16 Difficult Airway and OMG, There's Blood Everywhere: *Navigating the Difficult Airway*

Caitlin Rublee and Michael Barrie

Case

A 42-year-old male presents to the emergency department with vomiting. The patient's family comes to the front desk and explains that the patient cannot get out of the car and has been vomiting blood. Security and nursing staff extricate the patient to a wheelchair and deliver him to a critical care bay while calling for physician help. You arrive to see the patient slumped in the wheelchair, dark blood pooling in his mouth and covering his shirt. The family tells you that he was just admitted for rectal bleeding, and he had left the hospital against medical advice earlier that morning. His baseline mental status is normal, but he is currently only responsive to painful stimulation. The patient is moved to the critical care bed and initial assessment is started.

Pertinent Physical Exam

Except as noted below, the findings of the complete physical exam are within normal limits.

- Blood pressure 99/40, pulse 143, temperature 97 °F (36.1 °C), temperature source Oral, respiratory rate 28, height 1.803 m (5′ 11″), SpO2 84%.
- Head, Eyes, Ears, Nose Throat: Atraumatic. The patient is actively vomiting. Trachea is midline. There is no appreciated oral edema.

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- Cardiovascular: Normal S1, S2. Tachycardic. Cool extremities, capillary refill 4 seconds.
- Abdomen: Distended, +fluid wave.
- Skin: Slightly jaundice, spider hemangiomas present on chest, and palmer erythema.
- Neuro: The patient is not following commands, GCS 9 (E2V2M5). Does move all extremities spontaneously. On initial presentation, the patient is more responsive, but during the evaluation, his mental status decreases to GCS 6 (E1V1M4).

Past Medical History Alcoholic cirrhosis with prior variceal bleeding.

Social History Current every day smoker, continues to drink alcohol.

Family History No pertinent past family history.

Pertinent Test Results

Labs were unavailable on initial evaluation. Follow up testing revealed:

Lab Results			
Test	Results	Units	Normal Range
WBC	14.1	K/μL	3.8–11.0 10^3 / mm^3
HGb	5.5	g/dL	(Male) 14–18 g/dL (Female) 11–16 g/dL
Platelets	135	K/μL	140–450 K/μL
Creatinine	1.4	mg/dL	0.6–1.5 mg/dL
Potassium	>10	mEq/L	3.5–5.5 mEq/L
Lactate	6.1	mmol/L	<2.0
INR	1.4	–	≤1.1
Glucose	110	mg/dL	65–99 mg/dL
pH	7.11	–	7.35–7.45

Emergency Department Management

The patient was critically ill requiring immediate intervention. He was placed on a monitor, two large-bore peripheral IVs were established, and blood pressure recycled frequently. A definitive airway, given his altered mental status and copious hematemesis (vomiting blood), was an initial priority. He was identified to have a difficult airway given the amount of blood in his oropharynx, high risk of aspiration, and risk for decompensation during intubation given his profound presumed hemorrhagic shock. The patient was immediately placed on a non-rebreather face mask, oxygen turned to "flush," and had a nasal cannula placed with oxygen turned to 15 liters per minute. Team members attempted to suction the airway while others prepared for intubation. The team elected for low-dose etomidate sedation without paralysis given the predicted difficult airway. After induction, the first attempt was performed with direct laryngoscopy with a Macintosh blade. The resident was

unable to visualize the vocal cords due to the amount of blood in the airway. A large-bore suction catheter was placed in the posterior oropharynx and left there during the attending physician's second attempt. With the assistance of a bougie device, the patient was successfully intubated with a 7.0 endotracheal tube. The balloon was inflated, and end tidal CO_2 was confirmed with a color-change device. The team continued resuscitation efforts initially with O negative trauma blood and subsequent massive transfusion protocol with O positive blood.

Updates on Emergency Department Course

The patient continued to have profound blood from oral gastric tube. A Blakemore tube was inserted in attempt to tamponade the presumed bleeding esophageal varices. The gastroenterology team was consulted, which recommended against immediate upper endoscopy because the patient was critically unstable. Gastroenterology instead recommended ongoing aggressive resuscitation in the intensive care unit. Interventional radiology was not available to discuss transjugular intrahepatic portosystemic shunt (TIPS) placement.

