

The EM Educator Series

The EM Educator Series: “I either got stabbed or shot in my neck”

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Case: An 18-year-old male is brought in by EMS after assault. He was stabbed to the neck, and EMS immediately placed pressure over the wound. He is tachycardic and hypotensive on arrival.

Questions for Learners:

1. What are the zones of the neck and key structures contained within these zones? Are these zones still pertinent for ED evaluation and management? What other injuries outside of neck should you consider?
2. What should you consider for airway management? RSI? Direct vs video vs fiberoptic vs cricothyrotomy?
3. What vascular injuries can occur, and what hard and soft signs?
4. Is a C-collar needed in penetrating trauma?
5. What laryngotracheal injuries do you need to consider?
6. What about pneumo- and/or hemothorax? What does subcutaneous emphysema suggest?
7. How do esophageal injuries present?
8. What diagnostic modalities can assist? What about CTA, endoscopy or esophagram, or bronchoscopy?

Suggested Resources:

- ✓ Articles:
 - [REBEL EM – Penetrating Neck Injuries](#)
 - [emDOCs.net – Neck Trauma: A Practice Update](#)
 - [emDOCs.net – The Sphincter Series: A Scary Airway Review](#)
 - [EM in 5 – Penetrating Neck Trauma](#)
 - [Management of Major Vascular Injuries: Neck, Extremities, and Other Things that Bleed.](#)
 - [Evaluation and management of neck trauma.](#)
 - [Management of penetrating neck injury in the emergency department: a structured literature review.](#)
- ✓ Podcasts:
 - [CORE EM – Episode 152.0 – Penetrating Neck Trauma](#)

Answers for Learners:

1. What are the zones of the neck and key structures contained within these zones? Are these zones still pertinent for ED evaluation and management? What other injuries outside of neck should you consider?

The neck is a particularly tricky area of assessment and management in the trauma patient, as it is the location for many vital structures. Concern for **vascular, neurologic, digestive tract, and airway injury** are of paramount importance in the evaluation of these patients, as all can be life-threatening. Oftentimes, the neck trauma patient **may appear stable, only to have delayed injury** found later, causing increased morbidity and mortality. Neck trauma can be split into penetrating injury and blunt injury.

The neck is divided into 3 Zones, which become important in evaluating and managing these patients, especially with regard to the structures lying within each division.

- **Zone I** (base of neck) – below the cricoid cartilage (to the sternal notch): mediastinal structures, thoracic duct, proximal carotid artery, vertebral/subclavian artery, trachea, lung, esophagus
- **Zone II** (mid-neck) – from the cricoid cartilage to the angle of the mandible: carotid/vertebral artery, larynx, trachea, esophagus, jugular vein, vagus and recurrent laryngeal nerves
- **Zone III** (upper neck) – above the angle of the mandible: distal carotid artery, vertebral artery, distal jugular vein, salivary/parotid glands, CNs 9-12

	Zone I	Zone 2	Zone 3
Anatomic Landmarks	Clavicle/Sternum to Cricoid Cartilage	Cricoid Cartilage to the Mandible	Superior Angle of the Mandible
Anatomic Structures in Zone	Proximal Common Carotid Artery	Carotid Artery	Vertebral Artery
	Subclavian Artery	Vertebral Artery	Distal Carotid Artery
	Vertebral Artery	Jugular Vein	Distal Jugular Vein
	Lung Apices	Pharynx	Salivary and Parotid Glands
	Trachea	Trachea	Cranial Nerves IX - XII
	Thyroid	Esophagus	Spinal Cord
	Esophagus	Larynx	
	Thoracic Duct	Vagus Nerve	
	Spinal Cord	Recurrent Laryngeal Nerve	
		Spinal Cord	

2. What should you consider for airway management? RSI? Direct vs video vs fiberoptic vs cricothyrotomy?

Airway management in neck injuries varies widely and is controversial. There is not an agreed upon “right way” to manage these airways. To make a long story short, early attempts at orotracheal intubation should be explored, and if failed, heroic techniques used.

