Managing the Difficult Airway and Aerodigestive Tract Injuries

ACSS Educational Conference

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Disclosures

- None

Why This Talk?

- Recent cases and talk update
- Outline (will focus on aerodigestive > vascular)
  - Overview of anatomy and pathophysiology
  - Workup, management, and key pitfalls
  - Troubleshooting common clinical problems
  - Questions (SCORE/SESAP/TrueLearn)
- *ABSITE pearls

Learning Objectives

- Overview of aerodigestive anatomy, pathophysiology, and injury
- Workup and management of the difficult airway
- Troubleshooting common clinical problems

Case

- 18M presents as a delta alert s/p GSW to neck
- How do you proceed?

Case

- 18M presents as a delta alert s/p GSW to neck
- How do you proceed? → Primary survey
- Inadequate delivery of oxygenated blood to the brain is the quickest killer of injured patients
  - Protected, unobstructed airway and adequate ventilation necessary to prevent hypoxemia
  - Failure to adequate assess airway
  - Failure to recognize need for intervention
  - Inability to establish airway
  - Failure to recognize incorrectly placed or displacement
  - Failure to recognize need for ventilation

Airway Assessment

- Consider: facial burns, maxillofacial trauma, neck trauma
- How do you assess the patient?

Airway Assessment

- Consider: facial burns, maxillofacial trauma, neck trauma
- How do you assess the patient?
- Hemorrhage obstructing field, swelling, secretions, hematoma or emphysema and displacement of structures
- Agitation (hypoxia) or obtundation (hypercarbia) present?
- Noisy breathing? Snoring, gurgling, stridor, dysphonia?
- Any tools for assessment?

BOX 2-1 LEMON ASSESSMENT FOR DIFFICULT INTUBATION

L = Look Externally: Look for characteristics that are known to cause difficult intubation or ventilation (e.g., small mouth or jaw, large overbite, or facial trauma).

E = Evaluate the 3-3-2 Rule: To allow for alignment of the pharyngeal, laryngeal, and oral axes and therefore simple intubation, observe the following relationships:

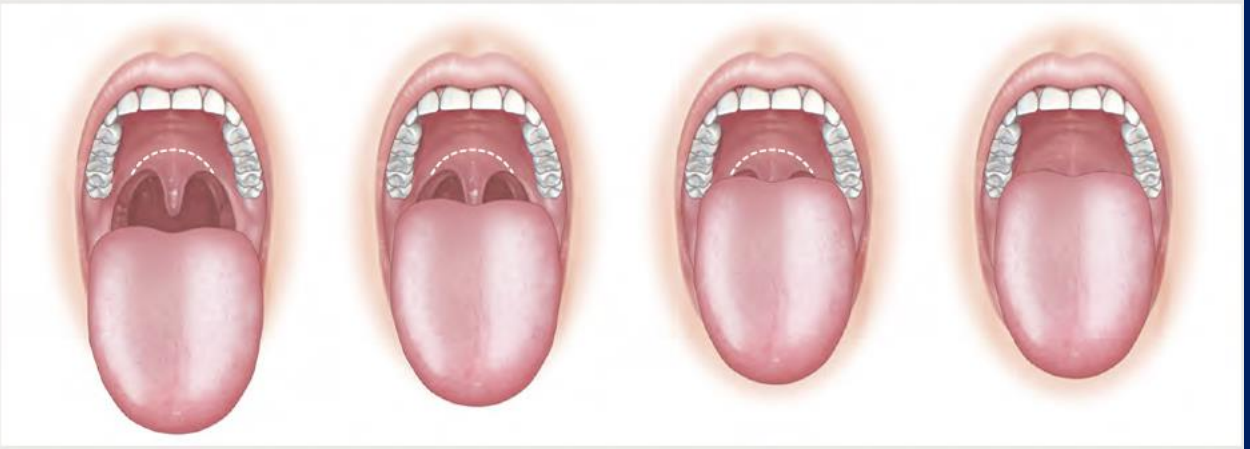
- The distance between the patient's incisor teeth should be at least 3 finger breadths (3)
- The distance between the hyoid bone and chin should be at least 3 finger breadths (3)
- The distance between the thyroid notch and floor of the mouth should be at least 2 finger breadths (2)

M = Mallampati: Ensure that the hypopharynx is adequately visualized. This process has been done traditionally by assessing the Mallampati classification. In supine patients, the clinician can estimate Mallampati score by asking the patient to open the mouth fully and protrude the tongue; a laryngoscopy light is then shone into the hypopharynx from above to assess the extent of hypopharynx that is visible.

O = Obstruction: Any condition that can cause obstruction of the airway will make laryngoscopy and ventilation difficult.

N = Neck Mobility: This is a vital requirement for successful intubation. In a patient with non-traumatic injuries, clinicians can assess mobility easily by asking the patient to place his or her chin on the chest and then extend the neck so that he or she is looking toward the ceiling. Patients who require cervical spinal motion restriction obviously have no neck movement and are therefore more difficult to intubate.

BOX 2-1 LEMON ASSESSMENT FOR DIFFICULT INTUBATION (continued)

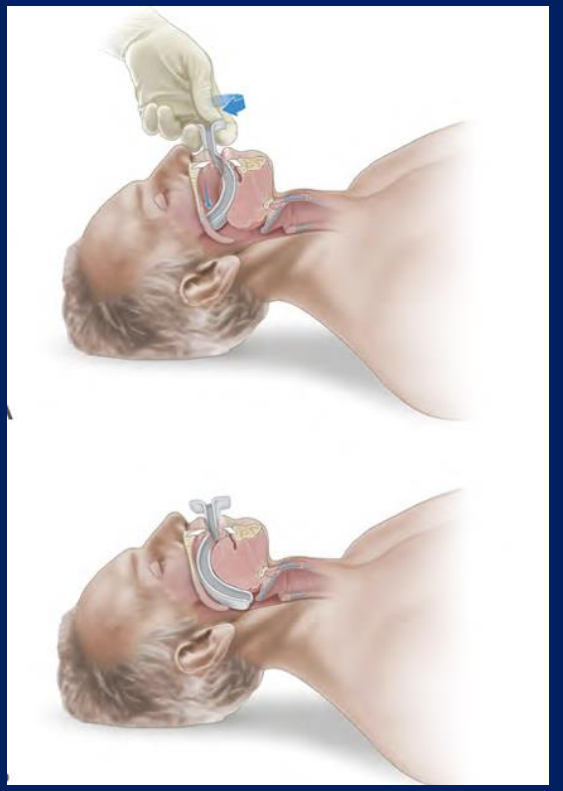


Mallampati Classifications. These classifications are used to visualize the hypopharynx. **Class I:** soft palate, uvula, fauces, pillars entirely visible; **Class II:** soft palate, uvula, fauces partially visible; **Class III:** soft palate, base of uvula visible; **Class IV:** hard palate only visible.

Airway Maintenance Techniques

Airway Maintenance Techniques

- Chin-lift
- Jaw-thrust
- Nasopharyngeal airway
- Oropharyngeal airway
- Extra/supraglottic devices

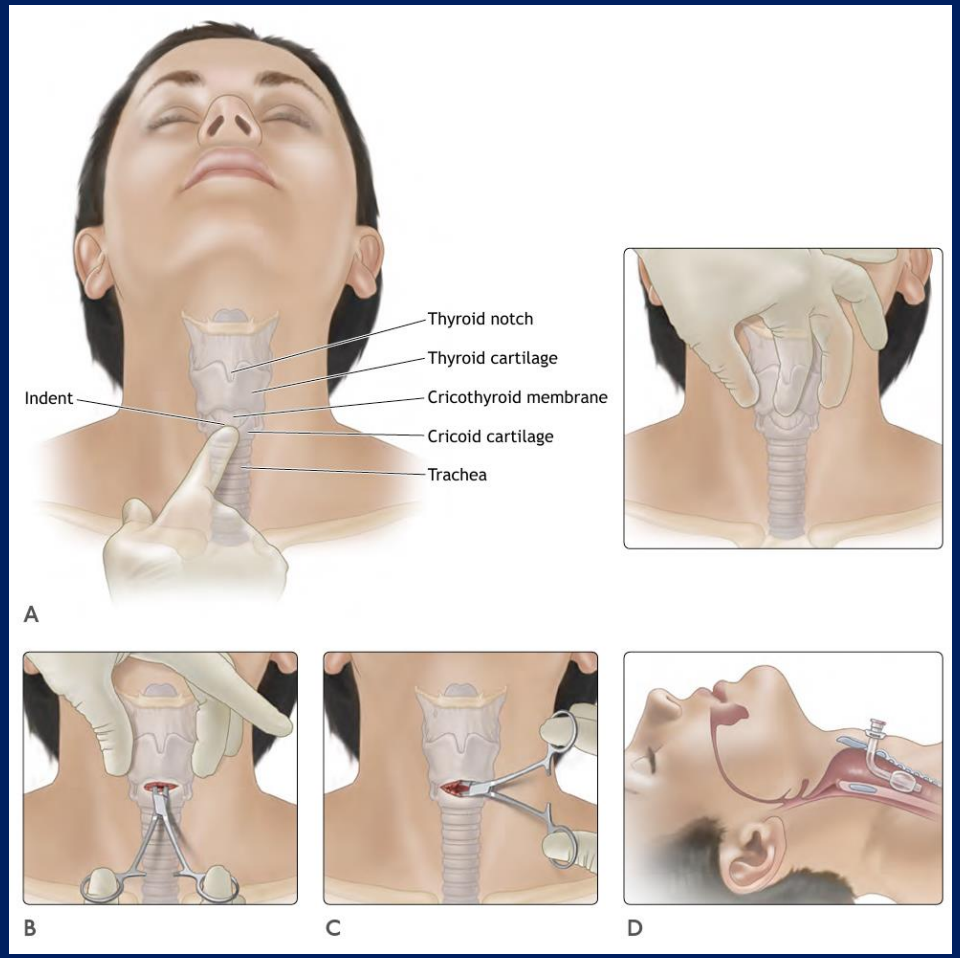


Definitive Airway

- A definitive airway is defined as:

Definitive Airway

- A definitive airway is defined as: a tube in the trachea with the cuffed inflated below the vocal cords
- Endotracheal intubation
  - Lots of adjuncts available (gum elastic bougie)
- Surgical airway

