Attribution Key

for more information see: http://open.umich.edu/wiki/AttributionPolicy

Use + Share + Adapt

{ Content the copyright holder, author, or law permits you to use, share and adapt. }

- **Public Domain – Government**: Works that are produced by the U.S. Government. (17 USC § 105)
- **Public Domain – Expired**: Works that are no longer protected due to an expired copyright term.
- **Public Domain – Self Dedicated**: Works that a copyright holder has dedicated to the public domain.
- **Creative Commons – Zero Waiver**
- **Creative Commons – Attribution License**
- **Creative Commons – Attribution Share Alike License**
- **Creative Commons – Attribution Noncommercial License**
- **Creative Commons – Attribution Noncommercial Share Alike License**
- **GNU – Free Documentation License**

Make Your Own Assessment

{ Content Open.Michigan believes can be used, shared, and adapted because it is ineligible for copyright. }

- **Public Domain – Ineligible**: Works that are ineligible for copyright protection in the U.S. (17 USC § 102(b)) *laws in your jurisdiction may differ*

{ Content Open.Michigan has used under a Fair Use determination. }

- **Fair Use**: Use of works that is determined to be Fair consistent with the U.S. Copyright Act. (17 USC § 107) *laws in your jurisdiction may differ*

Our determination **DOES NOT** mean that all uses of this 3rd-party content are Fair Uses and we **DO NOT** guarantee that your use of the content is Fair.

To use this content you should **do your own independent analysis** to determine whether or not your use will be Fair.
Objectives

- Epidemiology of Trauma Care
- History of Development of Trauma Care
- Mechanisms of Injury
- Basics of Trauma Management
  - Primary Survey
  - Resuscitation
  - Secondary Survey
  - ABCDE Format
  - Cervical Spinal Immobilization
- Specific Case Examples
Initial Assessment and Management of the Trauma Patient
Epidemiology

Road Traffic Accidents are major cause of long term morbidity and mortality in developing nations
  – In the first quarter of 2009, 372 deaths in Ghana from Road Traffic Accidents
  – 25% increase from previous year

WHO predicts that by 2020, Road Traffic Accidents will be second leading cause of loss of life for world’s population

High Morbidity = Loss of income to society

Challenges in Developing Countries
  – Technological Advances in Trauma Care
  – Lack of Infrastructure for Trauma Management

EMS
Pre-hospital notification
MD/RN Training in trauma care
Injury: Scale of the Global Problem

- 5.8 million deaths/year
- 10% of world's deaths
- 32% more deaths than HIV, TB and Malaria combined

Source: Global Burden of Disease, WHO, 2004
Injury: Scale of the Global Problem


World Health Organization, who.int
Epidemiology

Trimodal Distribution of Trauma Deaths

- Golden Hour = 80% of trauma deaths in first hour after injury
- Rapid trauma care has greatest level of impact in these patients
History of Trauma System Development

- Standardized Trauma Assessment
  - Nebraska Cornfield, 1976
  - Orthopedic Surgeon
  - Lead to development of ATLS

- Trauma Systems Development
  - First developed my military in wartime
    - i.e. MASH Units
  - Expanded in US to Level 1, 2, 3 Trauma Centers
    - Urban Systems
    - Statewide networks of systems
    - Level 1 – Highest level of care, Leaders in research, clinical care and education
    - Level 2 – Provides definitive care in wide range of complex traumatic patients
    - Level 3 – Provides initial stabilization and treatment. May care for uncomplicated trauma patients
    - Level 4 – Provides initial stabilization and transfers all trauma patients for definitive care
Mechanisms of Injury

■ Blunt Trauma
  – Compression Forces
    ■ Cells in tissues are compressed and crushed
    ■ E.g. Spleen
  – Shear Forces
    ■ Acceleration/Deceleration Injury
    ■ E.g. Aorta
      – Shearing force = Spectrum from Full thickness tear (Exsanguination) to Partial tear (Pseudoaneurysm)
  – Overpressure
    ■ Body cavity compressed at a rate faster than the tissue around it, resulting in rupture of the closed space
    ■ E.g. Plastic bag
    ■ E.g. in trauma = diaphragmatic rupture, bladder injury
Mechanisms of Injury

