

AIRWAY MANAGEMENT IN CRITICALLY ILL PATIENTS

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Introduction

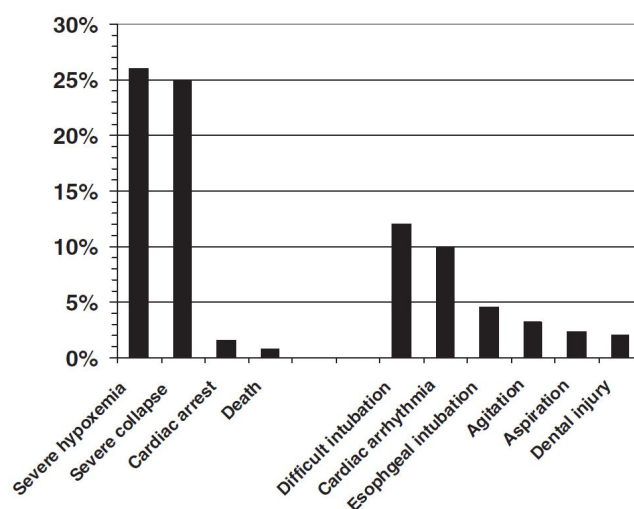
- In the operating theater, endotracheal intubation (ETI) is done generally in controlled circumstances by anesthesiologists and carries a low risk of complications
- In the intensive care unit (ICU), ETI is often performed under suboptimal conditions, in patients with limited physiologic reserve and by individuals who have variable levels of expertise in airway management

Reported incidence of difficult intubation (≥ 3 attempts) and complications associated with intubation in critically ill patients

Study (n)	≥ 3 attempts	Severe hypoxaemia	Severe hypotension	Oesophageal intubation	Aspiration	Cardiac arrest
Griesdale 2008 [5] (136)	13.2%	19.1% ($\text{SpO}_2 < 80\%$)	9.6%	7.4%	5.9%	
Mort 2004 [3] (2833)	10%	4.7% ($\text{SpO}_2 < 70\%$)		9.7%	2.1%	1.8%
Martin 2011 [6] (3423)	10.3%			1.3%	2.8%	
Jaber 2006 [4] (253)	12%	26% ($\text{SpO}_2 < 80\%$)	25%	4.6%	2%	2%
Schwartz 1995 [1] (297)	8%			8%	4%	3%
Mayo 2011 [7] (101)	20%	14% ($\text{SpO}_2 < 80\%$)	6%	11%		

Anaesthesia, 2011, 66 (Suppl. 2), pages 81–92

Incidence of endotracheal intubation complications



Crit Care Med 2006; 34:2355–2361)

