Trauma in the Field
“Catastrophic Haemorrhage”
CPD UL
10th Dec 2014
F. Feerick AP, MSc
Trauma in the Field – "Catastrophic Haemorrhage"

CPD UL

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F. Feerick AP, MSc
Objective

• To recognise trauma patients with suspected *catastrophic haemorrhage* are *time critical* and must be appropriately treated & evacuated to an appropriate medical facility *immediately*
**Motivation**

- After a traumatic injury, haemorrhage is responsible for over 35% of pre-hospital deaths and over 40% of deaths within the first 24 hours.

http://www.nationaltraumainstitute.org/home/hemorrhage.html
What We Will Cover

- Current Practice (CPG’s)
- Recognising Shock
- Evidence Based Practice
- Damage Control Resuscitation (DCR)
- Lethal Triad
- Catastrophic Haemorrhage Control:
  - Field dressings
  - Haemostatics
  - Tourniquet
  - Tranexamic acid
  - Permissive hypotension
  - Hypothermia
  - Handling
What We Will Cover

• Package, Pre-Alert & Transport
• Appropriate Facility
• Future Practice (CPG’s)
• Tips in the field
• Summary
Current Practice (CPG's)
Current Practice (CPG's)
Current Practice (CPG's)

Special Authorisation:
Paramedics are authorised to continue the established infusion in the absence of an Advanced Paramedic or Doctor during transportation.
Recognising Shock

“By the time a patient’s blood pressure begins to drop the patient is already profoundly hypovolemic”

PHTLS: Prehospital Trauma Life Support, 6th edition, p. 177
<table>
<thead>
<tr>
<th>Class of haemorrhagic shock</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>Up to 750</td>
<td>750–1500</td>
<td>1500–2000</td>
<td>&gt; 2000</td>
</tr>
<tr>
<td>Blood loss (% blood volume)</td>
<td>Up to 15</td>
<td>15–30</td>
<td>30–40</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Pulse rate (per minute)</td>
<td>&lt; 100</td>
<td>100–120</td>
<td>120–140</td>
<td>&gt; 140</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Normal</td>
<td>Normal</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Pulse pressure (mm Hg)</td>
<td>Normal or increased</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Respiratory rate (per minute)</td>
<td>14–20</td>
<td>20–30</td>
<td>30–40</td>
<td>&gt; 35</td>
</tr>
<tr>
<td>Urine output (mL/hour)</td>
<td>&gt; 30</td>
<td>20–30</td>
<td>5–15</td>
<td>Negligible</td>
</tr>
<tr>
<td>Central nervous system/mental status</td>
<td>Slightly anxious</td>
<td>Mildly anxious</td>
<td>Anxious, confused</td>
<td>Confused, lethargic</td>
</tr>
</tbody>
</table>
Recognising Shock

“Respiratory rate, pulse pressures, cap-refill, mental status & LOC are more sensitive indicators of hypovolemia than blood pressure”

PHTLS: Prehospital Trauma Life Support, 6th edition, p.177
Evidence Based Practice

- **Vagus nerve stimulation improves coagulopathy in hemorrhagic shock: a thromboelastometric animal model study:** Journal of Trauma Management & Outcomes 2014

- **Hospital mortality among major trauma victims admitted on weekends and evenings: a cohort study:** Kevin B Laupland, Chad G Ball, Andrew W Kirkpatrick Journal of Trauma Management & Outcomes 2009, 3:8 (27 July 2009)

- **Red blood cell transfusion within the first 24 hours of admission is associated with increased mortality in the pediatric trauma population: a retrospective cohort study:** Taylor J Stone, Paul J Riesenman, Anthony G Charles Journal of Trauma Management & Outcomes 2008, 2:9 (20 October 2008)

- **Tranexamic acid: a review of its use in the treatment of hyperfibrinolysis:** McCormack PL. J Intensive Care Med. 2014 Nov 10

- **ABC to <C>ABC: redefining the military trauma paradigm:** Hodgetts T, Mahoney P, Evans G. et al Battlefield advanced trauma life support. 3rd edn. Defence Medical Education and Training Agency, Joint Service Publication, 570. 2006

