Evaluation & Management of Penetrating Wounds to the NECK

Goal

- Effectively identify patients with a high probability of injury requiring surgical intervention
- Define the role of diagnostic tests in assessing penetrating neck trauma
- Identify patients who might be discharged home directly from the Emergency Department

Zones of the Neck

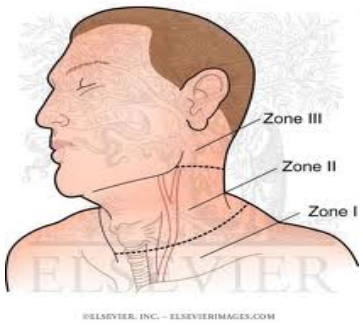
Zones of the neck are important for two reasons:

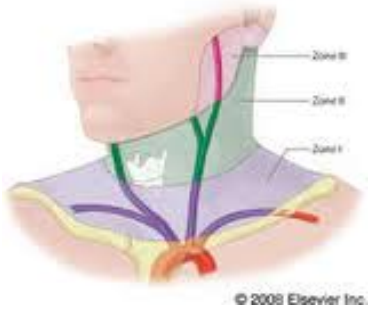
1. They have implications for management of vascular injuries
2. They allow you to describe the wound to others

Zone I - Extends between the clavicle and the cricoid cartilage. Proximal control of a vascular injury might require entering the chest.

Zone II - Extends between cricoid cartilage and the angle of the mandible. Proximal and distal control of vascular injuries is often straightforward. Consider that tangential injury is possible, in that an entrance wound is in Zone II, yet a vascular injury is in Zone I or III.

Zone III - Extends between the angle of the mandible and the base of the skull. Distal control of a vascular injury is limited by the base of the skull. In the absence of immediate indications for operation, imaging should be performed to plan ahead.





Initial Evaluation in the Trauma Bay

a) Evaluate the neck fully. A C-Spine collar might obscure wounds. Take off the dressings.
b) Evaluate the location of the wounds to get a sense of the neck zone.
c) If the wound does not penetrate the platysma, then it is likely that no further evaluation is required and the patient can be discharged home. If platysmal penetration is not certain, then a CT scan can be performed to rule out penetration.
d) A CXR should be obtained in all circumstances (assuming the platysma has been penetrated)
e) If the patient is going to the OR, then an AP and lateral film (with markers on the external wounds) should be performed to evaluate the trajectory and assure there are no secondary missile fragments whose trajectory might alter the approach (e.g. bilateral exploration vs unilateral)
f) External hemorrhage should be managed by direct pressure. ***Do not*** probe/explore the wound. Insertion of an NG tube should be withheld until the patient is in the operating room
g) Patients should be evaluated specifically with a history and physical evaluating for changes in phonation, odynophagia, cranial nerve abnormalities, paresthesia or weakness in the extremities. *Horner's syndrome* (meiosis, ptosis, anhydrosis) is often missed as are physical evidence of injuries to the hypoglossal or spinal accessory nerve. If intact, document the normal exam.

Airway Management in the Trauma Bay

The patient should be intubated in the trauma bay if there is hypoxemia, inability to ventilate, stridor, expanding hematoma, gross hemorrhage, or decreased LOC.

Remember the following:

a) Loss of an airway can occur at any time. Cricothyroidotomy should be considered before the airway is lost.
b) Patients arrive with a C-Spine collar in place. In the absence of blunt trauma, C-Spine immobilization is rarely necessary. In most cases, immobilization can be ignored, making intubation easier.
c) If the plan is to go to the operating room from the trauma bay, it is best to wait until the OR for intubation if the airway is patent. Extensive manipulation of the airway in a suboptimal environment might further threaten the airway and might lead to airway loss or exsanguinating hemorrhage.

Indications for Immediate Operation

- Active hemorrhage
- Shock not responding to resuscitation
- Expanding hematoma
- Pulsatile hematoma
- Hypotension
- Airway compression or dyspnea
- Air bubbling through wound (if airway cannot be safely established)

Operative Approach

a. The patient should be positioned with a roll under their shoulders to extend their neck
b. The chest and a groin should be prepped (as a saphenous vein graft might be required)
c. Zone I and II injuries should be approached through an incision along the anterior sternomastoid. This incision allows easier extension into the chest if required.
d. Zone I injuries involving the ***right subclavian, common carotid arteries or innominate*** are best approached with extension via a *median sternotomy* while injuries to the ***left subclavian*** might require a high (3rd intercostals space) *anterolateral thoracotomy*.

