The Difficult Airway

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Injury/Disease Demographics

Definitions

- "Difficult airway" is defined whereby a trained anesthetist experiences difficulty with an inability to intubate, an inability to ventilate or both
- "Difficult to intubate" is defined as taking more than 3 attempts using a conventional laryngoscope or more than 10 minutes to complete intubation
- "Difficult to ventilate" is defined as inadequate ventilation that is not reversed with mask ventilation or oxygen saturation could not be maintained above 90%

Demographics

- Studies have indicated that 2% of deaths related to anesthesia are related to a failure to manage the difficult airway.[1]
- Difficult face mask ventilation occurs about 1:10,000 and 15% of those can lead to a difficult intubation.[1]
- The incidence of failed intubation is about 1 in 2000 in the elective setting, 1 in 300 during rapid sequence intubation in the obstetric setting, and approximately 1 in 50-100 in emergency department or intensive care unit setting.[2]

Assessment for Intubation

1. Airway Assessment
   History:
   - Review previous anesthesia records
   - History of intubation trauma
   - Previous surgery, radiation therapy to head/neck
   - Airway disease process
   - Systemic disease process (ankylosing spondylitis)
   - Sleep apnea
   - Traumatic injury to oropharynx or cervical spine
   - Previous tracheostomy
   - Gastro-esophageal reflux
   - Full stomach

   Physical Exam:
   - Stridor
   - Hemoptysis
   - Obesity
   - Short neck
   - Decreased mouth opening
   - Receding jaw
   - Buck teeth or missing upper teeth
   - Respiratory difficulty
   - Neck masses
   - Angioedema
   - Position of trachea/larynx

2. Airway Evaluation
    - Predictors of difficult intubation in the adult population are related to anatomy, pathology, and provider experience.
    - Mallampati score remains the most reliable predictor of the difficult airway.
    - Other tools that are predictive include presence of obstructive sleep apnea syndrome, reduced mobility of cervical spine, limited mouth opening, neck circumference > 17 inches, severe hypoxia, and coma.
    - The mnemonic **LEMON** can assist in the evaluation of the difficult airway:

      Look: external features (buck-teeth, prominent mandible, obesity, facial hair, unusual facial shape)

      Evaluate: facial and neck relationships → **3-2-2 rule**

        - 3 fingers between the patient's upper and lower teeth
        - 3 fingers between mandible and the hyoid bone
        - 2 fingers between the notch of the thyroid cartilage and the floor of the mandible

      Mallampati score (Figure 1)

        - Class I: the entire palatal arch, including the bilateral facial pillars, is visible down to the bases of the pillars
        - Class II: the upper part of the facial pillars and most of the uvula are visible
        - Class III: only the soft and hard palates are visible
        - Class IV: on the hard palate is visible