Learning Points

Priming Questions

1. How do you identify the potentially difficult airway?
2. What special preparations are necessary for the anticipated difficult airway?
3. What techniques will improve chances of success during intubation?

Introduction/Background

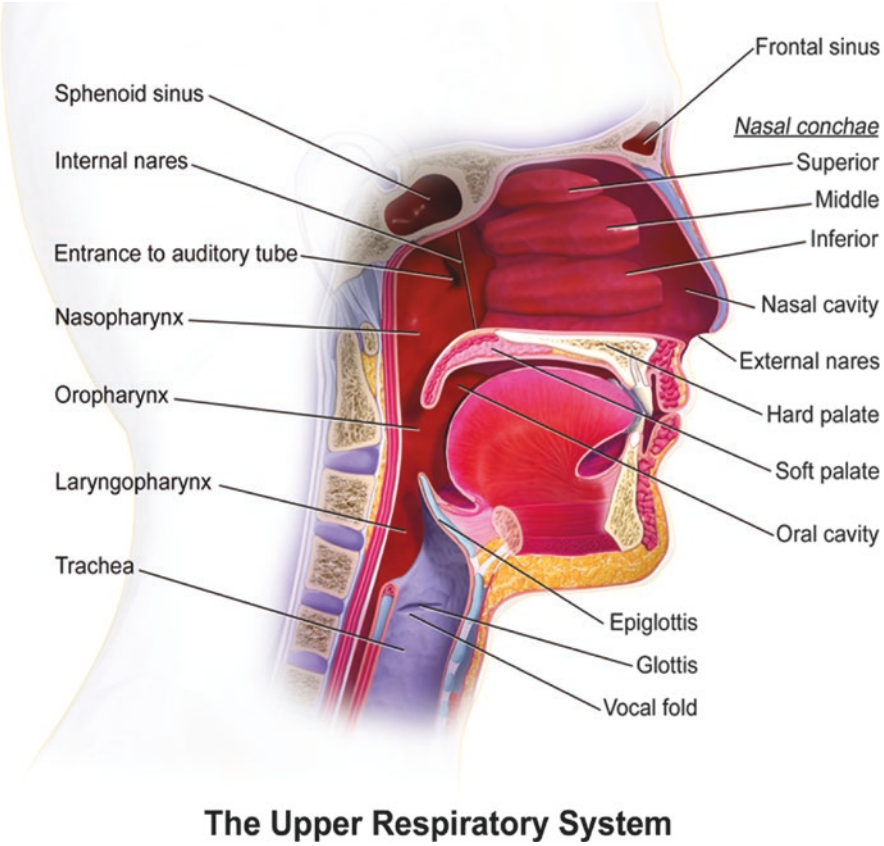
1. While managing a patient's airway is a routine aspect of emergency medicine, the anticipated difficult airway often unnerves even the most seasoned emergency physician. Fortunately, these events are rare [1, 2], but the provider must always be prepared for the myriad of airway challenges about to roll in the front door.
2. Applying a step-wise checklist to every airway approached, including the crashing patient with a difficult airway, will provide a sense of security.
3. Even an anticipated "easy" airway can have surprise difficulties. It is best to always prepare for the worst and have a stepwise approach to various backup options, including surgical airway options for the "can't intubate, can't oxygenate" scenario.
4. Brown and Walls have developed approaches for evaluating difficult airways [3]. The first question is whether the patient is crashing—cardiopulmonary arrest, respiratory arrest, and agonal respirations. If not, as the patient in the case was initially, the difficult airway algorithm can be followed using the "P's

of rapid-sequence intubation (RSI)" to maximize first-pass success: This is a slightly modified version of the P's of RSI: Plan B, predict a difficult intubation or bag-valve mask, preparation, "preintubation" optimization, preoxygenation, positioning, paralysis, put to sleep, placement with proof, and postintubation management.

