MULTIPLE TRAUMA

EPIDEMIOLOGY.

- Unintentional accidents are the leading cause of death in people aged 1-44 years.
- MVCs account for up to 26% of all injury-related deaths
    - Up to 55% of MVC occupant fatalities are *unrestrained*.
- Huge role for public education & prevention programs to reduce death and expenditure on trauma-related injuries.
    - Alcohol & driving, seat-belts, firearm safety etc.

TRAUMA SYSTEMS.

- Overall 15% mortality reduction due to presence of trauma systems.
- Prehospital: requires appropriately injured patients to be transferred to appropriate levels of care. (Avoid under & over-triage).

PRINCIPLES OF DISEASE:

- Common patterns of injuries can be anticipated on the basis of *mechanism of injury*
- Injury patterns can differ greatly between adults & children despite being subjected to similar mechanisms.
    - Children: larger head size, surface area, less protected abdominal cavity. More vulnerable to multi-system pathology.
    - Elderly patients more prone to extremity, craniofacial & closed-head injuries.

PENETRATING TRAUMA:

- Basic anatomic principles are useful in the assessment of patients with penetrating trauma
    - Knife wounds --> expect injuries along track of wound
    - GSW --> amount of tissue damage is related to the KINETIC ENERGY of the bullet imparted to the patient, which is dependent upon:
        - BULLET CALIBRE (weight)
        - VELOCITY
- Hence gun shot leads to injury to surrounding tissue due to direct laceration, crush in jury, shock waves and cavitation
- Close proximity to a shot-gun creates devastating tissue injury.

BLUNT TRAUMA MECHANISMS OF INJURY
see table below.

Table 33-1 Blunt Trauma Mechanisms and Associated Injuries

MECHANISM OF INJURY	ADDITIONAL CONSIDERATIONS	POTENTIAL ASSOCIATED INJURIES
Motor vehicle collisions		
Head-on collision		Facial injuries Lower extremity injuries Aortic injuries
Rear-end collision		Hyperextension injuries of cervical spine Cervical spine fractures Central cord syndrome
Lateral (T-bone) collision		Thoracic injuries Abdominal injuries—spleen, liver Pelvic injuries Clavicle, humerus, rib fractures
Rollover	Greater chance of ejection Significant mechanism of injury	Crush injuries Compression fractures of spine
Ejected from vehicle	Likely unrestrained Significant mortality	Spinal injuries
Windshield damage	Likely unrestrained	Closed head injuries, coup and countercoup injuries Facial fractures Skull fractures Cervical spine fractures
Steering wheel damage	Likely unrestrained	Thoracic injuries Sternal and rib fractures, flail chest Cardiac contusion Aortic injuries Hemo/pneumothoraces
Dashboard involvement/damage		Pelvic and acetabular injuries Dislocated hip
Restraint/seat belt use		
Proper three-point restraint	Decreased morbidity	Sternal and rib fractures, pulmonary contusions
Lap belt only		Chance fractures, abdominal injuries, head and facial injuries/fractures
Shoulder belt only		Cervical spine injuries/fractures, "submarine" out of restraint devices (possible ejection)
Airbag deployment	Front-end collisions Less severe head/upper torso injuries Not effective for lateral impacts More severe injuries in children (improper front seat placement)	Upper extremity soft tissue injuries/fractures Lower extremity injuries/fractures
Pedestrian versus automobile		
Low speed (braking automobile)		Tibia and fibula fractures, knee injuries
High speed		Waddle's triad—tibia/fibula or femur fractures, truncal injuries, craniofacial injuries "Thrown" pedestrians at risk for multisystem injuries
Bicycle		
Automobile related		Closed head injuries "Handlebar" injuries Spleen/liver lacerations Additional intra-abdominal injuries Consider penetrating injuries
Nonautomobile related		Extremity injuries "Handlebar" injuries
Falls	LD_{50} 36–60 ft	
Vertical impact		Calcaneal and lower extremity fractures Pelvic fractures Closed head injuries Cervical spine fractures Renal and renal vascular injuries
Horizontal impact		Craniofacial fractures Hand and wrist fractures Abdominal and thoracic visceral injuries Aortic injuries