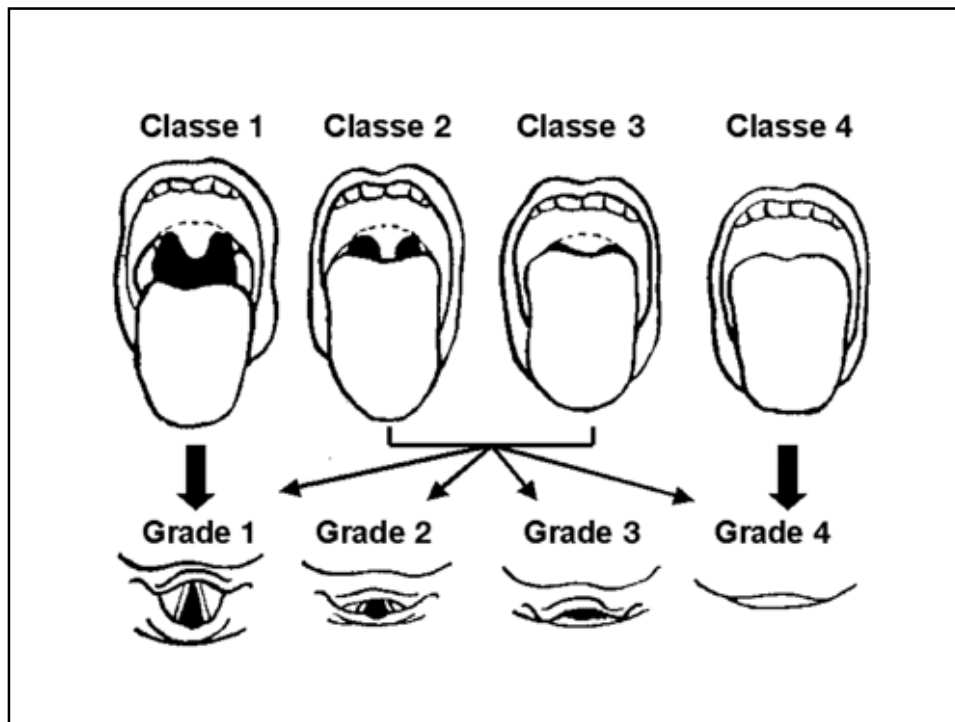
Definition

- Difficult airway
- Difficult mask ventilation
- Impossible mask ventilation
- Difficult intubation
- Difficult laryngoscopy

Airway Assessment and Documentation

- Urgent rather than emergent...A targeted airway history and physical examination should be performed
- LEMON
 - ...Look externally
 - ...Evaluate the 3-3 Rule
 - ...Mallampati Score
 - ...Obstruction
 - ...Neckmobility

In isolation, non-reassuring physical exam features have a low to moderate sensitivity (20–62%) and a moderate to fair specificity (82–97%)



History and physical exam features predictive of difficult mask ventilation and difficult ETI

Mask ventilation	Endotracheal intubation
Snoring or obstructive sleep apnea	History of difficult intubation
Beard	Interincisor distance <3 fingers
Mallampati III or IV	Mallampati III or IV
Age ≥ 55	Decreased neck range of motion
Limited jaw protrusion	Prominent overbite
Thyromental distance <3 fingers	Thyromental distance <3 fingers
Body mass index ≥ 30	
Lack of teeth	
Thick/obese neck anatomy	

Lung (2011) 189:181–192

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**VGHI Intensive Care Unit
Pre Intubation Airway
Assessment Record**

Individual Completing Pre Intubation Airway Assessment Record: _____

Date of Evaluation: ____ (day) / ____ (mth) / ____ (year)

Patient History:

Has the patient had a previous difficult intubation? (i.e. Fiberoptic) ☐ yes ☐ no
Comment: _____

Does the patient have an unstable c-spine or previous spinal fusion? ☐ yes ☐ no
Specifics: _____

Does the patient have a history of OSA with CPAP use? ☐ yes ☐ no
Any treatment: _____

Does the patient have a history of burns to the head or neck? ☐ yes ☐ no
Comment: _____

Does patient have severe rheumatoid arthritis? ☐ yes ☐ no
Comment: _____

Has the patient had previous airway surgery or a previous tracheostomy? ☐ yes ☐ no
Specifics: _____

Clinical Examination – LEMON Assessment Method:

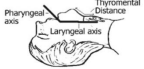
L – Look externally for characteristics known to cause difficult laryngoscopy (please circle all that apply)

Face ☐ Small jaw ☐ Edema ☐ Loose Teeth ☐ Disfiguring of the Jaw
☐ Facial hair ☐ Prominent Teeth ☐ Difficult Bag/Mask Ventilation (2 person, use of airway, inability to maintain seal)

Thorax / Abdomen ☐ Pregnancy ☐ Massive ascites ☐ Morbid obesity
☐ Bowel Obstruction

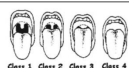
E – Evaluate the 3-3 Rule:

Mouth opening – 3 finger breadths ☐ yes ☐ no
Thyro-Mental distance – 3 finger breadths ☐ yes ☐ no



M – Mallampati Score

Mallampati Class: _____



O – Obstruction (Is there any condition that can cause obstruction of the airway which would make laryngoscopy and ventilation difficult?)

