Penetrating Neck Trauma

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What IS Penetrating Neck Trauma?

- Injuries from GSW, stabbing, penetrating debris
- Violates the platysma
- Often injures multiple structures
- Mortality highly variable: 2-65%
Prehospital Management

- Cervical spine immobilization?
- Airway management?
- Venous access?
Prehospital Management

- Cervical spine immobilization? Of course!
  - Or maybe not...
    - Less than 0.5% of patients with penetrating wounds to the neck have an unstable cervical spine injury
    - All of them tend to have signs or symptoms of neurologic impairment or altered mental status, so...
      - If altered, immobilize
      - If neuro findings, immobilize
Prehospital Management

- Airway management?
  - Oxygen; suction as needed
  - Position of comfort if possible
  - Assist, intubate as needed

- Venous access?
  - On opposite side of injury, if possible
Assessment of the Patient

- Where is the injury?
  - Anterior or posterior?
  - Deep to the platysma?
  - Which zone(s) is (are) involved?
Anterior or Posterior?

- Most important structures are in the anterior triangle
- Posterior: Spinal cord
Anatomy of the Neck: Triangles

- **Anterior Triangle**  
  - Midline anteriorly  
  - Sternocleidomastoid posteriorly  
  - Clavicle inferiorly  
  - Mandible superiorly

- **Posterior Triangle**  
  - Sternocleidomastoid anteriorly  
  - Trapezius posteriorly  
  - Clavicle inferiorly
The Platysma

- Is the injury deep to the platysma?
- If not, just close and go
Zones of the Neck
Anatomy of the Neck

- **Zone I**
  - Between the sternal notch and clavicles inferiorly and the cricoid cartilage superiorly

- **Zone II**
  - Between the cricoid cartilage inferiorly and the angle of the mandible superiorly

- **Zone III**
  - Between the angle of the mandible inferiorly and the base of the skull superiorly
Zone I Contains:

- Common carotid artery
- Vertebral artery
- Subclavian artery
- Major vessels of the upper mediastinum
- Apices of lungs
- Esophagus
- Trachea
- Thyroid
- Thoracic duct
- Spinal cord
Zone II Contains:

- Common carotid artery
- Vertebral artery
- Larynx
- Trachea
- Esophagus
- Pharynx
- Internal jugular vein
- Vagus nerve
- Recurrent laryngeal nerve
- Sympathetic trunk
- Spinal cord
Zone III contains:

- Internal and external carotid arteries
- Vertebral arteries
- Jugular veins
- Salivary and parotid glands
- Cranial nerves IX-XII
- Spinal cord
- Floor of mouth / skull
Penetrating injuries broken down by zone

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<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Zone I</td>
<td></td>
<td>20%</td>
<td>14%</td>
<td>16%</td>
<td>15%</td>
</tr>
<tr>
<td>Zone II</td>
<td></td>
<td>77%</td>
<td>36%</td>
<td>64%</td>
<td>85%</td>
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<tr>
<td>Zone III</td>
<td>39%</td>
<td>25%</td>
<td>18%</td>
<td>20%</td>
<td>8%</td>
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<tr>
<td>Post Triangle</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>42%</td>
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What gets injured?

<table>
<thead>
<tr>
<th>Location</th>
<th>Study 1 (1275)</th>
<th>Study 2</th>
<th>Thoma</th>
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<tbody>
<tr>
<td>Arterial</td>
<td>320 (25%)</td>
<td>12.8%</td>
<td>13.3%</td>
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<tr>
<td>Venous</td>
<td>281 (22%)</td>
<td>11.3%</td>
<td></td>
</tr>
<tr>
<td>Tracheolaryngeal</td>
<td>253 (20%)</td>
<td>10.1%</td>
<td>3.9%</td>
</tr>
<tr>
<td>Pharyngoesophageal</td>
<td>240 (19%)</td>
<td>9.6%</td>
<td>8.8%</td>
</tr>
<tr>
<td>Spinal cord</td>
<td>76 (6%)</td>
<td>3%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Neurologic, other</td>
<td>85 (7%)</td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td>Thoracic duct</td>
<td>20 (2%)</td>
<td>0%</td>
<td></td>
</tr>
</tbody>
</table>
Assessment of the Patient

- Where is the injury?
  - Anterior or posterior?
  - Deep to the platysma?
  - Which zone(s) is (are) involved?
- Is the patient stable or unstable?
- Are there any “hard findings” on exam?
Signs of injury: Examine for These

**Hard Signs**
- Expanding Hematoma
- Severe active bleeding
- Shock not responsive to IVF
- Decreased/absent radial pulse
- Vascular bruit or thrill
- Cerebral ischemia
- Airway obstruction

**Soft Signs**
- Hemoptysis/hematemesis
- Oropharyngeal blood
- Dyspnea
- Dysphonia/dysphagia
- Subcutaneous/mediastinal air
- Chest tube air leak
- Non-expanding hematoma
- Focal neurologic deficit
Initial Management

- Venous access; opposite side of injury
- Oxygen; airway management as needed*
- Bleeding profusely? Pressure; do not clamp structures
Airway Management

- What are the issues?
  - Potential to lose the airway if injury worsens
  - Potential to worsen the injury by patient coughing, worsening bleeding, direct trauma
Penetrating Neck Injury
Airway Management

- Immediate airway management
  - Decreasing mental status
  - Expanding hematoma
  - Direct laryngotracheal trauma
  - Hypoventilation
  - Hypoxia

- Selective intubation
  - Ah… here’s where the rubber meets the road
Selective airway management

- Consider in any patient leaving the ED for a study or transportation
- Consider in any patient who may develop airway compromise

Okay, that sounds good, but...

