Atrium Health
Musculoskeletal Institute

Initial Evaluation of the Orthopedic Trauma Patient

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OrthoCarolina

Carolina NeuroSurgery & Spine Associates

Outline

- Evaluation
  - ATLS/ABCDE
  - Primary, Secondary, Tertiary Exams
- Urgencies & Emergencies
- Damage Control Orthopedics
- PEARLS

Trauma

- Major public health issue with high disability, death, and societal cost
- Three peak times of death after trauma
  - 50% within the first few minutes - massive hemorrhage/neuro injury
  - 30% within the first few days - shock, hypoxia, neurologic injury
  - 20% within days to weeks – multisystem organ failure, infection
- With evolution of safety, decreased rates of
  - Closed head injury
  - Thoracolumbar injuries
  - Need for extraction

The Golden Hour

- Golden Hour
  - Period of time when life/limb threatening injuries should be treated to decrease mortality
  - Estimated 60% of preventable deaths can occur during this time

Initial Evaluation

- Advanced Trauma Life Support (ATLS) protocol
  - Primary survey
  - Secondary survey
  - Tertiary survey

Primary Survey

A: Airway

- Evaluation:
  - Maintain C-spine precautions
  - Integrity of airway
    - Traumatic obstruction
      - Ex: facial fractures, tracheal injury, foreign body, aspiration
    - Unable to protect airway due to altered consciousness
    - Cervical spine injuries (C3-5)
- Intervention:
  - Endotracheal intubation or cricothyrotomy with mechanical intervention

B: Breathing

- Evaluation
  - Chest x-ray
    - Pneumothorax, hemothorax, fractures (rib, sternum, flail chest), pulmonary contusion
  - Arterial blood gas
- Intervention:
  - Respiratory support if not already established
  - Management of contributing / chronic conditions
    - Chest tubes, pain management

C: Circulation

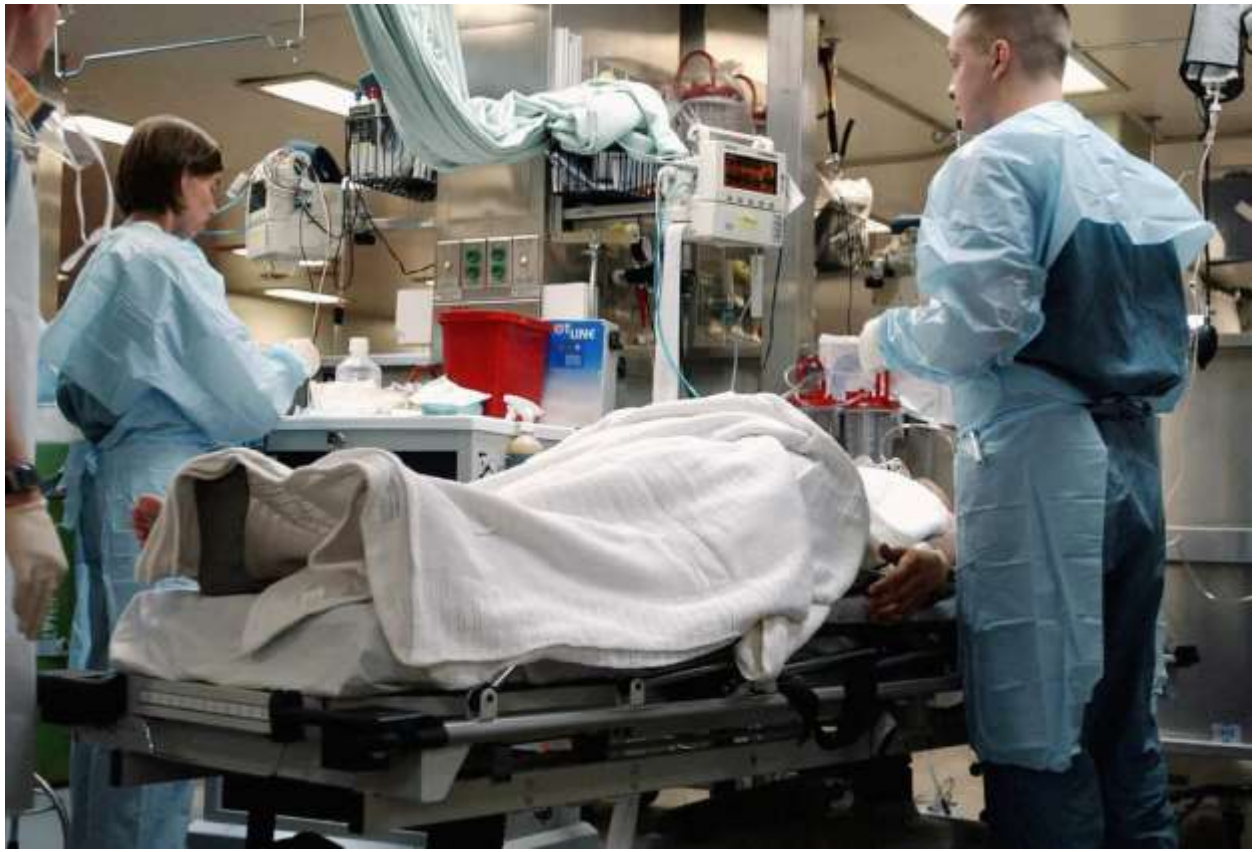
- Evaluation:
  - Pulses, capillary refill, peripheral perfusion
  - AP chest, AP pelvis
- Intervention:
  - Pressure to any obvious hemorrhage
    - Tourniquets, pelvic binder/sheet
  - Resuscitation
    - Packed red blood cells
    - Massive transfusion protocol

