Author(s): Patrick Carter, Daniel Wachter, Rockefeller Oteng, Carl Seger, 2009-2010.

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Advanced Emergency Trauma Course

Introduction and Course Overview
Initial Assessment and Management

Presenter: Patrick Carter, MD

Ghana Emergency Medicine Collaborative
Patrick Carter, MD • Daniel Wachter, MD • Rockefeller Oteng, MD • Carl Seger, MD
Objectives

- Introduction to AETC Course
- Course Curriculum
- 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
AETC Course

- Advanced Emergency Trauma Course
- Developed by University of Michigan and University of Utah Emergency Medicine Faculty
- General Overview of Trauma Management
  - U.S. based EM Curriculum
  - ATLS Curriculum
- 5 day course
  - 20 hours of didactic teaching
  - Skill Stations for vital trauma procedures
  - Review and testing on day 5
AETC Course

Evaluation Tools
- Pre/Post Test of Trauma Knowledge
- Pre/Post Skill Station Evaluations
- Post Course Survey
- 6 Month Post Course Survey

Research Study
- Voluntary Involvement
- Course utilizes new teaching techniques
  - Open educational Resource Material
  - Low Technological Simulation Tools
AETC Course Schedule

- **Day 1**
  - Introduction and Course Overview
  - Initial Assessment and Management of Trauma Patient
  - Airway and Ventilation Management
  - Shock

- **Day 2**
  - Thoracic Trauma
  - Abdominal and Pelvic Trauma
  - Genitourinary Trauma
  - Head Injury
  - Cervical Spine and Spinal Cord Trauma

- **Day 3**
  - Maxillofacial Trauma
  - Penetrating and Blunt Neck Trauma
  - Orthopedic and Extremity Trauma
  - Burn Evaluation and Management

- **Day 4**
  - Environmental Injuries
  - Ballistics and Penetrating Extremity Injuries
  - Wound Care
  - Special Populations: Pregnancy and Pediatrics
  - Pre-hospital Management and Transfer to Definitive Care

- **Day 5**
  - Course Material Review
  - OSCE Evaluation
  - Written Test Evaluation
  - Post Course Survey
AETC Skill Stations

- Airway Stations
  - Oro/Nasotracheal Intubation
  - Airway Adjuncts
  - Difficult Airway
  - Surgical Airway
- Thoracic Procedures
  - Chest tube
  - Pericardiocentesis
  - Thoracotomy
- FAST Exam
- Wound Care
- IV Access Stations
  - Intraosseous Lines
  - Central Venous Lines
  - Venous Cut down
- Orthopedic Stations
  - Cervical Spine and Spinal Immobilization
  - Splinting
- Radiograph Review
- Trauma Scenario Review

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Advanced Emergency Trauma Course
Initial Assessment and Management of the Trauma Patient

Source: www.aic.cuhk.edu.hk/web8toc.htm
Accessed 9/20/09 – Yahoo images via Creative Commons
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
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

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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 . . . Coming Attractions

Organize Trauma Response Team

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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
  - NRBM (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

Source:
www.ossur.com/
bracesandsupports/
neckandspine/
prehospit...necollars/
phillyblockhead
Accessed 9/20/09
Yahoo Images
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
    - 2\(^{nd}\) Intercostal space, Midclavicular line
  - Tube Thoracostomy
    - 5\(^{th}\) 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 Thoracotomy for control of bleeding

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Accessed 9/20/09 – Yahoo Images
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

[Image of a wound and dressing]

Middle and bottom image:

http://www.brooksidepress.org/Products/OperationalMedicine/DATA/operationalmed/Procedures/TreataSuckingChestWound.htm
Accessed 9/20/09, Yahoo Images

Accessed 9/20/09, Yahoo Images

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Needle Thoracostomy

- Needle Thoracostomy
  - Midclavicular line
  - 14 guage angiocath
  - Over the 2\textsuperscript{nd} rib
  - Rush of air is heard
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

[Images and references included for visual and textual content]
Circulation

Shock
- Impaired tissue perfusion
- Tissue oxygenation is inadequate to meet metabolic demand
- Prolonged shock state leads to multiorgan 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)
Circulation

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/bedsheet
  - Restore circulating volume
    - Crystalloid Resuscitation (2L)
    - Administer Blood Products
  - Immobilize fractures

- **Responders vs. Nonresponders**
  - Transient Response to volume resuscitation = sign of ongoing blood loss
  - Nonresponders = Consider other source for shock state or operating room for control of massive hemorrhage

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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

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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
    - To verbal command
    - To pain
    - No response
  - Best Motor Response
    - Obeys verbal commands
    - Localizes to pain
    - Withdraws from pain
    - Flexion to pain (Decorticate Posturing)
    - Extension to pain (Decerebrate Posturing)
    - No response
  - Verbal Response
    - Oriented/Conversant
    - Disoriented/Confused
    - Inappropriate words
    - Incomprehensible words
    - No response

GCS ≤ 8
Intubate
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
  - Not clinically intoxicated with alcohol or drugs
  - Non-tender at all spinous processes
  - No focal neurological deficits
  - 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

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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

![Image of a patient in hospital bed with visible seatbelt sign](http://www.itim.nsw.gov.au/images/seat_belt_mark_2.jpg)
Physical Exam

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

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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**
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

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http://dukehealth1.org/images/deps_taped_sm.gif
Accessed 9/20/09 – Yahoo Images
Classic Radiographical Findings

- Pelvic Fracture

Accessed 9/20/09 – Yahoo Images
Classic Radiographic Findings

- Femur Fracture

Source: www.flickr.com/photos/40939239@N08/3771820024/
Accessed 9/20/09 – Yahoo Images
Classic Radiographic Findings

- Epidural Hematoma
  - Middle Meningeal Artery

- Subdural Hematoma
  - Bridging Veins
Classic Radiographic Findings

- Diaphragmatic Rupture w/ spleen herniation
Classic Radiographic Findings

- Widened Mediastinum – Aortic Injury
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
Case Example

- 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

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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
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