AIRWAY MANAGEMENT

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Perhaps the most important responsibility of the anesthesiologist is “management of the patient’s airway”

Miller RD’s Anesthesia 2000
Barash PG, Cullen BF, Stoelting RK’s Clinical Anesthesia 2001
What should we know about “airway management”?

- Airway anatomy and function
- Evaluation of airway
- Clinical management of the airway
  - Maintenance and ventilation
  - Intubation and extubation
  - Difficult airway management
Airway anatomy

The term “airway” refers to the upper airway, consisting of

- Nasal and oral cavities
- Pharynx
- Larynx
- Trachea
- Principle bronchi
Anatomy of upper airway
The Respiratory Pathway

- Base of tongue
- Vallecula
- False cord
- Trachea
- Glossoepiglottic fold
- Epiglottis
- Epiglottic tubercle
- Vocal fold
- Vestibular fold
- Aryepiglottic fold
- Cuneiform cartilage
- Corniculate cartilage
Nerves

V₁  V₂  V₃

IX
Vagus nerve

- Superior laryngeal n
  - External br
    (Motor)
    • cricothyroid m
  - Internal br
    (Sensory)
    • area above cord

- Recurrent laryngeal n
  - Motor br
    • intrinsic m
  - Sensory br
    • area below cord
Evaluation of the airway

- History
- Physical examination
- Special investigation
Evaluation of the airway

“History”

- Previous history of difficult airway
- Airway-related untoward events
- Airway-related symptoms/diseases
Evaluation of the airway

Physical examination

- Ease of open airway and maintenance
- Ease of tracheal intubation
- Teeth
- Neck movement
- Intubation hazards
- Signs of airway distress
Evaluation of the airway

Anatomic characteristics associated with difficult airway management

- Short muscular neck
- Receding mandible
- Protruding maxillary incisors
- Long high-arched palate
- Inability to visualize uvula
- Limited temporomandibular joint mobility
- Limited cervical spine mobility
- Interincisor distance < 2 FB or 3 cm
Evaluation of the airway

Assessment of airway associated with difficult airway management

- Mallampati’s classification ≥ Class III
- Atlanto-occipital joint extension ≤ 35°
- Hyoid-mental distance ≤ 3 cm or 2 FB
- Thyromental distance ≤ 6 cm or 3 FB
- Horizontal length of mandible ≤ 9 cm
- Sternomental distance ≤ 12 cm
Mallampati’s classification

<table>
<thead>
<tr>
<th>Class</th>
<th>Soft palate</th>
<th>Fauces</th>
<th>Uvula</th>
<th>Pillar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Soft palate</td>
<td>Fauces</td>
<td>Uvula</td>
<td>Load</td>
</tr>
<tr>
<td>Class II</td>
<td>Soft palate</td>
<td>Fauces</td>
<td>Uvula</td>
<td>Load</td>
</tr>
<tr>
<td>Class III</td>
<td>Soft palate</td>
<td>Load</td>
<td>Uvula</td>
<td>Load</td>
</tr>
<tr>
<td>Class IV</td>
<td>Soft palate</td>
<td>Load</td>
<td>Load</td>
<td>Hard palate</td>
</tr>
</tbody>
</table>
Signs of upper airway obstruction/airway distress

- Hoarse voice
- Decreased air in and out
- Stridor
- Retraction of suprasternal / supraclavicular / intercostal space
- Tracheal tug
- Restlessness
- Cyanosis
How to open the airway?

