Airway

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Objectives:
• Recognize a difficult or challenging airway
• Differentiate and familiarize yourself with available algorithms, instruments, and techniques to secure an airway
• Practice with direct laryngoscopy, video laryngoscopy, and a 4 step technique to a surgical airway
Airway Education
ETCCC14

*Brad Morris, RN, CFRN, PA-C*
*Don VanBoerum, MD*
Airway Priorities

1. Oxygenate
2. Ventilate
3. Protect Airway
Airway Management

- Spontaneous ventilation
- Assisted mask/bag ventilation
- Controlled mask/bag ventilation
- Intubation + controlled ventilation
- Surgical airway + controlled ventilation

Use the least aggressive means necessary for airway management
Indications for Intubation

*Insufficient Oxygenation*
*Insufficient Ventilation*
*Loss of airway protection*
*Impending airway problems (CNS, Trauma)*
Preparation

Oxygen

Ambu bag with mask

Suction

Laryngoscope (working)

different size ETT

Suction

Plan B (Adjuncts)
Prevention of Failure

Assess situation
Decision for specific airway management
Communicate
Plan B
Reassess (change plan, if needed)
Prevention of Failure

Do not mess with a perfectly fine airway.
Difficult Airway
Preparation

Oxygen
Ambu bag with mask
Suction
Laryngoscope (working)
different size ETT
Suction
Plan B
Glidescope
Glidescope

Mean percentage of glottis opening (POGO) achieved by laryngoscope, on a scale of 0-100, in the various intubation scenarios with the conventional Macintosh, Macintosh + LMA, and Macintosh + LMA combined with the Macintosh valvelaryngoscope. (All tests are significant between peroral and entoracheal intubation at P < 0.05.)
Endotracheal Intubation
Depends Upon Manipulation of:

- Cervical spine
- Atlanto-occipital Joint
- Mandible
- Oral soft tissues
- Neck hyoid bone

Additionally:

- Dentition
- Pathology - Acquired and Congenital
The Normal Airway

*History of one or more easy intubations w/o sequelae*

*Normal appearing face with regular features*

*Normal clear voice*

*Absence of scars, burns, swelling, infections, tumour, or hematoma*

*No history of radiation of the head or neck*

*Ability to lie supine asymptomatically; no*
The Normal Airway

Patent nares

Ability to open mouth widely with TMJ rotation and subluxation (3 – 4 cm or two finger breaths)

Mallampati Class I

- Patient sitting straight up, opening mouth as wide as possible, with protruding tongue; the uvula, posterior pharyngeal wall, entire tonsillar pillars, and fauces can be seen

At least 6 cm (3 finger breaths) from tip of mandible to thyroid notch with neck extension

At least 9 cm from symphysis of mandible to mandible angle
The Normal Airway

*Slender supple neck w/o masses; full range of neck motion*

*Larynx moveable with swallowing and manually moveable laterally (about 1.5 cm each side)*

*Slender to moderate body build*

*Ability to extend atlanto-occipital joint (normal extension is 35°)*
Risk Factors For Difficult Intubation

El-Canouri et al. - prospective study of 10,507 patients demonstrating difficult intubation with objective airway risk criteria

- Mouth opening < 4 cm
- Thyromental distance < 6 cm
- Mallampati grade 3 or greater
- Neck movement < 80%
- Inability to advance mandible (prognathism)
- Body weight > 110 kg

Positive history of difficult intubation
Signs Indicative of a Difficult Intubation

*Trauma, deformity: burns, radiation therapy, infection, swelling, hematoma of face, mouth, larynx, neck*

*Stridor or air hunger*

*Intolerance in the supine position*

*Hoarseness or abnormal voice*

*Mandibular abnormality*

- Decreased mobility or inability to open the mouth at least 3 finger breaths
- Micrognathia, receding chin
  - Treacher Collins, Pierre Robin, other syndromes
  - Less than 6 cm (3 finger breaths) from tip of the mandible to thyroid notch with neck in full extension
- < 9 cm from the angle of the jaw to symphysis

Increased anterior or posterior mandibular length
Signs Indicative of a Difficult Intubation

Laryngeal Abnormalities

- Fixation of larynx to other structures of neck, hyoid, or floor of mouth.

