination. A well fitted semi-rigid collar should be applied or the neck maintained in a neutral position using inline manual immobilisation. The collar may need to be removed during intubation [whilst maintaining inline immobilisation].

Chest

Inspection and palpation of the entire chest wall including clavicles, scapulae and sternum.
Percussion and auscultation of the chest.
Review supine chest x-ray. All chest x-rays should be supine until cervical or thoracolumbar spinal injury has been excluded.

Abdomen, pelvis and perineum

Abdominal injury is potentially life-threatening and must be diagnosed and treated vigorously. Abdominal findings may change with a change in the patient's overall condition or progression of abdominal pathology. This requires repeated re-evaluation of the abdomen.

In the conscious patient a thorough clinical examination should be performed.
In a patient with impaired consciousness due to head trauma or drugs, clinical examination of the abdomen must be followed by non-clinical examination.
[see Abdominal Trauma]

Review of pelvic x-ray

In male patients if urethral trauma is suspected, urinary catheterisation should not be attempted before examination of the rectum and genitalia has been performed.
**Thoracolumbar spine and back**

Patient should be removed from spinal boards as soon as possible by immobilising the patient and sliding the board out or log-rolling.

Log-roll - using three assistants and maintaining inline immobilisation of the neck, the patient should be log-rolled under supervision of the Airway Doctor and the entire thoracolumbar area inspected and palpated including perianal sensation. Formal rectal exam is not routinely required unless spinal cord injury, penetrating injury or urethra/injury is suspected.

The patient should remain supine in a neutral position and treated as a spinal patient until cervical and thoracolumbar spinal injury have been excluded. In patients with altered conscious level or significant distracting injuries, clinical examination of the thoracolumbar spine is unreliable and must be accompanied by thoracolumbar x-ray (or CT).

*NOTE: a scoop stretcher is an efficient way to transfer injured patients onto the CT table.*

**Musculoskeletal**

All limbs and extremities should be inspected and palpated for tenderness, crepitus, and abnormal movement. Neurovascular impairment should be detected. In the patient with impaired conscious level, an injured limb needs careful evaluation for compartment syndrome.

Splints should be applied where appropriate
*(see also NMDHB Fracture guidelines)*

**Neurological**

Level of consciousness should be assessed using the Glasgow Coma Score
Pupillary responses should be reassessed
Perform thorough assessment for localising signs
Many trauma patients are in significant pain.

Pain relief is aided by:

- Establishing rapport with the patient and explaining what is happening during the resuscitation and by providing reassurance
- Splinting of injured extremities
- Gentle movement and handling
- Prevention of shivering
- Cooling of burns (Max 20 mins)

Opioids should be given by the intravenous route in severe trauma. They are best titrated in small increments until the desired effect is achieved. They may cause hypotension, respiratory depression and vomiting. Local anaesthetics may be used to relieve pain. In particular, femoral nerve block is very effective for the pain associated with femoral fracture. Early anaesthetic consultation regarding femoral catheter placement should be considered particularly in children.

Intranasal Fentanyl maybe considered initially in children.
**HEAD INJURY**

Airway, breathing and circulatory management take priority over neurological assessment. Head injury may initially appear the most obvious, it is not initially the most important. Oxygenation, ventilation and maintenance of adequate cerebral perfusion pressure are vital.

Once hypoxaemia and hypotension have been corrected and the patient stabilised, neurological assessment can be undertaken.

The Glasgow Coma Score provides the basis for assessment of consciousness.

**GLASGOW COMA SCORE:**

<table>
<thead>
<tr>
<th>Response</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eye-opening</td>
<td></td>
</tr>
<tr>
<td>Spontaneous</td>
<td>4</td>
</tr>
<tr>
<td>To voice</td>
<td>3</td>
</tr>
<tr>
<td>To pain</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Best Verbal Response</td>
<td></td>
</tr>
<tr>
<td>Orientated</td>
<td>5</td>
</tr>
<tr>
<td>Confused</td>
<td>4</td>
</tr>
<tr>
<td>Inappropriate</td>
<td>3</td>
</tr>
<tr>
<td>Incomprehensible</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
<tr>
<td>Best Motor Response</td>
<td></td>
</tr>
<tr>
<td>Obeying</td>
<td>6</td>
</tr>
<tr>
<td>Localising /purposeful movement</td>
<td>5</td>
</tr>
<tr>
<td>Withdrawal</td>
<td>4</td>
</tr>
<tr>
<td>Abnormal flexion</td>
<td>3</td>
</tr>
<tr>
<td>Extension</td>
<td>2</td>
</tr>
<tr>
<td>None</td>
<td>1</td>
</tr>
</tbody>
</table>