Indications for neck exploration where imaging might be considered prior to operation at the discretion of the trauma surgeon

All the patients meeting criteria below will require an operation. The only purpose of imaging might be to limit the extent of neck exploration.

- Instrument in situ e.g. knife
- Air bubbling through wound (if airway has already been established)
- Major soft tissue injuries that can't be repaired in the trauma bay

Textbooks differentiate between ***hard signs*** (highly suggestive of significant injury) and ***soft signs*** (suggestive but requires confirmation by imaging)

	Hard Signs	Soft signs
Vascular	*Severe active bleeding *Large expanding hematoma *Unexplained shock *Absent or diminished pulse *Bruits	*Stable hematoma *Mild hypotension *Low GCS *Hemiplegia
Aero-digestive	*Air bubbling through wound *Dyspnea	*Hemoptysis *Subcutaneous emphysema *Hoarseness *Odynophagia *Hematemesis
Nerves		*Cranial Nerves: examine 7,9,10,11,12

		*Brachial Plexus: examine axillary, musculocutaneous, radial, medial & ulnar nerves *Sympathetic chain: Check for Horner's syndrome
Chest		*Pneumothorax *Hemothorax

Patients *NOT* Meeting Immediate Criteria for Operation

Zone II

There are three potential options for patients not meeting criteria for immediate neck exploration:

1. Imaging and Observation
   a. Imaging requires a CT of the soft tissues of the neck and a CT angiogram to evaluate the carotid and vertebral arteries. Markers should be placed on entry/exit wounds.
   b. The esophagus is difficult to evaluate by CT. If the patient has odynophagia, hematemesis, or the CT suggests that the trajectory is close to the esophagus, then contrast esophagography or esophagoscopy should be performed.
   c. Evaluation of the larynx and airway is indicated if there is subcutaneous emphysema, hemoptysis or hoarseness. This is usually performed by either laryngosocpy +/- bronchoscopy depending on the level of injury.
   d. Pros and cons

      Pros: Simple, low risk to patient, potential early discharge within 12-24 hours

      Cons: Occupies a bed (in ED or ward), radiation exposure

2. Routine Neck exploration
   a. Exploration of the neck in the operating room through either an incision along the anterior border of the sternocleidomastoid (if a unilateral exploration is required) or through a transverse collar incision (if bilateral exploration is required).
   b. The patient should be positioned with a roll under their shoulders to extend their neck.
   c. The chest and a groin should be prepped (if a saphenous vein graft is required)
   d. Exploration requires evaluation of the carotid sheath and its structures, the esophagus, and the larynx/trachea. The trajectory of the impaling instrument/missile should be followed. Areas might be omitted from exploration if they are not in the trajectory.
   e. Pros and cons

      Pros: Equivalent diagnostic accuracy to imaging without radiation exposure

      Cons: High rate (50%) of negative exploration. Potential for iatrogenic injury.

3. Observation alone

a. Observation and serial physical exam including auscultation of the carotid arteries is 95% sensitive for detecting arterial and aerodigestive tract injuries that require repair
b. Serial physical exam *every 3-4 hours* should be done by the same person who did the initial assessment
c. Evaluation includes searching for new symptoms, and new findings on physical exam (expanding hematoma or a thrill on asculation)
d. Pros and cons:

Pros: simple, low risk to patients,
Cons: occupies a bed (ED or ward), potential late recognition of an injury that require operative repair if the patient is not closely watched, late recognition of esophageal injuries has significant morbdidity

Zone I & III

Given the challenges with surgical exposure, the threshold for exploration is high and usually dependent on diagnostic imaging.

- CT angiography should be performed with evaluation of the aortic arch and above. Markers should be placed on entry and exit wounds. Conventional angiography might be considered as the first initial evaluative step if there is a high likelihood of therapeutic need (e.g. embolization, stenting)
- Injuries in zone I might require input cardiac, thoracic, or vascular surgery to determine the optimal approach.
- Injuries in zone III might require expertise from ENT (for those involving the hypopharynx) or vascular/neurosurgery to address injuries to the high internal carotid artery.