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Advanced Emergency Trauma Course

Penetrating and Blunt Neck Trauma

Presenter: Rockefeller Oteng, MD

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

Lecture Objectives

- The discuss the different mechanisms of injury
- To review the anatomy of the neck
- To discuss the types of injuries related to blunt and penetrating mechanisms
- Discuss management techniques

Epidemiology

- This is an area in which there isn't a great deal of information
- In the U.S. it's suggested that neck trauma accounts for 5%-10% of all serious traumatic injuries
- Predominance is towards men from 20 to 30 years of age

Epidemiology

- Neck injuries can be very deceiving
- Seemingly minor injuries can quickly become life threatening.
- There are a great deal of vessels from all the different body systems in this tight space
- The insidious nature of injury to this area often leads to a delay in diagnosis

Anatomy

- Given the critical nature of the contents of the neck, there is a need for a systematic approach to evaluation and management
- This approach is based on a good understanding of the underlying anatomy

Anatomy

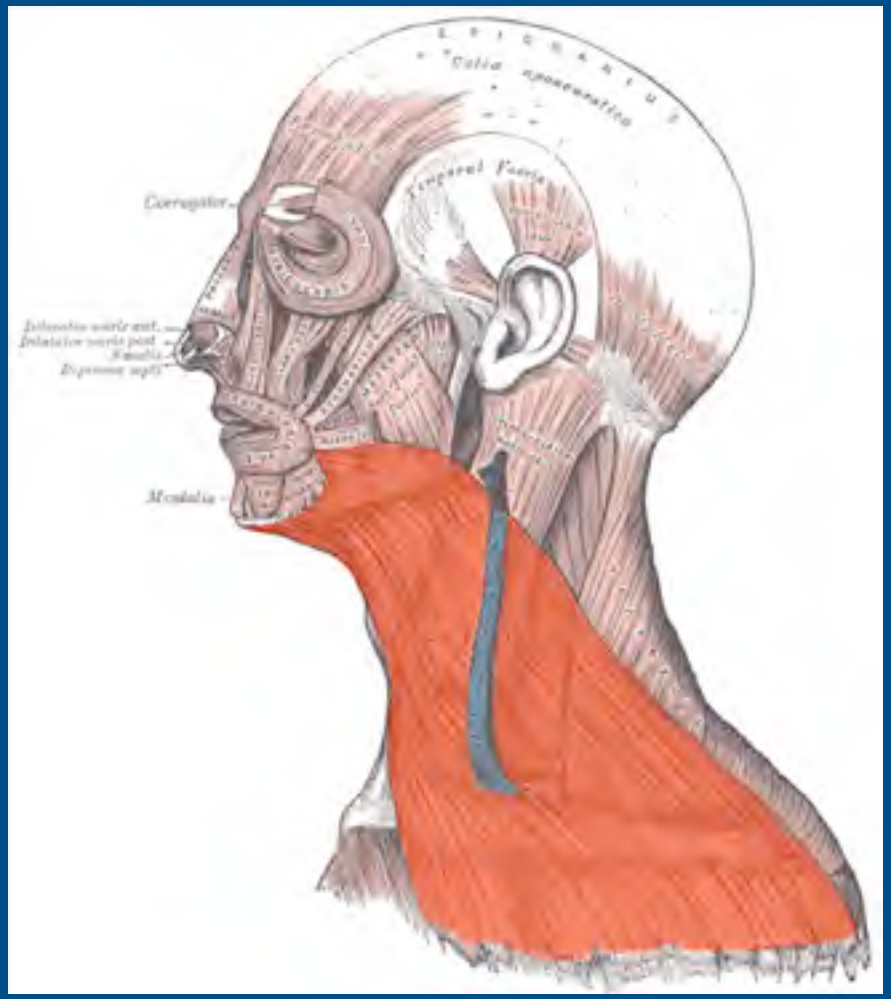
- Neck contents are contained by two discrete fascial layers:
  - The superficial fascia :
    - Which envelops the platysma muscle.
  - The deep cervical fascia:
    - Contains the sternocleidomastoid and trapezius muscles.
    - It is also used to mark the pretracheal region which includes the trachea, larynx, thyroid gland, and pericardium

Anatomy

- Deep facial contents continued:
  - It invests the prevertebral area
    - Containing the prevertebral muscles, phrenic nerve, brachial plexus, and axillary sheath
    - The carotid sheath encloses the carotid artery, internal jugular vein, and vagus nerve.