5. Mortality from variceal bleeding has decreased threefold in the last 20 years yet remains a major cause of morbidity and mortality [4]. Avoiding hypoxia, allowing for restrictive transfusion with balanced resuscitation [5], and considering Sengstaken–Blakemore placement for a maximum of 24 hours to tamponade massive bleeding are recommended [6]. Recognizing and managing the factors leading to a difficult airway in the first place are imperative with continued resuscitation.

Physiology/Pathophysiology

1. Airway is placed first on the algorithm for evaluating the critical patient (airway, breathing, circulation) for good reason. Obstruction or failure of the patient's airway will rapidly lead to cardiopulmonary collapse and death.
2. There are many indications for placing a definitive airway.
   - *Respiratory failure*—when the patient is unable to oxygenate or ventilate to adequately meet physiologic needs. This is a clinical decision, but blood gas analysis showing pH < 7.3, $PaCO_2$ > 55 mmHg (or rise of $PaCO_2$ by 10 mmHg acutely in chronic CO_2-retaining patients like COPD), or PaO_2 of less than 60 mmHg on FiO2 > 40% could be suggestive of respiratory failure.
   - *Respiratory muscle fatigue*.
   - *Aspiration protection* if patient is too obtunded to protect their airway.
   - *Mechanical obstruction*—distortion of airway structures could block the airway. Potential etiologies include traumatic disruption, space-occupying lesions (Ludwig's angina, retropharyngeal abscess, malignancy), angioedema, neck hematomas, and foreign bodies.
   - *Other*—less common indications for intubation include intentional hyperventilation for cerebral edema (but rarely used), and core rewarming if patient is profoundly hypothermic.
3. The airway consists of the nose, mouth, posterior oropharynx, epiglottis, larynx, vocal cords, and trachea.



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4. To successfully intubate the patient, the operator must be able to align the airway structures to visualize the vocal cords. Especially when performing direct laryngoscopy, this is best performed by placing the patient in sniffing position [8]. Instead of simply hyperextending the neck, the provider should align the head and neck so the face is looking perpendicular to the bed with the ear lobe aligned with the sternal notch.

Proper Ear-to-Sternal Notch Positioning

Proper positioning with earlobe in line with sternal notch and face parallel to the floor using multiple blankets. (Used with permission courtesy of Colin Kaide)

Making the Diagnosis

Differential Diagnosis in this Patient Presentation

- Upper GI bleed
  - Variceal bleeding
  - Peptic ulcer disease
  - Mallory-Weiss tear
  - Dieulafoy's lesions
  - Malignancy
  - Mimics: epistaxis, tonsillar bleeding
- Elevated ammonia leading to altered mental status and aspiration
- Gastroenteritis with vomiting and aspiration
- Coagulopathy

1. The first step in realizing the anticipated difficult airway is to take the time to assess every patient requiring intubation for anticipated difficulties. Generally, taking the time to assess the airway completely will avoid potential pitfalls. It is when the provider rushes to intubate and is not appropriately prepared when disaster can ensue.
   - Consider preexisting difficult airway
   - Special considerations in trauma immobilization
   - Mechanical distortion of the airway
2. A validated tool called the "LEMONS law" can help predict a difficult intubation [3].
   - Look externally—short muscular neck, full dentition, protruding upper incisors, high-arched palate, receding mandible, severe facial trauma, and clinician gestalt

- Evaluate internally—3-3-2 rule
  - The rule describes the ideal external dimensions of the airway.
  - 3- the opening of the jaw should be far enough to accommodate three fingers (3–4 cm)
  - 3- the distance from the tip of the chin to the hyoid bone should be at least 3 fingerbreadths
  - 2- the distance from the floor of the mouth to the thyroid cartilage should be at least 2 fingerbreadths.
- Mallampati- Class I–II have low intubation failure rates while Class IV has failure rates reported over 10% of the time. While difficult to predict, the Mallampati has the highest sensitivity for diagnosing difficult intubation [9].
  - Mallampati Class I: No difficulty: Soft palate, uvula, fauces, and pillars visible
  - Mallampati Class II: No difficulty: Soft palate, uvula, and fauces visible
  - Mallampati Class III: Moderate difficulty: Soft palate and base of uvula visible
  - Mallampati Class IV: Major difficulty: Hard palate only visible