- **Prehospital use of haemostatic dressing QuikClot ACS+™ for hemorrhage control of a perineal trauma.** Travers S1, Dubourg O, Ribeiro Parenti L, Lefort H, Albarello S, Domanski L. 2012 Dec;31(12
Damage Control
DCR-Principles

“Hypovolaemic shock secondary to uncontrolled haemorrhage is by far the most common shock scenario seen in pre-hospital practice”

ABC of Prehospital Emergency Medicine, 1st edition, 2013, p. 35
DCR-Path

- Uncontrolled haemorrhage
- Hypovolaemia
- Inadequate perfusion of vital organs
- Anaerobic metabolism
- Progressive systemic lactic acidosis
- Limiting heat production/hypothermia
- Acidosis & hypothermia impair coagulation leading to further bleeding

ABC of Prehospital Emergency Medicine, 1st edition, 2013, p.36
The Lethal Triad

Acidosis

Hypothermia

Death

Coagulopathy
DCR - Principles

Blood clot formed immediately after injury is the most effective

- Protect at all costs
- First clot = Best clot

*ABC of Prehospital Emergency Medicine, 1st edition, 2013, p.36*
Catastrophic Haemorrhage Control C-ABC

- Tourniquet
- Blood products
- Field dressings
- Haemostatic agents

Premissive hypotension
Tranexamic acid
Prevent hypothermia
Haemostatic Ladder

Direct pressure & elevate

Indirect pressure

Field dressings

ABC of Prehospital Emergency Medicine, 1st edition, 2013, p. 38
Haemostatics

- Useful where tourniquets cannot be applied (e.g. neck, axilla, groin, perineum).

*ABC of Prehospital Emergency Medicine, 1st edition, 2013, p.38*
“Analysis of data from the Vietnam war, identified that bleeding from limb wounds accounts for more than half the potentially preventable deaths in combat, and that 7% of combat deaths may have been prevented by using a limb tourniquet”.

Tranexamic Acid

Tranexamic acid acts to aid clotting

"Tranexamic acid significantly reduced all-cause mortality and death due to bleeding in trauma patients with significant bleeding, particularly when administered early after injury...... very cost effective and potentially life saving“:....Mc Corrmack. PL, Pubmed, 2008

# Medication Formulary

**Clinical Level:** AP

<table>
<thead>
<tr>
<th>Medication</th>
<th>Tranexamic Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Class</strong></td>
<td>Anti-fibrinolytic</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>An anti-fibrinolytic which reduces the breakdown of blood clots</td>
</tr>
<tr>
<td><strong>Presentation</strong></td>
<td>Ampoule 500 mg in 5 mL</td>
</tr>
<tr>
<td><strong>Administration</strong></td>
<td>Intravenous (IV) (CPG: 5/6.6.8).</td>
</tr>
<tr>
<td><strong>Indications</strong></td>
<td>Suspected significant internal or external haemorrhage associated with trauma</td>
</tr>
<tr>
<td><strong>Contraindications</strong></td>
<td>Hypersensitivity to the active substance or to any of the excipients, Acute venous or arterial thrombosis, History of convulsions, Severe hepatic impairment</td>
</tr>
<tr>
<td><strong>Usual Dosages</strong></td>
<td>Adult: 1 g IV/IO (infusion in 100 mL NaCl), Paediatric: Not indicated</td>
</tr>
<tr>
<td><strong>Pharmacology/Action</strong></td>
<td>Tranexamic acid exerts an anti-haemorrhagic activity by inhibiting the activation of plasminogen to plasmin, by binding to specific sites of both plasminogen and plasmin, a molecule responsible for the degradation of fibrin, a protein that forms the framework of blood clots.</td>
</tr>
<tr>
<td><strong>Side effects</strong></td>
<td>Common: Diarrhoea, vomiting, nausea. Other undesirable effects include visual disturbance, impaired coloured vision, dizziness and headache.</td>
</tr>
<tr>
<td><strong>Additional information</strong></td>
<td>Caution with head injury</td>
</tr>
</tbody>
</table>
Premissive Hypotension

Partial restoration of blood pressure after haemorrhage, prior to definitive haemorrhage control

Avoidance of needless cold fluids preserves normothermia & prevents excessive dilution of red blood cells, platelets & clotting factors

ABC of Prehospital Emergency Medicine, 1st edition, 2013, p. 42
Premissive Hypotension

Target BP 80-90 mmHg unless traumatic brain injury suspected where a SBP > 100 mmHg is preferred.

