



EM CASES SUMMARY

Episode 199 Airway Trauma

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Case study: Penetrating neck trauma

Consider a 25-year-old woman who presents with a stab wound to the anterior neck. She arrives with a heart rate of 145, oxygen saturation at 90%, and audible gurgling sounds, indicating potential airway compromise. This is a high-stakes scenario where every decision, especially regarding airway management, could have life-altering consequences. The injury, located just off the midline in the anterior neck, immediately raises concerns about airway obstruction, major vascular injury, or both.

Re-sequencing the trauma airway: A paradigm shift

While working through the standard ATLS approach of A then B then C can be a helpful memory tool, our trauma resuscitations often require simultaneous assessment and management of all three or a total re-ordering of priorities. Some traumas may require a CAB approach or a CBA approach. Intubation is *not* always the first priority in trauma and, in fact, it may worsen outcomes if done prior to adequate resuscitation. Instead of focusing on letters, we should be focusing on identifying and managing the most immediate threat to life for each patient. Look for and immediately manage the following:

1. **Massive hemorrhage:** For example, a spurting artery that needs immediate management/compression or an unstable pelvis that needs binding.
2. **Severe airway compromise:**
 1. **Dynamic airway:** If you wait even minutes, you may miss the opportunity to secure an airway. For example, expanding neck hematoma.
 2. **Critical hypoxia:** Despite maximum noninvasive ventilation, O2 saturation is still <90%.
3. **Obstructive shock:**
 - o Tension pneumothorax/ hemothorax: Consider bilateral finger thoracostomies/ chest tube before airway management.
 - o Cardiac tamponade: Very high-risk intubations, should likely be done in the OR if patient still has a BP. If cardiac arrest, consider thoracotomy if your resources allow.

The decision to intubate the trauma patient

The old dogma of “*GCS 8 = intubate*” oversimplifies the indications for intubation in the trauma patient, and may cause more harm than good. The decision to intubate a trauma patient is a nuanced one and based on multiple data points. Sometimes the need for intubation is obvious and sometimes a confluence of factors over time pushes the decision in one direction or another. Key considerations in this decision include:

- **Hemodynamic stability:** Resuscitate before you intubate
- **Dynamic airway or critical hypoxia:** Intubation needs to be prioritized, as above
- **Intractable pain:** Intubation may be required to manage severe pain (eg. amputation)
- **Agitation:** In some agitation patients, intubation may be the only way to safely facilitate necessary care (ie. procedures, CT scans)
- **Airway protection:** If the patient is at risk of aspiration or losing their airway, intubation may be required

Timing of intubation: Early vs. delayed?

There is mixed evidence about the optimal timing of intubation in trauma patients. There is some evidence to suggest prehospital airway management improves outcomes in trauma patients. Conversely, there is evidence to suggest that prehospital intubation increases mortality in trauma patients. Further, there is evidence that trauma patients have better outcomes when intubated in the OR compared to ED. This mixed and even contradictory evidence may be due to the high variability in clinical context. Our experts recommend that the clinical context be the primary consideration, so that the timing of intubation, like the decision to intubate, be considered carefully on a case by case basis.

***Clinical Pearl:** "A procedure is never going to trump context" – procedures like RSI are not inherently life-saving—what matters is how and when they are used, tailored to the patient's physiologic state. If there are no immediate indications for intubation, pause to consider if intubation can be delayed until the patient is in the optimal setting.*

Airway management in penetrating neck trauma

In patients with direct trauma to the airway, or potential airway trauma, our attention should be primarily focused *hard signs* and *soft signs* instead of zones of the neck. Zones of the neck tells us about the *entry* but nothing about the *trajectory/ pathway* of the injury. If we base our management solely on the zone where the entry wound is, we will mismanage our patients.

- If there are any hard signs present, the patient needs immediate management in the OR.
- If only soft signs present, we likely have time to image their neck and then make decisions about subsequent management.

