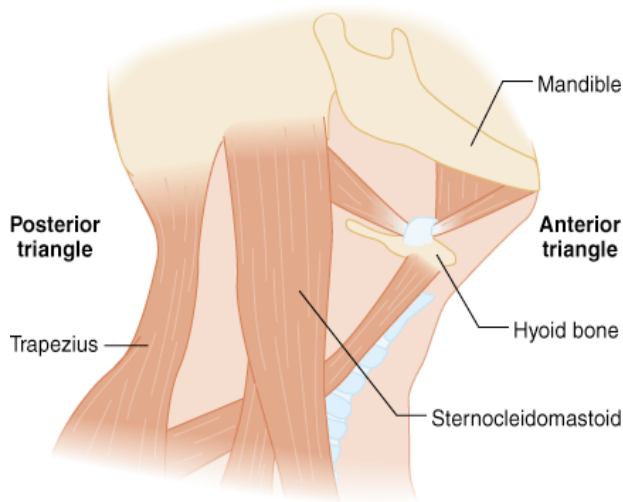


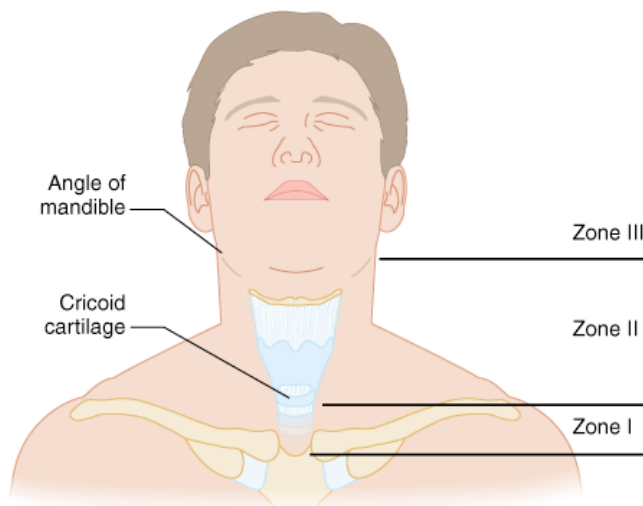
TRAUMA TO THE NECK

ANATOMY:

- The neck contains a high concentration of vascular, aerodigestive and spinal structures in a relatively confined space.
 - Other structures include the thyroid/parathyroid, lower cranial nerves, brachial plexus & thoracic duct.
- The neck can be divided into TRIANGLES or ZONES



- Anterior triangle laden with vital structures (both neurovascular and aerodigestive).
 - Formed by midline anteriorly, posteriorly by SCM and superiorly by lower border of mandible
- Posterior triangle --> more favourable, less morbidity.
 - Formed by SCM, clavicle and trapezius



ZONE I.

Clavicles to cricoid. Proximal carotids & vertebral aa, major thoracic vessels, lungs, oesophagus, trachea, thoracic duct & spinal cord

ZONE III.

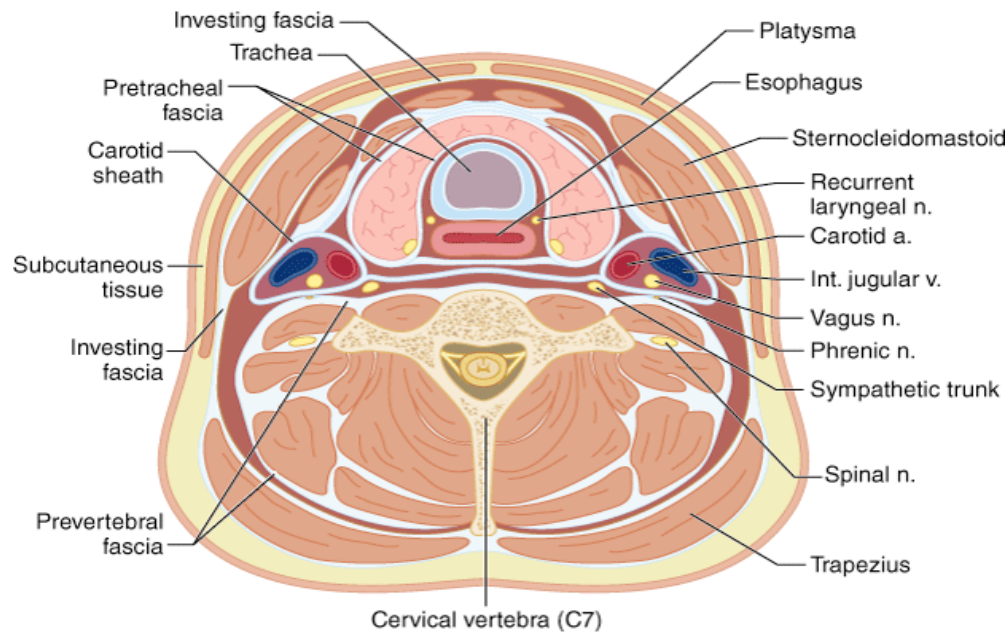
Between angle of mandible and base of skull. Distal carotids/vertebrals, pharynx, spinal cord.