Palpable radial pulse is indicative of blood flow to the peripheries rather than any specific BP.
Prevent Hypothermia

Forms part of the lethal triad, exacerbates acidosis, coagulopathy & causes further hemorrhage.
Minimal Handling

- Avoid disruption of formed clots
- Careful cutting of clothing
- Limited 15 degree log roll onto scoop
- Consider pelvic binder if pelvis # suspected
Pre-hospital alerting for massive transfusion is crucial in order to minimize delays to receiving blood products.
Local ED Vs Trauma Centre
All shocked trauma patients should be triaged to a major trauma centre with the ability to deliver massive transfusion & rapid transfer to theatre.
CPG's of the future
SECTION 6
TRAUMA

External Haemorrhage – Adult

Open wound

- Active bleeding
  - Yes: Catastrophic haemorrhage
    - Yes: Posture elevation, examination, pressure
    - No: Caoch applied
  - No: Consider applying a dressing impregnated with a haemostatic agent

- Inability to control bleeding
  - Yes: Apply tourniquet if limb injury
  - No: Consider oxygen therapy

- Haemorrhage controlled
  - Yes: Apply additional dressing(s)
  - No: Depress proximal pressure point

- Haemorrhage controlled
  - Yes: Go to Shock CPR
  - No: Apply tourniquet

Equipment list
- Sterile dressing (various sizes)
- Crepe bandage (various sizes)
- Conforming bandage (various sizes)
- Triangular bandage
- Trauma tourniquet
- Dressing impregnated with a haemostatic agent

EMT Special Authorisations:
EMTs, having completed the BTEC course, may be privileged by a licensed CFR provider to apply a tourniquet on its behalf.
Catastrophic haemorrhage

Yes

No

Posture
Elevation
Examination
Pressure

Apply tourniquet if limb injury

consider applying a dressing impregnated with haemostatic agent

Request
ALS

EMT Special Authorisation:
EMTs, having completed the BTEC course, may be privileged by a licensed CPG provider to apply a tourniquet on its behalf.
SECTION 6
TRAUMA

**Shock from Blood Loss (trauma) – Adult**

1. **Control external haemorrhage**
   - Oxygen therapy

2. **Suspected significant internal/external haemorrhage**
   - Transesamic acid 3 g IV/AO (in 100 mL NaCl)

3. **Head injury with GCS ≤ 8**
   - NaCl (0.3%), 350 mL IV/AO aliquots to maintain SBP 120 mmHg
   - NaCl (0.3%) 250 mL IV/AO aliquots to maintain palpable radial pulse (SBP 90 - 100 mmHg)

4. **Maintain normo-temperature**
5. **Continue fluid therapy until handover at ED**

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**Special Authorisation:**
Paramedics are authorised to continue the established infusion in the absence of an Advanced Paramedic or Doctor during transportation.
With polytrauma consider application of a pelvic splint

NaCl (0.9%), 500 mL IV/IO

Suspected significant internal/external haemorrhage

No

Tranexamic acid 1 g IV/IO (in 100 mL NaCl)

Yes

Head injury with GCS ≤ 8

Yes

NaCl (0.9%), 250 mL IV/IO aliquots to maintain SBP 120 mmHg

No

NaCl (0.9%), 250 mL IV/IO aliquots to maintain palpable radial pulse (SBP 90 - 100 mmHg)

Maintain normo-temperature
Tips in the field

- Patients who are tachycardic, tachypnoeic with cold clammy skin are in compensated shock until proven otherwise.
- Loss of radial pulse and/or reduced LOC indicates decompensation.
- Non-invasive BP readings can be unreliable & provide false reassurance.
- Pelvic binder & splinting of long bone # should be undertaken as part of primary survey.
- Always secure iv/io access sites & lines securely prior to moving patient.
US COMBAT CASUALTIES 2001-2011
DIED OF WOUNDS 506
KILLED IN ACTION 4090
PREVENTABLE 1075
HEMORRHAGE 92%
Summary