HARD SIGNS

Refractory shock
Pulsatile/ severe hemorrhage
Large/ expanding hematoma
Bruit/ thrill
Stridor/ airway obstruction
Severe subcutaneous emphysema
Bubbling wound
Severe hematemesis
Massive hemoptysis
Focal neurological deficit

SOFT SIGNS

Transient hypotension
History of hemorrhage, now resolved
Small/ stable hematoma
Dysphagia
Dysphonia
Odynophagia
Minor hematemesis
Minor hemoptysis
Dyspnea

Pre-oxygenation in penetrating neck trauma

Use nasal prongs + NRB to oxygenate these patients. Positive pressure ventilation (ie. BVM) should be avoided whenever possible. If necessary, bagging should be slow with low tidal volumes. Raising intrathoracic pressure in patients with decreased preload from hemorrhage can create a pseudo-obstructive shock picture and worsen their clinical status. It can also worsen subcutaneous emphysema and lead to airway compromise.

***Warning:** avoid positive pressure ventilation whenever possible in patients with penetrating neck trauma*

C-spine immobilization in penetrating trauma

C-spine immobilization is generally *not* recommended for isolated penetrating neck injuries, but it should be considered if concomitant blunt trauma, or in certain rare clinical situations (ie. isolated GSW to the neck with focal deficits suggesting spinal cord injury). The Eastern Association for the Surgery of Trauma (EAST) performed a systematic review of 24 studies

in 2018 that showed no benefit to spinal immobilization for penetrating trauma in either mortality or neurologic recovery, even in those with a direct neck injury. In difficult airway situations where maintaining C-spine immobilization is indicated in the blunt trauma patient, but securing the airway is a struggle, some degree of neck movement may be required.

Intubation strategy options in penetrating neck trauma

Airway strategies for these patients can be divided into crash scenarios and scenarios with more time to act.

- In a crash situation, the airway plan will likely be RSI with “double set up”. If intubation from above fails, promptly move to front of neck access (FONA).
- If you have time, call for a more experienced operator and ensure the patient is in the optimal setting (ie. in some situations, that may mean holding off on airway management until OR). Consider:
 - [Awake intubation](#) or
 - [Ketamine-facilitated awake intubation](#) or
 - [Combined fiberoptic + video laryngoscopy](#)

***Clinical Pearl:** If the clinical situation allows, let the patient maintain their position of comfort (ie. sitting up).*

***Clinical Pearl:** Soft signs can evolve into hard signs over minutes. Frequent reassessments for the presence of hard signs are important.*

***Clinical Pearl:** In penetrating neck trauma, inspect the back and axilla to identify other injuries that may require immediate treatment (eg stab wound to the upper back causing tension pneumothorax). Get a quick look at these areas early on in your assessment. For example, have the patient lift their arms and sit up when they are being transferred off the EMS stretcher.*

Management of the soiled airway in the trauma patient

- Prepare your team and equipment ahead of time.
- Double all your equipment (ie. O2, 2 DeCanto or meconium aspirator suction catheters).
- The [SALAD](#) technique can be used for soiled airway intubations.
- Use just enough suction to clear the airway, and no more, because O2 delivered to the airway is also being suctioned out.
- Give the paralytic enough time to work manipulating the airway to decrease the risk of vomiting.

***Pearl:** in the soiled airway, suction just enough to clear the airway and no more, as further suctioning will remove critical supplemental oxygen from the airway*

Airway medications: Optimal dosing in the hemodynamically unstable trauma patient

The classic teaching to give half of the usual induction dose and double the paralytic dose in hemodynamically unstable patients may not lead to better outcomes. There is mixed evidence about dosing induction and paralytic agents for these patients, but there are a few general principles that can help guide our decisions:

- Our patients should be adequately resuscitated before receiving induction medications. If you give a lower-than-normal dose of ketamine to an under-resuscitated patient even if they have pressors running, they may still crash. Pay attention to the shock index and aim for it to be <1 *before* intubation.
- Remember also that the transition to positive pressure ventilation decreases preload further and can worsen hemodynamics
- Be judicious in dosing the induction agent (our experts recommend this despite limit evidence)
- Consider titrating your induction agent to effect as in a [rapid Delayed Sequence Intubation \(DSI\)](#)

- Our experts also recommend using a high paralytic dose to ensure adequate and timely paralysis

Airway management in head injured patients

The initial management of head injured patients has significant long-term effects that may be overlooked in the ED. Even *transient* hypotension, hypoxia, and hyperventilation have shown in observational studies to have significant morbidity/ mortality consequences. We may not see the effects of these episodes in the trauma bay, but we have a duty to prevent them whenever possible.

