43rd Annual Dalhousie Spring Refresher (Emergency Medicine)

Interactive Trauma Case

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• No conflicts of interest
Interactive Trauma Case
Objectives

• Approach to the agitated or altered trauma patient

• Apply critical thinking to emergency decisions regarding airway management, breathing, fluid resuscitation & altered level of consciousness

• Review of basic emergency procedures & useful tricks
Situation

• 8am Handover, winter icy conditions

• Radio Patch: ATV accident 2 patients
  o Patient 1: Head injured, GCS 14, lac to head, no other injuries
    Vitals
    Altered Mental status with strong smell of Alcohol
    BP 110/60, HR 90, sats 92% on RA 98% on 2L, BG 5.1
  o Patient 2: Other crew will patch in later
Trauma Centre?

Nova Scotia Trauma Program

Trauma Resuscitation & Transport Indications

1-800-743-1334
**Physiologic**
- Loss of vital signs en route
- Systolic BP < 90 with hypoperfusion
- Ventilatory compromise (rr < 10 or > 30)
- Glasgow Coma Scale less than 12 with evidence of torso or extremity trauma
- Pregnant patient (> 20 weeks) with fetal heart rate < 120 or > 160

**Anatomic**
- Amputation proximal to elbows or knees
- 2 or more proximal long bone fractures
- Suspected spinal cord injury
- Severe maxillofacial injury with potential airway compromise
- Burns > 15% TBSA
- Pregnant patient (> 20 weeks) with penetrating injury or significant blunt injury
Mechanism

- Gunshot wound proximal to knee/elbow
- Significant penetrating wound to head, neck, chest, abdomen or groin
- Ejection from vehicle
- Pedestrian thrown (hit by car) or run over
- Fall from height > 6 meters (20 feet)

Logistical

- Simultaneous arrival of 3 or more multi-trauma patients

- If emergency physician feels TTA is necessary for injured patient
Pre-arrival preparations

• Room

• Staff
  o Nursing
  o Physicians
  o Lab
  o Radiology
  o Surgeon
  o Security

• Equipment
  o ABCs:
    • Intubation
    • Ventilation
    • Circulation – Vascular access – IO, IV
      o Bleeding control
      o Ultrasound
Your Assessment

- Confused, yelling, slurring words
- Becoming agitated
- Yelling, ripping off BP cuff, trying to sit up

- What is your approach at this point?
# The Rapid Sedation Take Down

<table>
<thead>
<tr>
<th></th>
<th>Dose</th>
<th>Onset</th>
<th>Duration</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ativan</strong>*</td>
<td>0.5-4mg IV/IM</td>
<td>5-20min IV</td>
<td>6-8 hours</td>
<td>Resp Compromise Hypotension Long duration of Effect</td>
</tr>
<tr>
<td></td>
<td>*typical: 1-2 mg IV/IM</td>
<td>15-30 min IM</td>
<td></td>
<td>*High doses required Paradoxical reaction</td>
</tr>
<tr>
<td></td>
<td>q15min, max?</td>
<td>IM</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Midazolam</strong>*</td>
<td>2-5mg IV/IM</td>
<td>15 min</td>
<td>1-2 hours</td>
<td>EHS Quicker on &amp; off Resp Compromise Hypotension</td>
</tr>
<tr>
<td></td>
<td>*typical: 5mg IV/IM</td>
<td></td>
<td></td>
<td>Paradoxical reaction</td>
</tr>
<tr>
<td></td>
<td>up to 30min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Haldol</strong>*</td>
<td>2-10 mg IV/IM</td>
<td>up to 30min</td>
<td>4-8 hours</td>
<td>Extra Pyramidal SE Prolonged QT Anticholinergic SE</td>
</tr>
<tr>
<td></td>
<td>*typical 5mg IV/IM q15-30min</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Ketamine</strong>*</td>
<td>1 mg/kg IV followed by 0.5 mg/kg q5-10min to effect</td>
<td>less than 1 min if IV</td>
<td>5-20 min, longer if IM</td>
<td>Maintain A/W reflexes Emergence reactions Laryngospasm Salivation Tachycardia Hypertension +limited research on ketamine for sedation in agitation +caution in elderly or CVS risk factors</td>
</tr>
<tr>
<td></td>
<td>3-5mg/kg IM</td>
<td>up to 20 min if IM</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Doses should be reduced in the elderly/physiologically compromised

- Be prepared to intubate

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*Ketamine* 1 mg/kg IV followed by 0.5 mg/kg q5-10min to effect

3-5mg/kg IM

less than 1 min if IV up to 20 min if IM

5-20 min, longer if IM

Maintain A/W reflexes Emergence reactions Laryngospasm Salivation Tachycardia Hypertension +limited research on ketamine for sedation in agitation +caution in elderly or CVS risk factors
Are paradoxical reactions an epidemiologic iceberg?