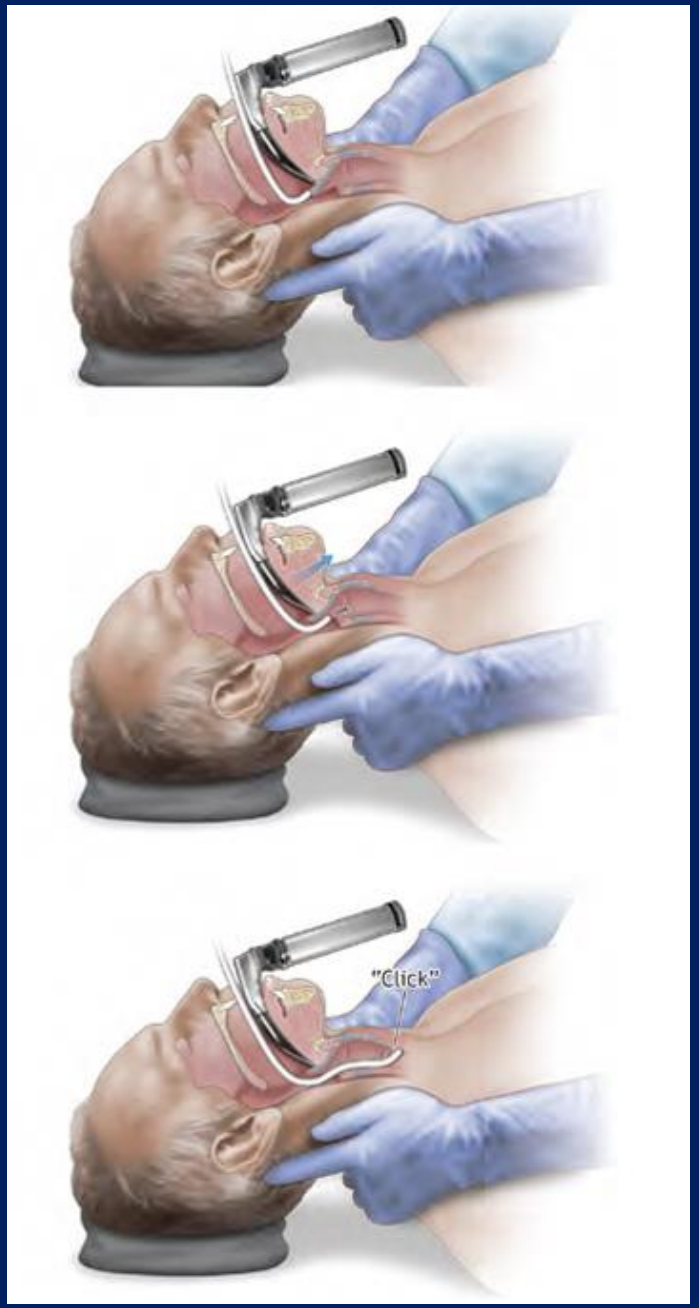


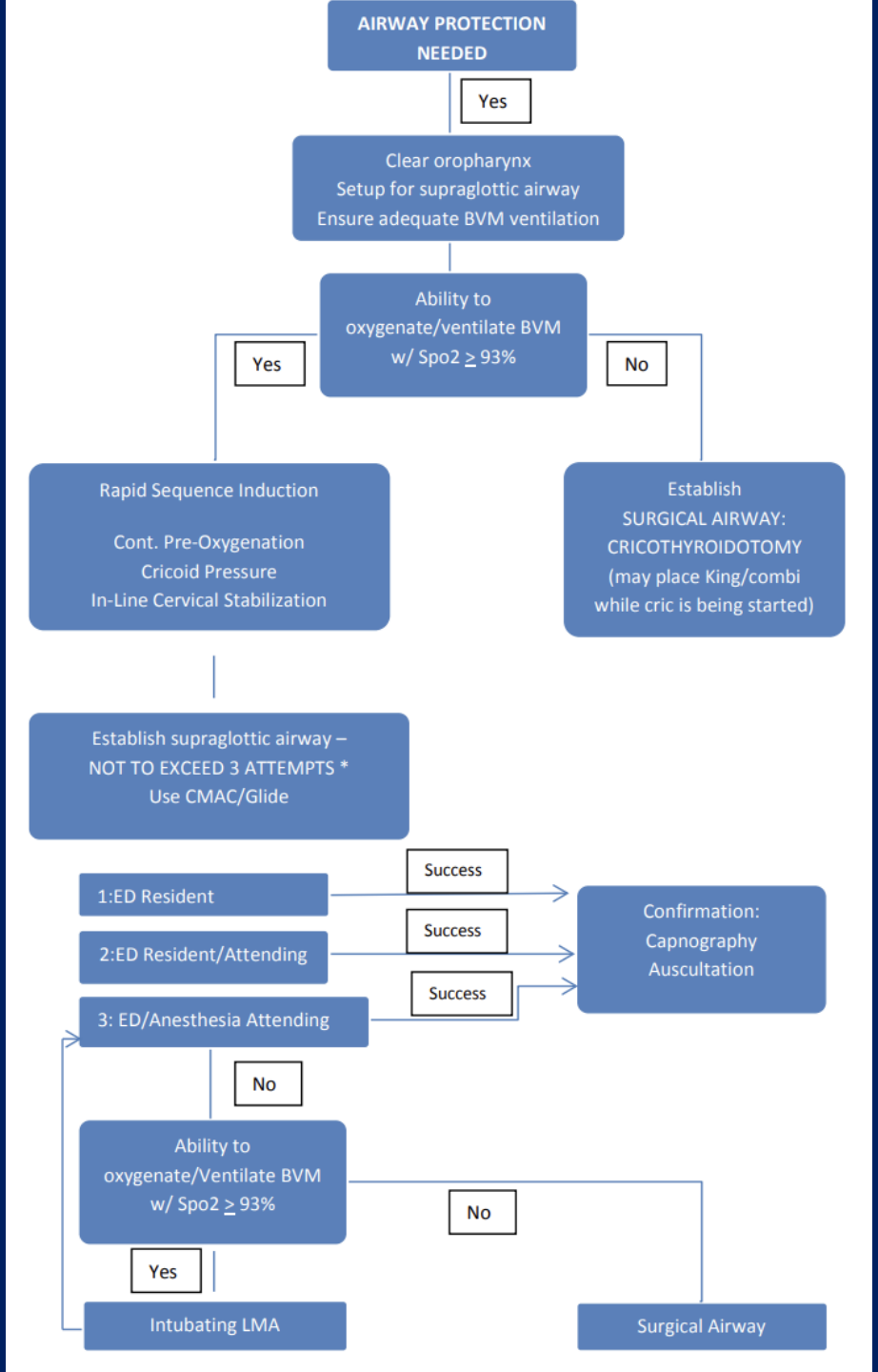
Definitive Airway

- Don’t forget c-collar considerations
- Don’t forget to have a plan in case of failure
- Order of events in intubation:

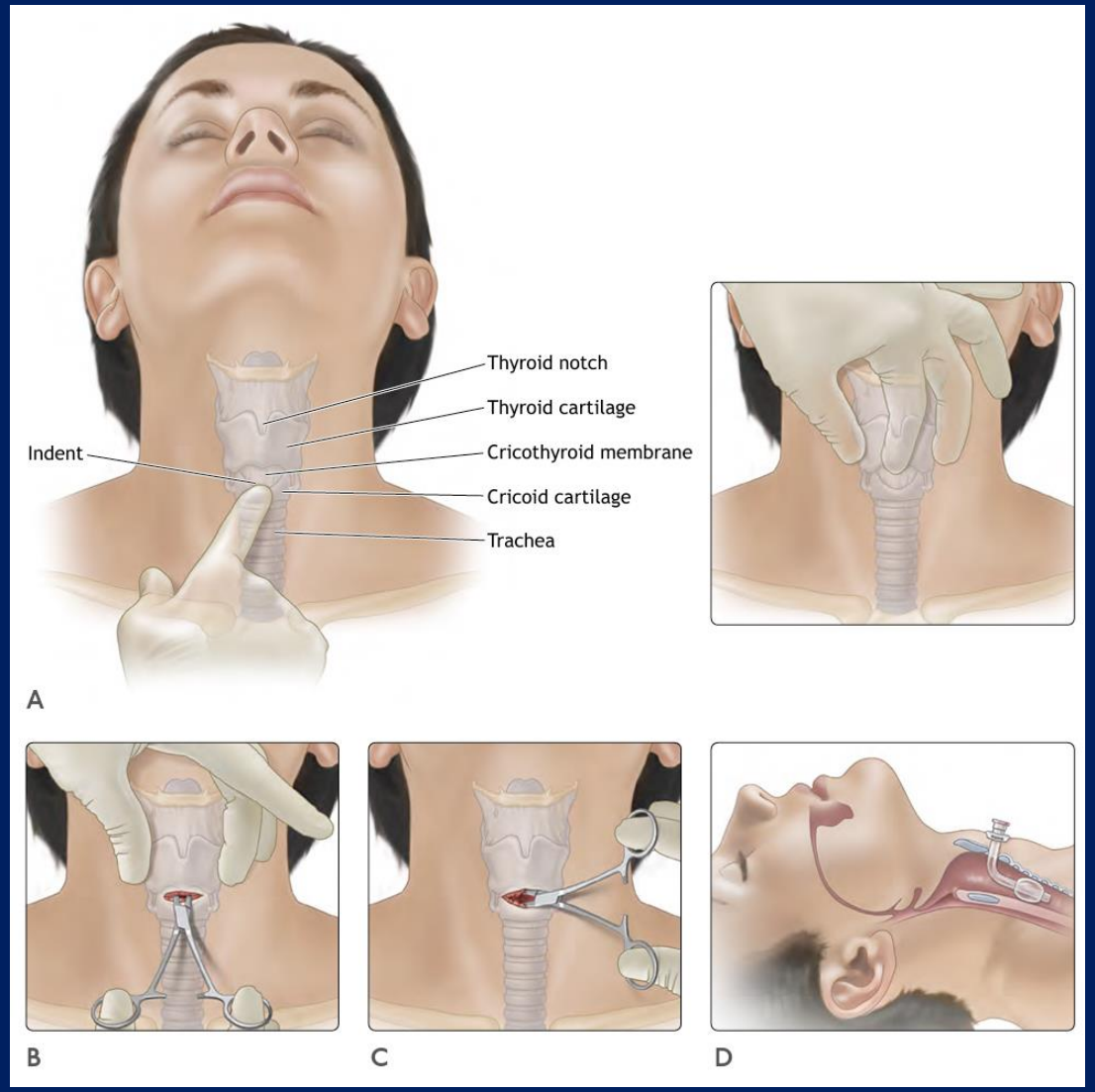
Definitive Airway

- Don’t forget c-collar considerations
- Don’t forget to have a plan in case of failure
- Order of events in intubation:
  - 1. Preoxygenation
  - 2. Cricoid pressure
  - 3. Induction agent (e.g. etomidate)
  - 4. Paralytic agent (e.g. succinylcholine)
  - 5. Intubate
  - 6. Confirm ventilation