MANAGEMENT:

GENERAL PRINCIPLES:

- Involves coordination of multiple providers, performing assessments, diagnostics and interventions SIMULTANEOUSLY
- It is our job to consider the worst possible injury and act accordingly until the diagnosis is either confirmed or excluded

PRIMARY SURVEY:

AIRWAY MANAGEMENT WITH CERVICAL SPINE CONTROL:

- Airway management was likely responsible for 16% of preventable errors contributing to trauma mortality
- Goals are threefold:
    - Airway protection
    - Adequate oxygention
    - Adequate ventilation
- Airway protection is mandated in various circumstances:
    - AIRWAY OBSTRUCTION --> immediate intervention
        - Confounded by debris, blood or vomitus (easily removable)
        - Neck/facial trauma may be more problematic
            - Swelling, haematoma formation and distorted anatomy
            - Early intervention as these conditions worsen over time
    - CONSCIOUSNESS IMPAIRED (GCS ≤ 8)
- If decision is made to intubate, brief neurological assessment important prior
    - RSI with in-line immobilisation is the method of choice
        - No reported cases of SCI when this is applied to orotracheal intubation in trauma
- CERVICAL SPINE CONTROL:
    - As part of airway
    - ***NEXUS*** --> Five criteria, which if all were negative gave a 99.6% sensitivity and 99.9% negative predictive value for the presence of fractures
        - No posterior midline tenderness
        - No evidence of intoxication
        - Alert mental status
        - No focal neurologic deficits
        - No painful distracting injuries
    - ***CANADIAN C-SPINE RULE*** --> incorporated mechanistic factors with examination findings. Showed better predictive values.
    - It is crucial to note that plain films can miss up to 15% of all cervical spine fractures (esp single cross table view)
        - CT sensitivity 98%
        - However --> can still have unstable ligamentous injuries

BREATHING AND ASSESSMENT OF VENTILATION:

- All trauma patients should be placed on supplemental oxygen due to poor outcomes in hypoxic patients (esp head injury)
- Signs of compromised breathing:
    - ↑'d work of breathing
    - ↑ RR
    - Penetrating wounds
    - Flail segments
    - Tracheal deviation
    - Distended neck veins
- Consider haemothorax, pneumothorax (tension, open, simple)
    - Decompress (either with needle thoracostomy for tension or tube thoracostomy with 32 Fr ICC)
    - If ≥ 1.5L drained primarily or if output > 200-400mL per hour or if persistent air leak --> OT
- ADJUNCTS:
    - CXR for all trauma patients --> this concept is being challenged as it may be too insensitive a tool to rule out mediastinal injuries/blunt dissection, even in patients with normal physical exam
    - US: more sensitive and rapid than CXR to assess for haemothorax or pneumothorax
    - In a patient with significant mechanism, CT is the imaging modality of choice.

CIRCULATION AND HAEMORRHAGE CONTROL:

- Assessment of haemodynamics and circulatory status
- Indications of adequacy of perfusion include;
    - Mental status, skin color/temperature, HR/BP, capillary refill
- Control of external haemorrhage is crucial
    - Direct pressure over tourniquets
- Obtain large bore access x2 --> consider US/intraosseous access if difficult.
    - Basic bloods plus group and screen
- Concept of PERMISSIVE HYPOTENSION
    - Based on concept that resuscitation to normal BP may worsen bleeding
    - Not proved/disproved by Cochrane review.
    - *Contraindicated in head injured patients* because of risk of hypoperfusion.
    - One study showed ↑'d mortality amongst those being getting aggressive IV resus prior to operative haemorrhage control
- ATLS guidelines mandate 2L crystalloid followed by blood (in practice go blood early).
    - O-positive for all except women of childbearing age, type specific when available

- ADJUNCTS:
    - Extended FAST (eFAST) as part of primary survey as a screening tool
        - Positive scan in hypotensive patients can identify with good sensitivity the need for emergent laparotomy
    - Pelvic x-ray --> source of significant haemorrhage and early recognition and closure can mitigate bleeding
    - Lactate and base excess used as measures of adequacy of resus