*NOTE: This is modified for Paediatric Patients [see posters in Resus.]*
GRADING OF HEAD INJURY

Mild head injury  GCS 14 - 15
Moderate head injury  GCS 9 - 13
Severe head injury  GCS 3 - 8

All patients with a moderate or severe head injury [GCS < 13] require surgical consultation and immediate CT head scan. The recent multidisciplinary ACC guidelines on head injury assessment are available in poster form in the Emergency Department and should be followed closely.

INDICATIONS FOR IMMEDIATE CT SCAN

1. GCS <13 when assessed (irrespective of time post injury)
2. GCS <15 two hours post injury (Discuss with surgeon)
3. any deterioration in condition
4. suspected open or depressed skull #
5. any sign of basal skull #
6. post traumatic seizure
7. focal neurological deficit
8. >1 episode of vomiting
9. amnesia >30 mins for events prior to injury
10. LOC or amnesia and any of:
   • age > 65
   • coagulopathy (bleeding/clotting disorder or antigoagulation. eg) Warfairn)
   • high risk mechanism eg. Pedestrian vs motor vehicle/ejected from vehicle/fall > 1m

Additional consideration in children

• Early vomiting is more common but ≥ 3 episodes should be considered significant.
• Tense Fontonelle
• Bruising, swelling, laceration > 5 cm if < 1 year old
• NAI
• Abnormal drowsiness
• Anaesthetic and radiation relative risk/benefit. Consult with specialist.
Altered conscious level should be attributed to head injury until proven otherwise. The decision to CT should be applied regardless of the influence of intoxication.

Patients with combined head / thoracic / abdominal trauma may present difficult investigation and management problems. The general recommendation is that patients who are bleeding and haemodynamically unstable, should have haemorrhage controlled prior to having CT scans of the head.

**Acutely elevated ICP**
- Intubate if GCS <8, combative, other significant injuries
- Consider neuroprotective RSI agents. Consult anaesthetist.
- Ventilate to maintain CO$_2$ at 30 - 35 mmHg
- Consider use of Mannitol 0.5 - 1g/kg IV [to provide short-term reduction in ICP] in consultation with the neuro surgeon.
- Early CT scanning and surgical consultation

**INDICATIONS FOR ADMISSION OF A HEAD INJURY PATIENT**

- Deteriorating GCS
- Clinically significant abnormalities on imaging
- GCS < 15 after imaging
- No CT available
- Focal neurological signs
- Post traumatic seizure
- Skull #
- High risk mechanism
- Continuing signs of concern
  - vomiting
  - headache
  - amnesia
  - intoxication
  - other injuries
  - age
  - CSF leak
• Suspected NAI
• No reliable observer available

NEURO OBS

• Every 15 mins if GCI < 15
• GCS 15 – ½ Hrly 2 hours, 1 Hrly 4 hours, then 2 Hrly

HEAD INJURY ADVICE

Age specific information sheets are available in the ED for all discharged patients.
Suspected C-spine injury

Immobilise C-spine

Conscious

Impaired Conscious Level (Wait GCS or ) (or CT Head indicated)

Unconscious / Focal neurology (consider sedation / intubation)

- Alert & orientated
- No neck pain
- No midline tenderness
- Free neck movement
- No neurological deficit / No paraesthesiae
- No other significant distracting injury
- Not intoxicated
- Age < 65

CT C-Spine

All criteria met

1 or more criteria not met

No x-ray required

C-spine x-rays [lat, AP, odontoid + swimmers]

Remove collar

Normal x-ray and neurology + minimal pain

Inadequate or Abnormal x-ray and / or neurology or ongoing significant pain

Consider CT C-Spine

Normal x-ray and neurology + minimal pain

Abnormal

Remove collar

Philadelphia collar + Orthopaedic Consultation

Normal + Normal Neurology [Beware SCIWORA] especially in children

[lat, AP, odontoid + swimmers]
An Alternative Approach:

**The Canadian C-Spine Rule**
(For alert (GCS = 15) and stable trauma patients where cervical spine injury is a concern)

1. Any High-Risk Factor Which Mandates Radiography?
   - Age > 65 years
   - Dangerous mechanism *
   - Paresthesias in extremities
   - Yes
   - No

2. Any one Low-Risk Factor Which Allows Safe Assessment of Range of Motion?
   - Simple rearend RTC **
   - Sitting position in ED
   - Ambulatory at any time
   - Delayed onset of neck pain ***
   - Absence of midline c-spine tenderness
   - No Radiography
   - Yes

3. Able to Actively Rotate Neck?
   - 45° left and right
   - Unable
   - Able
   - No Radiography

* Dangerous Mechanism:
  - fall from elevation > 1M / 5 stairs
  - axial load to head. eg. Diving
  - RTC high speed (> 100 km/hr), rollover, ejection
  - motorbike / bicycle collision

** Simple Rearend RTC Excludes:
  - pushed into oncoming traffic
  - hit by bus / large truck
  - rollover
  - hit by high speed vehicle

*** Delayed:
  - i.e. not immediate onset of neck pain
**SPINAL CORD INJURY**

- High index of suspicion required
- Beware of SCIWORA [Spinal cord injury without radiological abnormality] especially in children
- Beware of a second vertebral fracture

**Complete Transverse Cord Syndrome**
- Total flacid paralysis
- Total anaesthesia
- Total analgesia
- Areflexia

**Incomplete Cord Syndromes**
- Incomplete transverse cord - partial paralysis and ↓ sensation
- **Sacral sparing** - preserved sensation in sacral segments
- **Central Cord** - limb weakness and sensory loss Upper greater than lower
- **Anterior cord** - motor & pain sensation lost below injured segment
- **Brown Séquard** - loss of motor & position sense on side of injury, loss of pain sensation on opposite side.
- **Cord concussion** - recovery within 48 hours

**Spinal Shock**
- Loss of voluntary movement, sensation and reflexes below injured segment. Variable duration hours to weeks. Recovery heralded by return of Babinski Response and perianal reflexes.
Neurogenic Shock  
Loss of sympathetic function below injury.
  - bradycardia
  - peripheral vasodilation - hypotension
    flushing, priapism
  - loss of sweating

*Note:* Use spinal injury documentation chart available in ED to aid assessment
**MANAGEMENT OF SPINAL CORD INJURY**

| Airway                                      | Altered gag, cough                              |
|                                            | Regurgitation risk                              |
|                                            | Vertebral haematoma                             |
|                                            | Bradycardia on pharyngeal manipulation          |
|                                            | Consider intubation/ng tube/atropine            |
|                                            | Immobilise c-spine                              |

| Breathing                                   | Paradoxical chest wall movement                 |
|                                            | Diaphragmatic fatigue or paralysis              |
|                                            | Provide $O_2$                                   |
|                                            | Consider ventilation                            |

| Circulation                                 | IV access                                       |
|                                            | Volume resuscitation                            |
|                                            | Rarely require chronotropic/vasoconstrictor/support |
|                                            | Monitoring                                      |
|                                            | Urinary catheter                                |
|                                            | Fluid balance                                   |

**Other considerations**

- Analgesia
- Temperature control
- Corticosteroids - Not currently recommended in N.Z.
- Skin protection [beware of prolonged use of spinal boards]
- Early orthopaedic and spinal unit consultation (contact Burwood Hospital spinal consultant on call – via CHCH Hospital switchboard)
CHEST TRAUMA

Less that 15% of thoracic trauma requires thoracotomy. The remaining 85% of cases can be managed by procedures such as needle thoracocentesis, chest drain insertion, and rarely pericardiocentesis.