- CPG’s...from here to there...
- Recognising shock.....looks familiar
- Evidence.....looks like were getting there
- DCR......what was that all about ???
- Lethal triad...acidy..coldey..no clotty, will diey
- Catastrophic Haemorrhage...plug it good boy
- Triage........pack em, stack em & rack em
- Tips in the field......mind the bull
Hands UP Any Questions ??
References

- *ABC to <C>ABC: redefining the military trauma paradigm*, Emerg Med J. Oct 2006;
- [http://www.nationaltraumainstitute.org/home/hemorrhage.html](http://www.nationaltraumainstitute.org/home/hemorrhage.html)
- [www.phecc.ie](http://www.phecc.ie)
Thank You
Objectives

• List the organs in the chest
• List the organs in the abdomen
• Describe 3 life threatening chest injuries
• Describe 3 common traumatic abdominal injuries
Overview

- Trauma – 3rd leading cause of death
- #1 cause of death for 1–44yr
- Leading cause – blunt trauma
- Chest injuries – 20% of all traumatic deaths
- Abdominal injuries – 10% of all traumatic deaths
Chest & Abdominal injuries

Chest anatomy
- Flail chest
- Pericardial tamponade
- Pneumothorax
- Haemothorax

Abdominal anatomy
- Hepatic injury
- Splenic rupture
- Renal injury
Group Work

Group 1
- Anatomy of the chest
- Describe a haemothorax
- Describe a ruptured spleen

Group 2
- Anatomy of the abdomen
- Describe a simple/tension pneumothorax
- Describe a hepatic injury

Group 3
- Great vessels
- Describe a cardiac tamponade
- Describe a renal injury
Flail Chest

- 2/3 or more ribs broken in 2 or more places
- Paradoxical breathing
- Ineffective breathing
- Ineffective ventilation
- Pulmonary contusion
Flail chest

- Bruising and paradoxical breathing on inspection
- Crepitus on palpitation
- Pain++
- Hypoxic, ↑RR & ↑HR
- Tx: 02 +/- ventilation, analgesia
- **No external stabilisation**
Pneumothorax

- Collection of gas/air in the pleural space
- CP, SOB
- Subcutaneous emphysema
- Sometimes difficult to diagnose
Tension pneumothorax

- Air in pleural space, one way valve effect
- Can push mediastinum and block venous return
- Classic signs – hyper extended chest, increased percussion, little movement in chest, deviated trachea, increased CVP
- Beware of tachycardiac, tachypnoeic patient – may result in PEA arrest
- Needle thoracostomy – mid clavicular line, 2nd intercostal space
Tension pneumothorax

Mediastinal shift

Heart
In a tension pneumothorax, air from a ruptured lung enters the pleural cavity without a means of escape. As air pressure builds up, the affected lung is compressed and all of the mediastinal tissues are displaced to the opposite side of the chest.
Haemothorax

- Collection of blood in the pleural space
- Often caused by rib fractures
- Small, moderate haemothoraces hard to detect
- Decreased chest expansion, dull to percuss, reduced breath sounds,
Cardiac tamponade

- Fluid accumulates in the pericardium
- Penetrating & blunt trauma
- Trauma presenting in PEA without hypovolaemia and tension pneumothorax
- Classic signs – Becks triad – hypotension, increased JVD, muffled heart sounds
Cardiac Tamponade

Compression of the heart due to fluid accumulation within the pericardium
Abdominal injuries

- Blunt (rural) or penetrating (urban)
- Tenderness, rigidity, guarding
- Blood loss, infection
- Pneumoperitoneum
- +/- Chest injury
- Solid organs are vascular
- May be in shock
Hepatic injury
Spleen
GRADE 3 RUPTURED SPLEEN

ANTERIOR VIEW

ACUTE BLEEDING

HEMOPERITONEUM

DETAIL VIEW

APPROX. 20 - 25% OF THE SPLEEN IS RUPTURED AND ADJACENT TO THE SPLEEN IS A LARGE AMOUNT OF FLUID
Renal Injury

Grade I

Grade II

Grade III

Grade IV

Grade V

Arterial Thrombosis
Summary

- Chest & abdominal injuries are a significant cause of death
- Recognition of the potential of injury is vital
- Rapid transport – correct facility
- Reduce on-scene times
Trauma Assessment – Overview

