Traumatic Dyspnea

Barry Jensen, NREMT-P, NCEE
EMT Program Director
UCLA Center for Prehospital Care
bjensen@mednet.ucla.edu
<table>
<thead>
<tr>
<th>Cause</th>
<th>Pathophysiology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lost airway or pulmonary injury</td>
<td>Inability of oxygen to reach the circulation</td>
</tr>
<tr>
<td>Tension pneumothorax</td>
<td>Diminished blood return to the heart</td>
</tr>
<tr>
<td>Cardiac tamponade</td>
<td>Diminished blood return to the heart</td>
</tr>
<tr>
<td>Hemorrhage</td>
<td>Inadequate oxygen-carrying capacity</td>
</tr>
<tr>
<td></td>
<td>Inadequate intravascular volume</td>
</tr>
<tr>
<td>Cardiac injury</td>
<td>Inadequate pump function</td>
</tr>
<tr>
<td>Spinal cord injury</td>
<td>Inappropriate vasodilatation</td>
</tr>
<tr>
<td></td>
<td>Inadequate pump function</td>
</tr>
<tr>
<td>Poisoning</td>
<td>Direct failure of cellular metabolism</td>
</tr>
<tr>
<td></td>
<td>Inappropriate vasodilatation</td>
</tr>
<tr>
<td>Sepsis</td>
<td>Direct failure of cellular metabolism</td>
</tr>
<tr>
<td></td>
<td>Inappropriate vasodilatation</td>
</tr>
</tbody>
</table>
Combat Death

- 31% Penetrating head trauma
- 25% Surgically uncorrectable torso trauma
- 10% Potentially surgically correctable trauma
- 9% Hemorrhage from extremity wounds
- 7% Mutilating blast trauma
- 5% Tension pneumothorax
- 1% Airway problems
- 12% Mostly from infections and complications of shock
Preventable Causes of Combat Death

60% Hemorrhage from extremity wounds
33% Tension pneumothorax
6% Airway obstruction e.g., maxillofacial trauma

* Data is extrapolated from Vietnam to present day Iraq and Afghanistan
The Fick Principle

These four elements must exist for perfusion to take place

- **Adequate oxygen** in the alveoli
- Adequate oxygen exchange to the pulmonary capillaries
- Adequate circulation
  - Adequate RBC’s, adequate perfusion pressure
- Adequate oxygen exchange into the tissues
Airway
Thorax and Respiratory System
Respiratory Tree and Perfusion
Thorax and Respiratory System

- Bronchioles
- Bronchi
- Trachea Rings of cartilage
- Pleural membrane
- Pleural cavity
- Diaphragm

Other diagrams include:
- Smooth muscle
- Elasin fibers
- Alveoli
- Capillaries
Hypoxia and the Brain
Causes of hypoxemia

1) Reduced partial pressure of oxygen in the inspired air

2) Alveolar hypoventilation

3) Ventilation-perfusion mismatch

4) Shunt (intracardiac or intrapulmonary)

5) Impaired alveolar-capillary diffusion
Oxygenation
Ventilation
Respiration
Biphasic (Bilevel) Positive Airway Pressure (BiPAP) and Continuous Positive Airway Pressure (CPAP)

- Two Levels (10/5) vs. One Level (10)
- Indications
- Contraindications
Primary Assessment

Scene
Responsiveness
Airway
Breathing
Circulation
Disability / Deformity
Environment / Expose
Assessment and Interventions

- Intervene During Primary
- Secondary on-scene vs. enroute
- Most ALS on the way to hospital
Pulse Oximetry

• Measures oxygenation
Capnography

• Measure ventilatory status
• ETCO2 35-45 mm Hg is the normal value for capnography
Hyperventilation
Hypoventilation
Intubated?
Arterial Blood Gas

- Partial Pressure of CO₂ (PaCO₂) and Oxygen (PaO₂) in blood and pH
MECHANISM OF INJURY
Front Impact
Lateral Impact
Pedestrian
Typical Pediatric Pattern and Considerations
Ultra slow motion footage of several thousand pounds of black powder exploding, showing very clearly the otherwise invisible shock wave.