DISABILITY:

- Rapid assessment of patient's neurologic status
    - GCS commonly employed but not perfect tool
- Intubated patients should undergo continuous capnography, and CO2 levels should be maintained on the lower end of normal

EXPOSURE:

- Undressing the patient in order to assess for inconspicuous injuries
    - Special attention to axilla, perineum and skin folds
- Prevent hypothermia (esp in extremes of age)

SECONDARY SURVEY:

- **AMPLE** history:
    - Allergies
    - Medications
    - PMHx
    - Last meal
    - Events/environment relating to injury

Table 33-3 Secondary Survey

REGION/SYSTEM	ASSESSMENT/EXAMINATION
General	Level of consciousness GCS score Specific complaints
Head	Pupils (size, shape, reactivity, visual fields) Contusions Lacerations Evidence of skull fracture (hemotympanum, Battle's sign, raccoon eyes, palpable defects)
Face	Contusions Lacerations Midface instability Malocclusion
Neck (maintain cervical immobilization)	Penetrating injury/lacerations Tracheal deviation Jugular venous distention Subcutaneous emphysema Hematoma Midline cervical tenderness
Chest	Respiratory effort/excursion Contusions Lacerations Focal tenderness/crepitus Subcutaneous emphysema Heart tones (muffled) Breath sounds (symmetrical)
Abdomen/flank	Contusions Penetrating injury/lacerations Tenderness Peritoneal signs
Pelvis/genitourinary	Contusions Lacerations Stability/symphyseal tenderness Blood (urethral meatus, vaginal bleeding, hematuria) Rectal examination
Neurologic/spinal cord	Midline bony spinal tenderness Mental status Paresthesias Sensory level Motor function, including sphincter tone
Extremities	Contusions Lacerations Deformity Focal tenderness Pulses Capillary refill Evaluation of compartments

SPECIAL CONSIDERATIONS/SITUATIONS:

- SEVERE HEAD TRAUMA:
    - In order to quickly identify patients with intracranial injuries who may benefit from neurosurgical evacuation, defer any procedures that do not correct a specific problem until after head CT

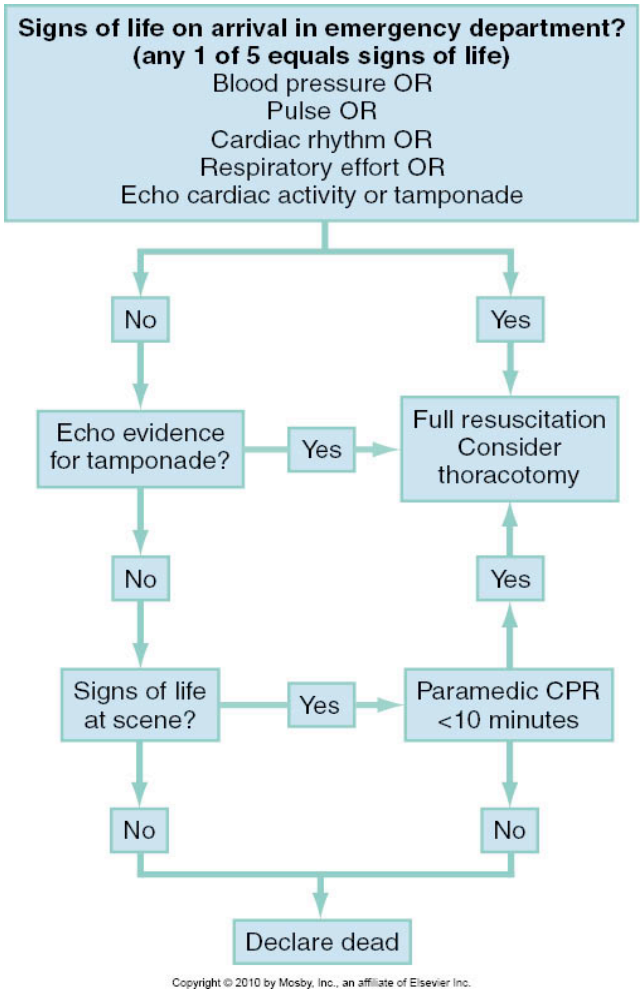
- TENSION OR OPEN PNEUMOTHORAX, MASSIVE HAEMOTHORAX
    - Apparent during primary survey

- PENETRATING ABDOMINAL TRAUMA:
    - Abdominal tenderness or distension on palpation, coupled with hypoperfusion, indicate the emergent need for surgery in a patient who has sustained a penetrating abdominal injury.