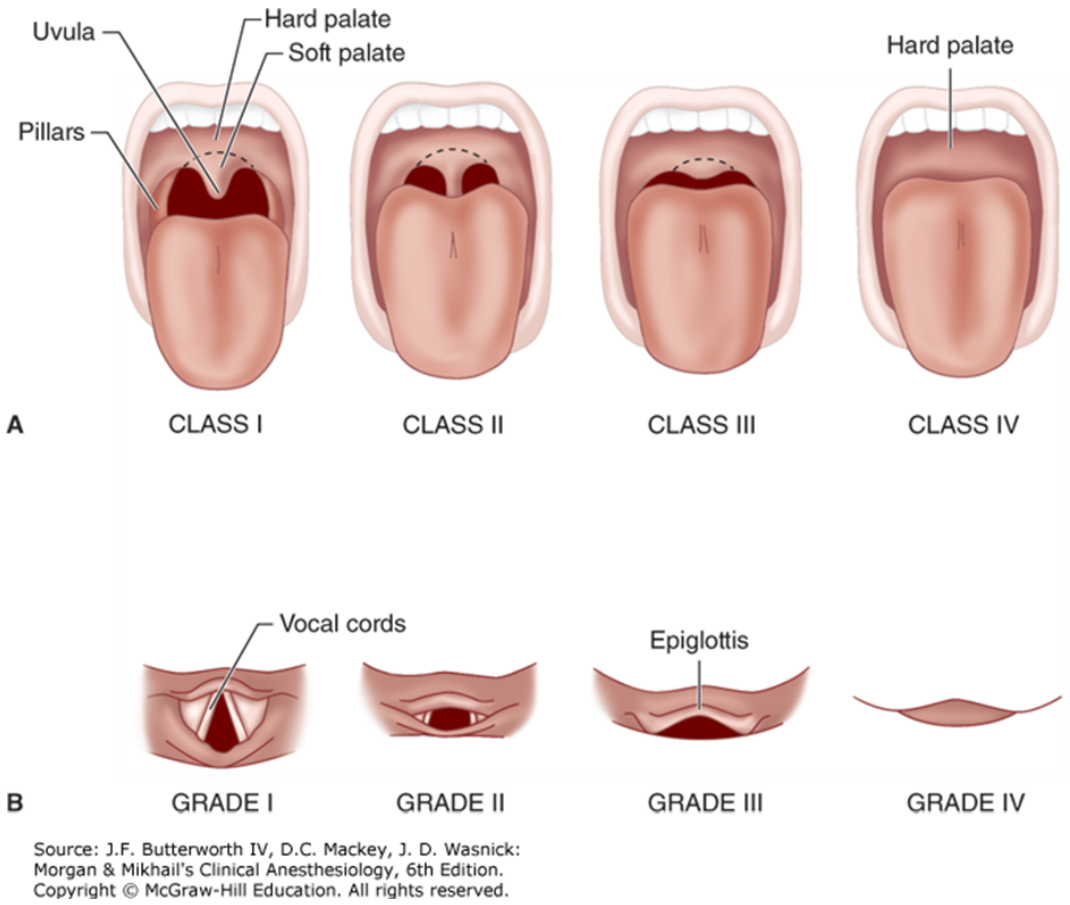

Figure 1. A: Mallampati classification of oral opening. B: Grading of the laryngeal view. A difficult orotracheal intubation (grade III or IV) may be predicted by the inability to visualize certain pharyngeal structures (class III or IV) during the preoperative examination of a seated patient. (Reproduced from Mallampati SR, Gatt SP, Gugino LD, et al. A clinical sign to predict difficult tracheal intubation: A prospective study. *Can Anaesth Soc J* 1985;32:429-434)

Obstruction: evaluate for presence of foreign body; consider presence of illness or injury

Neck mobility (or lack thereof in cervical spine immobilization or changes due radiation): mobility is necessary to align the airway axes to facilitate intubation

3. Preparation
    - Preparation, equipment and communication errors were the most common causes of complications during emergent airways
    - Explicit role assignments should be performed along with closed loop communication
    - Clear articulation of the primary and secondary airway management plans should be performed
    - Presence of two operators

4. Preoxygenation

- Adequate preoxygenation maximizes time for intubation
- The pre-oxygenated patient may have a 5-8 minute oxygen reserve
- Bag mask ventilation (BMV) is the first step in airway management with the exception of rapid sequence intubation
- BMV should be avoided in rapid sequence intubation to reduce stomach inflation due to the risk of aspiration
  If BMV is challenging then use of an oral or nasal airway, positive end-expiratory pressure valve, high flow nasal cannula or noninvasive positive pressure ventilation can help improve oxygenation

5. Choice of Laryngoscope
   - Direct laryngoscopy may be performed with a functioning light handle and there are an assortment of blades
     - Macintosh blades have a curved designed for tongue displacement and the curved blade will lift the epiglottis indirectly, facilitating speed and ease of intubation
     - Miller blades are straight and can lift the epiglottis directly and provide a better view of laryngeal structures
   - Video laryngoscopes offer an improved view of the glottis compared with direct laryngoscopy and increased the rate of first-time success intubations in the ICU
   - Video laryngoscopy also provides the supervisor and trainee the identical view of the glottis
     - Care must be taken to use the proper stylette with the video laryngoscope
   - Flexible bronchoscope can also be used adjunctively

6. Supraglottic Airway Devices
   - Can be used with spontaneously breathing patients
   - Can aid endotracheal intubation when BMV and endotracheal intubation have failed
   - All SADs consist of a tube that is connected to a respiratory circuit or breathing bag, which is attached to a hypopharyngeal device that seals and directs airflow to the glottis, trachea and lungs
   - These devices occlude the esophagus with varying degrees of effectiveness
   - Examples:
     - Laryngeal mask airway is not a substitute for an endotracheal tube but can be used as a temporizing measure in patients who cannot be mask ventilated or intubated. It can be used a conduit for an intubating stylet or bronchoscope. Variations in LMA design include ProSeal LMA which permits gastric decompression; I-Gel which uses a gel occlude rather than an inflatable cuff; Fastrach intubation LMA which facilitates endotracheal intubation through LMA device; LMA CTrach incorporates a camera to facilitate passage of an endotracheal tube
     - Esophageal-Tracheal Combitube is two fused tubes with two inflatable cuffs and the distal lumen usually lies within the esophagus and the perforations force air into the larynx
     - King Laryngeal Tube has a small esophageal balloon and a larger balloon for the oropharynx

To Cricoid or Not to Cricoid?