- Frontal Impact Collisions
- Lateral Impact Collisions (T bone)
- Rear Impact Collisions
- Rollover Mechanism
- Open Vehicle or Motorcycle/Moped
- Pedestrian Vs. Car
- Penetrating Injury (Guns vs. Knives)
Basics of Trauma Assessment

- **Preparation**
  - Team Assembly
  - Equipment Check

- **Triage**
  - Sort patients by level of acuity (SATS)

- **Primary Survey**
  - Designed to identify injuries that are immediately life threatening and to treat them as they are identified

- **Resuscitation**
  - Rapid procedures and treatment to treat injuries found in primary survey before completing the secondary survey

- **Secondary Survey**
  - Full History and Physical Exam to evaluate for other traumatic injuries

- **Monitoring and Evaluation, Secondary adjuncts**

- **Transfer to Definitive Care**
  - ICU, Ward, Operating Theatre, Another facility
Preparation for Patient Arrival

Organize Trauma Response Team

TL: Team Leader
A: Anaesthetist
GS: General Surgeon
OS: Orthopaedic Surgeon
ED: Emergency Department Physician
AA: Anaesthetic Assistant
N1: Nurse 1
N2: Nurse 2
R: Radiographer
S: Scribe

Top and bottom images: [http://www.trauma.org/archive/resus/traumateam.html](http://www.trauma.org/archive/resus/traumateam.html)
Primary Survey

- Airway and Protection of Spinal Cord
- Breathing and Ventilation
- Circulation
- Disability
- Exposure and Control of the Environment
Primary Survey

Key Principles

– When you find a problem during the primary survey, FIX IT.
– If the patient gets worse, restart from the beginning of the primary survey
– Some critical patients in the Emergency Department may not progress beyond the primary survey
Airway and Protection of Spinal Cord

Why first in the algorithm?
- Loss of airway can result in death in < 3 minutes
- Prolonged hypoxia = Inadequate perfusion, End-organ damage

Airway Assessment
- Vital Signs = RR, O2 sat
- Mental Status = Agitation, Somnolent, Coma
- Airway Patency = Secretions, Stridor, Obstruction
- Traumatic Injury above the clavicles
- Ventilation Status = Accessory muscle use, Retractions, Wheezing

Clinical Pearls
- Patients who are speaking normally generally do not have a need for immediate airway management
- Hoarse or weak voice may indicate a subtle tracheal or laryngeal injury
- Noisy respirations frequently indicates an obstructed respiratory pattern
Airway Interventions

- Maintenance of Airway Patency
  - Suction of Secretions
  - Chin Lift/Jaw thrust
  - Nasopharyngeal Airway
  - Definitive Airway

- Airway Support
  - Oxygen
  - NRB (100%)
  - Bag Valve Mask
  - Definitive Airway

- Definitive Airway
  - Endotracheal Intubation
    - In-line cervical stabilization
  - Surgical Cricothyroidotomy
Protection of Spinal Cord

- General Principle: Protect the entire spinal cord until injury has been excluded by radiography or clinical physical exam in patients with potential spinal cord injury.

- Spinal Protection
  - Rigid Cervical Spinal Collar = Cervical Spine
  - Long rigid spinal board or immobilization on flat surface such as stretcher = T/L Spine

- Etiology of Spinal Cord Injury (U.S.)
  - Road Traffic Accidents (47%)
  - High energy falls (23%)

- Clinical Pearls
  - Treatment (Immobilization) before diagnosis
  - Return head to neutral position
  - Do not apply traction
  - Diagnosis of spinal cord injury should not precede resuscitation
  - Motor vehicle crashes and falls are most commonly associated with spinal cord injuries
  - Main focus = Prevention of further injury
C-spine Immobilization

- Return head to neutral position
- Maintain in-line stabilization
- Correct size collar application
- Blocks/tape
- Sandbags