Non equipment:
- head tilt / chin lift / jaw thrust

With equipment:
- oral/nasopharyngeal airway
- endotracheal intubation
- laryngeal mask airway (LMA)
- combitube
- cricothyrotomy
- tracheostomy
Basic Airway Management (Manual / Non equipment)

1. Head tilt
2. Chin lift
3. Jaw thrust
Figure 5–6. An adult face mask.

22 mm orifice
Transparent/ black rubber
Hook
Minimize dead space
One-handed face mask technique
Two-handed face mask technique
Airway obstruction

Oral airway

Nasal airway
Indications for tracheal intubation

- Airway protection
- Maintenance of patent airway
- Pulmonary toilet
- Application of positive pressure ventilation
- Maintenance of adequate oxygenation
- Route for emergency drug during cardiac arrest
Technique of Direct Laryngoscopy & Intubation
How is the best laryngoscopic view achieved?
“Sniffing Position”

Figure 50-6  “Sniff” position. A volunteer positioned on the Popitz pillow (DermaCare, Louisville, KY) demonstrates cervical flexion and a small degree of atlanto-occipital extension. The flexion aligns the laryngeal and pharyngeal axes. Further extension of the head results in the true sniffing position.
FIGURE 53–8. A–D, Head and neck position and the axes of the head, neck, and upper airway.
Laryngoscopic view (LV classification)

Cormack - Lehane grading system

Grade I

Grade II

Grade III

Grade IV
## Oral endotracheal tube size guideline

<table>
<thead>
<tr>
<th>Age</th>
<th>Int diameter (mm)</th>
<th>Length (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full term</td>
<td>3.5</td>
<td>12</td>
</tr>
<tr>
<td>Child</td>
<td>4 + Age/4</td>
<td>12 + Age/2</td>
</tr>
<tr>
<td>Adult</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>7.0 – 7.5</td>
<td>20-23</td>
</tr>
<tr>
<td>Male</td>
<td>7.5 – 8.0</td>
<td>21-24</td>
</tr>
</tbody>
</table>
Preparation for Rigid Laryngoscopy

- Suction
- Airway
- Laryngoscope
- Endotracheal tube (ET or ETT)
- Stylet
- Anesthetic machine / Breathing system / Self-inflating bag
- Monitoring: Pulse oximeter, Capnograph, ECG
- Local anesthetics infiltration / spray
Stylet
Signs of Tracheal Intubation

- Respiratory gas moisture disappearing on inhalation and reappearing on exhalation
- Chest rise & fall
- No gastric distention
- ICS filling out during inspiration
- Reservoir bag having the appropriate compliance
Signs of Tracheal Intubation

- Breath sounds over chest wall
- No breath sounds over stomach
- Hearing air exit from ET when chest is compressed
- Large spontaneous exhaled tidal volumes
Signs of Tracheal Intubation

“More reliable signs”

- CO₂ excretion waveform
- Rapid expansion of a tracheal indicator bulb
Signs of Tracheal Intubation
“Most reliable signs”

- ET visualized between vocal cords
- Fiberoptic visualization of cartilaginous rings of the trachea and tracheal carina
Techniques for routine intubation

- (Preoxygenation)
- Administration of induction agent
- Adequate mask ventilation
- Administration of neuromuscular (NM) blocking agent
- Continue mask ventilation
- Intubation
- Confirm ET in trachea
Techniques for “rapid-sequence” (crash) induction and intubation

- Preoxygenation 5 min (or 8 deep breaths)
- Administration of induction and NM blocking agents
- Cricoid pressure (Sellick’s maneuver)
- “No” mask ventilation
- Intubation
- Check ET in trachea
- Release cricoid pressure
Cricoid Pressure (Sellick’s maneuver)
Complications:

• During laryngoscopy & intubation
• While tube in place
• Following extubation
Complications:

During laryngoscopy & intubation

- **Malpositions**
  - Esophageal intubation
  - Bronchial intubation

- **Trauma**
  - Dental damage
  - Lip, tongue, pharyngeal, laryngeal, tracheobronchial injuries
  - Dislocated mandible
  - Retropharyngeal dissection
  - Cervical spine injury

- **Aspiration**
Complication:

During laryngoscopy & intubation

- Physiologic reflexes
  - HT, arrhythmia
  - Intracranial HT
  - Intraocular HT
  - Bronchospasm
- Tube malfunction
  - Cuff perforation
**Oropharyngeal airway**

*Figure 50-3* Oropharyngeal airway in place. The airway follows the curvature of the tongue. It pulls the tongue and the epiglottis away from the posterior pharyngeal wall and provides a channel for the passage of air. (Adapted from Dorsch JA, Dorsch SE: Understanding Anesthesia Equipment, 4th ed. Baltimore, Williams & Wilkins, 1999.)

