

Episode 10 – Trauma Pearls and Pitfalls

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Intubation considerations

- Consider Lidocaine pretreatment 3min prior to induction for RSI in head-injured patients, although good outcome data is lacking; Fentanyl pretreatment for head-injured patients is recommended by our experts if there is adequate time
- Etomidate – great cardiovascular profile, but no analgesic properties and results in myoclonic jerks
- Ketamine – great CV profile, and should be considered in hypotensive, head-injured patients
- Propofol – because of the high risk of hypotension in trauma patients, it probably shouldn't be used, even in normotensive patients
- Perform a basic neurological examination before chemical paralysis of an altered patient, with pupillary size and response, movement of all extremities, GCS and response to pain to avoid missing a spinal cord lesion and to know whether to work up a blunt vascular injury if CT head is normal
- Avoid the use of fiberoptic airway devices in the trauma patient with an airway full of blood; instead, consider a 'bougie'

Damage-control resuscitation (DRC) – 5 factors:

1. *Avoid hypothermia*, which worsens coagulopathy, by keeping the trauma room warm, having warmed crystalloids and blankets readily available, using *Bair huggers* and *Level-1 infusers*, and covering the patient as much as possible
2. *Permissive hypotension* - maintaining BP (or MAP) lower than the individual patient's normal values in order to allow thrombus formation of injured vessels while still perfusing end-organs; no specific number should be targeted as per our experts, but rather base the target BP on clinical factors (i.e. Is the patient mentating well? Is there adequate urine output? Is this elderly patient usually hypertensive? Is there a 3-hour transport time?); avoid hypotension and hypoxia at all costs in head-injured patients, as it has been shown to worsen outcomes; finally, avoid over-resuscitation, which may lead to compartment syndrome (abdominal and extremity), worsening ICP, and ARDS, pulmonary edema and prolonged ICU stay
3. *Ratio of 1:1:1 for pRBC:FFP:platelets* – although this makes physiologic sense, our experts are not convinced by the available data given that most retrospective studies are plagued by survival bias (i.e. the longer you survive, the more FFPs you will get because it takes longer to thaw them than to just transfuse pRBC; therefore, did you survive *because* you got a 'better' ratio of products, or did you get a 'better' ratio *because* you survived); instead, our experts recommend starting FFP and platelets after 4 units of pRBCs
4. *Rapid and early correction of coagulopathy*, which is both dilutional and secondary to the injury itself
5. *Damage Control Surgery*, whereby the abdomen is simply packed to stop the bleeding (+/- splenectomy if necessary), then the patient is brought to the ICU where the patient's physiological parameters are improved, and then the patient is taken back to the O.R. for definitive repair of all injuries

Hemostasis

- Recombinant factor VIIa – CONTROL trial showed it to be not beneficial and possibly harmful (i.e. increased thrombo-embolic events such as MI or DVTs) in trauma patients
 - CONTROL Trial: *J Trauma. 2010 Sep;69(3):489-500.*
- Tranexamic acid – CRASH-2 trial, with over 20,000 trauma patients worldwide, showed a 1.5% reduction in mortality, but the population was very heterogeneous and mostly in developing countries
 - CRASH-2 Trial: *Lancet. 2010 Jul 3;376(9734):23-32. Epub 2010 Jun 14.*
- Prothrombin complex concentrate (*Octaplex*) – Used, in conjunction with vitamin K, for reversal of warfarin-induced coagulopathy; although the INR returns to normal very quickly (much faster than FFP), it is unclear whether it translates into improved clinical outcomes over FFP

Quick pearls from our experts

- C-collars are associated with decubitus ulcers, raised ICP, pneumonia and delirium, on top of providing relatively poor immobilization (compared to sand bags and tape) and leading to increased ICU and hospital length of stay, so whenever possible, clear the C-spines of patients ASAP
- C-spines of an intubated patient may be cleared if the CT scan is completely normal, i.e. no bony fractures and no soft tissue abnormalities, realizing that if ligamentous injuries are missed, they should become obvious when the patient regains consciousness and can then be re-examined, after which an flexion-extension views x-rays or MRI can be considered
- Vascular access – 2 large-bore antecubital peripheral IVs are enough in most cases, and in severely injured patients a femoral *cordis* may be considered: although there are higher risks of thrombus formation and infection compared with other central line locations, they will be changed rapidly in the ICU and they avoid the difficulties associated with subclavian (i.e. iatrogenic pneumothorax) and intra-jugular access (i.e. in the way of the intubation, and can't rotate the neck in trauma patients whose C-spine has not been cleared)
- Studies have found no difference in mortality in the choice of initial fluid for trauma: normal saline, Ringer's lactate and even colloids appear to all be similar initially; hypertonic saline may be considered, but our experts are not convinced by the evidence; moreover, there is no role for vasopressors in trauma, except in neurogenic shock when other causes of shock have been excluded
- "Every trauma patient is unstable until proven otherwise", so recognize occult shock in patients with currently normal vital signs but with physiology (young athlete with low resting heart rate and BP) or pharmacology (elderly on beta-blocker) that may make their vital signs look normal despite having significant ongoing bleeding; patient's at extremes of age are especially at risk of rapidly deteriorating
- In CT-proven intracranial bleed, consider starting anti-convulsant therapy (Phenytoin) in the ED, which can then be stopped after 1 week if no seizure occurred
- In spinal cord injuries, steroids are not recommended as they appear to have extremely small clinical benefits (if any), and lead to a significant increase in complications (eg, pulmonary infections)
- FAST exam: FAST is a 'rule-in' exam, i.e. a positive scan helps in directing an unstable patient directly to the OR, and not a 'rule-out' exam, i.e. it cannot exclude all injuries, such as <200cc of blood, mesenteric and bowel hematomas, and diaphragmatic and pancreatic injuries, which CT scan can also miss