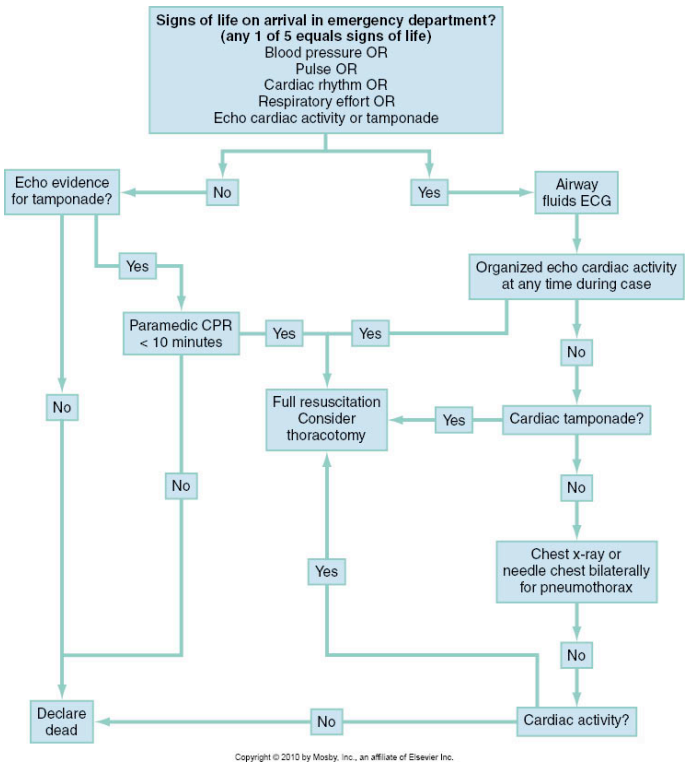
- IMPALED OBJECTS.
    - Stay in situ until OT to ensure prompt vascular control

- TRAUMATIC ARREST:
    - Unless obvious signs of death are present in the field --> transport to ED
    - For any patient in traumatic arrest upon arrival, the CRITICAL DECISION to be made is the appropriate level of resuscitation and specifically the NEED FOR ED THORACOTOMY
    - One analysis of 862 patients showed survival rates (neurologically intact) was 3.9%
        - Best outcomes were in stab wounds to the chest
        - 23% in stab wounds with breathing or pulse in the field
        - 38% in those who were moribund but had some indication of respiration or pulse on arrival to ED
    - Strongest recommendation for EDT is for victims of penetrating chest trauma with witnessed signs of life during transport to or in the ED and at least cardiac electrical activity upon arrival
    - In patients with blunt trauma, prolonged CPR, or delayed transport HAVE DISMAL OUTCOMES
    - When performed, the goal of EDT is to manage rapidly correctable traumatic injuries and allow for transfer to definitive operative intervention
    - Once the chest is open, a number of measures can be undertaken:
        - Tamponade may be relieved by pericardiotomy (after isolation/recognition of the phrenic nerve)
        - Cardiac lacerations can be repaired (or point pressure)
        - Compressing or cross-clamping the pulmonary hilum
            - Damage to bronchus is likely
        - Descending aorta is compressed to maximise coronary and cerebral perfusion
        - Open cardiac massage can also be performed

ROSENS OUTLINES THE TWO FOLLOWING ALGORITHMS FOR ED THORACOTOMY IN PENETRATING AND BLUNT TRAUMA WITH ARREST



PENETRATING TRAUMA



BLUNT TRAUMA