James Heilman, MD, Wikimedia Commons

Paladinsf (flickr)
Breathing and Ventilation

- **General Principle:** Adequate gas exchange is required to maximize patient oxygenation and carbon dioxide elimination
- **Breathing/Ventilation Assessment:**
  - Exposure of chest
  - General Inspection
    - Tracheal Deviation
    - Accessory Muscle Use
    - Retractions
    - Absence of spontaneous breathing
    - Paradoxical chest wall movement
  - Auscultation to assess for gas exchange
    - Equal Bilaterally
    - Diminished or Absent breath sounds
  - Palpation
    - Deviated Trachea
    - Broken ribs
    - Injuries to chest wall
Breathing and Ventilation

- Identify Life Threatening Injuries
  - Tension Pneumothorax
    - Air trapping in the pleural space between the lung and chest wall
    - Sufficient pressure builds up and pressure to compress the lungs and shift the mediastinum

- Physical exam
  - Absent breath sounds
  - Air hunger
  - Distended neck veins
  - Tracheal shift

- Treatment
  - Needle Decompression
    - 2nd Intercostal space, Midclavicular line
  - Tube Thoracostomy
    - 5th Intercostal space, Anterior axillary line
Breathing and Ventilation

■ Hemothorax
  
  – Blood collecting in the pleural space and is common after penetrating and blunt chest trauma
  
  – Source of bleeding = Lung, Chest wall (intercostal arteries), heart, great vessels (Aorta), Diaphragm
  
  – Physical Exam
    ■ Absent or diminished breath sounds
    ■ Dullness to percussion over chest
    ■ Hemodynamic instability
  
  – Treatment = Large Caliber Tube Thoracostomy
    ■ 10-20% of cases will require Thoracostomy for control of bleeding

Breathing and Ventilation

- **Flail Chest**
  - Direct injury to the chest resulting in an unstable segment of the chest wall that moves separately from remainder of thoracic cage
  - Typically results from two or more fractures on 2 or more ribs
  - Typically accompanied by a pulmonary contusion
  - Physical exam = paradoxical movement of chest segment
  - Treatment = improve abnormalities in gas exchange
    - Early intubation for patients with respiratory distress
    - Avoidance of overaggressive fluid resuscitation

Breathing and Ventilation

- Open Pneumothorax
  - Sucking Chest Wound
  - Large defect of chest wall
  - Leads to rapid equilibration of atmospheric and intrathoracic pressure
  - Impairs oxygenation and ventilation

- Initial Treatment
  - Three sided occlusive dressing
  - Provides a flutter valve effect
  - Chest tube placement remote to site of wound
  - Avoid complete dressing, will create a tension pneumothorax


Middle and bottom images:
Author unknown, http://www.brooksidepress.org/Products/OperationalMedicine/DATA/operationalmed/Procedures/TreataSuckingChestWound.htm
**Needle Thoracostomy**

- Midclavicular line
- 14 gauge angiocath
- **Over** the 2nd rib
- Rush of air is heard

Author unknown,
Tube Thoracostomy

- Insertion site
  - 5th intercostal space,
  - Anterior axillary line
- Sterile prep, anesthesia with lidocaine
- 2-3 cm incision along rib margin with #10 blade
- Dissect through subcutaneous tissues to rib margin
- Puncture the pleura over the rib
- Advance chest tube with clamp and direct posteriorly and apically
- Observe for fogging of chest tube, blood output
- Suture the tube in place

Complications of Chest Tube Placement
- Injury to intercostal nerve, artery, vein
- Injury to lung
- Injury to mediastinum
- Infection
- Allergic reaction to lidocaine
- Inappropriate placement of chest tube

Circulation

- Shock
  - Impaired tissue perfusion
  - Tissue oxygenation is inadequate to meet metabolic demand
  - Prolonged shock state leads to multi-organ system failure and cell death

- Clinical Signs of Shock
  - Altered mental status
  - Tachycardia (HR > 100) = Most common sign
  - Arterial Hypotension (SBP < 120)
    - Femoral Pulse – SBP > 80
    - Radial Pulse – SBP > 90
    - Carotid Pulse – SBP > 60
  - Inadequate Tissue Perfusion
    - Pale skin color
    - Cool clammy skin
    - Delayed cap refill (> 3 seconds)
    - Altered LOC
    - Decreased Urine Output (UOP < 0.5 mL/kg/hr)
Types of Shock in Trauma