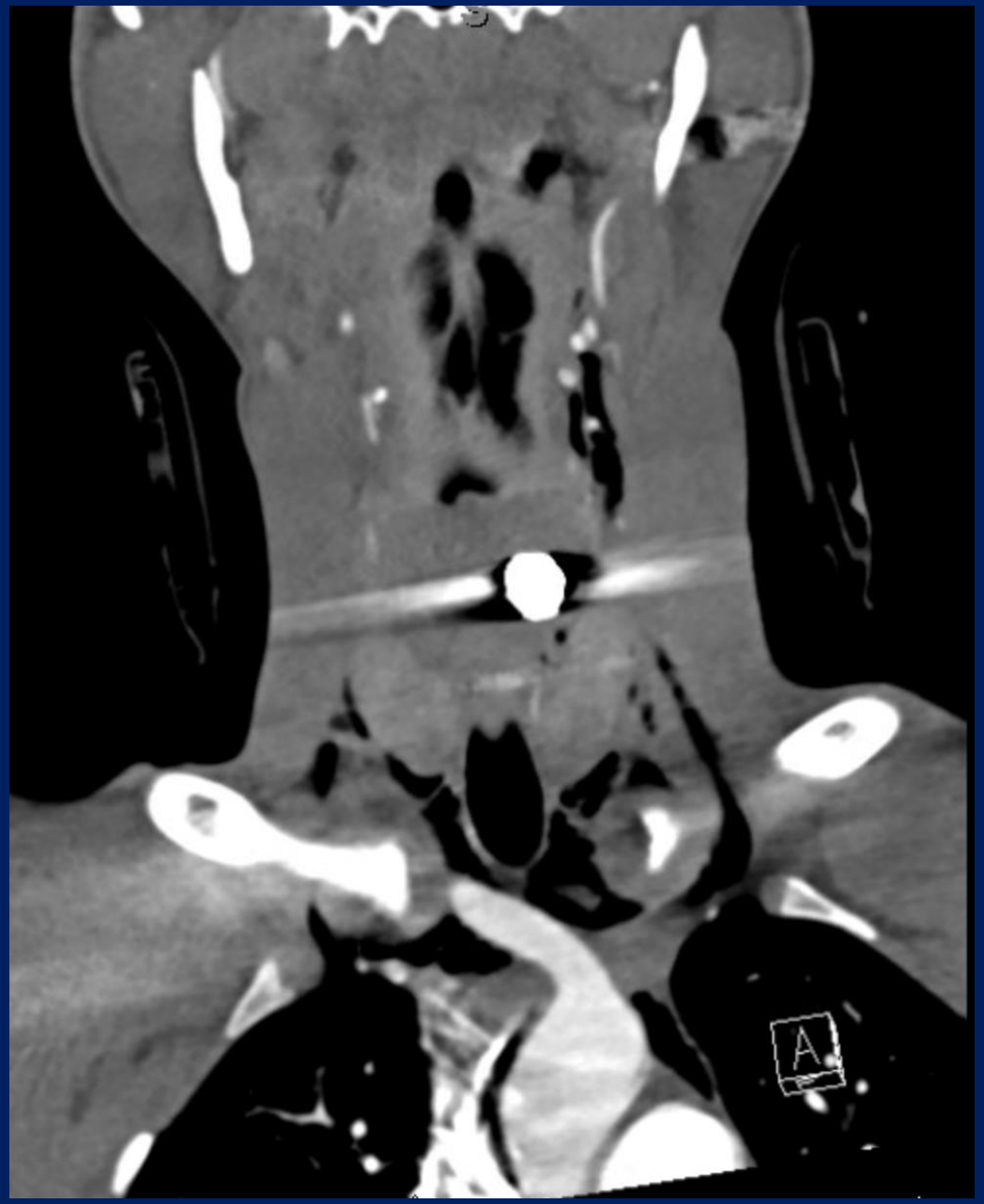

AIRWAY PROTECTION NEEDED
Yes
Clear oropharynx
Setup for supraglottic airway
Ensure adequate BVM ventilation
Ability to oxygenate/ventilate BVM w/ Spo2 ≥ 93%
Yes
No
Rapid Sequence Induction
Cont. Pre-Oxygenation
Cricoid Pressure
In-Line Cervical Stabilization
Establish SURGICAL AIRWAY: CRICOTHYROIDOTOMY (may place King/combi while cric is being started)
Establish supraglottic airway – NOT TO EXCEED 3 ATTEMPTS *
Use CMAC/Glide
1:ED Resident
Success
2:ED Resident/Attending
Success
3: ED/Anesthesia Attending
Success
Confirmation:
Capnography
Auscultation
No
Ability to oxygenate/Ventilate BVM w/ Spo2 ≥ 93%
No
Yes
Intubating LMA
Surgical Airway

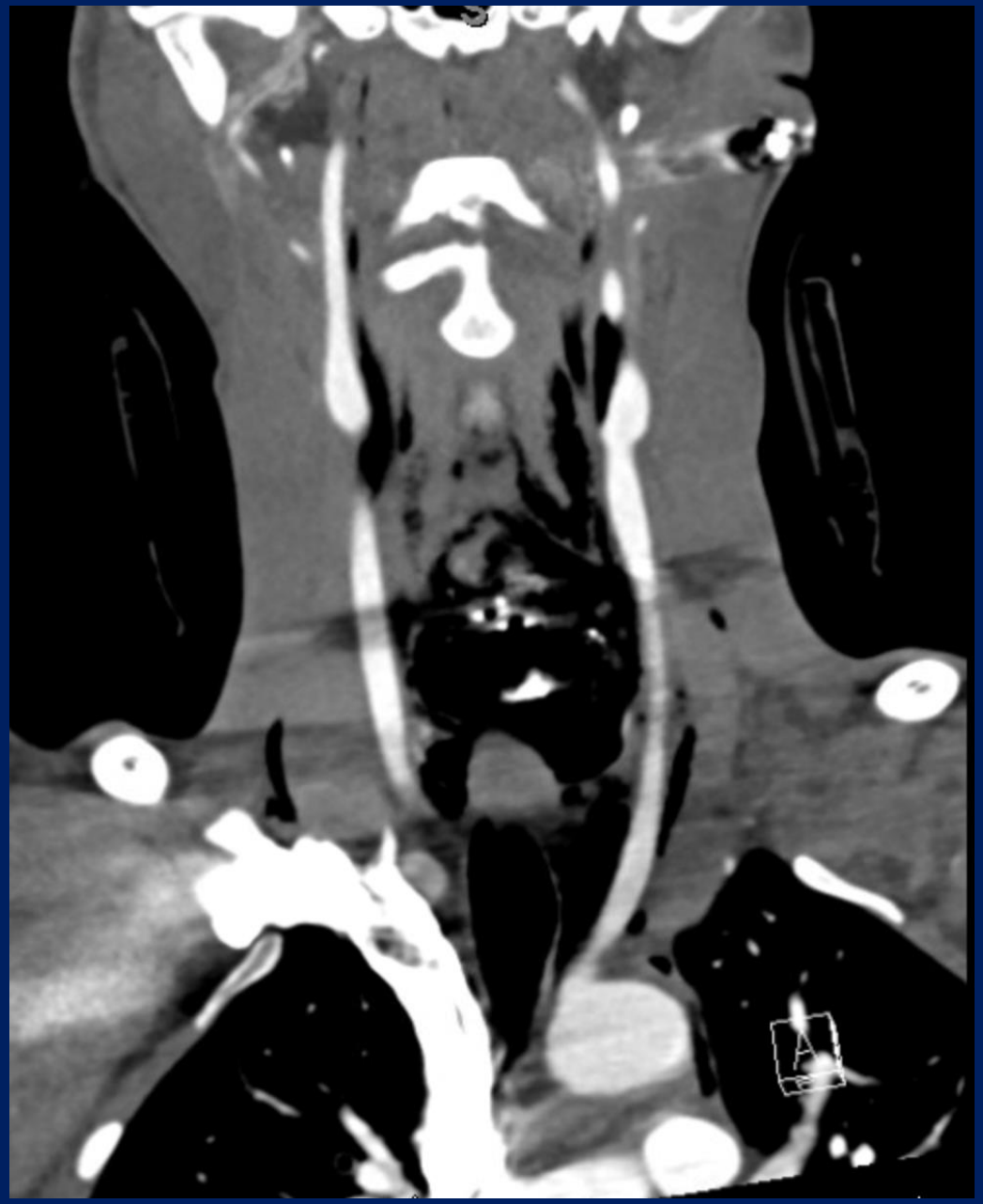
Cricothyroidotomy



Return to Case

- 18M presents as a delta alert s/p GSW to neck
- Successful endotracheal intubation
- Remainder of primary survey intact
- Secondary survey notable for massive subcutaneous emphysema
- Stable for scan