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- Obstruction—Signs include muffled voice, stridor, sense of dyspnea, and difficulty tolerating secretions.
- Neck mobility—Poor neck mobility from cervical spine immobilization or a history of ankylosing spondylitis or rheumatoid arthritis, for examples, restrict optimal sniffing positioning for intubation.
- Saturation—A saturation less than 90% in and of itself can create a difficult intubation as the time before desaturation is significantly less. A saturation this low on maximum oxygenation predicts a rapid desaturation.

3. It is also important to consider if the patient is a potentially difficult cricothyrotomy. Use the SMART mnemonic [10].
   - S—surgery
   - M—mass
   - A—access/anatomy
   - R—radiation (or other scarring)
   - T—trauma

4. It is rare to have a truly "crash" airway, one that must be secured immediately or the patient may rapidly deteriorate. In these rare cases, always assume that the patient will have a difficult airway and have immediate backup plans in mind for failed first attempts.

Treating the Patient

1. With any intubation, the key is using a step-wise approach. One standard approach is to go through the "P's of RSI [3]." Some argue that every approach begins with Plan B as well to assist with anticipating difficulties. Below is a modified version of the "Ps of RSI."

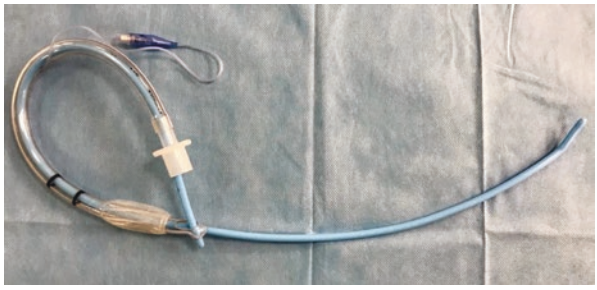
The P's of Rapid-Sequence Intubation

- *Plan B*. Advance planning for multiple contingencies gives the intubator many pre-thought-out options to deal with unanticipated difficulties. Having a strategy that goes beyond A and B can help to set oneself up for success in a potential failure situation. Further, the plan should be verbalized to the team prior to intubation.
- *Predict a difficult intubation*. Use the "LEMONS Law" as described earlier to determine a potentially difficult intubation.
- *Preparation*. Wear personal protection equipment, establish IV access with blood pressure cuff on opposite extremity. Have medications labeled and drawn up. Have equipment (direct and video laryngoscopes, varying sizes of endotracheal tubes, bougie) including Plan B equipment such as scalpel, Laryngeal Mask Airway (LMA) at bedside ready to use.
- *Preintubation optimization*. Resuscitate before you intubate! Optimize blood pressure with fluids or blood products and pressor support anticipating a reduction in blood pressure during RSI.
- *Preoxygenation*. Provide oxygen via non-rebreather turned to wide open. This is also called "flush," and it can provide up to 50 liters per minute (LPM). Begin at least 3 minutes prior to intubation. Place a nasal cannula at 15 LPM and maintain nasal cannula throughout intubation [11]. This combination and flow rate can provide an FIO_2 greater than 90%.
- *Positioning*. Position patient with ear to sternal notch.
- *Paralyze*. Deliver paralytic medications via rapid IV push in rapid succession with induction agents.
- *Put to sleep*. Deliver induction medications via rapid IV push in rapid succession with paralytic agents.
- *Placement with proof*. Pass the tube through the cords. Consider using bougie in setting of difficult airway, some evidence demonstrates increased first-pass success in setting of difficult airway [12]. Confirm placement with end-tidal carbon dioxide detection and pulmonary auscultation.
- *Post intubation management*. Obtain chest X-ray, treat hypotension, and order sedation and analgesia if indicated.