D: Disability

- Evaluation:
  - Neurologic
    - Pupillary exam
    - Glasgow Coma scale
    - Rectal exam
    - Sensory / motor / reflexes
- Intervention:
  - Maintain log roll
  - Maintain spinal precautions

E: Exposure with environmental control

- Evaluation:
  - Completely undress the patient
- Intervention:
  - Prevention of hypothermia
    - Warmed fluids
    - Bair hugger / blankets



Assessment of Shock

- Vital signs
  - Hypovolemic: ↑ heart rate ↓ blood pressure
  - Neurogenic: ↓ heart rate ↓ blood pressure
- Labs
  - Metabolic Acidosis
  - Lactate > 2.5
  - Base excess > 8
  - Coagulopathic
  - Hypothermic < 35°C

Classification of Hemorrhagic Shock:

PARAMETER	Class			
	I	II	III	IV
Blood loss (%)	0–15	15–30	30–40	>40
Central nervous system	Slightly anxious	Mildly anxious	Anxious or confused	Confused or lethargic
Pulse (beats/min)	<100	>100	>120	>140
Blood pressure	Normal	Normal	Decreased	Decreased
Pulse pressure	Normal	Decreased	Decreased	Decreased
Respiratory rate	14–20/min	20–30/ min	30–40/min	>35/min
Urine (mL/hr)	>30	20–30	5–15	Negligible
Fluid	Crystalloid	Crystalloid	Crystalloid + blood	Crystalloid + blood

Hemorrhagic Shock

- Evaluation:
  - Identification of source:
    - Physical examination / inspection
    - Radiographs
    - Focused assessment with sonography for trauma (FAST) scan
  - Intervention
    - Bleeding control – tourniquet, direct pressure, pelvic binder, etc
    - Resuscitation

Resuscitation

- Intravenous fluids
  - Crystalloid isotonic solution → lactated ringers preferred
- Blood products
  - Emergency release blood – O negative
  - Packed red blood cells
  - Massive transfusion protocol
    - 1:1:1 ratio of pRBC : plasma : platelets
- Continued evaluation
  - Urine output (goal: ≥ 30 cc/h)
  - Lactate (goal: < 2.5 mmol/L)
  - Base deficit (goal: -2 to +2)