Beware of patients age and comorbidities

Be careful of on-scene time for serious trauma

Primary survey

Vital signs

Focused assessments

Reassess

Multi-system trauma markers
- GCS <13
- BP <90
- RR <10, >29
- MOI
Objectives

• Review of pelvic injuries
• Type of pelvic fractures
• Associated injuries
• Prehospital management
• Pelvic stabilisers
• Summary
Pelvic fractures: incidence

Pelvic fracture

- 20 / million
- 7.9-9.3 % all trauma
- 20% poly-trauma
- 20% fatal falls

C-spine injury

- 3.84 / million
- 0.85% all trauma


Pelvic fracture in paediatric population

- Less likely injury: 1-3% of all fractures
- Lethal injury from:
  - diaphragmatic injury
  - Solid visceral organ injury
- Clinical examination not reliable <4Y/O

Reference: JARCALC (2009)
Causes of pelvic fractures

- High energy
  - RTC 50%
  - Pedestrian vs vehicle
  - Cyclist / motorcyclist
  - Fall from height
  - Crush injury

- Low energy (Trivial fall)
  - Elderly
  - Degenerative bone disease
  - Radiotherapy
  - Obesity

References: Lee and Porter 2006, JRCALC 2009
Types of pelvic fractures
Lateral compression

- 60-70%
- Stable

Ref: http://learningradiology.com/mobile/msk/mostcommonmsk.htm
Anterior posterior compression

- Open book
- 15-20%
- Unstable
- Vital role for pelvic stabilisation

Ref: http://learningradiology.com/mobile/msk/mostcommonmsk.htm
Vertical shear

- 5-15%
- unstable

Ref: http://learningradiology.com/mobile/msk/mostcommonmsk.htm
Straddle

- Stable

Ref: http://learningradiology.com/mobile/imagesmobile/Straddle%20Fx.jpg
Signs & Symptoms

- Mechanism of injury
  - Head on RTC
  - Lateral impact
  - Pedestrian vs vehicle
  - Cyclist / motorcyclist
  - Fall from height
- GCS < 13
- Shortening of lower limb

- Hypotension without external bleeding
- Contusion
- Bleeding
- Deformity
- Swelling
- Pain
  - Pelvis
  - Groin
  - Hips

Associated injuries

- Closed head injury 51%
- Long bone fracture 48%
- Thoracic 20%
- Intra-abdominal 30.7%
- Genitourinary 5%
- Haemorrhage
  - “Lethal Triad” (hypothermia, coagulopathy, acidosis)
- Death 14%
- Lumbosacral spine fracture

Ref: Demetriades 2002 and Giannoudis 2007
Pre-hospital management

- CAcBCDE or MARCH
- Apply early before spinal immobilisation
- Time critical
- Oxygen as per CPG
- Avoid “log roll”
  - Use Orthopaedic stretcher
  - NO spinal board straps on iliac crest!
- Rapid transport to trauma centre
- IV access en route:
- Permissive hypotension
- Analgesia

Pelvic stabiliser available

- Improvised (unable to ascertain the tension)
  - Bed sheet clamped
  - Vest type extrication device
  - Vacuum mattress

- Commercial
  - SAM Pelvic Sling II
  - T-POD
  - Flamingo
  - PelvicBinder™
  - Stuart Pelvic Harness
  - Prometheus
SAM Pelvic Sling II

- Only binder with force control
- New standard issue to National Ambulance Service
- Standard size fits 98% adults
  - Large and Small available
Contraindications

- Positioned on iliac crest
- Isolated Neck Of Femur fracture
- Traumatic hip dislocation
- Pregnancy?
- Recommendation from SAM Medical on the use of the SAM sling in the pregnant trauma patient

Queensland Ambulance Service, Australia

- Ref: Australia, Queensland Ambulance Service (2011) *Clinical Practice Procedures – Trauma* Queensland Government [online] available: 
Questions?
Summary

• High incidence in trauma
  – More that C-Spine
• Associated with severe injuries and death
• Apply early
• Avoid “log roll”
• Time critical
• SAM Pelvic Sling II new to NAS
References


References (continued)