2. Additional tips for success in the difficult airway
   - Endotracheal tube (ET) introducer—bougie
     - Also called the gum elastic bougie, the ET introducer is made of plastic with an angled distal tip. The 30-degree-angled coude tip allows the device to more easily navigate anteriorly around the epiglottis and through the vocal cords. When successfully placed in the trachea, the provider can feel the bougie bumping the anterior tracheal rings, and the angled tip should lodge at the carina or smaller airways. After placement, the provider can slide the ET tube over the introducer into the airway. A few tips and tricks for ET introducer success:
       - Do not use an introducer with a hyperangulated blade such as with a glidescope. The bougie introducer is too flexible to follow the hyperangulated course.
       - Do not remove the laryngoscope blade when passing the ET tube. This will move the tongue and potentially allow direct visualization of the ET tube entering the airway.
       - Consider preloading the ET tube on the introducer. One technique described as the "kiwi grip" or d-loop technique places the distal end of the bougie into the ET tube vent ("Murphy's eye").

Kiwi Grip

Photos courtesy of Michael Barrie, MD



   - Suction-assisted laryngoscopy and airway decontamination (SALAD). Coined by anesthesiologist Dr. Jim Ducanto, this process explains how to decontaminate the airway that is full of vomitus or blood [13, 14]. In this description, the endotracheal tube can be attached to a meconium aspirator, and then attached to suction. This converts the ET tube into a large bore suction catheter. The patient then can be intubated using this same ET tube, which will then allow for suctioning of aspirated contents in the airway. Alternatively, this ET tube can be intentionally directed into the esophagus and left on to suction to help clear the airway, and then the patient is intubated with another ET tube.
   - Video-assisted laryngoscopy can be useful in the difficult airway, but in this case with a bloody airway, they generally do not work. The camera is easily obscured, and also the hemoglobin in the blood will absorb light, making it even more difficult to see.

3. It is important to always consider surgical airway options in any difficult airway. Generally, the hardest part of a surgical airway is deciding to do one. It is important to realize when other approaches to managing the airway have failed and quickly convert to a surgical approach. Here are three descriptions of common emergency surgical airways.
   - Open cricothyrotomy—the cricothyroid membrane is located just below the thyroid cartilage. In an open cricothyrotomy, the only tools the operator needs are a scalpel and a bougie. Perform a vertical incision in the skin over the cricoid cartilage, and then a horizontal incision through the cricoid cartilage. Then, with the blade in the airway, rotate the blade 90° to open up the hole. Slide the bougie into the airway, and then use this in a Seldinger technique to insert the 6–0 ETT.
   - Needle cricothyrotomy—this approach uses a Seldinger technique, inserting a needle through the cricoid cartilage until aspirating air, then insert a quide wire into the airway. The needle is removed, and then a device with dilator is inserted over the guidewire. Then the wire is removed.
   - Retrograde intubation—similar to the needle cric, enter the airway with a needle until aspirating bubbles, but then guide the wire superiorly out the mouth. The ETT can be delivered over the guidewire through the mouth to orotracheally intubate. This will only be successfully if the upper airway anatomy will cooperate with passing a small endotracheal tube.

Case Conclusion

The patient was admitted to the intensive care unit. However, over the course of hours, the patient became progressively acidotic, with ongoing bleeding despite appropriate Blakemore tube placement, blood product administration, cephalosporin antibiotics, somatostatin analogue, and pressor support. The patient expired from presumed upper gastrointestinal hemorrhage from bleeding varices and decompensated cirrhosis.

Discussion

Fortunately, the difficult airway is a rare event but one that providers should always be prepared for. The first step in managing the difficult airway is recognizing the potential for a difficult intubation. As time allows, prepare for each step of the intubation with multiple back up strategies if initial attempts fail. Be prepared to move to advanced techniques including surgical airway, especially if unable to oxygenate or ventilate the patient. The provider that clearly states their plan to the team and confidently works through their checklist will make management of the difficult airway look routine.

Pattern Recognition

Anticipated Difficult Airway

- Abnormal findings in the LEMONS law
- Abnormal vital signs that could portend peri-intubation arrest
- Vomit or blood in the airway

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