Macroglossia

Deep, narrow, high arched oropharynx

Protruding teeth

Mallampati Class 3 and 4
Signs Indicative of a Difficult Intubation

Neck Abnormalities
- Short and thick
- Decreased range of motion (arthritis, spondylitis, disk disease)
- Fracture (subluxation)
- Trauma

Thoracoabdominal abnormalities
- Kyphoscoliosis
- Prominent chest or large breasts
- Morbid obesity
- Term or near term pregnancy

Age 50 – 59
Male gender
Difficult Intubation - History

Previous Intubations

Dental problems (bridges, caps, dentures, loose teeth)

Respiratory Disease (sleep apnea, smoking, sputum, wheeze)

Arthritis (TMJ disease, ankylosing spondylitis, rheumatoid arthritis)

Clotting abnormalities (before nasal intubation)

Congenital abnormalities

Type I DM

NPO status
Difficult Intubation - Physical Exam

General:
- LOC, facies and body habitus, presence or absence of cyanosis, posture, pregnancy

Facies:
- Abnormal facial features
  - Pierre Robin
  - Treacher Collins
  - Klippel – Feil
  - Apert’s syndrome
  - Fetal Alcohol syndrome
  - Acromegaly

Nose:
- For nasal intubation
- Patency
Pierre Robin
Treacher Collins
Difficult Intubation - Physical Exam

TMJ Joint – articulation and movement between the mandible and cranium

Diseases:

- Rheumatoid arthritis
- Ankylosing spondylitis
- Psoriatic arthritis
- Degenerative join disease

Movements: rotational and advancement of condylar head

Normal opening of mouth 5 – 6 cm
Difficult Intubation - Physical Exam

Oral Cavity

- Foreign bodies

Teeth:

- Long protruding teeth can restrict access
- Dental damage 25% of all anesthesia litigations
- Loose teeth can aspirate
- Edentulous state
  - Rarely associated with difficulty visualizing airway

Tongue:

- Size and mobility
## Structured Approach to Airway Management

### MOUTHS

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<tr>
<th>Component</th>
<th>Description</th>
<th>Assessment Activities</th>
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<tr>
<td><strong>M</strong>andible</td>
<td>Length and subluxation</td>
<td>Measure hyomental distance and anterior displacement of mandible</td>
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<tr>
<td><strong>O</strong>pening</td>
<td>Base, symmetry, range</td>
<td>Assess and measure mouth opening in centimetres</td>
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<td><strong>U</strong>vula</td>
<td>Visibility</td>
<td>Assess pharyngeal structures and classify</td>
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<td><strong>T</strong>eeth</td>
<td>Dentition</td>
<td>Assess for presence of loose teeth and dental appliances</td>
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<td><strong>H</strong>ead</td>
<td>Flexion, extension, rotation of head/neck and cervical spine</td>
<td>Assess all ranges and movement</td>
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<tr>
<td><strong>S</strong>ilhouette</td>
<td>Upper body abnormalities, both anterior and posterior</td>
<td>Identify potential impact on control of airway of large breasts, buffalo hump, kyphosis, etc.</td>
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Bag/Valve/Mask Ventilation

Always need to anticipate difficult mask ventilation
Langeron et al. 1502 patients reported a 5% incidence of difficult mask ventilation

5 independent risk factors of difficult mask ventilation:

- Beard
- BMI > 26
- Edentulous
- Age > 55 years of age
- History of snoring (obstruction)

Two of these predictors of DMV

- Sensitivity and specificity > 70%

DMV  Difficult Intubation in 30% of cases
Pre - oxygenation

*Traditional:*
- 3 minutes of tidal volume breathing at 5 ml/kg 100% O₂

*Rapid*
- 8 deep breaths within 60 seconds at 10 L/min

Always ensure pulse oximetry on patient
Optimal Position – “sniffing position”

- Flexion of the neck and extension of the antlanto-occipital joint
Optimal position:

- flexing neck and extending the atlantooccipital joint
Positioning

**Figure 7.4.** Cervical flexion.

**Figure 7.5.** Extension of the atlantooccipital joint.
Insert blade into mouth
Sweep to right side and displace tongue to the left
Advance the blade until it lies in the valeculla and then pull it forward and upward using firm steady pressure without rotating the wrist
Avoid leaning on upper teeth
May need to place pressure on cricoid to bring cords into view
Laryngoscopy Grade

Grade I - 99%
Grade II - 1%
Grade III - 1/2000
Grade IV - 1/10,000
Insertion

_Insert cuff to ~ 3 cm beyond cords_

_Tendency to advance cuff too far_
  - Right mainstem intubation

Cuff Inflation

- Inflate to 20 cm H₂O
- Listen for leak at patients mouth
- Over inflation can lead to ischemia of trachea
Confirmation ETT Position