☐ Tumors ☐ Stridor ☐ Congenital Defects (Down's, Goltz, Pierre-Robin Syndrome) ☐ Other obvious deformity _____

N – Neck mobility

Can the patient move their jaw forward? ☐ yes ☐ no
Can the patient fully bend / extend the head and neck? ☐ yes ☐ no
Is the patient in a c-spine collar? ☐ yes ☐ no

Preintubation airway assessment record

- ☐ Has the patient had a previous difficult intubation?
- ☐ Does the patient have an unstable c-spine or previous spinal fusion?
- ☐ Does the patient have a history of OSA with CPAP use?
- ☐ Does the patient have a history of burns to the head or neck?
- ☐ Does patient have severe rheumatoid arthritis?
- ☐ Has the patient had previous airway surgery or a previous tracheostomy?

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**VGHI Intensive Care Unit
Post Intubation
Airway Assessment Record**

Individual Completing Post Intubation Airway Assessment Record: _____

Date of Intubation: ____ (day) / ____ (mth) / ____ (year)

Level ☐ PGY (circle) 1 2 3 ☐ Attending Physician ☐ Clinical Associate ☐ ICU Fellow ☐ Respiratory Therapist ☐ Other _____

Specialty ☐ Internal Medicine ☐ Emergency Medicine ☐ Surgery ☐ Anesthesiology ☐ Critical Care ☐ Other _____

Location of Intubation: ☐ ICU ☐ Pre-hospital (EHS) ☐ Ward ☐ Other Facility ☐ Emergency ☐ OR

Total Number of Intubation Attempts: _____

Size of OETT / EVAC placed: _____

Confirmed Position at the Teeth: _____


Was Anesthesia called for Assistance? ☐ YES ☐ NO
☐ YES – failed attempt ☐ YES – anticipated difficult airway

Modality Utilized for Intubation:

Attempt	Performed by	Successful?	Cricoid?	Technique (circle all appropriate)
1		Y N	Y N	L GS B LW FOB LMA S
2		Y N	Y N	L GS B LW FOB LMA S
3		Y N	Y N	L GS B LW FOB LMA S

L = laryngoscope B = Bougie GS = Glidescope LW = lightwand
FOB = fiberoptic S = Surgical LMA = laryngeal mask airway

Glottic View during Intubation: _____



Drug Utilized during Intubation: ☐ Sedated ☐ Awake

☐ Midazolam ☐ Fentanyl ☐ Ketamine ☐ Etomidate ☐ Succinylcholine
☐ Rocuronium ☐ Vasopressors ☐ Other _____

Date of Tracheostomy: ____ (day) / ____ (mth) / ____ (year) Type of Tube Placed: _____

Date of First Change: ____ (day) / ____ (mth) / ____ (year) Surgical Service: _____

Comments/ Concerns During Airway Procedures (Intubation or Tracheostomy): _____

Postintubation airway assessment record

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Patient Optimization

This step is crucial to the success of ETI...