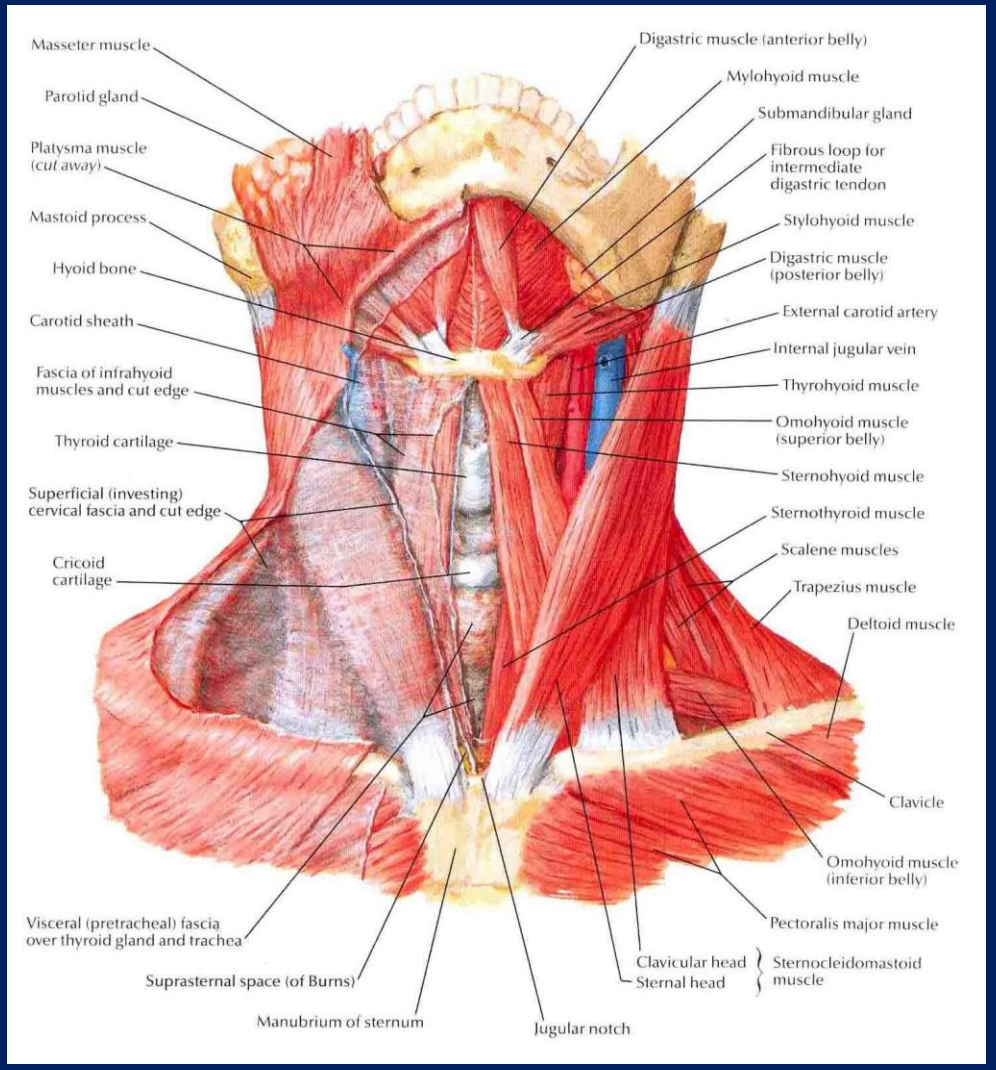


Neck Trauma

- Injuries to the neck:
  - Uncommon, but highest relative mortality rate of all body regions
  - 20% mortality for AIS > 3 in the National Trauma Data Bank
  - Zone 1 injuries = Most lethal
- Penetrating (missile, stab, bite, etc)
  - MC mechanism of injury to the neck
- Blunt (assault, strangulation, “clothes line,” flexion-extension)
  - Represents ~5%
  - Can result in compression or fracture of the larynx/trachea, esophageal/pharyngeal tears, or cerebrovascular injuries (BCVI)

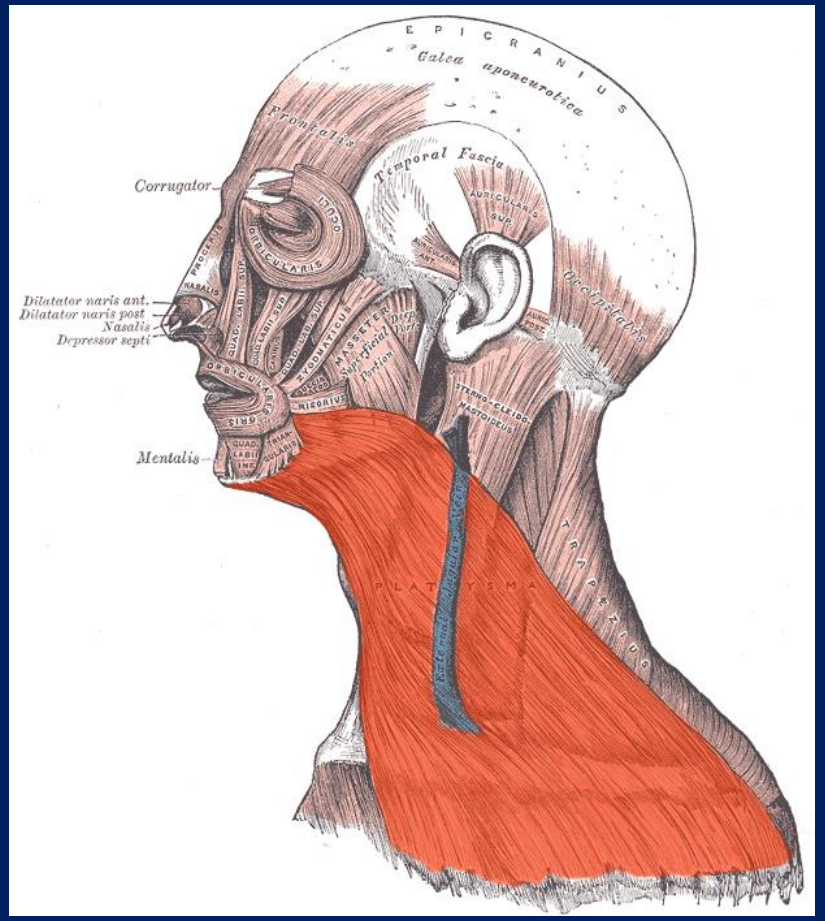
Anatomy Review

- Vital structures → tiger country
  - Airway: larynx, trachea, lungs
  - Vascular: subclavian, carotid, vertebral, jugular
  - Nerves: spinal cord, brachial plexus, cranial nerves, and peripheral nerves
  - GI tract: pharynx, esophagus
  - Thoracic duct
- Skeletal Landmarks
  - Mandible (Zone II/III)
  - Hyoid (C3 level)
- Muscular Landmarks
  - Platysma: historically delineates superficial vs deep injury
  - Sternocleidomastoid: divides anterior & posterior triangles