- Hemorrhagic
  - Assume hemorrhagic shock in all trauma patients until proven otherwise
  - Results from Internal or External Bleeding

- Obstructive
  - Cardiac Tamponade
  - Tension Pneumothorax

- Neurogenic
  - Spinal Cord injury

Sources of Bleeding

- Chest
- Abdomen
- Pelvis
- Bilateral Femur Fractures
Circulation

- Emergency Nursing Treatment
  - Two Large IV Lines
  - Cardiac Monitor
  - Blood Pressure Monitoring

- General Treatment Principles
  - Stop the bleeding
    - Apply direct pressure
    - Temporarily close scalp lacerations
  - Close open-book pelvic fractures
    - Abdominal pelvic binder/bed sheet
  - Restore circulating volume
    - Crystalloid Resuscitation (2L)
    - Administer Blood Products
  - Immobilize fractures

- Responders vs. Nonresponders
  - Transient response to volume resuscitation = sign of ongoing blood loss
  - Non-responders = consider other source for shock state or operating room for control of massive hemorrhage
Circulation

- Pericardial Tamponade
  - Pericardium or sac around heart fills with blood due to penetrating or blunt injury to chest
  - Beck’s Triad
    - Distended jugular veins
    - Hypotension
    - Muffled heart sounds
  - Treatment
    - Rapid evacuation of pericardial space
    - Performed through a pericardiocentesis (temporizing measure)
    - Open thoracotomy
Pericardiocentesis

- Puncture the skin 1-2 cm inferior to xiphoid process
- 45/45/45 degree angle
- Advance needle to tip of left scapula
- Withdraw on needle during advance of needle
- Preferable under ultrasound guidance or EKG lead V attachment

Complications
- Aspiration of ventricular blood
- Laceration of coronary arteries, veins, epicardium/myocardium
- Cardiac arrhythmia
- Pneumothorax
- Puncture of esophagus
- Puncture of peritoneum
Circulation

- A word about cardiac arrest . . .
  - Care of the trauma patient in cardiac arrest
    - CPR
    - Bilateral Tube Thoracostomy
    - Pericardiocentesis
    - Volume Resuscitation
  - Traumatic cardiac arrest due to blunt injury has very low survival rate (< 1%)
    - No point for emergency thoracotomy
  - Selected cases of cardiac arrest due to penetrating traumatic injury may benefit from emergent thoracotomy
    - Pericardial tamponade
    - Cross clamp aorta
Disability

- **Baseline Neurologic Exam**
  - Pupillary Exam
    - Dilated pupil – suggests transtentorial herniation on ipsilateral side
  - AVPU Scale
    - Alert
    - Responds to verbal stimulation
    - Responds to pain
    - Unresponsive
  - Gross Neurological Exam – Extremity Movement
    - Equal and symmetric
    - Normal gross sensation
  - Glasgow Coma Scale: 3-15
  - Rectal Exam
    - Normal Rectal Tone

- **Note:** If intubation prior to neuro assessment, consider quick neuro assessment to determine degree of injury
Disability

- **Glasgow Coma Scale**
  - **Eye**
    - Spontaneously opens 4
    - To verbal command 3
    - To pain 2
    - No response 1
  - **Best Motor Response**
    - Obeys verbal commands 6
    - Localizes to pain 5
    - Withdraws from pain 4
    - Flexion to pain (Decorticate Posturing) 3
    - Extension to pain (Decerebrate Posturing) 2
    - No response 1
  - **Verbal Response**
    - Oriented/Conversant 5
    - Disoriented/Confused 4
    - Inappropriate words 3
    - Incomprehensible words 2
    - No response 1
Disability

Key Principles

– Precise diagnosis is not necessary at this point in evaluation
– Prevention of further injury and identification of neurologic injury is the goal
– Decreased level of consciousness = Head injury until proven otherwise
– Maintenance of adequate cerebral perfusion is key to prevention of further brain injury
  ■ Adequate oxygenation
  ■ Avoid hypotension
– Involve neurosurgeon early for clear intracranial lesions
Disability