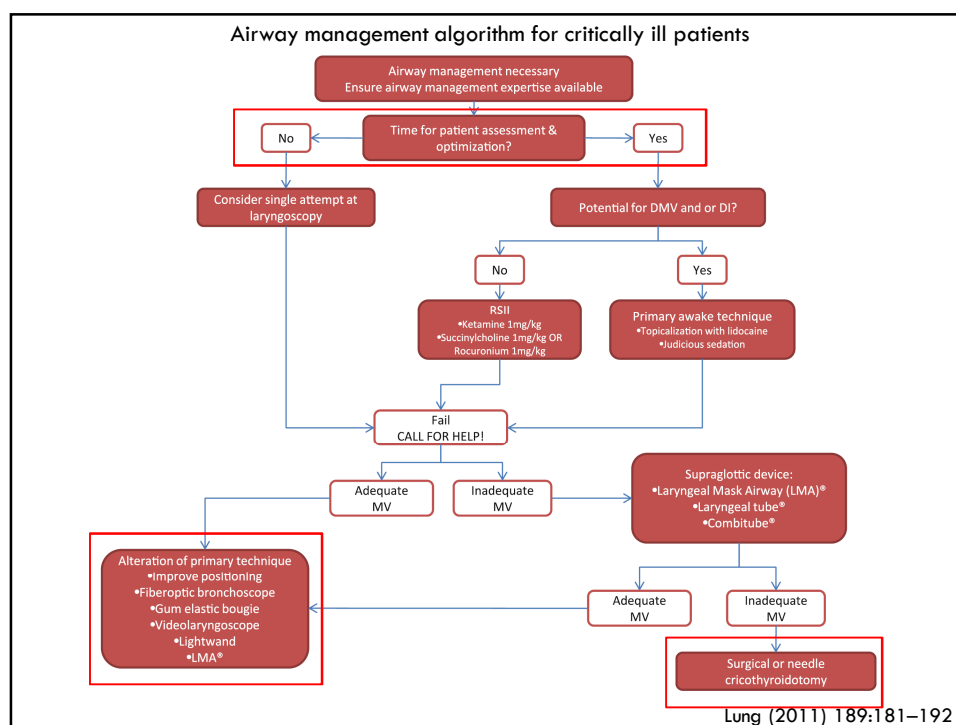
- NG tube should be considered if the patient is at high risk for aspiration
- If no contraindications, the patient should be placed in the sniffing position which facilitates glottic exposure
- Preoxygenation can be performed by applying a nonrebreathing face mask with a FiO_2 of 1.0, or by using noninvasive positive-pressure ventilation (NIPPV)

Patient Optimization

- Hypotension is also common, with up to 30% of patients having an episode of severe cardiovascular collapse
- **Intravascular volume expansion** with isotonic crystalloid solutions and immediate access to **vasopressors** should be considered in most patients as they may help attenuate the hemodynamic instability around the time of ETI

Algorithm Approach

- ASA difficult airway algorithm is an excellent resource, it is designed for anesthesiologists in the operating theater and can be cumbersome
- ASA: if the airway cannot be secured after multiple attempts → “awaken the patient” and consider reparation
- ASA: does not address patient optimization



Based on the perceived difficulty of ETI and mask ventilation, there are two basic approaches to securing the airway:

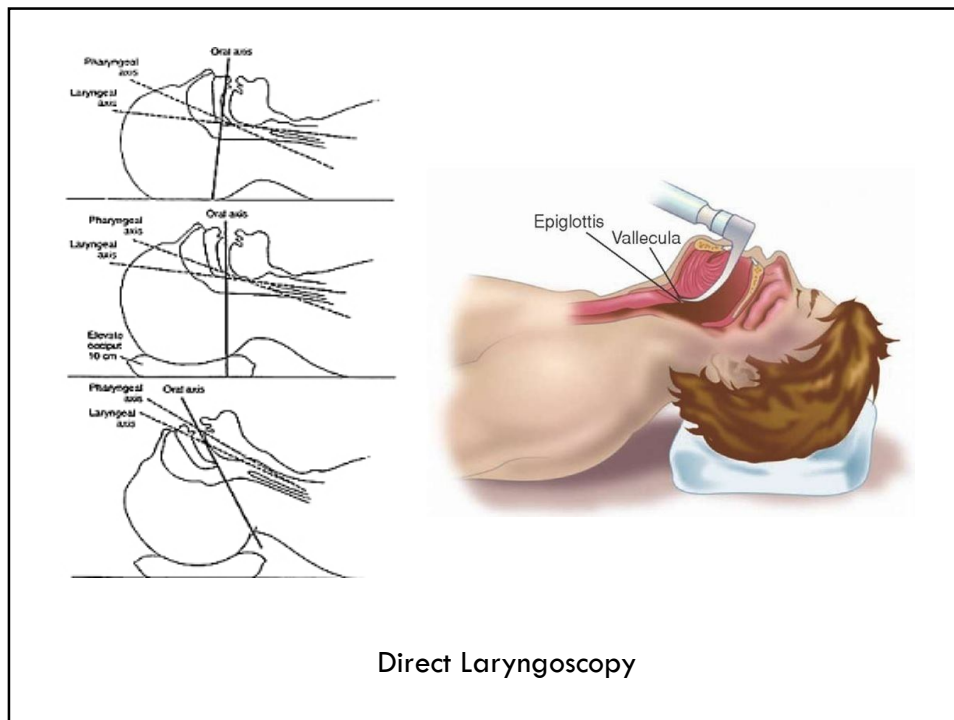
- (1) The “awake” technique with maintenance of spontaneous ventilation
- (2) The “Rapid Sequence Induction and Intubation (RSII)” technique with abolition of spontaneous ventilation