BP targets in head injured trauma patients

In head injured polytrauma patients with other sources of bleeding, you may have competing priorities with respect to BP targets. For the rest of the body, be inclined to tolerate a lower MAP, but for the head injury a higher sBP target is preferred. If the patient is posturing with signs of raised ICP, target a higher sBP. If they have a mid-range GCS, no signs of raised ICP and hemorrhage is the most important clinical priority, be less aggressive with the BP target. Based on current evidence:

- For patients with an **isolated head injury**, sBP target = 100-140 mmHg.
- For patients with a **spinal cord injury**, MAP target = 80-85 mmHg.

Key considerations prior to intubating a head injured patient

- Prior to intubation, perform a brief but specific **neurologic examination *before* intubation**. This should include pupils, posturing, GCS (include information about the individual components), and lateralizing findings; the brief neuro exam is often overlooked, and once the patient is paralyzed, it's difficult to assess what their true baseline was – this can profoundly impact both the immediate and long-term decision-making process, especially when neurosurgeons get involved.

- Using **waveform capnography** while preoxygenating to help assess adequacy of airway seal. It also helps to avoid hypo/hyperventilating.
- Have **hypertonic saline** available to give if signs of raised ICP
- Consider pre-intubation **arterial line** for more accurate monitoring. This can allow for responsive titration of induction medications.
- In general, use **ketamine** (or etomidate if you have access) and **rocuronium** to intubate these patients; propofol is a reasonable alternative if there is no concomitant hemorrhage and they are hypertensive.
- Consider pre-intubation **fentanyl** (adult dose 200-300 mcg) to blunt the sympathetic response to intubation, but be ready to act because this may, rarely, cause apnea
- Consider **pre-emptive vasopressors**; if you anticipate a drop in blood pressure during intubation, having norepinephrine ready and potentially even running before induction.

Post-intubation care is just as important as preparation, if not more.

Employ reverse Trendelenburg, head of bed 30 to 40 degrees, hypertonic saline if appropriate, monitor end-tidal CO₂ (if blown pupil, target pCO₂ between 30-35), and appropriate post-intubation sedation and analgesia (usually propofol and fentanyl) to target BP. Monitor pupils post-intubation for signs of deterioration.

For more on Neuroprotective Intubation check [EM Quick Hits 55](#)

Airway in the agitated trauma patient

Management of the agitated trauma patient is closely related to the management of the head injured patient. The main priority is to gain rapid control of the situation as this is a potential safety issue for both the patient and staff. If IV access not available, our experts recommend using IM ketamine (usual adult dose 200-400 mg IM). The next priority is to get IV access, vital signs, and complete a brief examination to assess injuries/ neurologic status. If the patient requires more sedation, consider titrating in

more ketamine or midazolam once IV access is established. This upfront sedation allows for a [Delayed Sequence Intubation](#) (DSI)-like approach to intubation if required.

***Clinical Pearl:** Critical hypoxia can present as agitation. To fix the agitation, first fix the critical hypoxia.*

For more on [Emergency Management of the Agitated Patient check EM Cases Ep 115](#)

Take-home points for airway assessment and management in trauma

- Trauma resuscitation should focus on the most immediate threats to life, sometimes requiring prioritization of circulation, airway, and breathing in a flexible CAB or CBA order. *Massive hemorrhage, severe airway compromise and obstructive shock* may all demand emergent intervention.
- Decisions around whether to intubate and when to intubate in trauma are complex. Key factors to consider include: hemodynamic stability, dynamic airway, critical hypoxia, intractable pain and agitation. Remember: *context trumps procedure*.
- In penetrating neck trauma, focus on hard signs versus soft signs rather than just the neck zone to dictate management. If hard signs, this patient needs immediate OR. If soft signs, consider imaging first. Avoid unnecessary positive pressure ventilation to prevent worsening shock and worsening subcutaneous emphysema.
- For the soiled airway in trauma, have large bore suction equipment available. The SALAD technique can help manage soiled airways, but use suction with caution to minimize interruption of O₂ delivery to the patient.
- For head injured patients, prevent *any* hypoxia, hypotension, and hypo/hyperventilation to reduce long-term morbidity and mortality. Remember to select BP target tailored to the most life-

threatening clinical problem when head injury occurs in the context of polytrauma. Consider pre-intubation arterial line.