Recognized PR due to procedural sedation

Unrecognized PR in complex critically ill patients

Intubation

• If hypotensive, reduce doses of sedative

• Primary set-up

• Secondary set-up - Plan for difficult a/w
Patient with altered MS

Dissociation with Ketamine

Preoxygenate 3min

Paralyze

ApOx

Bougie Assisted Chest Tube

• **INDICATIONS**
  - Obesity
  - Subcutaneous Emphysema
  - Anticipated difficult placement

• **BENEFITS**
  - Possible faster time to definitive chest tube placement
  - Helps ensure proper posterior / superior positioning
  - Minimizes number of violations of the parietal pleura

• **TIPS**
  - Watch your depth – to avoid possible mediastinal injury
  - If stuck in soft tissue, gently turn the chest tube over the bougie

http://www.tamingthesru.com/blog/annalsofpod/bougie-assisted-chest-tube
ATLS: Shock

- Isolated intracranial injuries do not cause shock

- Hemorrhage is the most common cause of shock in trauma patients.
What is your goal blood pressure?

EHS guideline: control external bleeding & administer fluid to maintain blood pressure ~100mmHg (~120mmHg if neuro trauma is suspected)

ATLS:

Fluid resuscitation and avoidance of hypotension are important principles in the initial management of blunt trauma patients.

In penetrating trauma with hemorrhage, delaying aggressive fluid resuscitation until definitive control may prevent additional bleeding.

A careful, balanced approach with frequent reevaluation is required.
Figure 1. Unadjusted Moving Average of Death Rate by Lowest Systolic Blood Pressure (SBP)

The solid line represents the moving average of the estimated death rate for each interval spanning 10 consecutive values, and the dotted lines represent the pointwise 95% CIs.

Spaite et al. 2016, e5

Hypotension in TBI
A single episode of hypotension doubles mortality, and this risk increases significantly with repeated episodes (an odds ratio [OR] of 8.1 for death in one study)
**Figure 3.** ORs for mortality by hypotension and hypoxia status. Reference group was the cohort with neither hypotension nor hypoxia. Error bars represent 95% CIs.

*Spaite et al. 2017, p. 69*
Hypotension in Trauma

• Identify & control hemorrhage
• Tranexemic acid
• Fluids
  o Permissive hypotension?
    • Mostly animal studies
    • Human studies exclude TBI patients
  o Which fluid, how much?
    • Cochrane review 2014 inconclusive
• Blood products
# UK National Guideline 2016: Major Trauma

## Table 78: Clinical evidence summary: FFP: platelets: RBCs

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of studies (no. of participants)</th>
<th>Imprecision</th>
<th>GRADE rating</th>
<th>Absolute difference</th>
<th>Control event rate (per 1000)</th>
<th>Relative 1:1:1 vs. 1:1:2</th>
<th>Control event rate for continuous outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (24 hours)</td>
<td>1 (n=680)</td>
<td>Serious</td>
<td>MODERATE</td>
<td>43 fewer (from 82 fewer to 14 more)</td>
<td>170</td>
<td>RR 0.75 (0.52 to 1.08)</td>
<td>-</td>
</tr>
<tr>
<td>Mortality (30 days)</td>
<td>1 (n=680)</td>
<td>Serious</td>
<td>MODERATE</td>
<td>39 fewer (from 91 fewer to 29 more)</td>
<td>260</td>
<td>RR 0.85 (0.65 to 1.11)</td>
<td>-</td>
</tr>
<tr>
<td>Transfusion-related metabolism complication</td>
<td>1 (n=680)</td>
<td>Very Serious</td>
<td>LOW</td>
<td>16 fewer (from 61 fewer to 48 more)</td>
<td>173</td>
<td>RR 0.91 (0.65 to 1.28)</td>
<td>-</td>
</tr>
<tr>
<td>Transfusion-associated circulatory overload</td>
<td>1 (n=680)</td>
<td>Very serious</td>
<td>VERY LOW</td>
<td>0 (from 10 fewer to 10 more)</td>
<td>0</td>
<td>Peto OR 7.48 (0.15 to 376.84)</td>
<td>-</td>
</tr>
<tr>
<td>Achieved haemostasis</td>
<td>1 (n=680)</td>
<td>None</td>
<td>HIGH</td>
<td>78 more (from 23 more to 141 more)</td>
<td>781</td>
<td>RR 1.1 (1.03 to 1.18)</td>
<td>-</td>
</tr>
<tr>
<td>Discharged home (at 30 days)</td>
<td>1 (n=680)</td>
<td>Serious</td>
<td>MODERATE</td>
<td>43 more (from 25 fewer to 126 more)</td>
<td>307</td>
<td>RR 1.14 (0.92 to 1.41)</td>
<td>-</td>
</tr>
</tbody>
</table>