**Continuous CO$_2$ monitoring or capnometry**

- Gold standard

*Must have at least 3 continuous readings without declining CO$_2$*

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**Figure 7.13.** The normal capnogram. Point $D$ marks the end-tidal CO$_2$, which is the best reflection of alveolar CO$_2$ tension. (From Barash, Cullen, and Stoelting,$^{14}$ with permission.)
Other Methods to Determine Placement of ETT tube

Auscultation

Visualization of tube through cords

Fiberoptic bronchoscopy

Pulse oximetry not improving or worsening

Movement of the chest wall

Condensation in ET tube

Negative Pressure Test

CXR
Airway Maneuvers

**BURP – Improves visualization of airway**

1. Posterior pressure on the larynx against cervical vertebrae (Backward)
2. Superior pressure on the larynx as far as possible (Upward)
3. Lateral pressure on the larynx to the right (Right)
4. With pressure (Pressure)
Causes of Failed Intubation

Poor positioning of the head
Tongue in the way
Pivoting laryngoscope against upper teeth
Rushing
Being overly cautious
Inadequate sedation
Inappropriate equipment
Unskilled laryngoscopist
Some Predictors of a Difficult Airway

- C-spine immobilized trauma patient
- Protruding tongue
- Short, thick neck
- Prominent upper incisors ("buckteeth")
- Receding mandible
- High, arched palate
- Beard or facial hair
- Dentures
- Limited jaw opening
- Limited cervical mobility
- Upper airway conditions
- Face, neck, or oral trauma
- Laryngeal trauma
- Airway edema or obstruction
- Morbidly obese
Additional Predictors: Medical History

- Joint disease
- Acromegaly
- Thyroid or major neck surgeries
- Tumors, known abnormal structures
- Genetic anomalies
- Epiglottitis
- Previous problems in surgery
- Diabetes
- Pregnancy
- Obesity
- Pain issues
Assess the Risk

Identifying a potentially difficult airway is essential to preparing and developing a strategy for successful ETI and also preparing an alternate plan in the event of a failed ETI.
Difficult to Bag (MOANS)

Mask Seal

Obesity or Obstruction

Age > 55

No Teeth

Stiff
Mask Seal

Small Hands

Wrong Mask Size

Oddly Shaped Face

Bushy Beard

Blood/Vomit

Facial Trauma
Obesity or Obstruction

**Obesity**

- Heavy chest
- Abdominal contents inhibit movement of the diaphragm
- Increased supraglottic airway resistance
- Billowing cheeks
- Difficult mask seal
- Quicker desaturation
Obesity or Obstruction

3rd Trimester Pregnancy

- Increased body mass
- Quick desaturation
- Increased Mallampati Score
- Gravid uterus inhibits movement of the diaphragm
Obesity or Obstruction

Obstructions

- Foreign Body
- Angioedema
- Abscesses
- Epiglottitis
- Cancer
- Traumatic Disruption/Hematoma/Burns
Age > 55

Associated with BVM difficulty, possibly due to loss of tone in the upper airway
No Teeth

*Face tends to “cave in”*

*Consider leaving dentures in for BVM and remove for intubation*
Stiff
Refers to Poor Compliance
Reactive Airway Disease
COPD
Pulmonary Edema/Advance Pneumonia
History of Snoring/Sleep Apnea

- Also predicts a higher Mallampati score
Difficult Laryngoscopy & Intubation

**LEMONS**

- Look Externally
- Evaluate 3-3-2
- Mallampati Score
- Obstruction
- Neck Mobility
- Scene and Situation
Look Externally

- Beards or facial hair
- Short, fat neck
- Morbidly obese patients
- Facial or neck trauma
- Broken teeth (can lacerate balloons)
- Dentures (should be removed)
- Large teeth
- Protruding tongue
- A narrow or abnormally shaped face
EVALUATE 3-3-2

Bottom of Jaw/Chin to Neck > 3 fingers
Jaw/Palate > 3 fingers wide
Mouth opens > 2 fingers wide

Any single indicator has poor specificity
EVALUATE 3-3-2

Mouth Opens at least 3 finger widths.

Three finger widths thyromental distance.

Two finger widths mandibulohyoid distance.
EVALUATE 3-3-2

Will patients mouth open wide enough to accommodate 3 fingers?

Will 3 fingers fit between the mentum and hyoid bone?