- In agitated trauma patients, prioritize safety with rapid IM sedation (ie. ketamine) if IV access is unavailable, then reassess to determine if intubation is indicated.
- Lower doses of induction agents and higher doses of paralytics may be beneficial in hemodynamically unstable patients. Aim to resuscitate to a shock index of <1 before intubation and titrate induction medications carefully.
- Use end-tidal CO₂ throughout the pre-oxygenation, intubation and post-intubation phases to help guide management

References

1. Petrosiaki A, Hicks C. Resuscitation Resequenced: A Rational Approach to Patients with Trauma in Shock. *Emerg Med Clin North Am*. 2018;36(1):41-60.
2. Kovacs G, Sowers N. Airway Management in Trauma. *Emerg Med Clin North Am*. 2018;36(1):61-84. doi:10.1016/j.emc.2017.08.006
3. Duggan LV, Doyle LN, Zunder JS, Hanna M. Blunt and Penetrating Airway Trauma. *Emerg Med Clin North Am*. 2023;41(15):e1-e15.
4. Knapp J, Doppmann P, Huber M, et al. Pre-hospital endotracheal intubation in severe traumatic brain injury: ventilation targets and mortality—a retrospective analysis of 308 patients. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*. 2023;31(1):46.
5. Davis DP, Stern J, Sise MJ, Hoyt DB. A follow-up analysis of factors associated with head-injury mortality after paramedic rapid sequence intubation. *J Trauma*. 2005;59(2):486-490.
6. Renberg M, Dahlberg M, Gellerfors M, Rostami E, Günther M. Prehospital and emergency department airway management of severe penetrating trauma in Sweden during the past decade. *Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine*. 2023;31(1):85.
7. Velopulos CG, Shihab HM, Lottenberg L, Feinman M, Raja A, Salomone J, Haut ER. Prehospital spine immobilization/spinal motion restriction in penetrating trauma: A practice management guideline from the Eastern Association for the Surgery of Trauma (EAST). *J Trauma Acute Care Surg*. 2018 May;84(5):736-744.
8. Fevang E, Perkins Z, Lockey D, Jeppesen E, Lossius HM. A systematic review and meta-analysis comparing mortality in pre-hospital tracheal intubation to emergency department intubation in trauma patients. *Critical Care*. 2017;21(1):192. doi:10.1186/s13054-017-1787-x
9. Dumas RP, Jafari D, Moore SA, Ruffolo L, Holena DN, Seamon MJ. Emergency Department Versus Operating Suite Intubation in Operative Trauma Patients: Does Location Matter? *World J Surg*. 2020;44(3):780-787.
10. Dunton Z, Seamon MJ, Subramanian M, et al. Emergency department versus operating room intubation of patients undergoing immediate hemorrhage control surgery. *Journal of Trauma and Acute Care Surgery*. 2023;95(1):69.
11. Miller M et al. Hemodynamic Response After Rapid Sequence Induction With Ketamine in Out-of-Hospital Patients at Risk of Shock as Defined by the Shock Index. *Ann Emerg Med* 2016.
12. Dewhurst E et al. Cardiac Arrest Following Ketamine Administration for Rapid Sequence Intubation. *J Intensive Care Med* 2013.
13. Manley G, Knudson MM, Morabito D, Damron S, Erickson V, Pitts L. Hypotension, hypoxia, and head injury: frequency, duration, and consequences. *Arch Surg*. 2001 Oct;136(10):1118-23.
14. Carney N, Totten AM, O'Reilly C, et al. Guidelines for the Management of Severe Traumatic Brain Injury, Fourth Edition. *Neurosurgery*. 2017;80(1):6.
15. Kwon BK, Tetreault LA, Martin AR, et al. A Clinical Practice Guideline for the Management of Patients With Acute Spinal Cord Injury: Recommendations on Hemodynamic Management. *Global Spine Journal*. 2024;14(3 Suppl):187S. doi:10.1177/21925682231202348