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Penetrating and Blunt Neck Trauma

Presenter: Rockefeller Oteng, 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.
Anatomy

- There are several ways in which to describe the neck anatomy.
- Classic anatomists 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

- Submental triangle
- Submandibular triangle
- Carotid triangle
- Muscular triangle

Olek Remesz (Wikipedia)
Posterior Triangle

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

- Injury to this area can have catastrophic outcomes
Posterior Triangle

Oleks Remes (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

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

Mysteriouskyn (Wikipedia)

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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

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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 may be 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.

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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
Diagnostic Tools

- **Vascular Evaluation = Angiography**
  - Gold Standard
  - Duplex ultrasound has recently gained prominence as a 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
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

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

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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
  - Laryngoscopy/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

Geerto (Wikipedia)

http://3.bp.blogspot.com/_at3Zq7CIMs/SUmf3jf5rGI/AAAAAAAABAo/MHPgOpUUmlE/s400/Hanging.jpg

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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?