**Nasopharyngeal airway**

*Figure 50-4* The nasopharyngeal airway in place. The airway passes through the nose and ends at a point just above the epiglottis. (Adapted from Dorsch JA, Dorsch SE: Understanding Anesthesia Equipment, 4th ed. Baltimore, Williams & Wilkins, 1999.)
Complications:

**While tube in place**

- Malpositioning
  - Unintentional extubation
  - Endobronchial intubation
  - ET cuff malposition
- Airway trauma
  - Mucosal inflammation
  - Excruciation of nose
- Tube malfunction
  - Ignition
  - Obstruction / Kinking
- Aspiration
Complications:

Following Extubation

- Airway trauma
  - Edema, Stenosis
  - Hoarseness / Sorethroat
  - Laryngeal trauma / malfunction

- Physiologic reflexes
- Laryngospasm
- Aspiration
Techniques for Difficult Airway Management

- Techniques for Difficult Ventilation
- Techniques for Difficult Intubation
Techniques for Difficult Ventilation

- Oral/Nasal Airway Insertion
- Two-person mask ventilation
- Laryngeal mask airway (LMA)
- Esophageal-tracheal combitube
- Surgical airway access
Two person Mask Ventilation

Three-hand jaw-thrust/mask seal

First person

Second person

Two-hand jaw-thrust/mask seal

First person

Second person
Laryngeal Mask Airway
Figure 50-5 Insertion of a laryngeal mask airway (LMA).  

A, The tip of the cuff is pressed upward against the hard palate by the index finger while the middle finger opens the mouth.  

B, The LMA is pressed backward in a smooth movement. Notice that the nondominant hand is used to extend the head.  

C, The LMA is advanced until definite resistance is felt.  

D, Before the index finger is removed, the nondominant hand presses down on the LMA to prevent dislodgment during removal of the index finger. The cuff is subsequently inflated, and outward movement of the tube is often observed during this inflation. 

(Courtesy of LMA North America, Inc., San Diego, CA.)
The Esophageal-tracheal combitube
Surgical airway management:

Percutaneous cricothyrotomy

FIGURE 53-19. A–H. Percutaneous approach to the cricothyroid membrane with the Melker cricothyrotomy kit. (Courtesy of Cook Critical Care, Inc.)
Jet Ventilation
Techniques for Difficult Intubation

- Stylet
- Intubating stylet-tube changer
- Alternative laryngoscope (e.g. McCoy, Bullard, Intubating LMA, etc)
- Awake intubation
- Blind intubation (oral or nasal)
- Fiberoptic intubation
- Illuminating stylet / Light wand
- Retrograde intubation
- Surgical airway access
Stylet
Bullard laryngoscope

Figure 50-14 Insertion sequence for the Bullard laryngoscope. A, Start position with the Bullard handle close to the chest and the tip within the mouth. B, Midway through rotation of the Bullard laryngoscope. C, Rotation of the Bullard laryngoscope is complete, with the tip lying on the posterior pharyngeal wall and the handle vertical. The anesthesiologist has used a jaw thrust to increase space behind the tongue. D, The anesthesiologist seeks and optimizes the view of the larynx. The Bullard laryngoscope has been moved anteriorly so that the tip lies posterior to and elevates the epiglottis.
Illumination Stylet
Light wand
Retrograde intubation