Anatomy

- The platysma, which is a very thin muscle, covers the entire anterior triangle
- Lies just beneath the subcutaneous tissue
- Is an important landmark when evaluating penetrating neck injuries



PD-EXP Gray's Anatomy (Wikipedia)

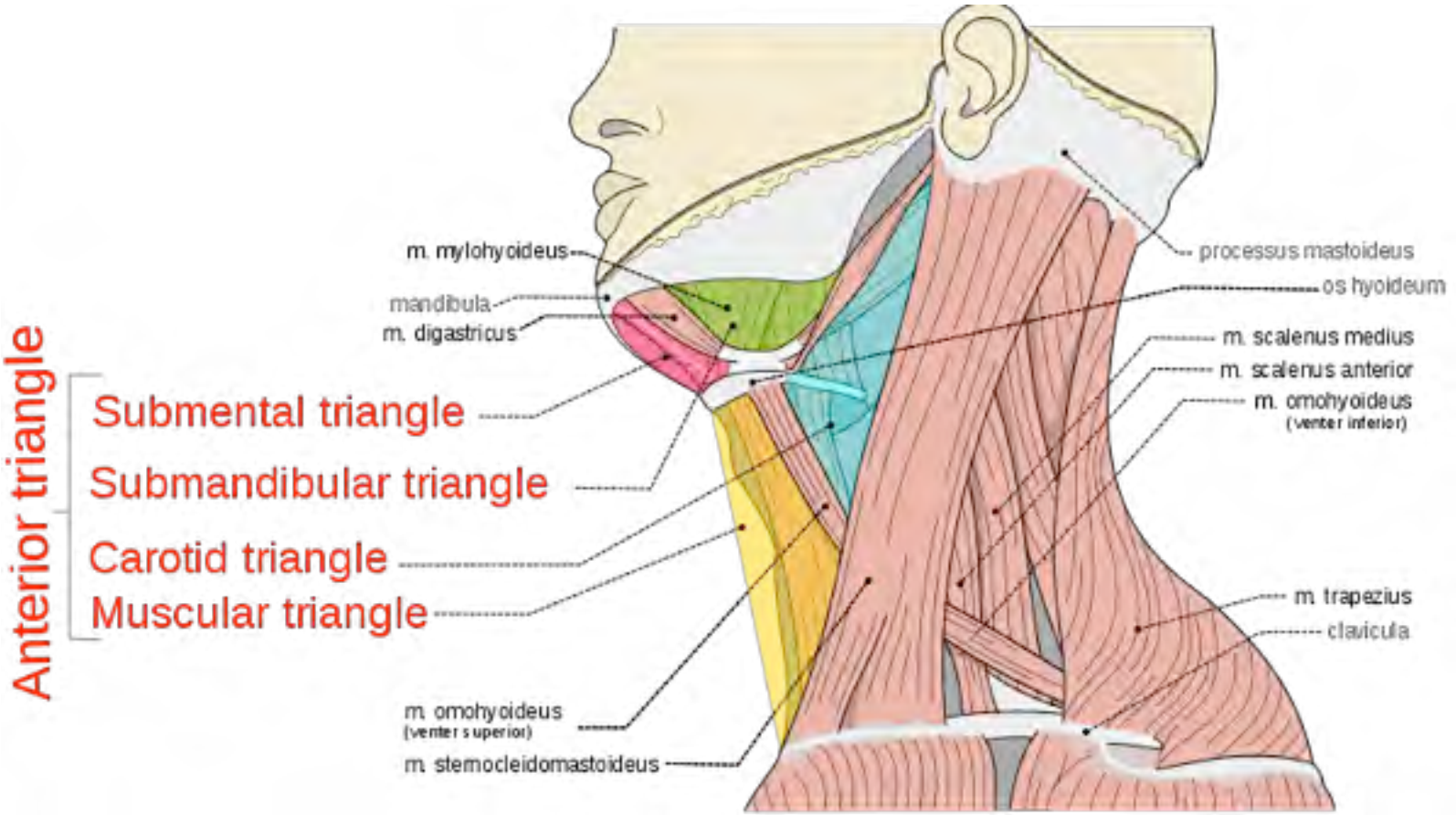
Anatomy

- There are several way in which to describe the neck anatomy
- Classic anatomist describe the triangles:
  - Anterior Triangle: Bound superiorly by:
    - Mandible
    - Anterior border of the sternocleidomastoid muscle
    - Midline of the neck
  - Posterior Triangle:
    - Posterior sternocleidomastoid muscle
    - Trapezius
    - Middle third of the clavicle inferiorly

Anterior Triangle

- Important structural contents include:
  1. Carotid Artery
  2. Internal jugular vein
  3. Vagus nerve
  4. Thyroid gland
  5. Larynx
  6. Trachea
  7. Esophagus