ZONE II.

Extends from inferior cricoid to angle of mandible. Carotids, vertebral arteries, larynx, trachea, oesophagus, jugular vein, vagus nerve, recurrent laryngeal, spinal cord.

FASCIAL LAYERS:

- *Platysma* is the most superficial structure beneath the skin.
- Tight fascial layers support muscles, vessels & viscera but also provide a tamponade effect with vascular injuries, but this can result in extrinsic airway compression and thus compromise



INITIAL MANAGEMENT:

FOLLOWING BASIC TRAUMA GUIDELINES/PRINCIPLES

AIRWAY:

- Blood or air dissecting into fascial compartments can quickly distort normal anatomy, making airway management difficult.
- Aggressive airway management mandated if:
 - Acute respiratory distress
 - Airway obstruction (real or threatened) from blood or secretions
 - Massive subcutaneous emphysema of the neck
 - Tracheal shift
 - Altered mental state
 - Expanding neck haematoma
- ACT EARLY
- If cricothyrotomy indicated;
 - Beware fractured larynx as intubation in this instance may result in false passage (any doubt = tracheostomy).
 - Avoid dislodging a contained haematoma.
- May be required to use an existing traumatic tracheostomy site for intubation as a lifesaving measure.

BREATHING --> AS USUAL

- Consider the potential for pneumothorax or haemothorax (esp. with Zone I injuries)

CIRCULATION:

- Direct pressure over active bleeding sites
- DO NOT CLAMP --> injury to vascular or nervous structures may result
- Avoid NG insertion if oesophageal or vascular injury suspected --> retching may dislodge clot/worsen injury

DISABILITY:

- Neurological deficits indicate direct nerve or spinal cord injury.
 - May result from cerebral ischaemia from carotid injury.
- C-spine fracture may occur from penetrating injuries, but if exam normal, this is very low risk.

Table 257-2 Signs and Symptoms of Neck Injury

Hard Signs	Soft Signs
Hypotension in ED	Hypotension in field
Active arterial bleeding	History of arterial bleeding
Diminished carotid pulse	Unexplained bradycardia (without central nervous system injury)
Expanding hematoma	
Thrill/bruit	Nonexpanding large hematoma
Lateralizing signs	Apical capping on chest radiograph
Hemothorax >1000 mL	Stridor
Air or bubbling in wound	Hoarseness
Hemoptysis	Vocal cord paralysis
Hematemesis	Subcutaneous emphysema
Tracheal deviation	Seventh cranial nerve injury

PENETRATING NECK INJURY:

- GSW that cross the midline are twice as likely to cause injuries to vital structures as those that do not (79 vs 31%, vascular injuries 48%, spinal cord 24%)
- IF PLATYSMA VIOLATED --> Surgical consultation indicated immediately.
 - If intact, local wound repair is all that is required.
- DO NOT PROBE WOUNDS --> risk of disruption of haemostasis
- Stable patients should be evaluated for HARD and SOFT signs of aerodigestive or neurovascular injury.
 - HOWEVER in one study, 30% of patients with no findings had positive neck explorations. Especially true for oesophageal injuries.
 - Serial examinations are crucial.