Awake Intubation

“To maintain spontaneous ventilation during ETI”

- Fiber-optic bronchoscope is almost always used for this technique in the operating room (→ direct laryngoscopy, video laryngoscopy)
- Complications → aspiration, hemodynamic instability, patient agitation, airway trauma, multiple attempts, or failed airway





Awake Intubation

Critical steps to this technique include:

- Patient communication and preparation
- Topicalization with local anesthesia
 - : Nebulization or direct application with lidocaine 2%
 - : The recommended total dose → 5 mg/kg
- Judicious patient sedation → extremely sensitive to sedation
- Establish a backup plan

Rapid Sequence Induction and Intubation

- The majority of critically ill patients should be considered to have a “full stomach”
- The period of highest risk for aspiration is between the administration of sedative medications and cuff inflation after a successful ETI
- The goal of RSII is to minimize this time at risk
 - may lead to relative anesthetic over- or underdosing...
 - we favor a quickly titrated induction

Medications Used in RSII

- Medications used in RSII
 - : Short-acting benzodiazepine (e.g., midazolam 0.5–2 mg IV) and a hypnotic agent (e.g., ketamine 0.5–1.5 mg/kg IV)
 - : Etomidate → avoid it given the concerns of adrenal suppression
 - : Propofol is associated with hypotension

Medications Used in RSII

- NMBA should be used only if the clinician is confident that he/she can (1) intubate the airway (2) mask ventilate in case of intubation failure
- Succinylcholine provides excellent intubating conditions in 60s at a dose of 1–1.5 mg/kg
 - contraindicated in patients with malignant hyperthermia, hyperkalemia (serum potassium ≥ 5.0 mEq/l), burns, stroke, spinal cord injury, multiple sclerosis
- Rocuronium at a dose of 1.0 mg/kg appears to provide acceptable intubating conditions by 60s

Controversies in RSII

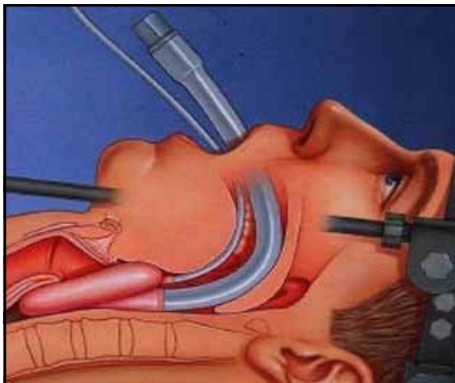
- Life threatening hypoxemia → gentle mask ventilation may be necessary
- Cricoid pressure possibly worsens glottic view, impairs mask ventilation, and increases the risk of aspiration by inducing vomiting



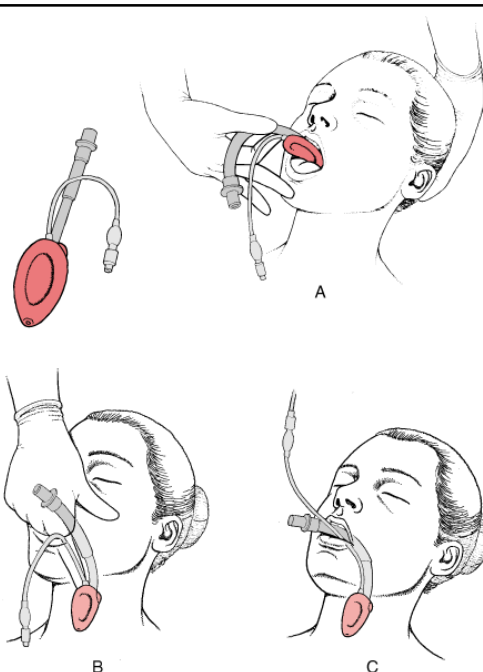
Failed or Unanticipated Difficult Airway