- The Sellick maneuver, or pressing fingers against the cricoid cartilage during rapid sequence intubation, has been espoused to prevent aspiration but was never tested in randomized controlled trials
- Since cricoid pressure was introduced into clinical practice, controversy has arisen including the necessity for the maneuver, its effectiveness in preventing aspiration, the amount of cricoid force needed and its reliability
- In the IRIS randomized controlled trial in France of 3,471 operative patients undergoing rapid sequence intubation, use of the Sellick maneuver demonstrated no difference in pulmonary aspiration and had a poorer view of the vocal cords. This study did not include patients outside the operating room.[3]
- While the release or adjustment of cricoid force may be justified if the glottic view is distorted, or when tracheal intubation is not optimal, it is not certain that cricoid pressure prevents aspiration
- If utilized, cricoid pressure requires preparatory instruction and periodic training

Management of Difficult Airway

- It is important to recognize the necessity of a multi-tier plan before attempting to address a difficult airway.

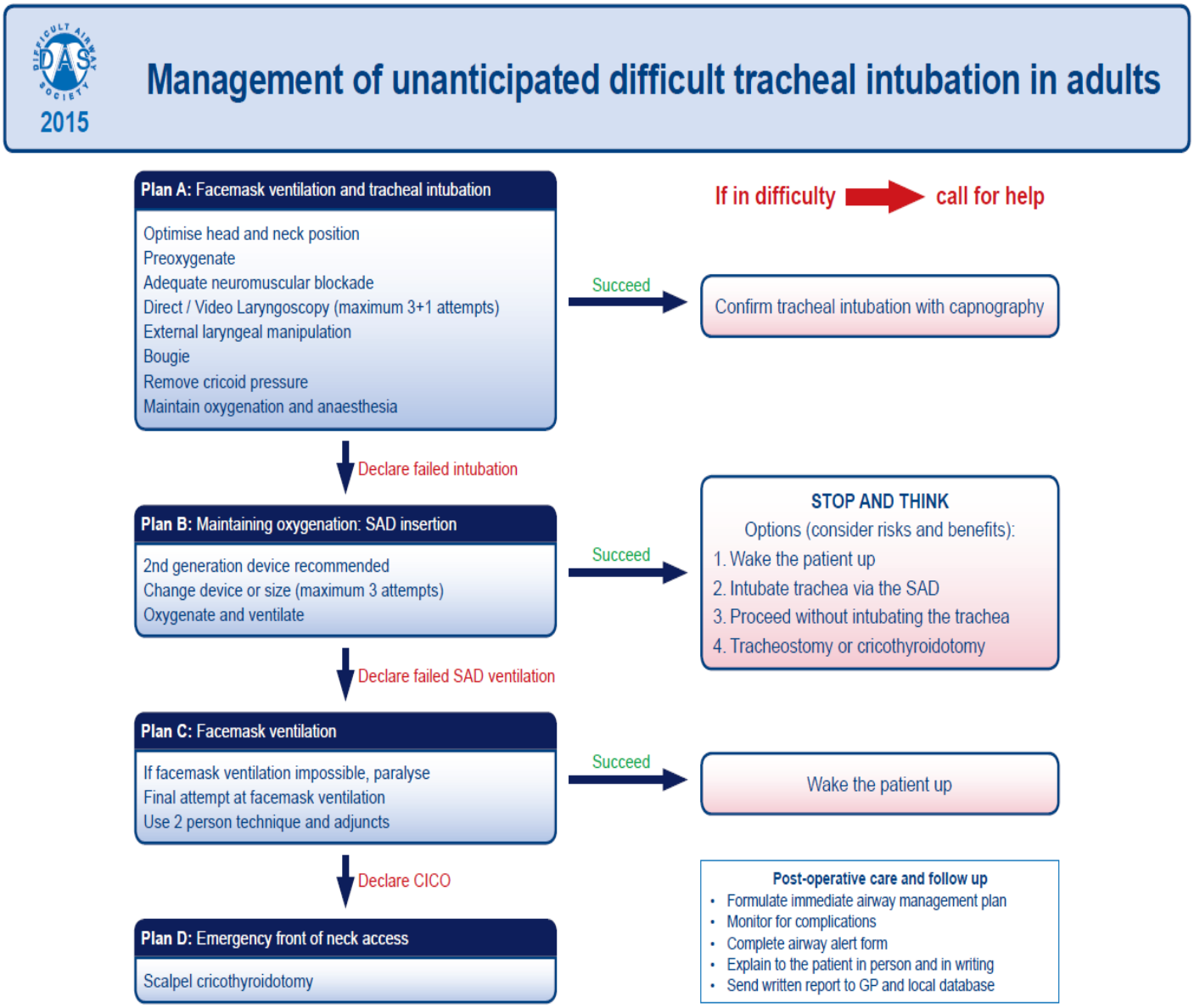

Figure 2. Management of unanticipated difficult tracheal intubation in adults. Difficult Airway Society, 2015. (Frerk C, et al. Difficult Airway Society 2015 guidelines for management of unanticipated difficult intubation in adults *Br J Anesth* 2015; 115: 827–848 Permission for the use of these algorithms for commercial purposes must be sought directly from Difficult Airway Society as they hold the copyrights)

- If intubation is difficult, there is little point in repeating the same procedure unless something can be changed to improve the chance of success
- Consider changing: patient's position, intubating device, adjuncts such as stylets or bougies
- Successful placement of a supraglottic airway device creates the opportunity to think about attempts at further intubation, waking the patient up, or proceeding to cricothyroidotomy
- The number of attempts at laryngoscopy should be limited to three

Indications for Operative Intervention

- A failure to intubate with resultant loss in the ability to oxygenate and ventilate

- Direct/video laryngoscopy has a maximum of 3+1 attempts
- If providers are unable to oxygenate and there are 3 failed attempts of supraglottic airway device, a final attempt at face mask ventilation should be performed with a 2 person technique
- Cricothyroidotomy should be performed

Cricothyroidotomy

- Standard Technique for Cricothyroidotomy:
    - Immobilize thyroid cartilage with non-dominant hand and palpate neck to identify cricothyroid membrane.
    - Make a generous vertical incision that extends above and below the cricothyroid membrane.
    - Make a transverse stab incision through the cricothyroid membrane and use a hemostat or dilator to widen the incision in the membrane
    - Insert a 6.0 ETT or cuffed tracheostomy and inflate cuff