Cervical Spinal Clearance

- Patients must be alert and oriented to person, place and time
- No neurological deficits
- Not clinically intoxicated with alcohol or drugs
- Non-tender at all spinous processes
- No distracting injuries
- Painless range of motion of neck
Exposure

- Remove all clothing
  - Examine for other signs of injury
  - Injuries cannot be diagnosed until seen by provider
- Logroll the patient to examine patient’s back
  - Maintain cervical spinal immobilization
  - Palpate along thoracic and lumbar spine
  - Minimum of 3 people, often more providers required
- Avoid hypothermia
  - Apply warm blankets after removing clothes
  - Hypothermia = Coagulopathy
  - Increases risk of hemorrhage
Exposure

Author unknown,
Exposure

Author unknown,
http://www.trauma.org/images/image_library/chest0044b.jpg
Trauma Logroll

- One person = Cervical spine
- Two people = Roll main body
- One person = Inspect back and palpate spine
Secondary Survey

- Secondary Survey is completed after primary survey is completed and patient has been adequately resuscitated.
- No patient with abnormal vital signs should proceed through a secondary survey.
- Secondary Survey includes a brief history and complete physical exam.
History

- **AMPLE History**
  - Allergies
  - Medications
  - Past Medical History, Pregnancy
  - Last Meal
  - Events surrounding injury, Environment

- History may need to be gathered from family members or ambulance service
Physical Exam

- Head/HEENT
- Neck
- Chest
- Abdomen
- Pelvis
- Genitourinary
- Extremities
- Neurologic
Physical Exam

- Difficult airway
Physical Exam

- Seatbelt sign

Accessed 9/20/09 – Google Image Search
Physical Exam

- Battle Sign
- Raccoon's Eyes
- Cullen’s Sign
- Grey-Turner’s Sign

http://sfghed.ucsf.edu/Education/ClinicImages/Battle's%20sign.jpg
Accessed 9/20/09 – Yahoo Images

http://health-pictures.com/eye/Periorbital-Ecchymosis.htm
Accessed 9/20/09 – Yahoo Images
Adjuncts to Secondary Survey

- Radiology
  - Standard emergent films
    - C-spine, CXR, Pelvis
  - Focused Abdominal Sonography in Trauma (FAST)
  - Additional films
    - Cat scan imaging
    - Angiography

- Foley Catheter
  - Blood at urethral meatus = No Foley catheter

- Pain Control
- Tetanus Status
- Antibiotics for open fractures
FAST Exam

• Focused Abdominal Sonography in Trauma

• 4 views of the abdomen to look for fluid.
  – RUQ/Morrison’s pouch
  – Sub-xiphoid – view of heart
  – LUQ – view of spleno-renal junction
  – Bladder – view of pelvis
FAST

• Has largely replaced deep peritoneal lavage (DPL)
• Bedside ultrasound looking for blood collection in an unstable patient.
• If the patient is unstable and a blood collection is found, proceed emergently to the operating theater.
FAST

• Sensitivity of 94.6%
• Specificity of 95.1%
• Overall accuracy of 94.9% in identifying the presence of intra-abdominal injuries.
  – Yoshil: J Trauma 1998; 45
FAST
Right Upper Quadrant - Morrison’s Pouch

- Between the liver and kidney in RUQ.
- First place that fluid collects in supine patient.
FAST Exam - RUQ

University of Louisville ED, www.louisville.edu/medschool/emergmed/ultrasoundfast.htm

University of Louisville ED, www.louisville.edu/medschool/emergmed/ultrasoundfast.htm
FAST – Sub-xiphoid

• Evaluate for pericardial fluid
• View through liver
  – Transhepatic or Parasternal
• Searches for fluid between heart and pericardium
FAST – Sub-xiphoid

University of Louisville ED,
www.louisville.edu/medschool/emergmed/ultrasoundfast.htm

University of Louisville ED.
www.louisville.edu/medschool/emergmed/ultrasoundfast.htm
FAST – Left Upper Quadrant

• View between the spleen and kidney
• Another dependent place that fluid collects
• Also see diaphragm in this view
FAST - LUQ