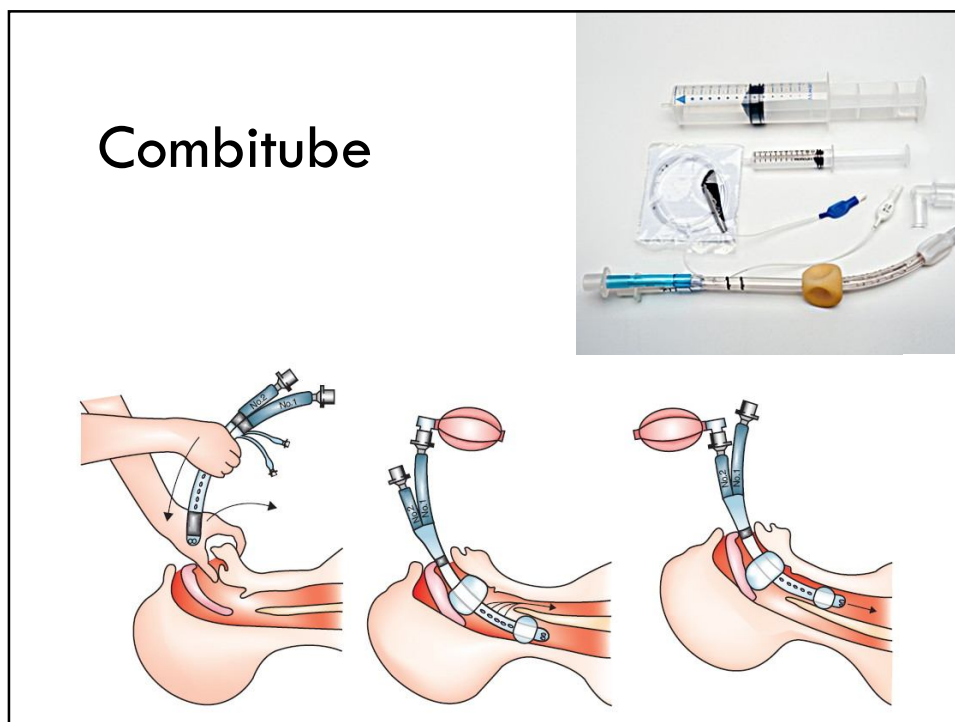
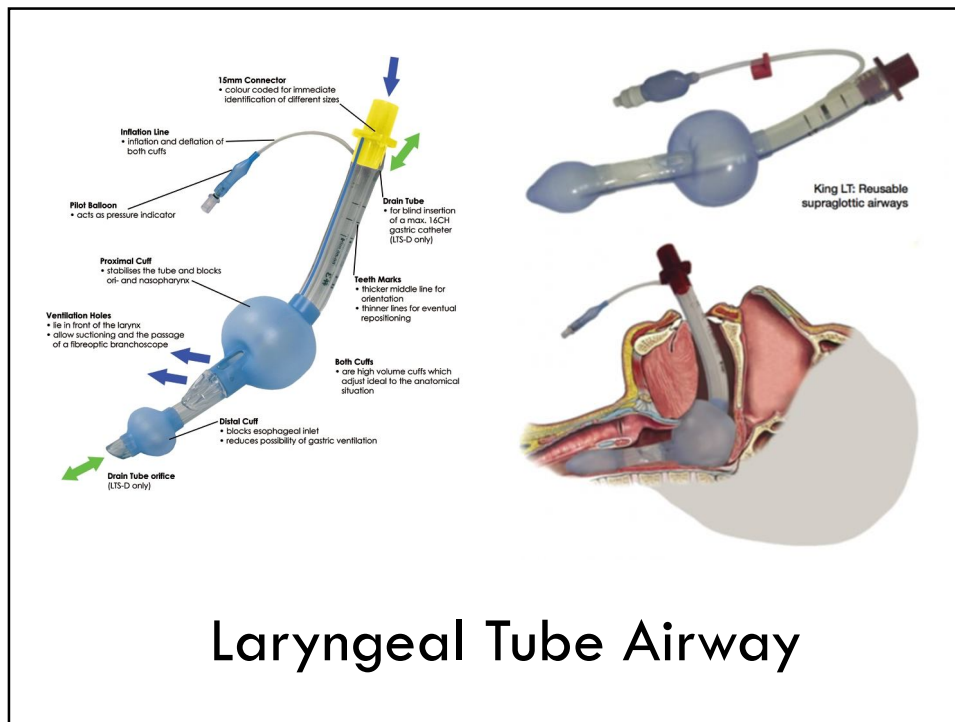
Immediate, life-threatening emergency..