Anterior Triangle

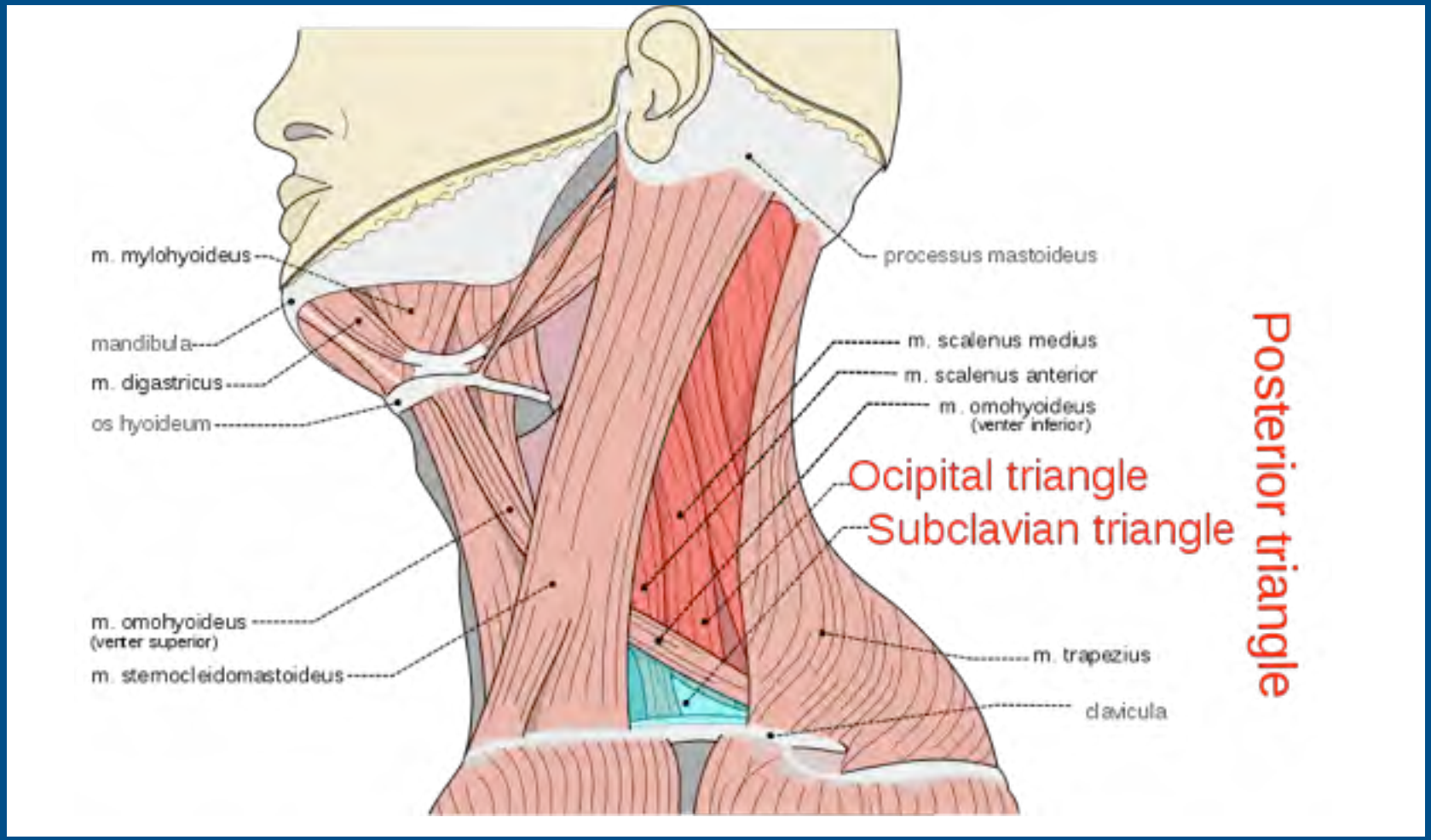


Posterior Triangle

- Has fewer vital structural contents:
  1. Subclavian artery
  2. Brachial plexus

- Injury to this area can have catastrophic outcomes

Posterior Triangle



 Olek Remesz (Wikipedia)

Zone Classification

- Anatomy classification is excellent for describing the static location of structures
- Injury is not static, and an injury to the neck may enter the anterior triangle and then pass through the posterior triangle.