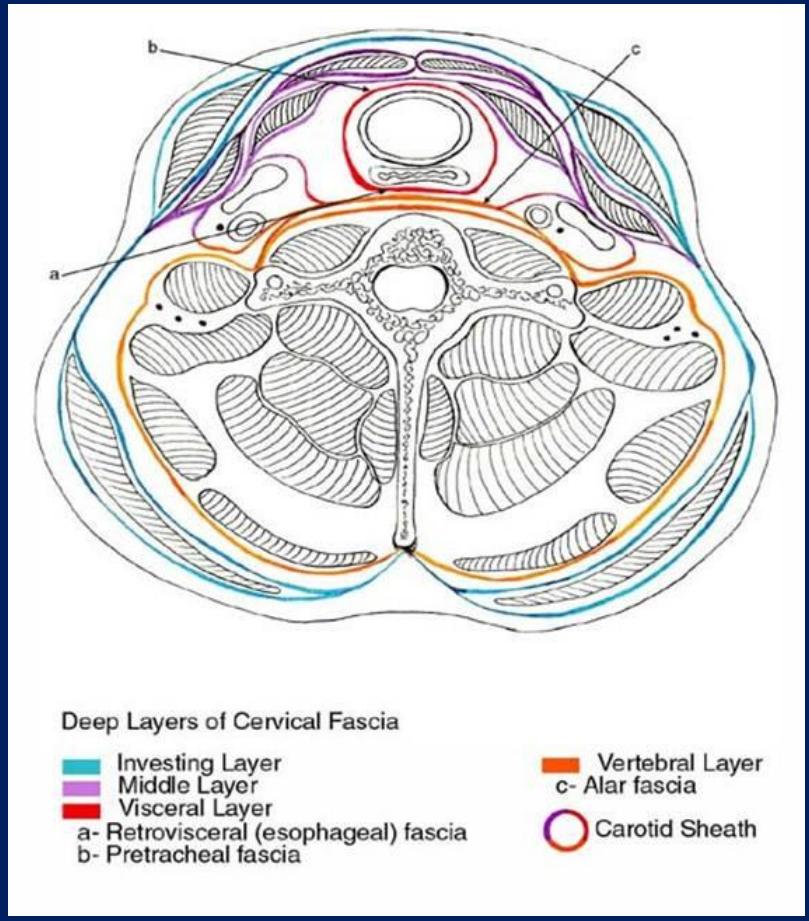


Anatomy Review: Fascia

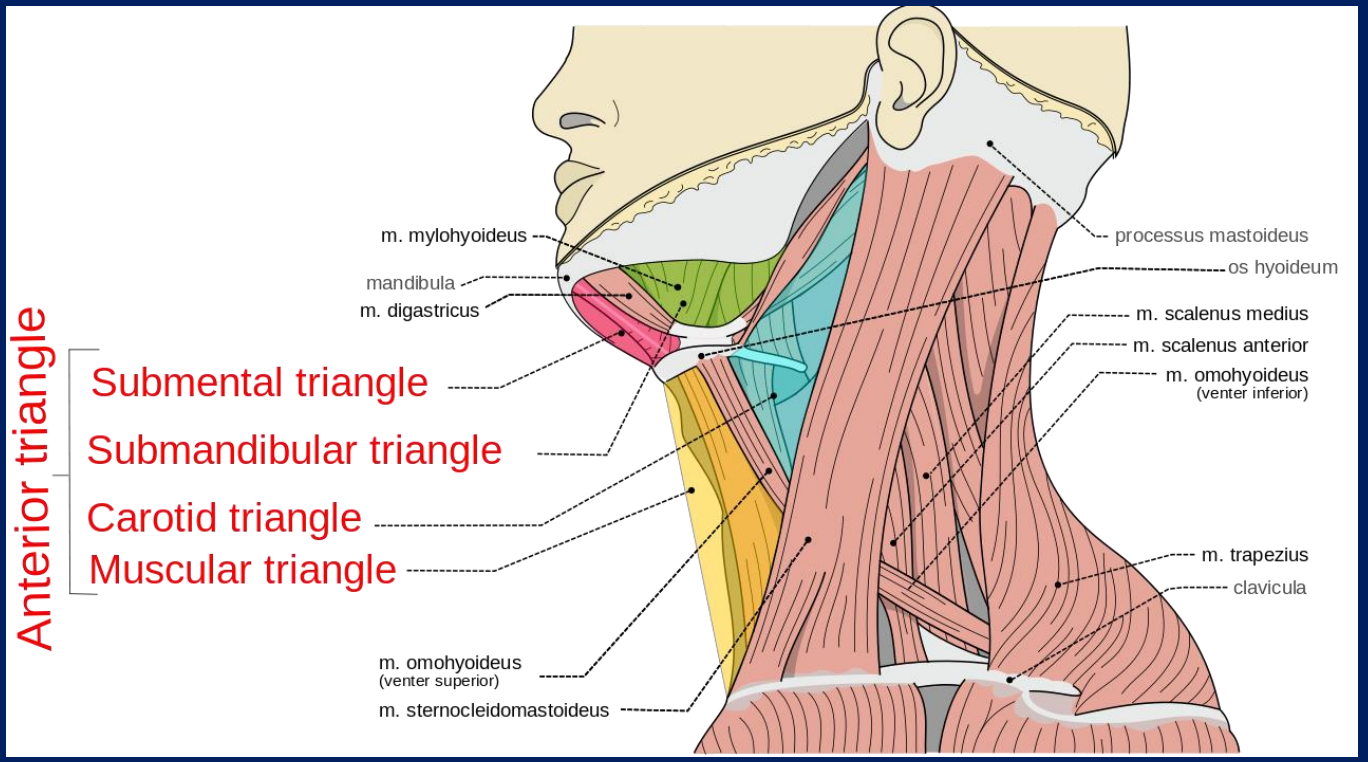
SUPERFICIAL

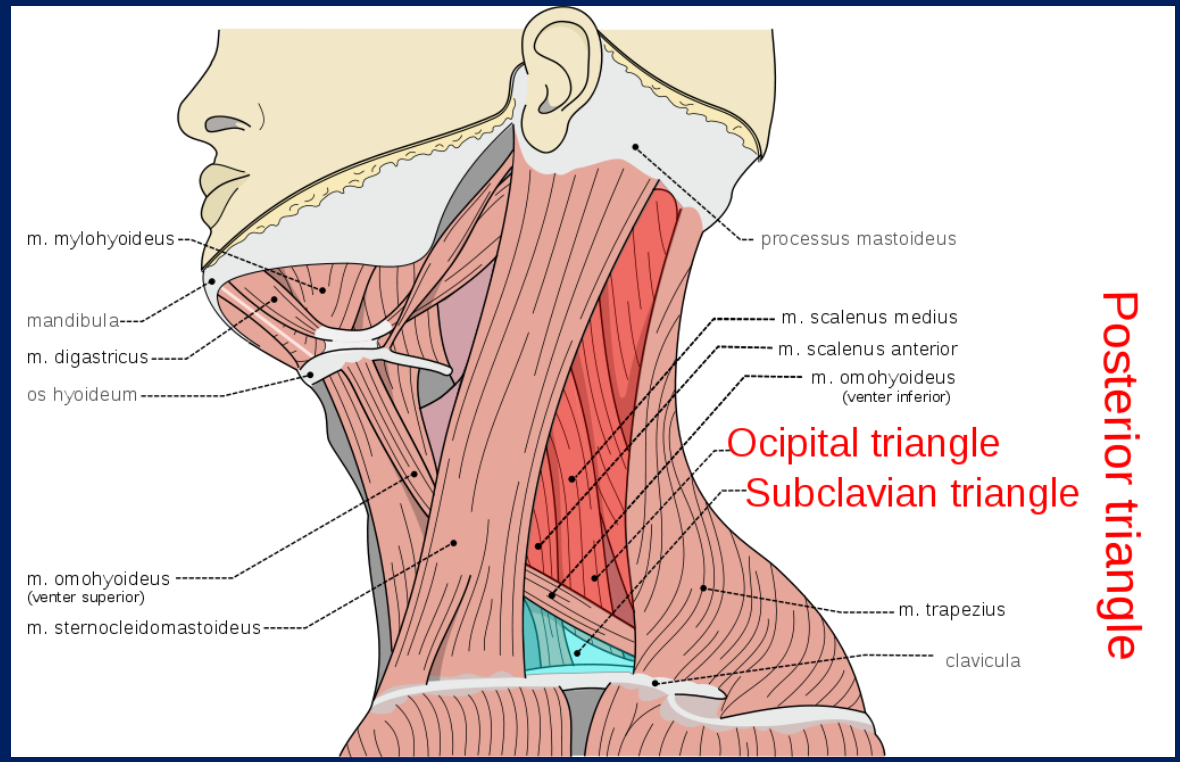


DEEP

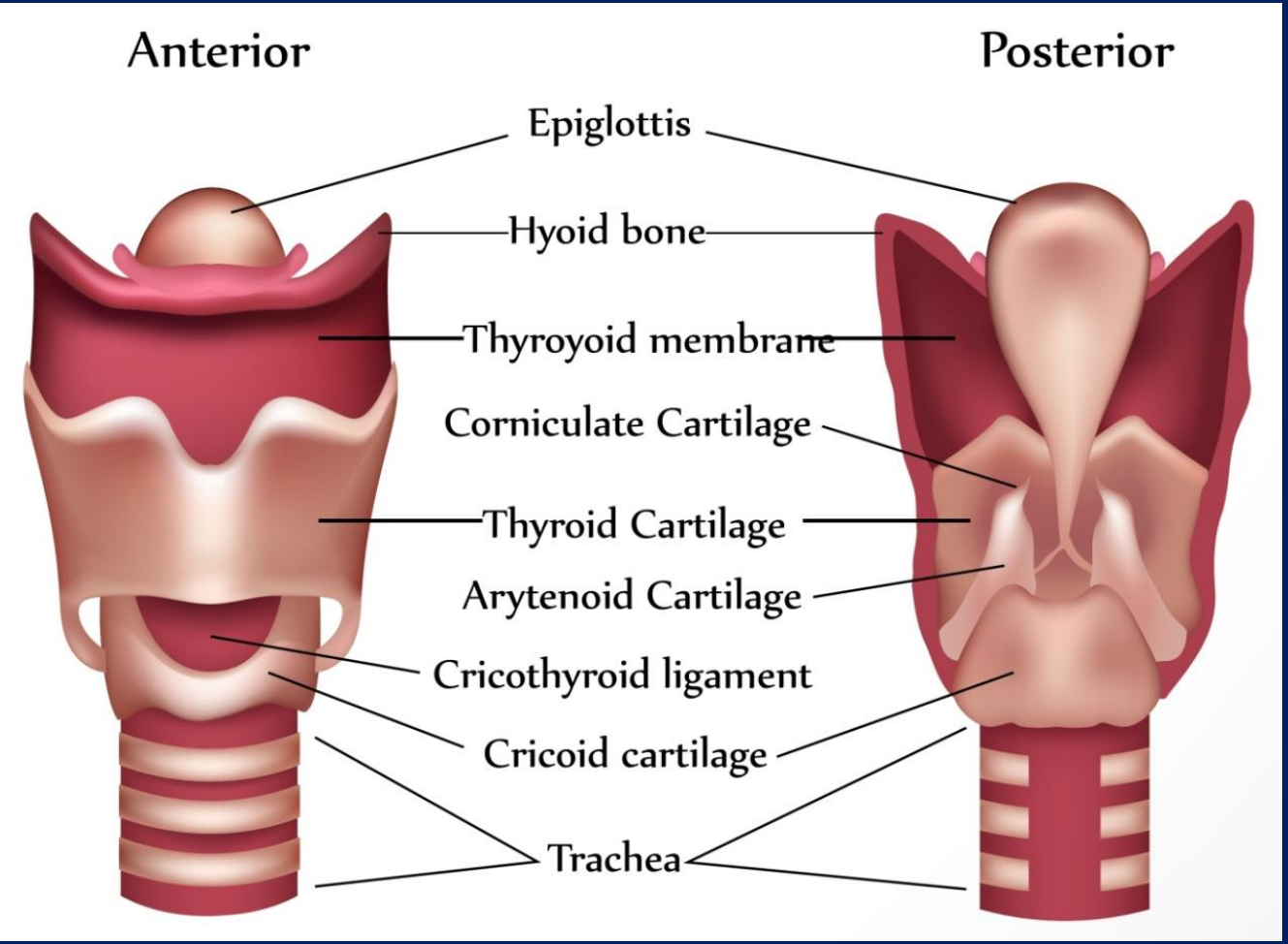


Anatomy Review: Triangles

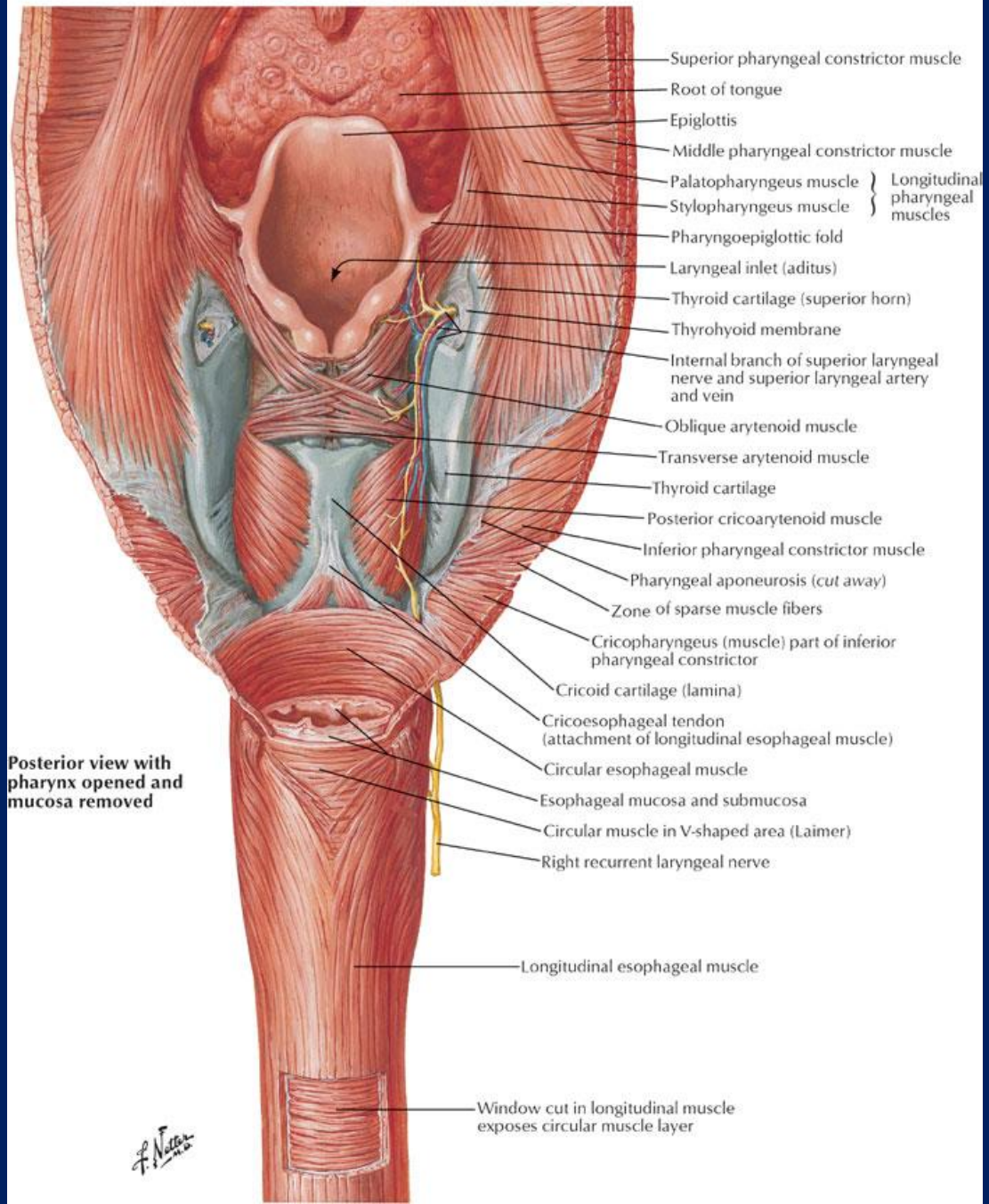




Laryngotracheal Complex & Esophagus

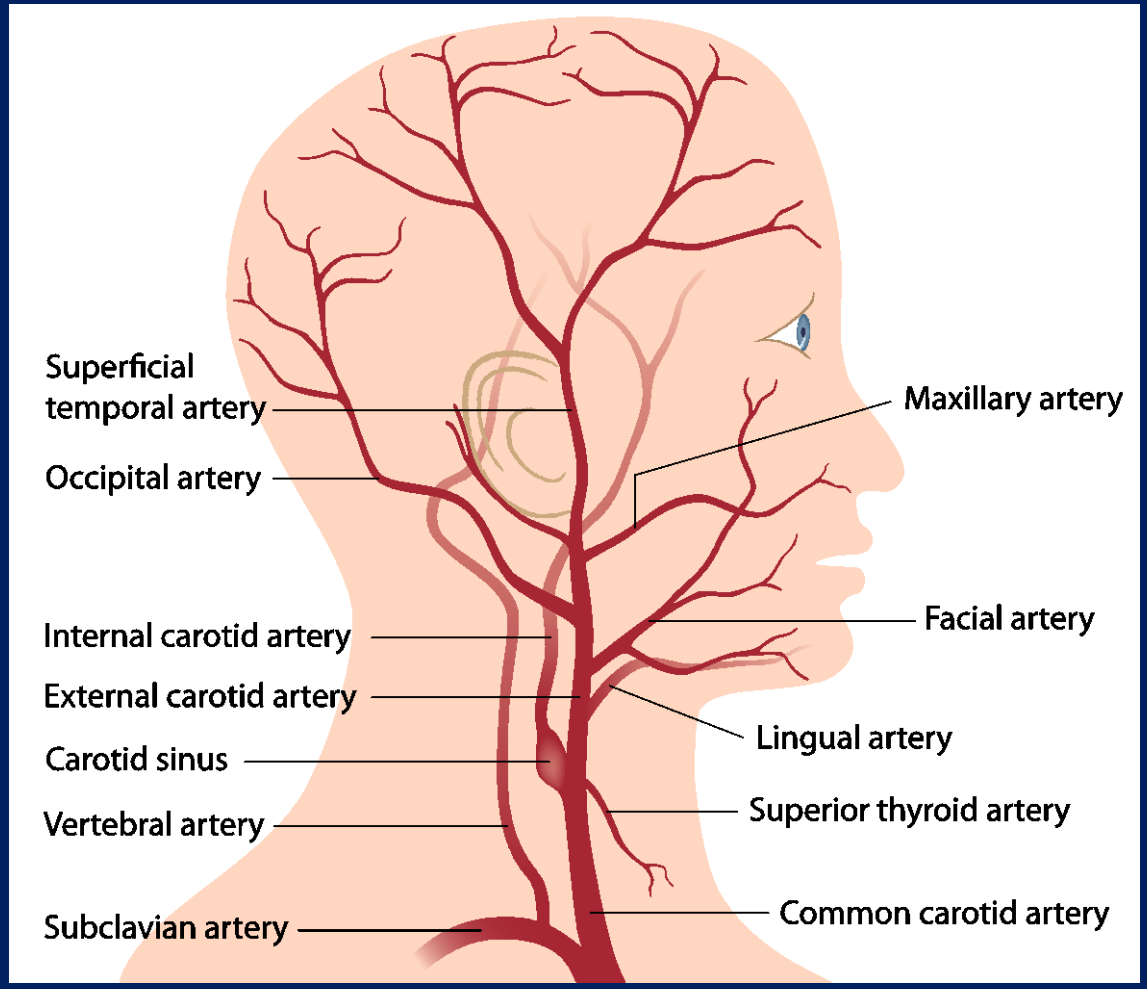


Pharyngoesophageal Junction



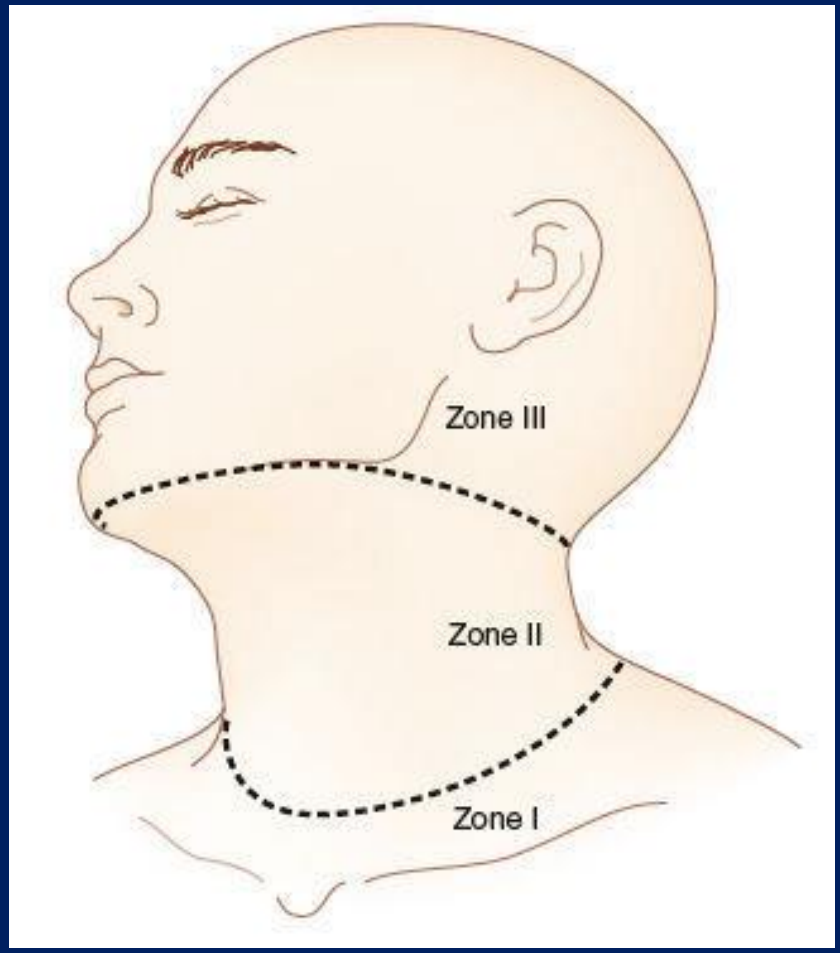
Posterior view with pharynx opened and mucosa removed

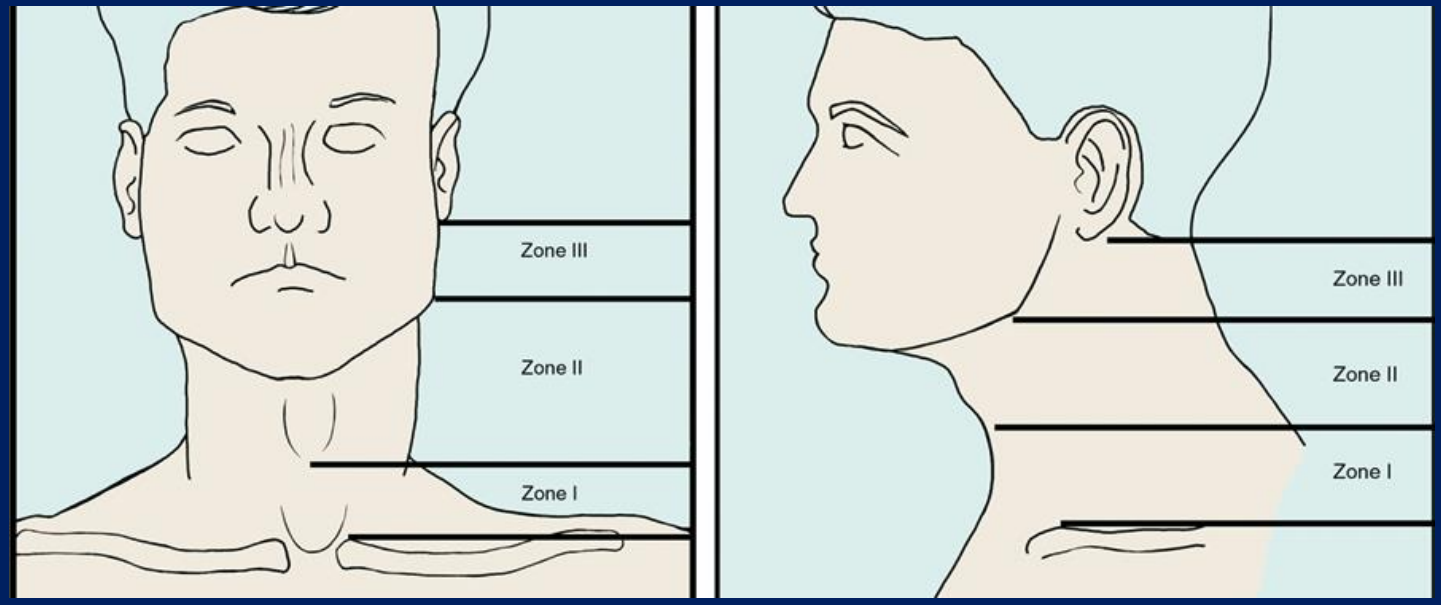
Anatomy Review: Blood Supply



Zones of the Neck

- Zone III: Angle of mandible → base of the skull
- Zone II: Cricoid cartilage → the angle of mandible
- Zone I: Clavicles/sternal notch → cricoid cartilage





*multi-zone frequency 16%

Zone 1 (18%)

- Subclavian vessels
- Brachiocephalic veins
- Common carotid arteries
- Aortic arch
- Jugular veins
- Esophagus
- Lung apices
- C-spine/cord
- Cranial nerve roots

Zone 2 (47%)

- Carotid and vertebral arteries
- Jugular veins
- Pharynx
- Larynx
- Trachea
- Esophagus
- C-spine/cord

Zone 3 (19%)

- Salivary and parotid glands
- Esophagus
- Trachea
- Vertebral bodies
- Carotid arteries
- Jugular veins
- Cranial Nerves IX-XII

Signs of Vascular Injury

Hard signs

Soft signs

Signs of Vascular Injury

Hard signs

- Expanding/pulsatile hematoma
- Active, brisk hemorrhage
- Hemorrhagic shock
- Audible bruit
- Palpable thrill
- Hematemesis

Soft signs

- Nonexpanding hematoma
- History of hemorrhage
- Proximity to bony injury/soft tissue destruction

Signs of Aerodigestive Injury

Hard signs

Soft signs

Signs of Aerodigestive Injury

Hard signs

- Airway obstruction
- Massive subcutaneous emphysema
- Air bubbles in wound
- Major hemoptysis/hematemesis

Soft signs

- Dysphonia
- Dysphagia
- Dyspnea
- Oropharyngeal blood
- Pneumomediastinum/ChT air leak