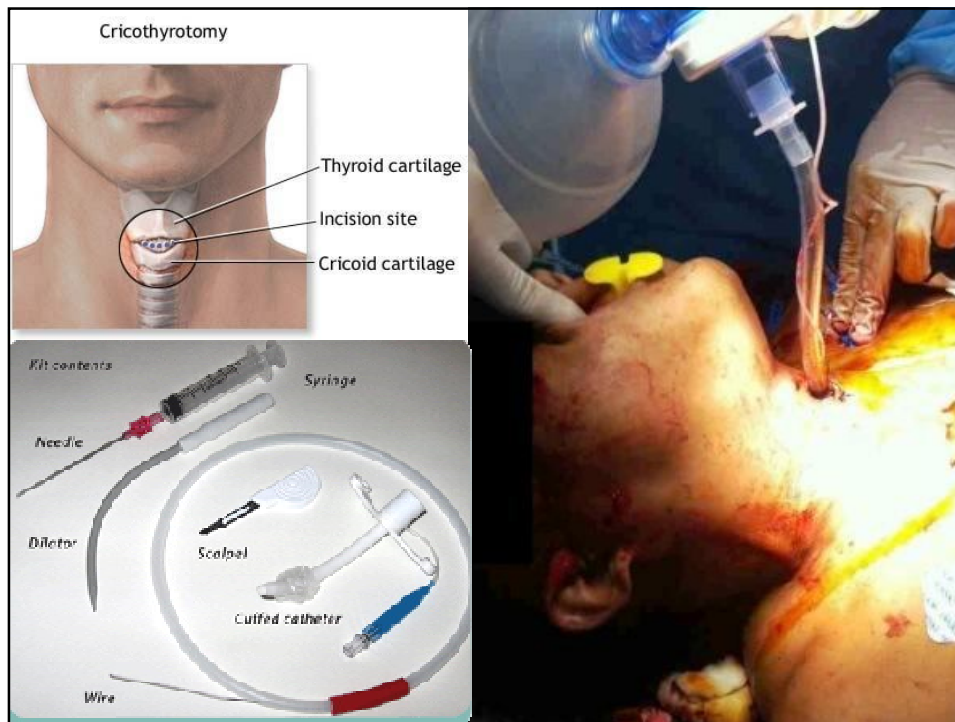
- Call for help
- Focus on mask ventilation using an adjuncts
 - : adequate → alternate strategy
 - : inadequate → supraglottic airway or a surgical airway
- Troubleshoot the causative factors