Figure 50-16 Retrograde intubation with the Cook Retrograde Intubation Set. A, After placement of an 18-gauge sheath needle into the larynx, the J end of the guidewire is inserted in a cephalad direction until it exits the mouth or nose. B, An 11.0 Fr Teflon catheter is threaded down over the guidewire until it contacts the laryngeal access site. The guidewire is removed from above. C, After advancing the Teflon catheter 2 to 3 cm, the endotracheal tube is advanced into the trachea while maintaining constant control of the catheter. (Courtesy of Cook Critical Care, Bloomington, IN.)
Figure 50-17 Variations on the retrograde technique. The cricothyroid membrane is indicated with an arrow. The guide has been inserted through the cricotracheal space, passed in a loop through the Murphy eye of the tracheal tube, and used to pull it toward the cricotracheal membrane. A hollow catheter has been passed through the tracheal tube for passage into the trachea to act as an introducer. These variations may not be used simultaneously in clinical practice.
Practice Guidelines for Management of the Difficult Airway

An update report by the American Society of Anesthesiologist

Anesthesiology
Feb 2013
1. Assess the likelihood and clinical impact of basic management problems:
   - Difficulty with patient cooperation or consent
   - Difficult mask ventilation
   - Difficult supraglottic airway placement
   - Difficult laryngoscopy
   - Difficult intubation
   - Difficult surgical airway access

2. Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management.

3. Consider the relative merits and feasibility of basic management choices:
   - Awake intubation vs. intubation after induction of general anesthesia
   - Non-invasive technique vs. invasive techniques for the initial approach to intubation
   - Video-assisted laryngoscopy as an initial approach to intubation
   - Preservation vs. ablation of spontaneous ventilation

4. Develop primary and alternative strategies:

   **AWAKE INTUBATION**
   - Airway approached by Noninvasive intubation
     - Invasive Airway Access
     - Succeed
     - Fail
     - Cancel
     - Consider feasibility of other options
     - Invasive airway access

   **INTUBATION AFTER INDUCTION OF GENERAL ANESTHESIA**
   - Initial intubation attempts successful
   - Initial intubation attempts unsuccessful
   - From this point onwards consider:
     - Calling for help.
     - Returning to spontaneous ventilation.
     - Awakening the patient.

   **FACE MASK VENTILATION ADEQUATE**
   - Consider/Attempt SGA
     - SGA adequate
     - SGA not adequate or not feasible
     - Emergency pathway
     - Ventilation not adequate, intubation unsuccessful
     - Emergency noninvasive airway ventilation

   **FACE MASK VENTILATION NOT ADEQUATE**
   - Alternative approaches to intubation
     - Successful intubation
     - Fail after multiple attempts
     - Invasive airway access
     - Consider feasibility of other options
     - Awaken patient
1. Assess the likelihood and clinical impact of basic management problems:

- Difficulty with patient cooperation or consent
- Difficult mask ventilation
- Difficult supraglottic airway placement
- Difficult laryngoscopy
- Difficult intubation
- Difficult surgical airway access
2. Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management.
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• Video-assisted laryngoscope as an initial approach to intubation
• Preservation v.s. ablation of spontaneous ventilation
4. Develop primary and alternative strategies:

**AWAKE INTUBATION**

- Airway approached by Noninvasive intubation
  - Succeed*
    - Cancel Case
  - FAIL
    - Consider feasibility of other options\(^{(a)}\)
    - Invasive airway access\(^{(b)*}\)
- Invasive Airway Access\(^{(b)*}\)
4. Develop primary and alternative strategies:

**INTUBATION AFTER INDUCTION OF GENERAL ANESTHESIA**

- Initial intubation attempts successful*
- Initial intubation Attempts UNSUCCESSFUL

FROM THIS POINT ONWARDS CONSIDER:
1. Calling for help.
2. Returning to spontaneous ventilation.
3. Awakening the patient.
Initial Intubation Attempts UNSUCCESSFUL

(Call for Help)
Supraglottic airway (SGA)

- Laryngeal mask airway (LMA)
- Intubation LMA (ILMA)
- Laryngeal tube
ADVANCED AIRWAY AND INTUBATION TECHNIQUES

- LMA proseal
- LMA (Fastrach)
- LMA CTrach
- C MAC video laryngoscope
- Airtraq laryngoscope
- Glidescope intubation
- Lightwand intubation
- Fiberoptic intubation
Thank you and Good Luck