Secondary Survey

- Follows completion of primary survey
  - Once resuscitation efforts are underway, hemodynamic improvement
- Head to toe evaluation of the patient including repeat vital signs
- Obtain as much of a history as possible
- Obtain all necessary diagnostic studies
  - Labs
  - Imaging
    - ± Lateral view C-spine
    - “Pan Scan”
      - CT Head, CT C-spine, CT Chest, CT Abdomen/Pelvis
        - Contrasted studies
        - Thoracic / lumbar spine on CT A/P

Tertiary Survey

- Full, repeated head-to-toe examination within 24 hours of injury
  - 12% of injuries missed in polytrauma missed in first 24 hours
    - 36% decrease in missed injuries with use of standardized tertiary survey
- Workup any new or different findings

Orthopedic Injuries

- Life > limb
  - Especially in the setting of polytrauma patient
- Many orthopedic injuries affect patient mortality

Ortho Trauma Urgencies & Emergencies

- Fractures / dislocations
  - Open
  - Associated with vascular compromise
    - Unstable pelvis
    - Knee dislocation
- Compartment syndrome
- Traumatic amputation
- Spine Injury with neurologic Deficit

Open Fractures

- Emergent management
  - **<u>Antibiotics</u>**
  - Bedside irrigation
  - Absorptive dressing
  - Reduction & immobilization
  - Tetanus

- Definitive management
  - Consensus is take to OR ***as soon as possible*** after life threatening conditions stabilized
    - Timing of debridement has NOT been associated with infection
    - Early administration of antibiotics leads to decreased rates of infections
  - Continue antibiotics until operating room

Knee Dislocation

- Emergent management
  - Control hemorrhage if present
  - Reduction & knee immobilizer
    - Neurovascular exam
      - ABI < 0.9 – CT angiogram / consult vascular
      - ABI > 0.9 – serial examinations

Unstable Pelvic Fractures

- Emergent management
  - Identification and bleeding control
    - Pelvic binder / sheet
  - Resuscitation
    - Associated with blood loss (up to 4L)
    - Nonresponsive: angiography, ORIF
  - Evaluation of concurrent injury
    - Genitourinary
    - Reproductive
    - Neuro / vascular

Compartment Syndrome

- Emergent management
  - Remove splint or dressing
  - Clinical assessment
    - Intra-compartment pressure monitor
  - OR for fasciotomy **NOW**

Traumatic Amputation / Mangled Extremity

- Emergent management
  - Control bleeding

Spine Injury with Neurologic Deficit

- Emergent management
  - Prevention of further injury
    - Spine precautions
    - Log roll procedures
    - Cervical spine collar
    - ± bedside traction
  - CT ± MRI if time allows
  - Complete and thorough, well documented assessment
    - Repeat assessments

Damage Control Orthopaedics

- Concept of delaying definitive treatment until physiology has improved
- Staging definitive management to avoid additional trauma to patient during a vulnerable physiologic period
  - Still controversial timing decision

- Replaced the 1980's philosophy of Early Total Care (ETC)— fixing long bone and complex fractures as soon as possible because patients were "too sick not to operate"
  - ETC led to exacerbation of "second hit" in subset of patient with instability

Damage Control Orthopaedics

- Injury Severity Score (ISS)
  - Three highest AIS values (from different anatomic areas)
    - Each value squared then added (sum)
  - Bilateral injuries are counted once

Injury Severity Score; ISS

Region	Injury Description	AIS	Square Top Three
Head & Neck	Cerebral Contusion	3	9
Face	No Injury	0	
Chest	Flail Chest	4	16
Abdomen	Minor Contusion of Liver Complex Rupture Spleen	2 5	25
Extremity	Fractured femur	3	
External	No Injury	0	
		Injury Severity Score:	50

AIS Score	Injury
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Survivable

ISS	
1-8	Minor
9-15	Moderate
16-24	Serious
25-49	Severe
50-74	Critical
75	Maximum