**Life threatening injuries identified in the primary survey:**

<table>
<thead>
<tr>
<th>Condition</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension Pneumothorax</td>
<td>Needle thoracentesis</td>
</tr>
<tr>
<td></td>
<td>Intercostal drain</td>
</tr>
<tr>
<td>Open Pneumothorax</td>
<td>Seal wound</td>
</tr>
<tr>
<td></td>
<td>Intercostal drain [not through wound]</td>
</tr>
<tr>
<td>Massive haemothorax</td>
<td>Chest drain [large bore eg 28-32F]</td>
</tr>
<tr>
<td></td>
<td>Volume replacement</td>
</tr>
<tr>
<td></td>
<td>Blood loss &gt; 1500mls initial or (&gt; 20mls/kg child)</td>
</tr>
<tr>
<td></td>
<td>200 mls/hr for &gt; 2 hrs or (&gt; 2 mls/kg / hr child)</td>
</tr>
<tr>
<td></td>
<td>Consider thoracotomy</td>
</tr>
<tr>
<td>Flail chest/pulmonary contusion</td>
<td>O₂</td>
</tr>
<tr>
<td></td>
<td>Supportive care - analgesia/pulmonary toilet</td>
</tr>
<tr>
<td></td>
<td>Consider CPAP</td>
</tr>
<tr>
<td></td>
<td>Selective intubation/mechanical ventilation</td>
</tr>
<tr>
<td>Cardiac Tamponade</td>
<td>Pericardiocentesis/thoracotomy</td>
</tr>
</tbody>
</table>

**Note:** In penetrating chest trauma with loss of vital signs immediately prehospital or in the Emergency Department - Emergency Department thoracotomy is indicated and maybe life saving.
OTHER SIGNIFICANT CHEST INJURIES INCLUDE:

- Multiple rib fractures [Analgesia/physio/respiratory support consider anaesthetic consult for thoracic epidural]
- Sternal fracture [if isolated and ECG normal, analgesia adequate: consider discharge]
- Pneumothorax [small: observe in hospital or intercostal drain moderate or large: intercostal drain].
- Subcutaneous emphysema
- Tracheobronchial injuries [Intercostal drain + fiberoptic bronchoscopy + operative repair]
- Ruptured diaphragm
- Oesophageal rupture [Gastrografin study/operative repair]
- Any injury in a patient with underlying respiratory compromise eg COAD

NOTE: Chest wall injury may be the only outward sign of significant underlying cardiorespiratory or mediastinal injury.

All patients with significant chest injuries require careful observation, appropriate analgesia [which may include anaesthetic consultation for thoracic epidural] and are likely to require ongoing intensive care therapy.

Prophylactic antibiotic cover is generally recommended for chest drain insertion in trauma particularly if multiple injuries, open wounds, complex chest injury requiring prolonged drainage.
# MEDIASTINAL INJURY

**Myocardial Contusion**
- Common, significant sequelae rare
- ECG non specific test
- Acute ECG changes or Arrhythmias require admission and cardiac monitoring
- Cardiac enzymes poorly predictive but consider troponin
- Consider echo - may demonstrate dyskinesis and pericardial tamponade

**Aortic rupture**
- High index of suspicion required, especially in deceleration injury
- CXR wide mediastinum 90% loss of aortic knuckle/aortopulmonary window
  widened paraspinal stripe
  L/apical pleural cap/haemothorax
  tracheobronchial/oesophageal/NGT deviation

**Clinically Suspected Rupture**

<table>
<thead>
<tr>
<th>Haemodynamically unstable</th>
<th>→</th>
<th>CXR Diagnostic → consider thoracotomy or transfer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>→</td>
<td>CXR non diagnostic → consider CTA or Bedside TOE (contact cardiologist)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Haemodynamically stable</th>
<th>→</th>
<th>CXR diagnostic → CTA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>→</td>
<td>CXR nondiagnostic → CTA</td>
</tr>
</tbody>
</table>
ABDOMINAL TRAUMA

- Abdominal examination can form part of the primary survey in the setting where the patient has severe shock and a source of blood loss is being sought.
- Otherwise abdominal examination is usually part of the secondary survey.
- Examination of the patient with abdominal trauma should include gastric tube insertion and urinary catheterisation [unless contraindicated].
- In consultation with the General Surgeon investigation of the patient with blunt abdominal trauma should proceed as follows:

<table>
<thead>
<tr>
<th>HAEMODYNAMICALLY STABLE</th>
<th>HAEMODYNAMICALLY UNSTABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear signs of abdominal injury.</td>
<td>Laparotomy</td>
</tr>
<tr>
<td>CT</td>
<td></td>
</tr>
<tr>
<td>No abdominal signs or signs unreliable due to:</td>
<td>DPL or USS [FAST] or Laparotomy</td>
</tr>
<tr>
<td>- altered conscious level [GCS &lt; 13]</td>
<td></td>
</tr>
<tr>
<td>- paralysis</td>
<td></td>
</tr>
<tr>
<td>- significant pelvic or chest injury</td>
<td></td>
</tr>
</tbody>
</table>
FOCUSED ABDOMINAL SONOGRAPHY FOR TRAUMA [FAST]

Rapid bedside assessment with ultrasound has emerged as the investigation of choice in the haemodynamically unstable patient with no reliable clinical signs of abdominal injury.

The examination is limited to 4 views: Morrisons Pouch, Perisplenic, Pelvis, Pericardium. FAST is aimed at the detection of free fluid. Free fluid in the abdomen in the unstable patient usually mandates laparotomy.

DIAGNOSTIC PERITONEAL LAVAGE (DPL)

Alternative to USS
Criteria for positive DPL

\[
\begin{align*}
\text{ASPIRATION} & : > 10\text{mls of frank blood} \\
\text{LAVAGE FLUID} & : \text{Obvious enteric contents} \\
& \quad \text{RBC Count} > 100\,000/\text{ml} \\
& \quad \text{WBC count} > 500/\text{ml} \\
& \quad \text{Exit of lavage fluid via:} \\
& \quad \quad \text{chest drain [diaphragm injury]} \\
& \quad \quad \text{Urinary catheter [bladder perforation]}
\end{align*}
\]

CT SCAN ABDOMEN

- preferred non-clinical examination in the haemodynamically stable patient.
- double contract preferred [oral and IV] at present if possible but this is controversial.
(assess on a case by case basis in consultation with surgeon and radiologist)
PENETRATING ABDOMINAL TRAUMA

- Early surgical consultation in all cases
- Evidence of:
  - Haemodynamically instability
  - Evisceration
  - Peritonism
  - Free gas on x-ray
  - Other evidence of internal injury

→ Mandates laparotomy
- If no evidence of the above, requires local wound exploration by the general surgeon or additional investigation/observation at the discretion of the surgeon.
PELVIC TRAUMA

Assessment of the pelvis is by clinical and when indicated radiological examination.

Clinical examination should include inspection, particularly of the perineum for bruising, rectal and genitourinary examination, and careful palpation for pelvic instability.

Pelvic fractures present two major problems:
1. Bleeding [most commonly venous associated with an open book pelvic disruption]
2. Associated injury to bladder, urethra, bowel, other solid organs

Patients who have a pelvic fracture and blood at the external urethral meatus should have a retrograde urethrogram. A retrograde urethrogram should also be undertaken in patients with a significant pelvic fracture who have not passed urine.

The haemodynamically unstable patient with a pelvic fracture requires a supraumbilical DPL or FAST ultrasound, in consultation with the General and Orthopaedic Surgeon.

If the DPL is positive or significant free fluid on FAST present, laparotomy is required.

If the patient with a pelvic fracture remains haemodynamically unstable a tightly applied sheet or SAM splint around the pelvis and urgent orthopaedic consultation is required. Continued instability may require pelvic angiography and embolisation, and/or operative stabilization.
LIMB INJURY

- Primary survey and resuscitation before limb assessment
- Manage hypovolaemic shock
- Control external haemorrhage by
  1. Direct pressure
  2. Wound cleaning/packing/pressure dressing and elevation [under temporary tourniquet control if necessary].
  3. Fracture splintage

- Assess neurovascular and functional status. Consider urgent orthopaedic/consultation and CTA or angiography if vascular injury suspected.
- Early decontamination of wounds / saline irrigation
- Antibiotics for open fractures
- Jewellery removal
- Early reduction and appropriate splintage of fractures/dislocations. As a general principle x-rays should be taken prior to [and after reductions] unless there is neurovascular compromise.
- Appropriate analgesia
- Awareness of complications such as compartment syndrome/fat embolism
- Appropriate consultation/follow up/rehabilitation
- See also NMDHB: Fracture Guidelines.
CRUSH SYNDROME