ZONE I INJURIES:

- Vascular control is difficult. Operative repair require thoracic approach.
- Beware haemopneumothorax

ZONE II INJURIES:

- Most liable to injury, but most amenable to surgical exploration.
- Risks injury to carotids/vertebrals, jugular veins, oesophagus, spine, larynx/trachea.
- SIGNIFICANT DISAGREEMENT ON MANDATORY EXPLORATION
 - Advocates: low complication rate, high morbidity if injuries missed, decreased mortality massively
 - Opponents: high negative exploration rate (40-63% in one study)

ZONE III INJURIES:

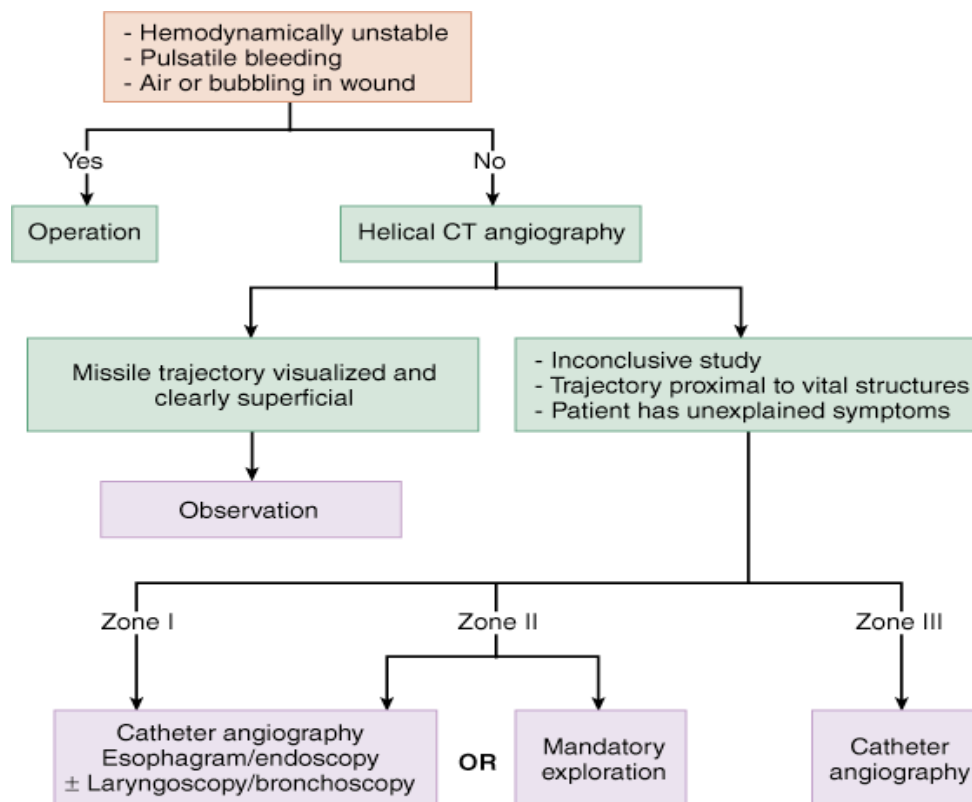
- Treat as cranial injuries
- Disarticulation of the mandible may be required for adequate exposure
- Consider IR, prior imaging (CTA) prior to OT (depending on stability)

- ZONE I and III → non-operative management preferred
- High index of suspicion for oesophageal injuries (haematemesis, odynophagia)
 - rare as oesophagus is in protected position (esp if tracheal injury)
 - combine oesophagoscopy/ contrast oesophagography → 100% sensitive.
 - If diagnosis delayed → mediastinitis, deep-space infections devastating → 19-22% mortality
- Laryngotracheal injuries suspected in zones 1 and 2 → air bubbling through wound, stridor, haemoptysis, subcut emphysema
- GSW → multiple zones may be involved

VASCULAR EVALUATION:

- CATHETER ANGIOGRAPHY IS GOLD STANDARD
 - Expensive, labour intensive and requires appropriate staff
- CTA = DIAGNOSTIC BUT NOT THERAPEUTIC
 - Allows visualisation of missile trajectory and can rule out significant vascular injuries if trajectory is remote from vital structures
 - 90% sensitive, 100% specific for major carotid/vertebral injuries.
 - Can miss pseudoaneurysms, small intimal flaps, AV fistula
 - Limited in zone I and III injuries
- US limited
- OPERATION:
 - For those that are unstable
 - Allows direct visualisation
 - Repair

TINTINALLI SUGGESTS THE FOLLOWING ALGORITHM:



IF SHOCK IS PROFOUND OR CARDIAC ARREST HAS ENSUED AND IS NOT RESPONSIVE TO FLUIDS --> **CONSIDER VENOUS AIR EMBOLISM:**

- Head-down, left lateral decubitus, ED thoracotomy and aspiration of air from RV.

An alternate approach...