New Injury Severity Score (NISS)

- Three highest AIS values regardless of anatomic region are utilized
- May be a better predictor of morbidity and mortality

Damage Control Orthopaedics

- Indicated if:
  - ISS > 20 with thoracic trauma or ISS > 40 without thoracic trauma
  - GCS ≤ 8
  - Multiple injuries in setting of severe pelvic/abdominal trauma and hemorrhage
  - Bilateral femur fractures
  - Hypothermia < 35°C
  - Pulmonary contusion
  - AIS ≥ 3 with head injury
  - IL-6 values > 500 pg/dL
- Stabilization with plans for staged definitive management
  - External fixation
  - Skeletal traction

Acute Inflammatory Window

- 2 – 5 days after trauma
- Surge in inflammatory markers → ↑ acute respiratory distress syndrome and multisystem organ failure

- Only life-threatening injuries should be treated in this period:
  - Includes unstable pelvic fractures, compartment syndrome, fractures with vascular injuries, unreduced dislocations, traumatic amputations, unstable spine fractures, cauda equina syndrome, open fracturs

Early Appropriate Care

- Identifies trauma patients and timing of most critical injuries while appreciating and minimizing secondary inflammatory response
- Guided by laboratory data
  - Lactate < 4.0 mmol/L
  - pH > 7.25
  - Base Excess > 5.5 mmol/L
- Optimal timing to OR within 36 hours
- Goals:
  - Decrease complications
  - Early mobilization

Multi-System Organ Failure

- Many theories surrounding etiology
- High incidence of mortality
- May be related to imbalance between inflammatory mediators

Acute Respiratory Distress Syndrome

- Clinical manifestations
  - Acute onset
  - Fever
  - Tachycardia
  - Hyperventilation
  - Diagnostics
    - Leukocytosis
    - Bilateral infiltrates on chest XR
- High incidence of mortality
  - Predictive of disseminated intravascular coagulation, acute renal failure, shock,
- Physiologic response to trauma
  - Systemic Inflammatory Response Syndrome (SIRS)
  - “First Hit” phenomena
  - Pro-inflammatory cytokine response

PEARLS

- Evaluation of polytrauma patient guided by ATLS protocol
- Collaborative approach with emergency department, trauma/general Surgery, vascular, neurosurgery, intensivists, and orthopedics from start to finish
- Recognition of indications for and implementation of damage control orthopedics
    - Address time sensitive urgencies and emergencies to ↓ morbidity/mortality
- Examine your patients the same way EVERY time
    - Don’t skip portions of exam based upon diagnosis “called for”
    - Take off splints – see with your own eyes!
- Know your resources and protocols for your hospital
- Remember, you are the orthopedic expert

References

Lack WD, Karunakar MA, Angerame MR, et al. Type III open tibia fractures: immediate antibiotic prophylaxis minimizes infection. *J Orthop Trauma*. 2015;29:1-6.

Nural MS, Yardan T, Guven H, et al. Diagnostic value of ultrasound in the evaluation of blunt abdominal trauma. *Dian Interv Radiol.* 2005; 11: 41-44.

Biffl WL, Harrington DT, Cioffi WG. Implementation of a tertiary survey decreases missed injuries. *J Trauma.* 2003; 54: 38-43.

Manson T, O'Toole RV, Whitney A, et al. Young-Burgess classification of pelvic ring fractures: does it predict mortality, tranfusion requirements, and non-orthopaedic injuries? *J Orthop Trauma.* 2010; 24: 603-609.

Smith, BP, Goldberg, AJ, Gaughan, JP, Seamon, MJ. A comparison of injury severity score and new injury severity score after penetrating trauma: A prospective analysis. *J of Trauma and Acute Care Surgery.* 2015; 79 (2): 269-274.

Pape HC, Aufm'Kolk M, Paffrath T et al. *J Trauma.* 1993; 34: 540-547.

OTA educational lectures.