- A more useful classification of neck anatomy for trauma is the Zone classification developed by Roon and Christensen

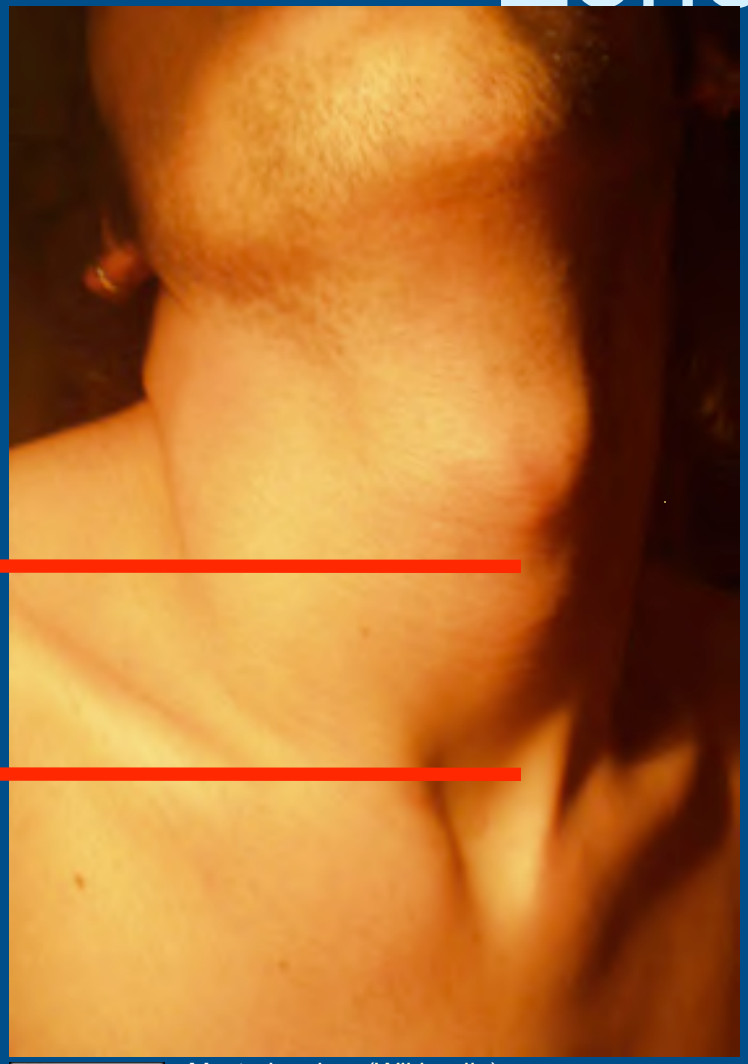
Zone Classification

- This classification system can guide the clinician in the diagnostic and therapeutic management
- Based on level of injury to the neck in a caudal to cranial orientation
- Zone 1:
  - Lower Border = Clavicles
  - Upper Border = Cricoid Cartilage