Music: Paul Haslinger; [www.youtube.com](http://www.youtube.com) 11/6/2012
Mechanisms of Blast Injury

- Primary
  - Over-pressurization wave
  - Gas filled structures
    - Lungs
    - GI Tract
    - Middle Ear
Blast Lung
PEARL #8: ALL PATIENTS WHO SURVIVE NEAR HANGING SHOULD BE ADMITTED TO HOSPITAL FOR AT LEAST 24 HOURS OF OBSERVATION

- these patients can develop delayed complications such as airway obstruction, noncardiac pulmonary edema, aspiration pneumonia, ARDS and cardiac arrhythmias
Case

32 y.o. in traffic accident, 70 mph frontal impact, unrestrained

Chest exam reveals diminished breath sounds on the left, dullness on percussion

You hear ...
Acute diaphragmatic rupture occurs in 1% to 7% of patients after major blunt trauma and the diagnosis is missed on initial presentation in up to 66% of these patients. Only about 10% diagnosed in acute phase of treatment.
How Would You Manage This Patient?
Upper Airway

- NASAL CAVITY
  - Superior, middle, and inferior turbinates
  - Hard and soft palates

- NASOPHARYNX
  - Tonsils/adenoids
  - Uvula

- OROPHARYNX
  - Tongue

- LARYNGOPHARYNX (HYPOPHARYNX)
  - Vallecula
  - Epiglottis

- LARYNX
  - Glottic opening
  - Vocal cords
  - Thyroid cartilage
  - Cricothyroid membrane
  - Cricoid cartilage
  - Thyroid gland
  - Esophagus
  - Trachea
Severe facial injuries after intubation on scene.
Figure 1: A 19-year-old Afghan man sustained extensive facial injuries and lost parts of his left forearm and left lower leg after a blast from an improvised explosive device, causing extensive soft tissue, neurovascular and bone injury.

Macdonald J C, Tien H C CMAJ 2008;178:1133-1135
Needle Cricothyrotomy Procedure
Why Would This be Needed?
Combat Device
Pneumothorax on X-Ray
How would you intervene?
What Potential Injuries?
How would you intervene?
CASE STUDY: “ROLLOVER”
Mechanism
Scene Size-Up

- Saturday, 0754
- Dispatch directs you to a car collision on the outskirts of town
- Highway patrol have diverted traffic
- There is one patient
- The fire department is already on scene, scene is safe
Initial Assessment

• Awake, supine, lying on ground
• A: Open, patient is moaning
• B: Rapid rate; labored, decreased tidal volume
• C: Skin pale, cool, dry; pulse rapid, weak, regular
• D: Severe due to pain, GCS: 3-3-5=11
• E: Obvious facial bruising and swelling with some right neck swelling
• *What is your general impression of this patient?*
General Impression

- Patient’s airway may be compromised
- She may have impending respiratory failure
- She is in probable shock (hemorrhagic)
• What are your initial management priorities?
BLS Management Priorities

• Place patient in spinal immobilization
• Give 15L O₂ by non-rebreather mask
• Place patient in supine for shock
• Initiate rapid transport
ALS Management Priorities

BLS management plus . . .

• Re-evaluate airway/breathing
• Establish 2 large bore IVs en route to trauma center
• Apply cardiac monitor en route
Rhythm?
Case Progression

- Sinus tachycardia @ 136
- Accessory airways not tolerated
- The patient is loaded on a backboard into the ambulance without difficulty
- Transport initiated to the nearest ED with lights and sirens
- En route the patient’s breathing becomes more labored
Additional Assessment

• Vital signs: RR 32, HR 136, BP 82/53, Wt 50kg
• S: Facial pain, shortness of breath, abdominal pain
• A: Unknown
• M: Unknown
• P: Unknown
• L: Unknown
• E: Patient was unrestrained driver whose face hit the windshield ("spidered"); there is steering wheel damage
Detailed Physical Exam

- **Head**: pupils midrange, reactive; facial edema and crepitus over cheeks with deformity
- **Neck**: swelling on right side; no JVD or tracheal deviation
- **Lungs**: clear and equal bilaterally
- **Chest**: no signs of trauma
- **Abdomen**: soft, non-tender, no distention
- **Pelvis**: stable, nontender, no instability
- **Extremities**: stable, nontender; no obvious trauma
Case Progression

- En route, the patient becomes unresponsive, and her O$_2$ saturation drops to 80%
- Repeat VS: RR 6, HR 42, BP 60/p
- Teeth are clenched
- Cannot visualize the vocal cords
• What do the vital signs indicate?

• What are your options for airway management?
Case Progression

- Patient is in respiratory failure
- Options:
  - Assist ventilation with bag-mask
  - Attempt intubation again - use paralytic
  - Perform needle cricothyrotomy
  - Bag-mask ventilation is difficult because of facial deformities
Case Progression

• Needle cricothyrotomy is successful; you are able to oxygenate the patient
• You arrive at the emergency department 5 minutes later without further incident
• The patient was taken to the operating room within 3 minutes of arrival
• A tracheostomy was performed
• She has facial surgery and exploratory abdominal surgery
Case Outcome

- She was found to have multiple facial fractures and a ruptured spleen
- She was hospitalized in the ICU for 1 week and was discharged after 3 weeks
- After 2 more facial surgeries, she was doing well