Will 2 fingers fit between the hyoid and thyroid notch?
  • If not, expect a difficult intubation
Mouth opens at least 3 fingers width?
Thyromental Distance

Distance from the mentum to the thyroid notch.

Ideally done with the neck fully extended. Can be done in-line

Helps determine how readily the laryngeal axis will fall in line with the pharyngeal axis.
Thyromental Distance

If the thyromental distance is short, <3 finger widths, the laryngeal axis makes a more acute angle with the pharyngeal axis and it will be difficult to achieve alignment.

Less space to displace the tongue.
Thyromental Distance-3 fingers?
Mandibulohyoid Distance- 2 fingers?

Measured from the mentum to the top of the hyoid bone.

The epiglottis arises from the thyroid and remains dorsal to the hyoid bone.

Therefore, the position of the hyoid bone marks the entrance to the larynx.
Mandibulohyoid Distance
Mandibulohyoid Distance

When the position of the hyoid bone is caudal or relatively caudal, a large portion of the tongue is situated in the hypopharynx instead of the mouth.

During laryngoscopy, this large hypopharyngeal tongue mass further compromises the compliance needed for its displacement.
Mandibulohyoid Distance

Patients who have a longer mandibulohyoid distance, greater than 2 finger widths, tend to be more difficult to intubate.

A more caudal hyoid bone thus indicates a relatively caudal larynx.
Upper & Lower Face

Measure the size of the upper face as compared to the lower face.

Should be roughly the same.

If the lower face is longer than the upper face then you should anticipate some degree of difficulty lining up the structures.
Upper and lower face equal?
Upper and lower face equal?
Mallampati Score: LEmons

The Oral Cavity:
- Palate
- Uvula
- Alveolar Arch
- Palatopharyngeal Arch
- Palatoglossal Arch
- Tonsil
Mallampati Score

Have patient sit up, and stick out tongue without phonating

May be unable to properly assess this in an emergent field situation

Modified version is to use a laryngoscope blade like a tongue blade to visualize the oropharynx – (not as sensitive or specific)
Mallampati Classification

Relates to tongue size to pharyngeal size.

Performed with patient in a sitting position, head neutral, mouth open wide and tongue protruding to the maximum.

The Subsequent Classification is assigned based upon the pharyngeal structures visible.
Mallampati Classification

Class I: Visualization of the soft palate, fauces, uvula, and anterior & posterior pillars
Mallampati Classification

**Class II**: Visualization of the Soft palate, fauces and uvula.
Mallampati Classification

*Grade III: Visualization of the soft palate and the base of the uvula.*
Mallampati Classification

*Grade IV: The soft palate is not visible at all.*
Mallampati Scoring

**Class 1**
Visualization of the soft palate, fauces, uvula, anterior and posterior pillars.

**Class 2**
Visualization of the soft palate, fauces and uvula.

**Class 3**
Visualization of the soft palate and the base of the uvula.

**Class 4**
Soft palate is not visible at all.
Mallampati Classification
Obstruction

*Laryngoscopy or intubation may be more difficult in the presence of an obstruction*

- Anatomy
- Trauma
- Foreign body obstruction
- Edema (burns)
Obstructions
Laryngoscopic View Grades

Grade 1: Full aperture visible
Grade 2: Lower part of cords visible
Grade 3: Only epiglottis visible
Grade 4: Epiglottis not visible
Obstructions
Laryngoscopic View Grades

Graded in order from the best view to worst.

Grade 1: Visualization of the entire laryngeal aperture
Obstructions

Laryngoscopic View Grades

Grade 2: Visualization of just the posterior portion of the laryngeal aperture.

Grade 3: Visualization of only the epiglottis

Grade 4: Visualization of the soft palate only.
Obstructions

Laryngoscopic View Grades

A severe grade III or IV view with failed endotracheal intubation occurs in 0.05-0.35% of patients.
Cormack & Lehane Grading

Grade I = \uparrow success & ease of intubation

% listed = incidence

10-30%

<5%

<1%
Neck Mobility

Ideally the neck should be able to extend back approximately 35°

Problems:

- Cervical Spine Immobilization
- Ankylosing Spondylitis
- Rheumatoid Arthritis
- Halo fixation
“BURP” – a.k.a. “External Laryngeal Manipulation”

**Backward, Upward, Rightward Pressure:** manipulation of the trachea

90% of the time the best view will be obtained by pressing over the thyroid cartilage

Differs from the Sellick Maneuver