Zone I

- Zone I Structures
  - Vertebral arteries
  - Proximal carotid arteries
  - Major thoracic vessels
  - Superior Mediastinum
  - Lungs, trachea
  - Esophagus
  - Spinal cord
  - Cervical nerve roots

Zone I



Zone 1

 Mysteriouskyn (Wikipedia)

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Zone II

- Begins at the inferior portion of the cricoid cartilage and extends upwards to the angle of the mandible
- Structures within this area include:
  - Carotid and vertebral arteries
  - Jugular veins
  - Pharynx, larynx, trachea, and esophagus
  - Cervical spine and spinal cord

Zone II

Zone 2

BY-SA Mysteriouskyn (Wikipedia)

PD-INEL MedScape

Zone III

- This zone is located in between the angle of the mandible and the base of the skull
- Vital structures include:
  - Distal carotid arteries
  - Vertebral arteries
  - Pharynx
  - Spinal cord

Zone III

Zone 3

Mysteriouskyn (Wikipedia)

MedScape

Initial Management

- Initial Management is the same as all trauma cases
  - Primary survey (ABCDE)
  - Resuscitation
  - Secondary survey
- Airway
  - Patients with acute respiratory distress need a definitive and secure airway

Initial management

- Airway
  - In neck trauma there is sometimes a debate as to when to intervene
  - Blood and air from facial and neck injuries can distort the normal anatomic appearance and increase the difficulty of intubation

Initial Management

- Airway
  - Securing the airway should be considered if the patient is going to be leaving your supervised area
  - Endotracheal intubation using rapid sequence technique is the first choice
  - Cricothyrodotomy is second line treatment when intubation is not successful
  - Care should be taken to when intubating to avoid an injured trachea

Initial management

- Airway
  - If larynx fracture is suspected, immediate cricothyrodotomy may be preferred
  - If there is a larynx disruption, intubation may result in complete transection or creation of a false lumen
  - An existing tracheostomy site maybe intubated if available
- IF C-SPINE INJURY SUSPECTED, NECK SHOULD BE IMMOBILIZED

Initial Management

- Breathing
  - All patients should receive high-flow oxygen
  - Based on the zone and the proximity to the thoracic inlet, there could be simultaneous injury to the thorax
  - If you notice any difficulty ventilating then suspect either upper airway injury or thorax
  - Evaluate for asymmetric breath sounds
  - Consider tension pneumothorax if there is evidence of tracheal deviation

Initial Management

- Circulation:
  - Active bleeding should be addressed immediately by direct point pressure
  - Do not clamp bleeding vessels because you could cause further ischemia
  - Avoid placing IV access where the flow would head towards the injured area.
    - Extravasation could create more distortion and compression

Initial Management

- Disability
  - Examine and inspect for evidence of focal neurological deficit
  - This could suggest direct nerve injury, or spinal cord injury or vascular injury leading to ischemia

Penetrating Injury

- There are several mechanisms for this penetrating injuries to the neck:
  - Knives
  - Gunshot wounds
  - Sharp implements
- All these mechanisms have the potential for severe injury
- Knives and guns make up nearly 95% of all these penetrating injuries.

Penetrating Injuries

- Due to higher kinetic energy, patients suffering from gunshot wounds suffer more damage than knife wounds
  - Bullets have a tendency to penetrate deeper and create a cavity
  - Secondary damage to tissues surrounding the actual track of the wound
  - Gunshot wounds to the lateral neck can cross the midline and create more damage

Penetrating Injuries

- Despite the different mechanisms, basic treatment principals are the same
- Once initial stabilization has occurred the wound itself should be evaluated.
- If the platysma has been disrupted then it MUST be assumed that a significant injury has occurred

Penetrating Injury

- If the platysma is intact then local wound repair treatment of choice
- Neck wounds must never be probed beneath the platysma
- Probing a deep neck wound could lead to disruption of hemostatic plug
- After determination of platysma violation, track of the wound and damaged structures must be evaluated

Penetration Injury

- Once the wound location has been found, you can generate a differential of potentially injured structures based on zone of injury
- If the platysma has been violated then a surgical consultation should be obtained