- In order to decrease ICP, raise the head of the bed 30° (if T/L-spines cleared) or tilt the entire bed, and consider hyperventilation (down to PCO₂ of only 35mmHg) only as a palliative measure for the herniating patient (blown pupil, hemiparesis) en route to the operating room – too much or too long hyperventilation results in respiratory alkalosis, which causes cerebral vasoconstriction and resultant decreased cerebral perfusion pressure; mannitol or hypertonic saline may be given as well
- Consider using bedside ultrasound for detection of pneumothoraces, as the sensitivity for detection has shown to be higher than supine CXR (98% versus 75%) when compared to a gold standard of CT scan
- Chest tubes should be inserted in the ‘triangle of safety’, i.e. between the nipple and axilla, anterior to the latissimus dorsi and posterior to the pectoralis muscle [*Safe insertion of chest drains. Int J Anesth 2009:19(2)*]
- Signs of vascular injury in penetrating trauma:
 - Hard signs, mandating surgical exploration: severe arterial bleeding, shock, large pulsatile or expanding hematoma, new palpable thrill or audible bruit, and distal ischemia based on the 6 Ps (pallor, poikilothermia, pain, paresthesia, paralysis, pulselessness)
 - Soft signs, mandating CT-angiogram: small bleeding, small and stable hematoma, injury to nerve, and proximity of tract to major vessel
 - Ankle-brachial index (ABI) of >90-95% decreases the likelihood of arterial injury
 - Pitfall: relying on an extremity pulse that is positive by Doppler to rule out vascular injury



Pelvic fractures

- Be suspicious in the setting of groin/scrotal or suprapubic swelling or hematoma, tenderness at or palpable defect of the symphysis pubis, blood at the urethral meatus, distal peripheral neuropathy, or pelvic fluid on FAST exam, as well as significant mechanism (see Young-Burgess classification below)
- If gentle inward pressure of the bony pelvis causes movement, DO NOT LET GO and have an assistant wrap the pelvis in a sheet or pelvic binder at the level of the greater trochanters (which is lower than the intuitive location of the iliac crest) before you let go; be sure there are no wrinkles in the sheet to minimize ulcers
- Recognize early pelvic fractures as they can bleed significantly from the venous plexus (most of the times), the canellous bone itself, or from arterial bleeds (which carries the highest mortality, and for which angio-embolization may be successful)
- Keep a high index of suspicion for pelvic hemorrhage, as the initial trauma pelvic x-ray does not correlate well with the level of bleeding – i.e. a seemingly small fracture may hemorrhage extensively if arterial structures are affected nearby
- Young-Burgess classification of pelvis fractures (combined mechanisms may occur):
 - Anterior-posterior compression fractures, i.e. ‘open-book’ injuries, with more neurovascular complications if the posterior pelvic structures (eg, sacro-iliac joints) are involved (usually heralded by a wider pubic symphysis on pelvic x-ray)
 - Lateral compression fractures, with more ligamentous disruption leading to worse results
 - Vertical shear fractures (worst kind), with hemi-pelvis dissociation as a result of a fall from height on an extended limb

Transfer of trauma patients to trauma centres from local hospitals

- If the decision to transfer is made early (based on serious mechanism or poor patient condition), DO NOT 'stay and play'! 'Less is more' in very sick patients! No blood work nor CT scans (they are often repeated at the trauma centre and often using different protocols!) are necessary (although IV access is necessary), and only a CXR (to decide whether a chest tube should be inserted) is required, and possibly a pelvic x-ray (bind it tightly if a fracture is clinically suspected or radiographically present)
- In some rare cases, with a hemodynamically unstable patient and a positive FAST scan, the local general surgeon might elect to perform a damage-control trauma laparotomy in order to prevent death from intra-abdominal solid organ exsanguination
- Other key points are to reduce badly displaced fractures and dislocations, and quickly closing (either with sutures or staples) big lacerations, especially on the scalp, after irrigation, as well as to insert a Foley catheter and an NG tube (or OG in the face of severe facial trauma) in the intubated patient
- Have a slightly lower than normal threshold for intubation, as conditions on the road or in the air are austere and the clinical situation may deteriorate quickly; consider sending blood in the ambulance if available
- Spine boards should be used only for the transfer of patients – log-roll the patient off the spine board ASAP
- Method of transport: the rule of thumb mentioned by our experts is 90min – only if land transport will take more than 90min should you consider using air transport, which is subject to availability, weather conditions, and night time capabilities

Our experts do not recommend *pan-scanning* all major trauma patients, and feel that studies that have shown an unacceptably high rate of missed injuries with selected CT compared to pan-scanning were poorly designed; some trauma centres have a protocol whereby they pan-scan all intubated patients, and do selective x-rays and CT scans for non-intubated patients