Inaba K et al. Evaluation of multidetector computed tomography for penetrating neck injury: a prospective multicenter study. J Trauma Acute Care Surg. 2012 Mar;72(3):576-83

- Hard signs or clinically unstable --> OT.
 - 89.7% have clinically significant injury.
- Soft signs --> *CT angiography*. \longrightarrow
 - 10-12% had true injury.
 - **NO false negatives.**
 - Sn 100%. Sp 97.5%
- 27/225 = positive.
- 4/225 = non-diagnostic due to artefact.

Negative scan --> investigations done.

Positive scan --> surgery.

BLUNT NECK INJURY:

- UNCOMMON BUT CAN RESULT IN SIGNIFICANT MORBIDITY.
- CONSIDER IN "CLOTHESLINE" INJURY
- MAY HAVE FEW OR NO INITIAL SIGNS

LARYNGOTRACHEAL INJURIES:

- Consider if patient has dysphonia, hoarseness, dysphagia, odynophagia, dyspnoea, haemoptysis or develops stridor, subcut emphysema, cervical ecchymosis/haematoma, tracheal deviation.
- Pain with tongue movement suggests injury to the epiglottis, hyoid or laryngeal cartilage
- Cricoid cartilage fracture can lead to death as it is the only complete solid ring in the larynx
- Cricothyrotomy should be avoided as this may worsen laryngeal injury
 - Airway compromise may be immediate or delayed
- Spiral CT invaluable adjunct in the stable patient *with a secure airway*:
 - Detects cartilaginous fractures, vocal cord integrity
 - Consider US/direct visualisation to assess for injury

VASCULAR INJURY:

- When signs develop, they may be incorrectly attributed to an associated head injury rather than a vascular injury
- Injuries to carotids, subclavians, and jugular veins can produce mortality through exsanguination, haematoma formation and resultant airway compromise, direct vessel injury leading to occlusion or embolisation, dissection (even after trivial trauma)

CAROTID ARTERY INJURY:

- Can occur with:
 - Hyperextension with compression against TV process
 - Hyperflexion with compression between mandible and spine
 - Direct blows
 - Intraoral trauma
 - Basilar skull fracture causing intracranial tears of the vessels
- TWO DIFFERENT LESIONS:
 - Pseudoaneurysm
 - Dissection --> thrombosis --> embolism and occlusion
- Findings:
 - Haematoma
 - Bruits
 - Pulse deficit
 - Ipsilateral Horner's
 - TIA
 - Contralateral motor/sensory deficits

VERTEBRAL ARTERY INJURY:

- Well described following chiropractic manipulation
- All mechanisms involve either hyperextension, excessive contralateral rotation or both
- Susceptible to mechanical injury because of their relationship to neighbouring bony structures
- Patients may be asymptomatic or may have transitory or delayed neurological symptoms:
 - Worst case --> WALLENBURG SYNDROME = LATERAL MEDULLARY INFARCTION.
 - Ipsilateral facial loss of pain and temperature sensation, cerebellar ataxia, Horner's, contralateral loss of pain and temperature sensation.
 - Isolated CN V, IX, X and XI injury
- Use of High resolution CTA has very high sensitivity, specificity and PPV/ NPV.

BLUNT VASCULAR INJURY SHOULD BE SUSPECTED IN:

- Flexion-extension mechanisms
- Neck seat-belt sign (one study showed of those with this sign only 0.76% had a significant vascular injury)
- Diffuse axonal injury
- Midface, mandibular or basilar skull fractures

ONCE DIAGNOSIS CONFIRMED --> anticoagulation to prevent risk of subsequent stroke (antiplatelets if contraindicated). If deficit is severe = stent

STRANGULATION AND NEAR HANGING:

- Hanging occurs when pressure is exerted on the neck and then tightened by the weight of the victim's body
 - COMPLETE IF FEET DO NOT TOUCH THE GROUND, INCOMPLETE IF THEY DO
- If victim drops a distance equal to their height (as in judicial hanging) --> death is by cervical fracture and transection of the cord
- CONstriction:
 - Causes jugular venous obstruction, stagnant cerebral blood flow and brain ischaemia
 - Death can occur from complete arterial occlusion/airway compromise or via arrest from carotid sinus stimulation.
- In ligature or manual strangulation --> death via asphyxiation or vascular occlusion
- Survivors can develop NEUROGENIC PULMONARY OEDEMA from massive sympathetic discharge --> poor prognostic implications
 - Can also get POST-OBSTRUCTIVE PULMONARY OEDEMA
- TREATMENT AIMED AT AIRWAY, RESPIRATORY, CARDIAC, NEUROLOGICAL AND PSYCHIATRIC COMPLICATIONS