Penetrating Injury

- Diagnosis and Management
  - Patients who are hemodynamically unstable or have obvious deep injury require immediate surgical attention (Operating Room)
  - Patients with normal vital signs will undergo further evaluation depending on the zones that appear to have been violated

Penetrating Injury

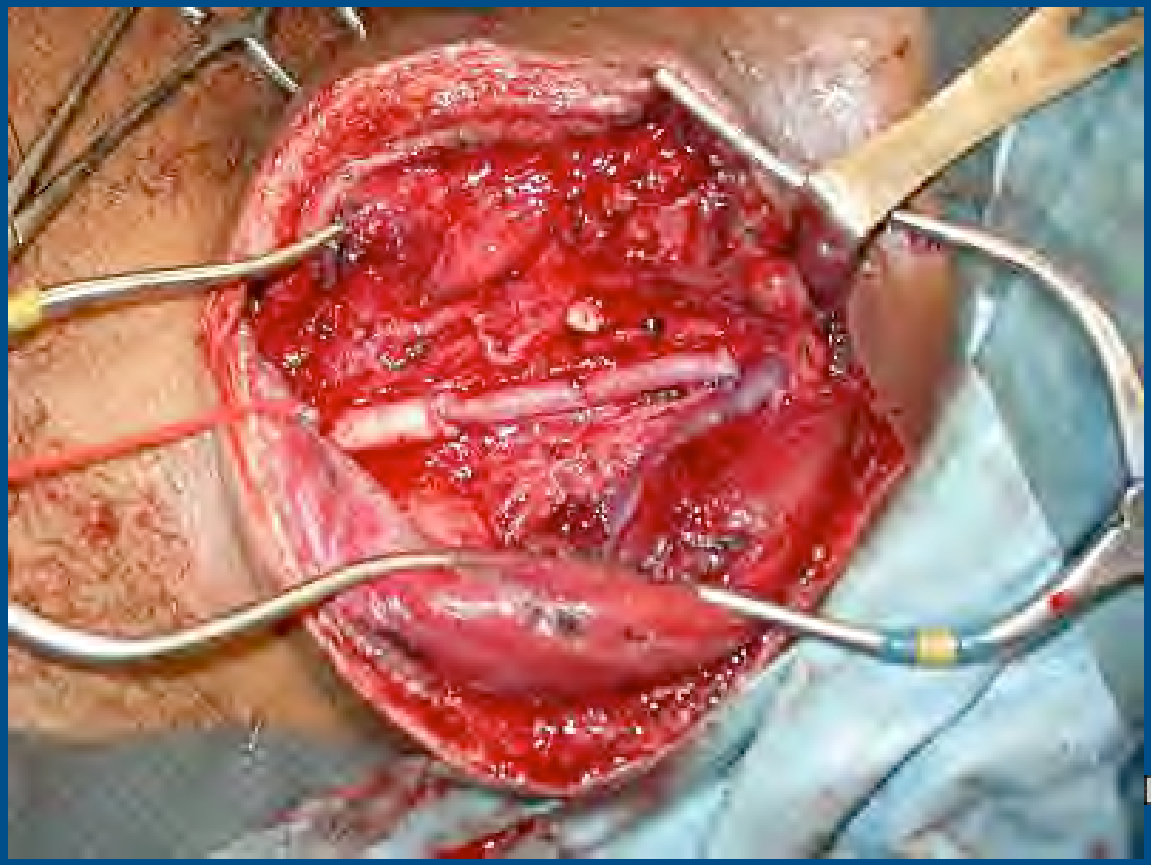
- Diagnosis and Management:
  - In Zones I and III non-operative studies are used to identify injuries
  - Zone I injuries often will require a thoracic surgeon to gain proximal vascular control
  - In zone III, attempts for distal control , may require mandibular dislocation.
  - Given these difficulties, routine exploration is not recommended

Penetrating Injury

- No true consensus regarding management of zone II injuries
- Current literature supports both operative and non operative approaches to injuries deeper than the platysma
- No clear evidence to support one treatment modality over the other