First Priority: Airway

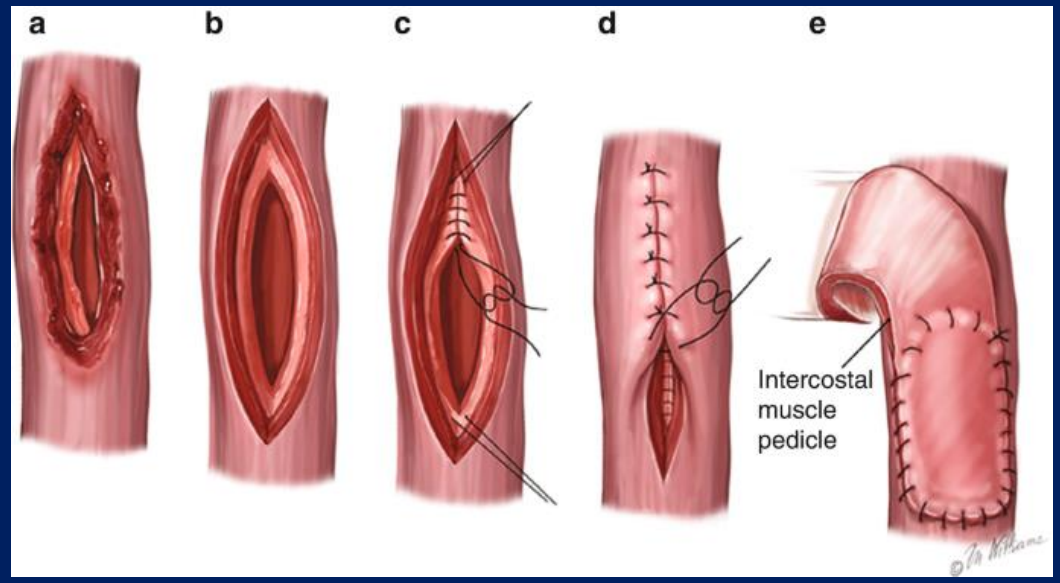
- 8-10% of patients present with airway compromise
- Airway compromise 2/2 direct trauma, severe edema, or hematoma
- GSWs more likely to result in large hematomas than knife wounds (20.6% vs 6.7%)
- Intubation
  - Endotracheal
  - ?Nasotracheal intubation
  - ?Fiberoptic intubation
  - ?Direct intubation into the distal transected segment
  - *if feasible, do in OR with colleagues
- Surgical airway
  - Cricothyroidotomy
  - Tracheostomy

Diagnosis

- 15% of pts with soft signs have a significant laryngotracheal injury
- Plain XR
  - Soft tissue emphysema
  - Airway compression
  - Fracture of laryngeal cartilages
- CT C-spine / CTA
- Contrast esophagram
  - Gastrografin 1st (water-soluble)
  - Barium 2nd (avoid mediastinitis)
- Endoscopy
  - Flexible vs rigid
  - Bronchoscopy/laryngoscopy
- Combo of esophagram + endoscopy nearly 100% sensitive for injury

Pharyngoesophageal Injury: Nonoperative and Operative

- No leak/contained perforation: unusual, most require repair
  - Nonoperative treatment → NPO, spit, abx, TPN
- Free perforation:
  - Cervical: Left neck incision
    - Once you locate the injury: ”extend myotomy to see full extent of mucosal injury, 2 layer repair, buttress with healthy tissue, and wide drainage”
      - Can’t repair it? → just leave drains
      - Can’t locate it? → just leave drains and repeat contrast study in 7 days
  - Proximal thoracic: Right thoracotomy
    - Most amenable to primary repair
      - Adequate longitudinal myotomy→ injury is normally more extensive than first thought
      - 2 layer closure
      - Cover with viable tissue (intercostal or diaphragmatic buttress)
  - Massive neck injury:
    - Cervical esophagostomy



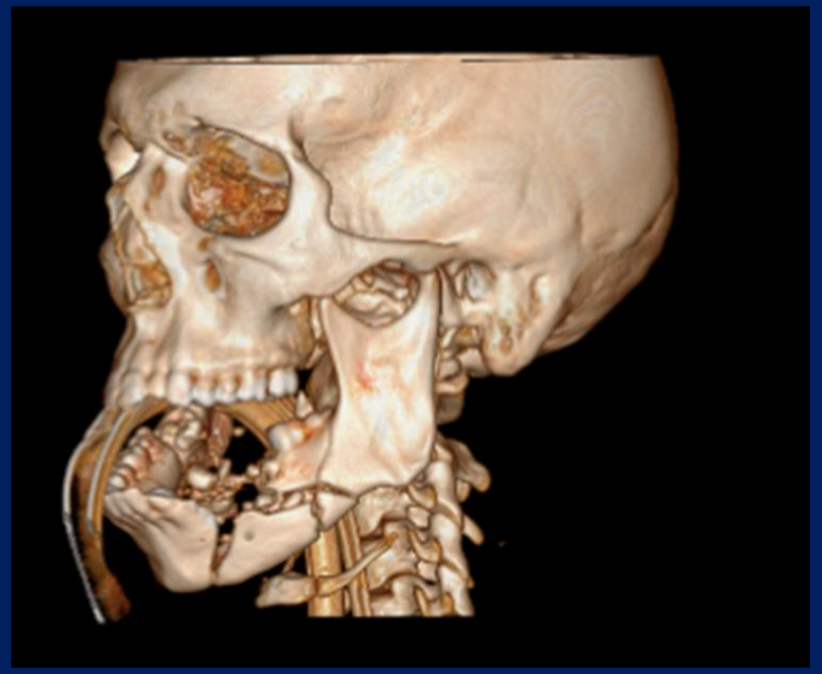
Laryngotracheal Injury: Nonoperative and Operative

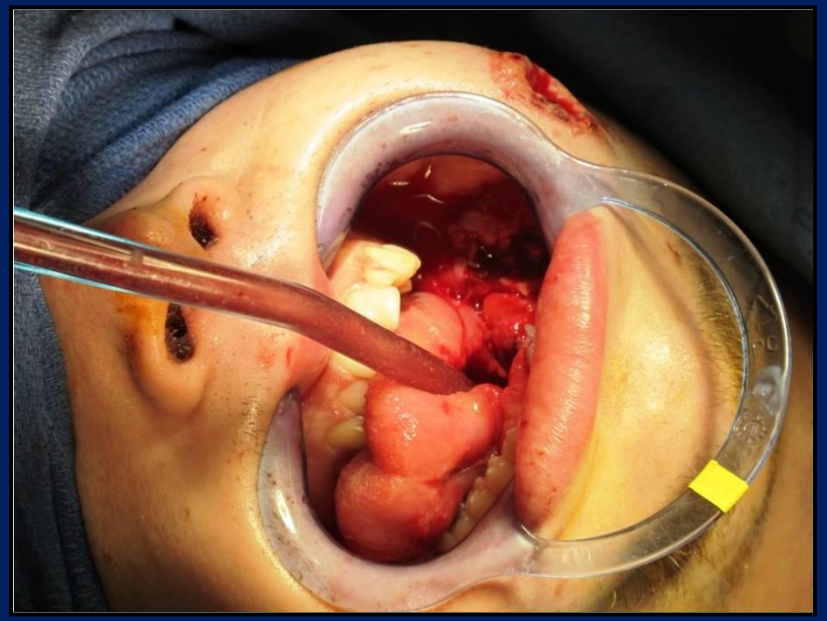
- Low-energy tracheobronchial injuries can often be treated nonop
- <4cm
- <1/3 circumference of trachea
- Well-opposed wound edges
- No significant tissue loss
- No esophageal injury, no sepsis
- Voice rest, humidified air, abx, PPI, +/- TPN

- Transverse collar incision can be utilized for most tracheal injuries
- Simple interrupted single layer including 2 rings, ?prolene vs PDS
- Laryngeal fractures
  - Enlist ENT
  - Even if patient is stable, delay of reduction makes it more difficult and return of normal function unlikely

Oropharyngeal Injury

- Special consideration, similar presentation as esophageal injury
- Usually diagnosed with a nasopharyngeal scope
- May have gastrografin swallow followed by barium if negative
- Flexible ± rigid esophagoscopy
- Depending on exact location, possible nonoperative management vs exploration and drainage → consider in setting of facial fxs





Blunt Trauma

- Special consideration, rare
- Maintain high index of suspicion based on crush/compression mechanism
- W/U same as with penetrating, contrast study, scope, etc

Conservative Therapy for Cervical Esophageal Perforation Following Blunt Trauma

The American Surgeon
2021, Vol. 87(9) 1518–1520

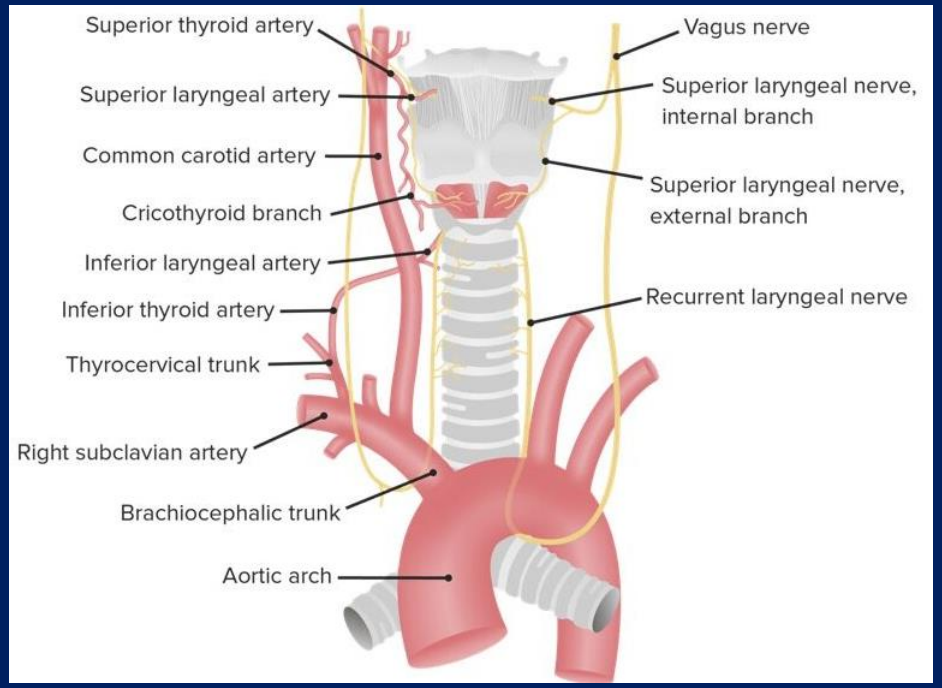
DOI: 10.1177/0003134820923327
journals.sagepub.com/home/asu
SAGE