- Systemic manifestation of limb compression
- **Muscle injury due to**
  - direct injury
  - ↑ compartment pressures
  - vascular injury
- **Rhabdomyolysis**
  - ↑ CK
  - Myoglobinuria
  - Acute renal failure
  - Acidosis
  - Hyperkalaemia
  - Systemic inflammatory response
  - Multiorgan dysfunction

**Management**
- Anticipate problem
- O₂
- Monitor
- Fluid resuscitation
- Maintain high urine output 2ml/kg/hr

**CONSIDER:**
- Alkalisation of urine
- Mannitol
- Dopamine
- Haemodialysis
- Fasciotomy/Debridement
BURNS

**FIRST AID**
Cover burn with burns sheet/cling film

**AIRWAY**
Airway Burn = airway protection asap
Anaesthetic Consultant
Intubation

**BREATHING**
0₂
Salbutamol for bronchospasm
Respiratory support as required for smoke inhalation;
Consider hydroxycobalamin 5mg IV if persisting cyanosis [suspected Cyanide toxicity.]
CXR
Escharotomy for respiratory restriction in circumferential full thickness burns

**CIRCULATION**
IV access
Blood for CBC/U&E/CK/X-match/Hbco
IV Fluid Resuscitation for Burn > 20% adult
> 10% child
IV crystalloid [Hartmanns preferred]
4mls/kg/% TBSA [see Burns documentation sheet]
- DO NOT include eruthema only in TBSA assessment
½ over 1st 8 hrs post burn. Remainder over following 16 hours
Monitor perfusion/urine output/maintain urine output > 1ml/kg/hr
Consider other injuries/medical illness/psychiatric state
Escharotomy of compromised limbs

**NASOGASTRIC**
↓ Gastric distension
Allows early nutrition

**BURN DRESSING**
Once assessed by ED Specialist/Surgeon
Clean & Debride
<table>
<thead>
<tr>
<th>DEPTH</th>
<th>OPTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erythema only 1°</td>
<td>Tegaderm/Opsite</td>
</tr>
<tr>
<td></td>
<td>Jellonet/adaptic</td>
</tr>
<tr>
<td></td>
<td>Liquidparafin to face</td>
</tr>
<tr>
<td>Superficial partial thickness 2°</td>
<td>Jellonet/Adaptic/Gauze/Crepe</td>
</tr>
<tr>
<td></td>
<td>Mepitel (see mepitel guideline)</td>
</tr>
<tr>
<td>Deep partial thickness 2°</td>
<td>Acticoat</td>
</tr>
<tr>
<td></td>
<td>SSD/jellonet/gauze/crepe</td>
</tr>
<tr>
<td>Full thickness 3°</td>
<td>Acticoat</td>
</tr>
<tr>
<td></td>
<td>SSD/jellonet/gauze/crepe</td>
</tr>
</tbody>
</table>

Note: If transfer to burns unit required imminently dress burn with cling film or simple jellonet/adaptic dressing only to allow specialist reassessment

- Analgesia
- Tetanus Prophylaxis
- Antibiotic prophylaxis not generally indicated. Consider in deep/full thickness burns if no silver based dressing available. 2) young children. 3) dirty or infected burns.

**MINOR BURNS:**  < 10% maybe suitable for outpatient management depending on pain control / social / psychological status

**MAJOR BURNS:** require admission - consider transfer to Regional Burns Unit if :

- Burns > 20% Adult
  - > 10% children / elderly
- Full thickness burn > 5%
- Significant burns to special areas Face / Hands / Perineum / Joints
- High voltage electrical
- Inhalational injury

See also: 1) Burns documentation sheet
2) NMDHB guideline: Acute Management of Paediatric Burns
• Trauma is the leading cause of death in children.

• These are major anatomic and physiological differences between paediatric and adult patients that play a significant role in the evaluation + management of trauma.

• A paediatrician should be involved in the care of all significant trauma in children under one and of the discretion of the trauma team leader in other cases.

• Major paediatric trauma should be managed in Resus 2 which is equipped with specialized equipment, modified Glasgow coma charts and a Broeslow tape.