## Table 79: Clinical evidence summary: Crystalloid: RBCs

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Number of studies (no. of participants)</th>
<th>Imprecision</th>
<th>GRADE rating</th>
<th>Absolute difference</th>
<th>Control event rate (per 1000)</th>
<th>Relative High versus low</th>
<th>Control event rate for continuous outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mortality (in hospital)</td>
<td>1 (n=452)</td>
<td>Very serious</td>
<td>VERY LOW</td>
<td>GIV</td>
<td>No adjusted data presented</td>
<td>OR 0.9 (0.58 to 1.45)</td>
<td>-</td>
</tr>
<tr>
<td>Nosocomial infection</td>
<td>1 (n=452)</td>
<td>Very serious</td>
<td>VERY LOW</td>
<td>GIV</td>
<td>No adjusted data presented</td>
<td>OR 1.3 (0.58 to 2.5)</td>
<td>-</td>
</tr>
<tr>
<td>Multiple organ failure</td>
<td>1 (n=452)</td>
<td>Serious</td>
<td>VERY LOW</td>
<td>GIV</td>
<td>No adjusted data presented</td>
<td>OR 1.7 (1.2 to 2.6)</td>
<td>-</td>
</tr>
<tr>
<td>Acute respiratory distress syndrome</td>
<td>1 (n=452)</td>
<td>None</td>
<td>VERY LOW</td>
<td>GIV</td>
<td>No adjusted data presented</td>
<td>OR 2.2 (1.5 to 3.1)</td>
<td>-</td>
</tr>
</tbody>
</table>
Fig. 2. Categories of SBP levels and its association with the corresponding odds of dying, compared to the baseline SBP of 110–129 mmHg (odds ratio ± 95% confidence intervals). Multivariable analysis (adjusted for age, gender, ISS and GCS) restricted to patients with complete covariate data. Univariable and multivariable analysis after imputation of missing SBP and GCS, including all 3444 patients.
Patch called in for MTV Patient 2

• 32 yo male pinned by the ATV
  o Partial amputation of left leg, bystander applied belt around leg
  o HR 140, RR 24, BP 118/80, sats 100%, BG 15.9, GCS 15
  o +abdo pain, no neck/back pain, no SOB
BLOOD COMPONENT / BLOOD PRODUCT USE DURING A MASSIVE TRANSFUSION

IDENTIFY AND TREAT ACTIVE BLEEDING (Obstetrical, Surgical, Trauma, Medical)

STABILIZE AND TRANSPORT TO REFERRAL CENTRE Care should be initiated within the resources and capabilities of the sending institution, which will vary depending on the hospital.

ACTIVATE MTP If patient is bleeding with anticipation of ongoing blood loss or bleeding requiring at least four (4) units of RBCs (adults) or 40 mL/kg (children) in four (4) hours.
- Establish or assign patient identification
- If the patient is transferred to another facility, the MTP will need to be activated in the second facility.

CALL BLOOD TRANSFUSION SERVICE/BLOOD BANK (BTS/BB) TO ACTIVATE MTP
- Provide contact information of physician leading the MTP
- Provide patient information
- BTS will notify the BTS/BB Medical Director as appropriate

MEDICAL-SURGICAL INTERVENTIONS
- Prior to initiation of treatment, send STAT:
  - CBC, INR/PTT, Fibrinogen, Electrolytes, Creatinine, Mg**, Ionized Ca**, serum lactate, Group and Screen, Blood Gas
  (blood work done based on facility’s capabilities)
- Consider cell salvage
- Warm all fluids
- Perform surgical/interventional radiology interventions as appropriate
- If treatment is within 3 hours of injury, consider tranexamic acid – 1 gram IV over 10 minutes followed by 1 gram IV every 8 hours.
- Anticoagulant reversal
  - Oral vitamin K, antagonists – (e.g., Warfarin/Aenocoumarol)
    - INR 1.7 to 5.0 – PCC 40 mL IV and vitamin K (Phytomenadione) 10 mg IV
    - INR ≥ 5.1 or Intracranial Hemorrhage or unknown INR – PCC 80 mL IV and vitamin K (Phytomenadione) 10 mg IV
  - Heparin – Protamine 1 mg IV for every 100 units of Heparin
  - Direct thrombin inhibitors/direct factor Xa inhibitors (Arixiban/Dabigatran/Rivaroxaban) - no known antitode. Replace fluid loss with appropriate fluid replacement. Transfuse RBCs, plasma and/or platelets as needed. Plasma will not reverse the anticoagulant effects of these drugs.

INITIAL TRANSFUSION MANAGEMENT
ADULTS:
- RBCs 6 units and
- Plasma 1500 mL and
- Platelets* 1 adult dose

PEDIATRICS:
- RBC 15 mL/kg and
- Plasma 10-15 mL/kg and
- Platelets* 5-10 mL/kg
*In hospitals where platelets are not inventoried and the patient will be managed on site, consider requesting platelets from CBS.