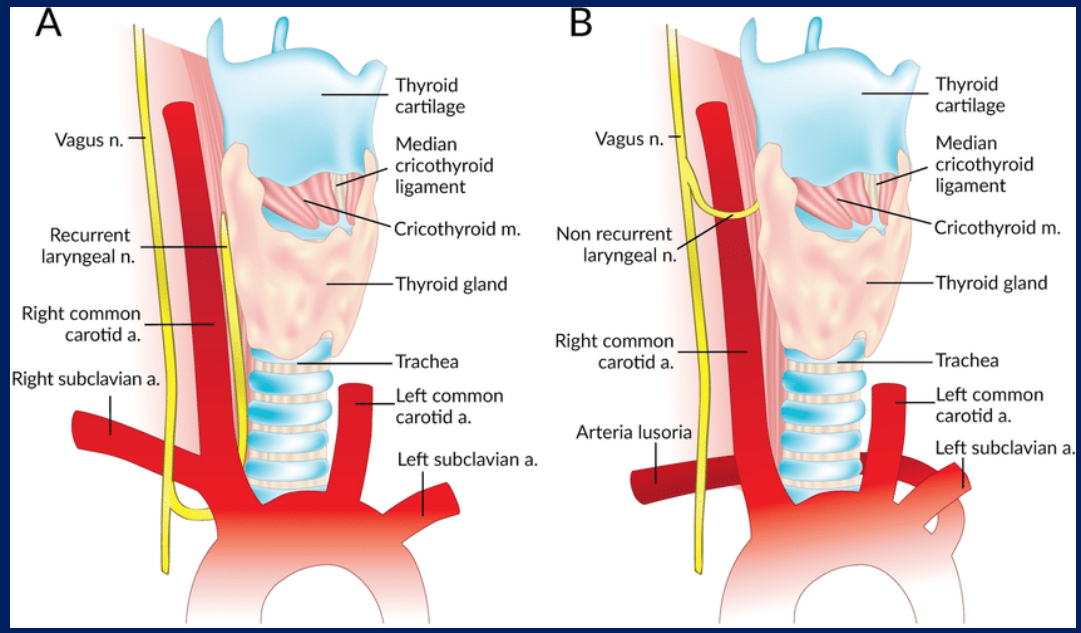
Patrick D. Melmer, MD[1], Christen E. Chaconas, MD[1], Allison L. McCrae, MD[1], and Jason D. Sciarretta, MD[2]

ABSITE/Boards Pearls

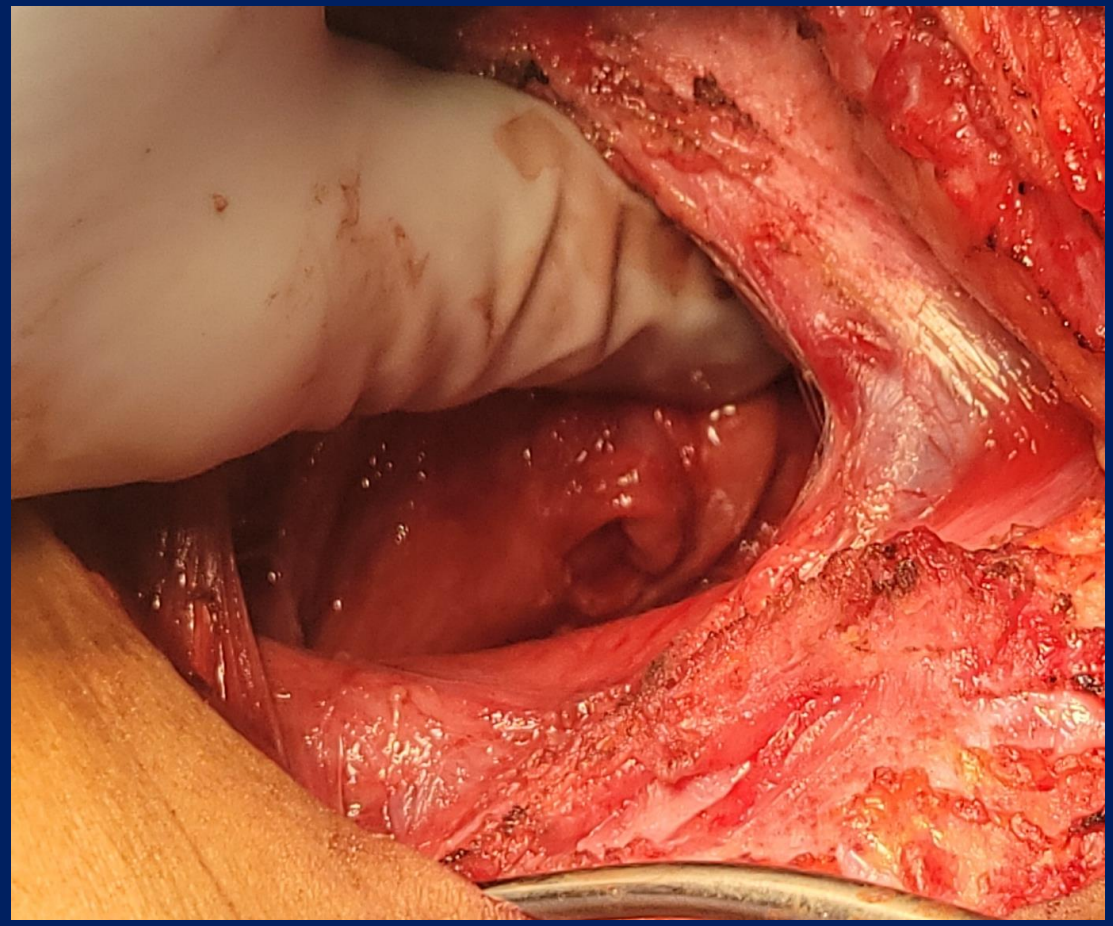
- Neck exploration
  - All things equal, explore the L side
  - L recurrent laryngeal nerve less likely to be injured
  - L nerve is longer, more vertical, and stays in the tracheoesophageal groove for the majority of its course
  - Stretch injury mitigated as greater length distributes superior traction forces over a longer segment of nerve

- Role of stenting?
  - Primarily shows up re: CA-related perforations or palliation
  - More debate with trauma, institution-dependent
  - Engage colleagues with these situations





Return to Case



Return to Case

A 46-year-old man is involved in an MVC and is brought to a level III trauma center 1 hour after the event. The patient has a patent airway, bilateral breath sounds, and a systolic blood pressure of 110 mm Hg on initial survey. He is noted to have a seat belt sign across his neck. His eyes are closed and open only to painful stimuli, he withdraws to pain, and he is moaning. His GCS is 8. The next step in management is

- A. measure intracranial pressure
- B. observe the patient
- C. CT head
- D. arrange transfer to level I trauma center
- E. intubate the patient

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A 25-year-old man sustains a left zone II neck stab wound. He is hemodynamically normal without hard signs of an aerodigestive or vascular injury. He has dysphagia. What is the next best step in management?

- A. CTA neck
- B. Esophagram
- C. Flexible esophagoscopy
- D. Angiography
- E. Neck exploration

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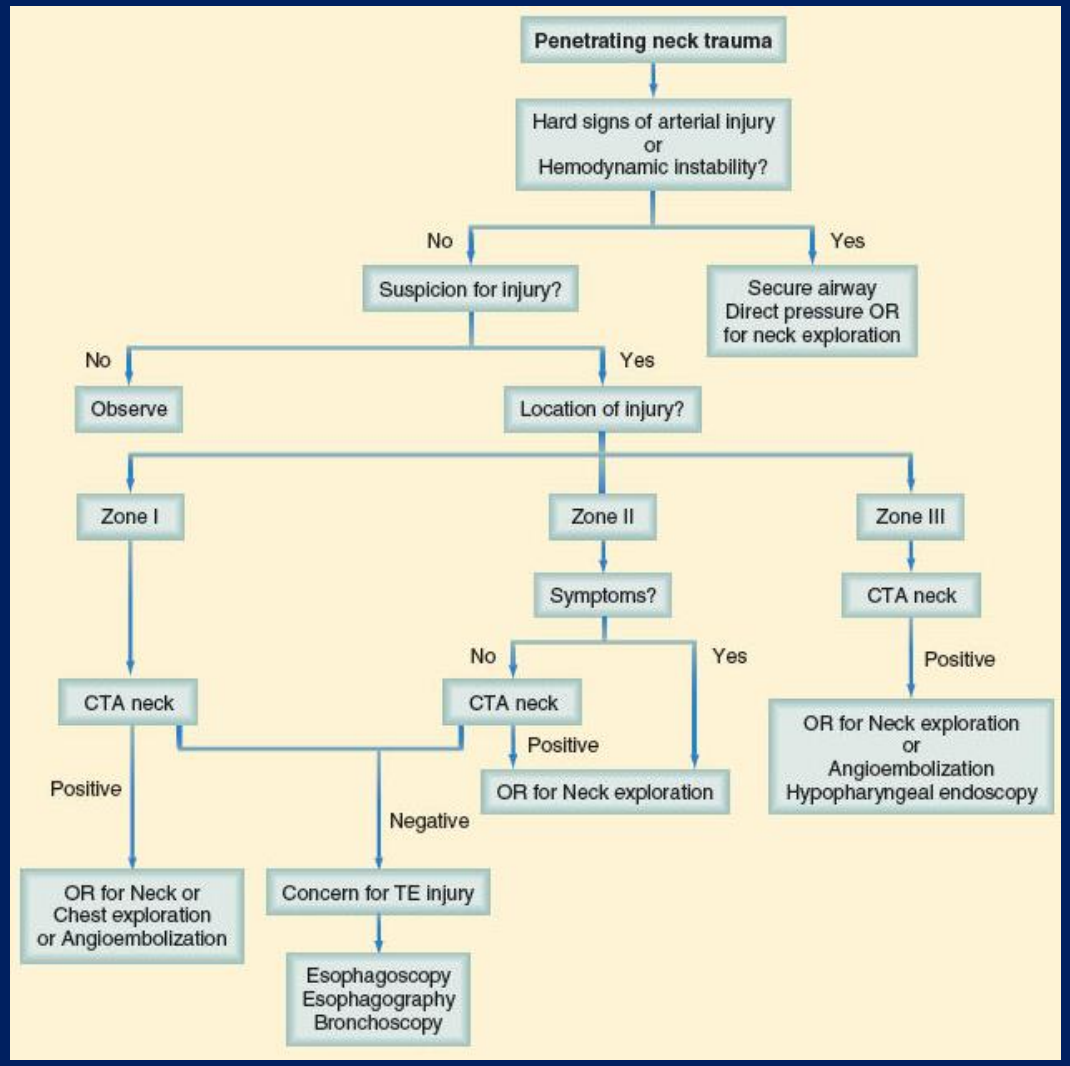
Summary

- Maintain a high index of suspicion and consider anatomy when evaluating for aerodigestive/vascular injuries of the neck
- EAST guidelines workup includes contrast esophagram, flexible esophagoscopy, and bronchoscopy
- Don’t sit on these patients – when in doubt serial physical examination is highly sensitive for detecting arterial and aerodigestive tract injuries that need repair



Thank you!

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- Behind The Knife, 2nd Ed.
- TrueLearn
- SCORE modules
- Sabiston Textbook of Surgery
- Surgical Recall
- Google images