Zone II Injury

- Operative management of GSW to carotid artery



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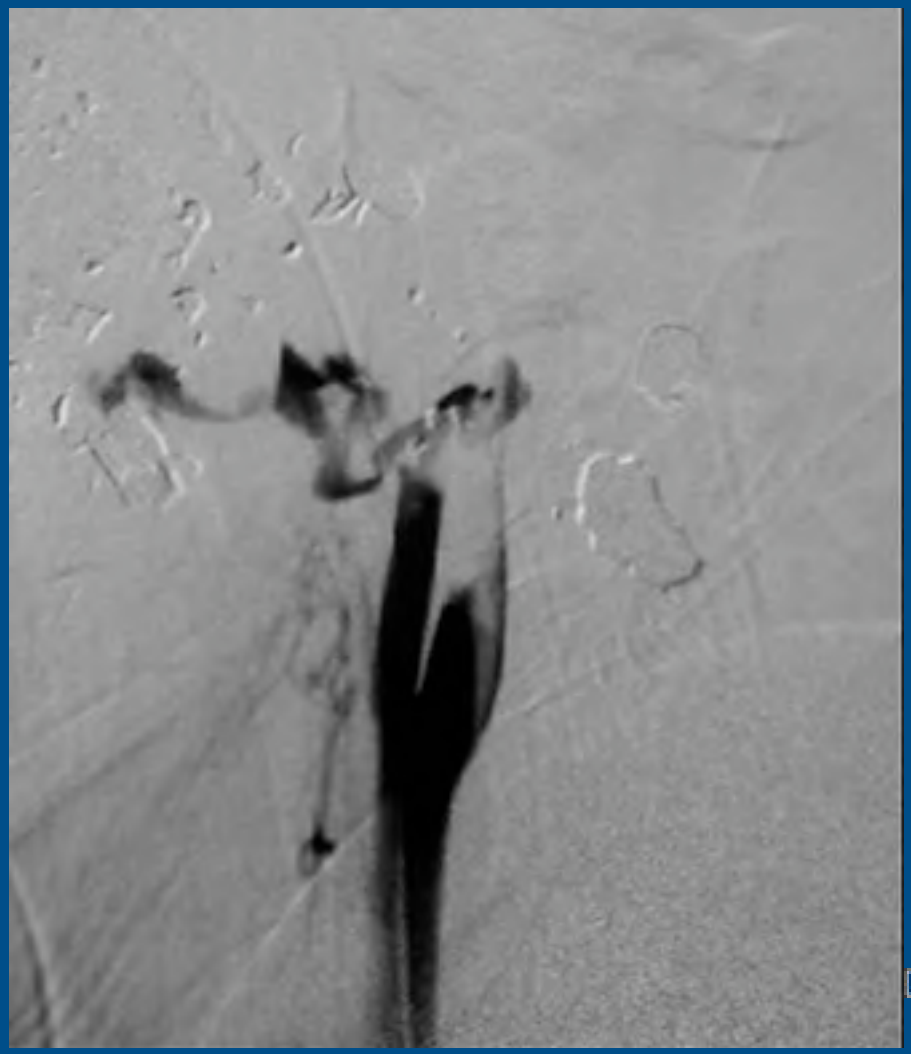
Diagnostic Tools

- Vascular Evaluation = Angiography
  - Gold Standard
  - Duplex ultrasound has recently gained prominence as less invasive tool
- Esophageal Evaluation
  - Esophogram
  - Performed for all Zone I/II Injuries
- Laryngotracheal Evaluation = Bronchoscopy
  - For all Zone I and II injuries

Angiogram – GSW to Carotid Artery



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Penetrating Neck Injury Management

- In summary for penetrating trauma
  - All hemodynamically unstable patients need surgical exploration immediately
  - Hemodynamically stable:
    - Zone 1:
      - Angiography
      - Esophogram/Endoscopy
      - Consideration for Bronchoscopy
    - Zone 2:
      - Same as above or Mandatory exploration by surgeon
    - Zone 3:
      - Angiography

Pediatric Considerations

- The initial management steps are the same as for the adult patient
- The diagnostic process may be associated with more morbidity as most children will require anesthesia to obtain studies
- Zone 2 injuries with stable vital signs are often observed closely