Many authors subscribe to the early management in the trauma patient = easier management. Potentially, the neck trauma airway can become progressively more difficult, i.e. with expanding hematoma/swelling/subcutaneous air, etc. This can all lead to airway narrowing and the risk that the patient will develop acute airway obstruction.

To head this off at the pass, many practitioners tend to err on the side of caution, with intubation in both blunt and penetrating neck injury earlier as opposed to later. There are no current agreed upon guidelines on “when to intubate”, or how to intubate, so obviously clinical judgment is in play here. As of now, it seems that the general consensus is that **patients should be intubated sooner rather than later**, before the patient clinically deteriorates and needs an emergent intubation with a distorted airway scenario.

For our purposes, anyone arriving with instability (either from an airway perspective with evidence of progressive or impending airway obstruction from subcutaneous emphysema or expanding hematoma, or instability from a hemodynamic standpoint from penetrating wounds) should be intubated.

Suggested by Walls, intubation should be performed in all GSWs to the neck regardless of evidence of platysma violation, as well as all stab wounds that violate platysma or show respiratory/vascular compromise. Ideally, an awake intubation with light IV sedation should be attempted if the patient can tolerate it; however, if the patient is agitated, combative, etc., RSI should be attempted instead.¹¹ **Several approaches to the airway have been proposed**, including awake fiberoptic intubation, RSI fiberoptic intubation, retrograde intubation, standard RSI orotracheal approach, or awake orotracheal approaches, based on individual patient circumstances, clinician experience, and urgency. The surgical airway is always an option.

A word of caution regarding surgical airways: they represent a failed airway scenario. Cricothyrotomy is still the go-to rescue airway and relatively contraindicated in the scenario of expanding hematoma over the cricothyroid membrane. Remember that emergent crics may be performed if the injury is above the cricothyroid membrane, or in the crashing patient regardless of location of suspected injury. It is **contraindicated in the patient whom the location of the injury is unknown, as it can result in complete disruption of the airway in cases of laryngotracheal dissociation.** In neck-trauma patients, **tracheostomy at least 1 tracheal ring below the injury** is a route that is more often chosen.

If the airway is obviously exposed and the hole in the trachea is evident, you can sometimes just put the ET tube into the existing hole or wound site. Grab the distal segment with a towel clip to stabilize the trachea, and then directly intubate through the wound.

If you have time, comfort level, and the resources, fiberoptics are ideal. The benefit of **awake fiberoptic** intubations (either orotracheal or nasotracheal) is that you can visualize the damage to the airway, look for mucosal tears, and potentially place the ETT distal to the injury. ETT cuff should be inflated distal to any evident mucosal injury to prevent worsening of the defect and potential airway compromise. Ideally with topical anesthesia methods, you can intubate the cooperative, relatively stable patient with a neck injury this way. Again, this is highly dependent on the clinician’s comfort level and availability of these resources.

The preferred initial method in the ED seems to be orotracheal intubation, with RSI having strong success rates, direct cord visualization, and few complications. If you are concerned that the patient

cannot be bagged (i.e. beard, obesity, developing airway distortion) try to avoid paralysis on the first attempt. Ketamine (1-2mg/kg slow IVP) is a great option for sedation in these patients that you don't want to paralyze, as it preserves respiratory drive. If you have time, try to put nebulized 4% lidocaine in the mix as well to facilitate your attempt. You can also use versed (0.05mg/kg) or fentanyl (1-2mcg/kg) for this purpose.