Laryngeal Mask Airway

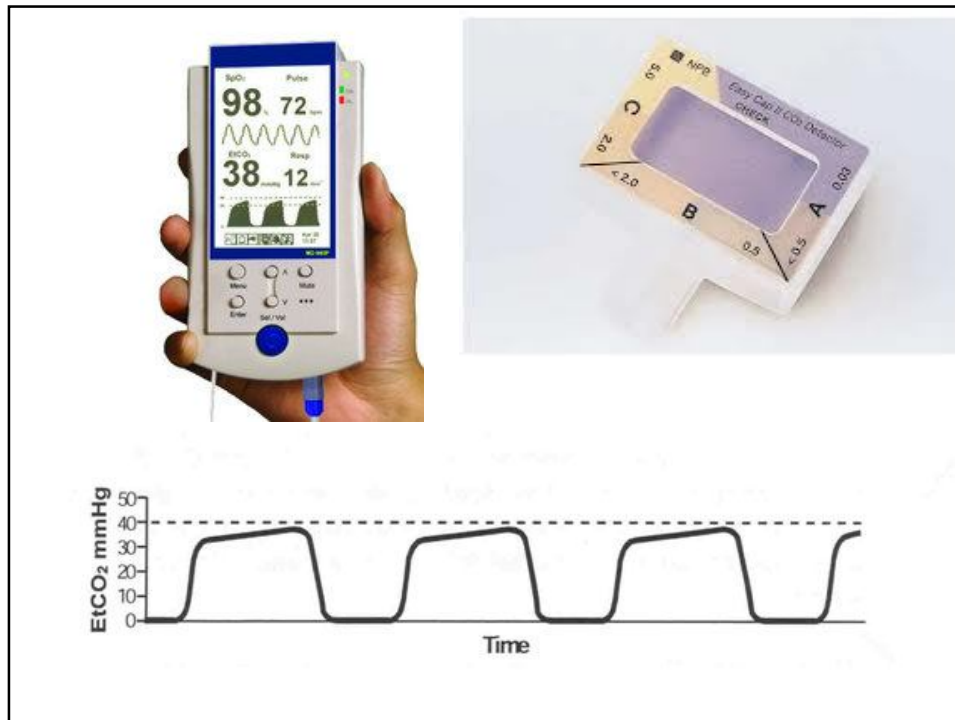






Postintubation Management

- Confirmation of endotracheal tube position
 - capnography
- Intravascular fluids and vasopressors should be immediately available to maintain end organ perfusion
- Avoiding agitation by implementing short-term sedation
- If hemodynamic stable → recruitment maneuver (CPAP 40 cmH₂O for 30 s)
- Lung-protective ventilation
- Portable chest X-ray



Safety in ETI will likely be found in broad, system-based change...

Intubation care bundle management

Preintubation

- Presence of two operators
- Fluid loading (isotonic saline 500 ml or starch 250 ml) in absence of cardiogenic pulmonary edema
- Preparation of long-term sedation
- Preoxygenation for 3 min with NIPPV in case of acute respiratory failure (FiO_2 100%, pressure support ventilation level between 5 and 15 cmH₂O to obtain an expiratory tidal volume between 6 and 8 ml/kg and PEEP of 5 cmH₂O

Intensive Care Med 2010; 36:248–255

Intubation care bundle management

During intubation

- Rapid sequence induction: etomidate 0.2–0.3 mg/kg or ketamine 1.5–3 mg/kg combined with succinylcholine 1–1.5 mg/kg
- Sellick maneuver

Intensive Care Med 2010; 36:248–255

Intubation care bundle management

Postintubation

- Immediate confirmation of tube placement by capnography
- Norepinephrine if diastolic blood pressure remains <35 mmHg
- Initiate long-term sedation
- Initial “protective ventilation”
 - : tidal volume 6–8 ml/kg of ideal body weight
 - : PEEP <5 cmH₂O
 - : respiratory rate between 10 and 20 cycles/min
 - : FiO₂ 100% for a plateau pressure of <30 cmH₂O

Intensive Care Med 2010; 36:248–255

Take Home

Solutions to these challenging airway problems include:

- Recognition of those patients with a potential airway problem
- Implementation of a plan to deal with their airway
- Immediate availability of a difficult airway trolley
- Use of capnography for every airway intervention
- Appropriate training of all intensive care unit staff including use of simulation