        - Depending on patient anatomy, a smaller tube may be needed and should be available
    - Ventilate and confirm placement then secure the tube

- Technique for Percutaneous Cricothyroidotomy:
    - Standard pre-packaged cricothyroidotomy kits include an introducer needle, syringe, scalpel, guidewire, dilator and an airway catheter
    - Identify the cricothyroid membrane and make a small vertical incision
    - Advance the needle on a syringe through the incision into the cricothyroid membrane withdrawing on the plunger as you advance
    - Once you aspirate airway, remove the syringe and place the guidewire through the needle and then remove the needle leaving only the guidewire
    - Thread the dilator/airway and advance along the wire into the airway
    - Inflate the cuff of the airway and remove the dilator and guidewire
    - Ventilate and confirm placement then secure the airway

Postoperative Management

- Careful examination and evaluation of surgical airway site is necessary to assure hemostasis and ensure ETT or tracheostomy is secured in place to avoid unplanned dislodgement
- Controversy surrounds whether to convert cricothyroidotomy to tracheostomy
- No study to date has demonstrated any benefit of routine conversion to tracheostomy however the prolonged use of a cricothyroidotomy may lead to chronic subglottic stenosis
- Operative revision may be needed to secure the airway, or may be indicated if a larger airway is needed (as when frequent suctioning is required)
- Prospective investigation evaluating the routine conversion of emergent cricothyroidotomy is warranted

Complications of Difficult Airway

- Approximately 6% of difficult intubations result in airway injury with 87% of injuries being temporary and 8% resulting in death

- Most frequent sites of injury were the larynx (33%), pharynx (19%), esophagus (18%), trachea (15%) but injuries can also include chipped teeth and temporomandibular joint injuries
- Most common types of laryngeal injuries include vocal cord paralysis (34%), granuloma (17%), arytenoid dislocation (8%) and hematoma (3%)
- Pharyngeal injuries include perforation (37%), lacerations and contusions (31%), localized infection (12%) and sore throat
- Esophageal perforation accounts nearly all types of esophageal airway injuries
- Tracheal injuries can include injury from creating a surgical tracheotomy (64%), tracheal perforation (33%) and infection (3%)
- Avoid excessive force and multiple (>3) attempts
- Tracheobronchial injury can result from over inflation of the endotracheal tube

Complications of Cricothyroidotomy

- Bleeding of the thyroid cartilage, cricoid cartilage, or tracheal rings
- Perforation of the posterior trachea or esophagus
- Unintentional tracheostomy
- Passage of the tube into an extra-tracheal location (i.e., false tract)
- Subcutaneous emphysema
- Obstruction
- Aspiration
- Vocal cord injury
- Pneumothorax
- Infection

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