Blunt Neck Trauma

- Blunt trauma to the neck is less frequent in occurrence
- Mechanism is often related to motor vehicle collisions
  - Hyperextension
  - Rotation
  - Hyper flexion
  - Direct blows against a non mobile object (most commonly seatbelts)

Blunt Trauma

- Other mechanisms include:
  - Direct blows during sports
    - E.g. Fists, elbows, fast moving soccer balls, hockey pucks
  - Handle bars from bicycles
  - Strangulation
- Often, less “exciting” on presentation but these injuries can be lethal or life threatening

Blunt Trauma

- Signs and symptoms of significant injury are often delayed
- If a significant mechanism for injury exists, then the patient should be closely observed for deterioration
- If significant mechanism exists, surgical consultation should be obtained early in evaluation period

Laryngotracheal Injury

- Following blunt neck trauma, Laryngotracheal injury should be ruled out
- These injuries can range from soft tissue swelling to bruising and vocal cord avulsions.
  - Fractures of the hyoid or cricoid cartilage
  - Nerve damage: recurrent laryngeal nerve
  - Disruption of the larynx or trachea

Laryngotracheal Injury

- Signs and symptoms:
  - Difficulty swallowing
  - Pain with swallowing
  - Difficulty breathing (feeling breathless)
  - Hoarseness of voice (or change in voice)
  - Subcutaneous emphysema
  - Tracheal deviation
- However signs and symptoms may be absent even with a major injury

Laryngotracheal Injury

- Blunt trauma to neck with swelling and subcutaneous emphysema

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http://www.ispub.com/ispub/ijorl/volume_9_number_1_10/extensive_laryngotracheal_trauma/trauma-fig1.jpg

Laryngotracheal Injury

- Management:
  - High index of suspicion is required to diagnose these types of injuries especially in the absence of classic symptoms
  - Securing an airway is the initial focus.
    - Endotracheal intubation should be attempted by the most experienced person
    - Other authors suggest immediate tracheostomy to avoid creating a false path or further injury to the unstable airway
    - Cricothyrodotomy should be avoided as this may worsen the injury

Laryngotracheal Injury

- Management (continued):
  - After securing a definitive airway:
    - X-rays to evaluated for free air
    - CT scan to evaluate for bony injury and to further define the type and degree of tracheal injury
    - Laryngosocopy/Bronchoscopy to evaluate vocal cords

Vascular Injury

- Vascular Injuries may be delayed in presentation
- Symptoms are often attributed to concurrent head injury
- Any mechanism that stretches or compresses the artery can lead to injury

Vascular Injury

- 5 injury mechanisms described:
  - Hyperflexion
    - Compression of artery between the spine and mandible
  - Hyperextension
    - Compression of artery against the transverse process of spine
  - Direct contact with force
  - Basilar skull fracture with injury to distal portion of carotid artery
  - Intra-oral trauma

Strangulation

- Strangulation injuries are the result of significant application of pressure to the neck
- Mechanism of strangulation injuries:
  - Hanging
  - Cord strangulation
  - Manual strangulation

Strangulation

- Pathophysiology
  - Compression results in spinal cord and brainstem injury
  - Compressive forces can lead to cerebral ischemia and then death
  - Compression also can cause mechanical airway obstruction
  - Bony fractures: Often associated with edema
    - Hyoid, cricoid and larynx

Strangulation vs. Judicial Hanging

PD-SELF Geerto (Wikipedia)

PD-EXP http://3.bp.blogspot.com/_at3Zkq7CIMs/SUmf3jf5rGI/AAAAAAAABAo/MHPgOpUUmIE/s400/Hanging.jpg

Strangulation

- Evaluation and treatment:
  - Airway – First priority
  - Breathing (respiratory mechanism)
    - Evaluate for evidence of pulmonary edema
  - Circulation
    - Evaluate for cardiac arrhythmia
    - Treat hypotension
  - Neurological complications
    - Secondary to ischemia and or hypoxia
- C-spine fracture should be suspected if hanging from a height greater than patients height

Questions?

 Dkscully (flickr)

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