University of Louisville ED,
www.louisville.edu/medschool/emergmed/
ultrasoundfast.htm

University of Louisville ED,
www.louisville.edu/medschool/emergmed/
ultrasoundfast.htm
FAST – Bladder View

• Evaluates for fluid in the pouch of Douglas
  – Posterior to bladder

• Dependent potential space
FAST – Bladder View

University of Louisville ED, www.louisville.edu/medschool/emergmed/ultrasoundfast.htm

University of Louisville ED, www.louisville.edu/medschool/emergmed/ultrasoundfast.htm
Interpret this FAST Image:

University of Louisville ED,
www.louisville.edu/medschool/emergmed/ultrasoundfast.htm
Trauma in Special Populations

- Pregnancy
  - Supine Hypotensive Syndrome
    - After 20 weeks, enlarged uterus with fetus and amniotic fluid compresses inferior vena cava
    - Decreases venous return and decrease cardiac output
    - Keep pregnant patients in left lateral decubitus position to avoid excessive hypotension
  - Optimal maternal and fetal outcome is determined by adequate resuscitation of mother
  - Fetal Monitoring
Trauma in Special Populations

- Pediatric Trauma Resuscitation
  - Differences in head to body ratio and relative size and location of anatomic features make children more susceptible to head injury, abdominal injury
  - Underdeveloped anatomy leads to chest pliability and less protection of thoracic cage
  - Cardiac Arrest
    - Typically result from respiratory arrest degrading into cardiac arrest
  - Resuscitation
    - Broselow Tape
    - ABCDE

Author unknown,
http://dukehealth1.org/images/deps_tape4_sm.gif
Classic Radiographical Findings

- Pelvic Fracture

Classic Radiographic Findings

- Femur Fracture

Author unknown,
www.flickr.com/photos/40939239@N08/3771820024/
Classic Radiographic Findings

- **Epidural Hematoma**
  - Middle Meningeal Artery

- **Subdural Hematoma**
  - Bridging Veins


[Image 2: Author unknown, http://rad.usuhs.edu/medpix/tachy_pics/thumb/synpic519.jpg]
Classic Radiographic Findings

- Diaphragmatic rupture w/ spleen herniation

Classic Radiographic Findings

- Widened Mediastinum – Aortic Injury

Author unknown,
www.trauma.org/index.php/main/image/45/print
Definitive Care

- Secondary Survey followed by radiographic evaluation
  - CatScan
  - Consultation
    - Neurosurgery
    - Orthopedic Surgery
    - Vascular Surgery

- Transfer to Definitive Care
  - Operating Room
  - ICU
  - Higher level facility
Mr. Jones – 45 y/o male involved in a rollover road traffic accident and was ejected from the vehicle. Patient was unrestrained. Patient was not ambulatory on scene of accident and is brought into trauma bay for evaluation.

– What concerns you about story?
– First steps of evaluation and management
Case Example

Exam
  – Awake, diaphoretic
  – Pulse = 120
  – BP = 90/60
  – RR = 18
  – O2 sat = 94%

What do you want to do next?
Case Example

- Preparation
- Primary Survey
  - Awake, alert, talking to provider
  - Breathing
    - Absent breath sounds on left
    - What do you want to do next?
  - Circulation
    - Vital Signs?
    - Access?
    - Resuscitation?
  - IV/O2/Monitor
  - Disability
    - GCS = 14
  - Exposure
Case Example

- Chest tube placed
  - Rush of air heard consistent with pneumothorax
- Repeat Vital Signs
  - Pulse 120
  - BP 80/40
  - RR = 15
  - O2 sat = 99% NRBM
- What do you want to do next?
  - Patient complaining of abdominal pain
  - Ecchymosis noted over left flank
  - Resuscitation?
Case Example

- Blood Product Administration
- Transfer to definitive care = Operating Theatre

Bonemesh (flickr)
Conclusion

- Assessment of the trauma patient is a standard algorithm designed to ensure life threatening injuries do not get missed

- Primary Survey + Resuscitation
  - Airway
  - Breathing
  - Circulation
  - Disability
  - Exposure

- Secondary Survey

- Definitive Care
Questions?
References