How to do it?????
Penetrating Neck Injury
Airway Management

- What are your options?
  - RSI with orotracheal intubation
  - Awake intubation
  - Fiberoptic
  - Videoscopic intubation
  - Extraglottic devices
  - Nasotracheal
  - Cricothyrotomy
Penetrating Neck Injury
Airway Management

- Airway Management
  - RSI with direct laryngoscopy
    - Most data available; usually a safe practice; have backup airway available
  - Fiberoptic intubation
    - Awake fiberoptic an option
    - May be difficult / impossible in a bloody airway
  - Videoscopic devices
    - Little data published; success rates high
Airway Management

- Airway Management
  - Extraglottic devices
    - Run the risk of worsening injury, dislodging clot, requires paralysis if patient awake
  - Nasotracheal intubation
    - Relatively contraindicated due to blind procedure
  - Cricothyrotomy / tracheostomy may be necessary
  - Direct intubation
    - Put the tube in the open wound, directly into the trachea
Penetrating Neck Trauma
Airway Management

- Mandavia, et al
  - USC, 1993-1996
  - 78% GSW, 21% SW
  - 748 patients
    - In 11%, airway emergently managed in ED
      - RSI - 39
      - Cricothyrotomy / tracheostomy - 2
      - No drugs - 5
      - Fiberoptic - 12
Penetrating Neck Trauma
The Traditional Approach

1. Wound Care, Discharge
   - No
   - Yes: Platysma Violation?

2. Emergent Airway, then OR
   - No
   - Yes: Patient Stable?

3. Zone I
   - Angiography, Esophagoscopy, Bronchoscopy
   - Observe
     - No
     - Yes: OR

4. Zone II
   - Symptomatic?
     - No: Observe
     - Yes: OR

5. Zone III
   - Symptomatic?
     - No: Observe
     - Yes: Angiography
Imaging?

- What does the current literature say?
2001 Gracias et al.

- Retrospective case series of 68 patients, 23 of which were included:
  - 13 patients were determined to have trajectories with low likelihood of vascular or aerodigestive injuries and managed non-operatively.
    - 4 were discharged from the ED
    - 7 were discharged within 24 hours
Retrospective case series of 120 patients, 65 of which were included:

- 24 received a CTA, 6 got explored (25%)
  - 25% determined to have injury
  - 0 negative explorations
- 41 received no CTA, 27 got explored (66%)
  - 34% determined to have injury
  - 13 had negative explorations (48%) and 4 minor superficial bleeding vessels
A prospective observational study of 203 patients with 159 stab wounds, 42 GSW’s, one automobile part and one explosive shrapnel:

- 25 were managed operatively
- 8 were managed endovascularly
- 158 received what the surgeon believed to be appropriate imaging and work-up and were managed expectantly
- No clinically relevant missed injuries
Retrospective case series of 19,363 pediatric trauma patients, including 39 children with 42 injuries violating the platysma:

- Six patients underwent mandatory exploration, four were nontherapeutic;
- Eighteen patients underwent imaging (68% CTA), 15 were observed and avoided surgical exploration.
Clinical Practice Guideline for Penetrating Zone II injuries:

- Selective operative management and mandatory surgical exploration have equivalent diagnostic accuracy therefore selective management is recommended to reduce unnecessary operations. (Level I)

- High resolution CTA offers appropriate diagnostic accuracy with minimal risk, making this the initial diagnostic study of choice when available. (Level II)

- CT angiography or duplex US can be used in lieu of arteriography to rule out and arterial injury in penetrating injuries to zone II of the neck. (Level II)

- CT of the neck (even without CT angiography) can be used to rule out a significant vascular injury if it demonstrates that the trajectory of the penetrating object is remote from vital structures. With injuries in proximity to vascular structures, minor vascular injuries such as intimal flaps may be missed. (Level III)
Invited Commentary

“The standard of care is no longer surgical exploration for all penetrating neck trauma as numerous studies have clearly demonstrated that stable patients can be imaged and/or observed.”
Imaging?

- Stable patients can be imaged and observed
- Unstable patients need to go to the OR
- Hard findings are critical in the diagnostic algorithm
Platysma Violation?

Patient Unstable or Hard signs of injury?

CTA Neck

Obvious Injury

No obvious injury but trajectory suggests possible injury

No obvious injury and trajectory away from vital structures

Observe/Discharge

Appropriate imaging or intervention

OR

Wound Care, Discharge

OR

Yes

No
References/Images

Any Questions?