• The general approach closely aligns that in Adults with attention to age specific vitals and recognition of altered patterns of injury and response to therapy. Serial Assessments are recommended.

• Paediatric patients are particularly vulnerable to hypothermia and attention to maintaining a warm environment and specific therapy for hypothermia is required.

• Radiology is not ‘routinely’ required unless clinically indicated. CT is the diagnostic test of choice in the evaluation of intraabdominal injury.

• Pain management in children requires appropriate combined use of explanation, positioning relaxation, distraction, ice, splinting, AMETOP, N₂O, simple analgesics, and in some cases IN Fentanyl / or IV medications.

• All paediatric trauma patients should be evaluated for the possibility of NAI.

• A more detailed discussion of Paediatric Trauma can be found in the APLS course text.
TRAUMA IN THE ELDERLY

- People over 65 represent the fastest growing segment of the population.

- Elder patients, are more susceptible to injuries and have a higher mortality rate for any given injury.

- Mechanisms of injury are different. Elderly are more likely to sustain injury from falls.

- Physiological changes of aging alter the way in which elderly manifest and tolerate injury.

- Elderly may have suffered a medical event that precipitated their trauma.

- They may subject to ‘polypharmacy’ and drug interaction.

- Resuscitation requires oxygen administration, a lower threshold for advanced airway control and aggressive but judicious fluid resuscitation.

- Frequent re-evaluation is prudent.

- End of life decisions may need to be considered but many elderly trauma patients can be returned to their pre-injury medical status and independence.
TRAUMA IN PREGNANCY

- Pregnancy should be considered in all female trauma patients of child bearing age (10 – 50)

- Pregnancy causes significant alterations in anatomy, physiology and laboratory values which influence the evaluation of trauma patients.

- Pregnancy may effect the pattern and severity of trauma and the response to resuscitation.

- Assessment of both mother and foetus is required

- Management of life threatening injuries in the mother comes first

- Major trauma carries a high risk of foetal demise.

- Minor trauma can cause foetal demise.

- The foetus can be distressed even though the mother looks well continuous CTG monitoring is required. A minimum of 4 hours monitoring is required in stable patients and 24 hrs if any abnormality is detected.

- Vigorous fluid resuscitation is required

- Beyond 20 weeks the patient should be tilted 30 degrees to the left to avoid the supine hypotensive syndrome.

- Plain radiography is not contraindicated in pregnancy and should be performed as necessary.

- USS is the diagnostic abdominal test of choice and is the best modality for simultaneous assessment of mother and foetus.

- A search should be made for conditions unique to the pregnant trauma patient such as uterine rupture, placental abruption, amniotic fluid embolism, isoimmunization and premature rupture of membrane.

- Perimortem C-section is indicated within 5 minutes of maternal cardiac arrest for a viable foetus (>24 weeks) with positive life signs.

- An obstetrician should be consulted early in all cases of trauma in pregnancy.

- Domestic violence screening should occur in all women who present to the Emergency Department.
The following Emergency Department trauma forms have been devised to improve documentation.

They simplify and standardise this process and can be used for subsequent audit.

Progress notes and the opinion of any consulted specialists should also be documented on continuation sheets.

Vital signs, fluids and drugs should be recorded on the Emergency Department resuscitation sheets and continued if necessary on standard hospital forms.

**Forms for insertion - Available in Resus 1**

Trauma Sheet  
Spinal Trauma Sheet  
Burns Sheet  
Resuscitation Sheet  
Major Incident Sheet
The Emergency Department has a subplan for the management of major incidents.

This plan is based around:

1. The disaster cupboard

2. Pre prepared disaster packs containing:
   - triage tags
   - pre-allocated NHI No's & labels
   - major incident sheets
   - blood & X-ray forms

3. Major Incident Response Diagram

4. Casualty Flow Plan and Disaster Map

5. Task Cards for key personnel

[See subplan for details]
TRAUMA PREVENTION

- Seatbelt Legislation
- Drink Driving Legislation
- Improved Road Engineering
- Car Design
- Child Restraints
- Helmet Use
- Road Safety
- Workplace Injury Awareness
- Home Safety
- Fire Safety
- Domestic Violence Support Services
- Child Protection
- TV Set Securing
- Pool Fencing


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Date of next Review: Jan 2012.