MAINTAIN
- Ionized calcium greater than 1.13 mmol/L
- Urine output greater than 0.5 mL/kg/h
- Systolic blood pressure greater than 70 mmHg
- Temperature greater than 35°C
- pH greater than 7.10

Hemoglobin above 70 g/L with RBCs:
- Adults: 2-10 units
- Pediatrics: 15 mL/kg
- Platelet count above 75 x 10^9/L or above 100 x 10^9/L (CNS Injury) with Platelets:
  - Adults: 1 adult dose
  - Pediatrics: 5-10 mL/kg
- INR below 1.7 with Plasma:
  - Adults: 500-1500 mL
  - Pediatrics: 10-15 mL/kg
- Fibrinogen above 1.5 g/L with Cryoprecipitate:
  - Adults: 10 units
  - Pediatrics: 1 unit/10 kg

REASSESS
- CBC, INR/PTT, fibrinogen, blood chemistries as appropriate

CONSIDER DISCONTINUING BLOOD COMPONENT THERAPY WHEN
- Shock has resolved
- Bleeding is under control
- Inform BTS when MTP is terminated

FOR ONGOING BLEEDING
- Reassess for the source of bleeding
- Repeat blood components based on lab results and in consultation with BTS, consider other Prohemostatic Drugs:
  - DDAVP
    - Adults: 10.0 mcg/m^2 IV
    - Pediatrics: 0.3 mcg/kg (max 20 mcg)

rFVIIa WARNING
rFVIIa should only be considered in rare circumstances after all other measures have been carried out and there is a likelihood the patient will survive.
- rFVIIa dosing is 0.020 – 0.050 mg/kg IV Direct
<table>
<thead>
<tr>
<th>Anticoagulant</th>
<th>Examples</th>
<th>Antidote</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heparin Sodium</td>
<td>Unfractionated Heparin (UFH)</td>
<td>Protamine sulfate 1 mg/100 Units (Note: Protamine Sulfate does not fully reverse LMWH)</td>
</tr>
</tbody>
</table>
| Low Molecular Weight Heparin (LMWH) | Dalteparin (Fragmin®)  
Tinzaparin (Innohep®) |                                                                 |
| Heparinoid                    | Danaparoid (Orgaran®)                         | No specific antidote                                                      |
| Vitamin K Antagonists         | Acenocoumarol (Sintrom®)  
Warfarin (Coumadin®) | vitamin K$_1$ (Phytonadione) 10 mg IV  
Prothrombin Complex Concentrate  
- INR 1.7 to 5.0 - 40 mL  
- INR greater than or equal to 5.1 or Intracranial Hemorrhage or unknown INR - 80 mL |
| Direct Thrombin Inhibitors    | Argatroban (Argatroban®)  
Bivalrudin (Angiomax®)  
Dabigatrin (Pradax®) | No specific antidote                                                      |
| Factor Xa Inhibitors          | Direct  
Apixaban (Eliquis®)  
Rivaroxaban (Xarelto®) | No specific antidote                                                      |
|                               | Indirect  
Fondaparinux (Arixtra®) |                                                                 |
| Antiplatelet agents           | Acetylsalicylic Acid (Aspirin®)  
Clopidogrel (Plavix®)  
Dipyridamole (Persantine®)  
Dipyridamole & ASA (Aggrenox®)  
Glycoprotein IIb/IIIa inhibitors  
- Abciximab (ReoPro®)  
- Tirofiban (Aggrastat®)  
Prasugrel (Effient®)  
Ticagrelor (Brilinta™)  
Ticlopidine (Ticlid®) | Platelet transfusion |
**Tourniquettes**

**Indications in the field:**
(I) amputation of a limb
(2) multiple-site injury
(3) uncontrolled bleeding from a major limb vessel
(4) multiple-casualty event
(5) night scenario

**Risks of tourniquet use:**
Nerve paralysis
Limb ischemia
Compartment syndrome
Rhabdomyolysis
Increased intravascular coagulation
Tourniquet-induced reperfusion /SIRS

**Recommendations:**
1) re-evaluate bleeding q2.
2) If bleeding under control, replace tourniquet with pressure bandage
3) Watch for signs of impending ischemia
4) Commercial tourniquets
Questions?
Key Points

• Consider Trauma Team Leader Consult early
• Consider ketamine if sedation necessary in trauma
• Hemorrhage is the most common cause of shock in trauma patients
• Give tranexemetic acid early if appropriate
• Tourniquettes save lives when used appropriately
Online resources regarding Sedation

• Emrap.org
  o https://www.emrap.org/episode/penetratingthe/paperchase2

• Emcrit.org

• Minh Le Cong
Thank you
References