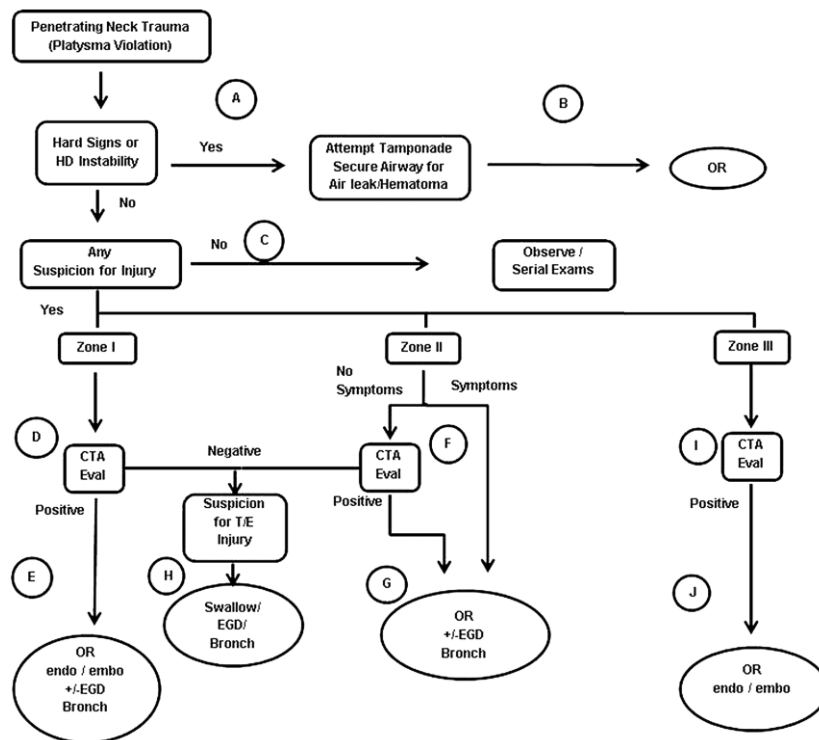
In a retrospective study of 748 patients with penetrating neck injuries evaluated in the ED, 11% (82) required urgent airway management, with 42 undergoing successful orotracheal intubation with 100% success rate, with 39 of them being with RSI as the initial method. Interestingly, RSI was successful in this study even after fiberoptic intubation failures in 3 patients. Thus, more than 2/3 of patients in this study with critical airways were successfully intubated with RSI.

Universally speaking, it is believed that blind intubation isn't a great plan with neck trauma because you can worsen the injury, hypothetically dislodge clots, or precipitate complete airway obstruction from what may have only been partial obstruction initially. However, a recent small study in 2004 showed a 90% success rate in prehospital blind nasotracheal intubations after failed orotracheal attempts by EMS staff, with similar mortality rates to orotracheally intubated patients.

An interesting and often undiagnosed injury to the neck initially is the "clothesline" in which there is a mechanism of blunt trauma to the neck so severe that it caused a complete tracheal transection. Of note, RSI is dangerous in these patients because it causes loss of respiratory muscle tone and can result in misalignment of the two segments of the trachea, which can make ventilation and orotracheal intubation difficult, if not impossible.

3. What vascular injuries can occur, and what hard and soft signs?

- Signs/symptoms
 - Hard signs: active hemorrhage, expanding or pulsatile hematoma, hematemesis
 - Soft signs: Venous oozing, non-pulsatile, nonexpanding hematomas, minor hemoptysis
- Diagnostics
 - CT Angiogram (CTA)
 - Most commonly used imaging modality for vascular trauma
 - Performance characteristics (Rosen's 2010)
 - Sensitivity 90-100%
 - Specificity 99-100%
 - Should be obtained in all patients with soft signs of vascular trauma and selectively in patients without hard or soft signs
 - Conventional angiogram
 - Previously considered the gold standard diagnostic modality for vascular injuries
 - Downsides: time consuming, large contrast load
 - Continues to be used in patients with negative CTA but high suspicion of injury



WTA Management Algorithm for Penetrating Neck Injury (Sperry 2013)

4. Is a C-collar needed in penetrating trauma?

There has been a shift towards removing the C-collar in many of these patients. The thought is that if there is no neurologic deficit and you can evaluate the spine (i.e. patient is not unconscious), then the C-collar can be removed by NEXUS criteria. Though there are no RCTs, there is a great amount of literature supporting this action. Unstable spine fractures are almost always associated with neurologic deficits or AMS.

So if you can remove the C-collar using NEXUS criteria, then remove it. **You want to be able to manage any serious airway or vascular injuries without restriction.** If unable to clear the cervical spine, then the collar can be partially removed, using in-line stabilization while securing the airway.

5. What laryngotracheal injuries do you need to consider?

- Signs/symptoms
 - Hard signs: Bubbling or air leakage from a neck wound, massive subcutaneous air
 - Soft signs: dyspnea, dysphonia, stridor, hemoptysis, subcutaneous emphysema, laryngeal crepitus
- Diagnostics
 - Plain X-rays: extraluminal air, foreign bodies, fracture of cartilaginous structures (i.e. larynx), edema
 - CT scan
 - Need to obtain thin slices (1-mm) and multiplanar reconstructions
 - Do not rely solely on the cervical spine CT

- Laryngoscopy and nasopharyngoscopy with flexible endoscopes are necessary for evaluating internal injuries

6. What about pneumo- and/or hemothorax? What does subcutaneous emphysema suggest?

Once the airway is secured, other injuries to the larynx or trachea are usually treated surgically in the OR. Concerning signs for emergent surgical intervention include **progressive subcutaneous or mediastinal emphysema, pneumothorax, severe dyspnea, or associated esophageal trauma.**

7. How do esophageal injuries present?

Esophageal injuries are often missed, and a delay in diagnosis is associated with increased morbidity and mortality, mainly due to the potential for **mediastinitis**. When surgery is performed within 24 hours post-injury, the survival rate is over 90%. When surgery is performed more than 24 hours post-injury, the survival rate is only 65%. Keep in mind that the **leading cause of delayed death in neck trauma is esophageal injury.**

8. What diagnostic modalities can assist? What about CTA, endoscopy or esophagram, or bronchoscopy?

If the patient is unstable, your only goal is getting the patient to the OR as quickly as possible. If stable, a **portable chest x-ray, as well as AP/lateral views of the neck** should be obtained – to look for any bullet fragments, soft tissue swelling, or air outside the trachea.

Next, we need to determine which of the three zones of the neck are involved. Zones I and III are worrisome areas, and these patients will all be getting vascular imaging. Zone II recommendations have changed over the years, to the point where now **CTA is obtained in all three zones of the neck.**

The “gold standard” of assessing the vasculature in neck trauma has been conventional angiography, as sensitivities are greater than 99%. Since the advent of multi-slice CT angiography, CTA has overtaken angiography as the first test ordered, as it is faster, less expensive, and non-invasive (and does not require IR). Sensitivity of multi-detector CT angiography is **90-100%**, when compared to conventional angiography and surgical exploration. Sensitivity is even better with 64-slice CT.

Duplex ultrasound has been used as well, with a comparable sensitivity to CTA, though it is very operator-dependent, and so is less frequently used emergently.

Angiography is only used if the CTA or duplex sonography is inconclusive or positive (and endovascular intervention is the next step). Multi-slice CT angiography has now supplanted angiography as the test of choice – in all three zones of the neck. It took some time, but Zone II recommendations are now similar to management of the other two zones.

Vascular assessment using CTA should be obtained even in blunt trauma, as there is a high miss rate of vascular injuries in blunt neck trauma – with delayed neurologic sequelae as a result.

Esophageal injuries are often clinically silent, so they ought to be investigated and ruled out. If the patient is stabilized, the EP may not be ordering these further tests, but they will be mentioned briefly. **Plain x-rays do not exclude injury to the esophagus.** Contrast-enhanced esophography has a

sensitivity of 89%, with rigid endoscopy having a similar sensitivity. Flexible endoscopy has a lower diagnostic yield than rigid endoscopy, but has a lower complication rate (i.e. less iatrogenic perforation). When both **contrast-enhanced imaging and endoscopy are used, sensitivity approaches 100%**.