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Airway Control

Advanced Care Paramedicine

Module: 06

Section: 02

Airway Control

AIRWAY ASSESSMENT

Case 01

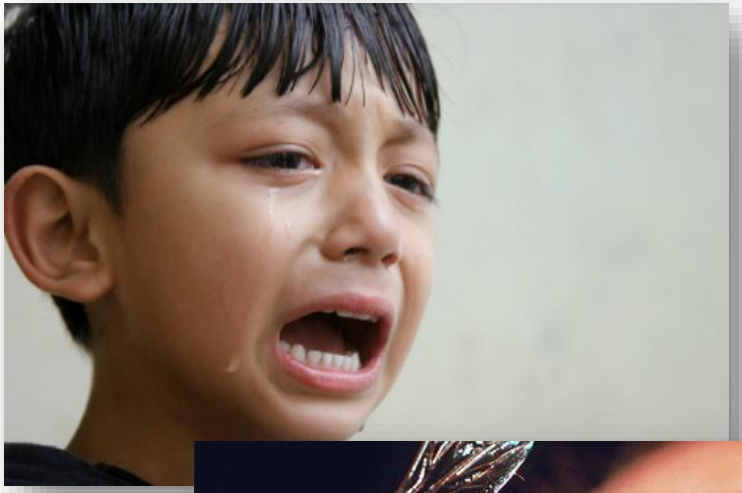
- You have responded to a 28 y/o M patient with an ALOC
- You find him on the couch snoring, friends called 911 because they are unable to wake him.
- What are looking for on initial assessment?
- What is your approach to this patient?
- What historic and physical exam findings are priority assessment details?

Case 02

- On scene with a 65 y/o male patient with SOB
- He is too short of breath to talk
- His wife is present, she called 911.
- What does your initial assessment include in terms of priority items?
- What findings help you determine the severity of his symptoms?

Case 03

- You are on scene with a 9 y/o M patient that is having an apparent allergic reaction.
- Hx of being stung by a bee 30 min ago
- Only symptom is local hives/itchy red skin at the site of the sting.
- Transport time is one hour.
- How do you monitor him enroute to hospital?
- How might the airway become involved?



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Case 04

Does this patient have an issue with his airway?

Airway Control

COMPONENTS OF THE AIRWAY ASSESSMENT

Scene Assessment

- Medications
- Home oxygen devices
- Allergens (animals, plants, etc)

Primary Assessment

- Is the airway patent?
- Is breathing adequate?
- Look, listen, and feel.
- If patient is not breathing
  - Open the airway
  - Assist ventilations as necessary

Primary Assessment

History

SAMPLE	OPQRST-ASPN
Signs and **S**ymptoms **A**llergies **M**edications **P**ast medical history **L**ast oral intake **E**vents preceding the incident	**O**nset **P**rovokes or **P**alliates **Q**ualify **R**egion or **R**adiation **S**everity **T**reatment **A**ssociated **S**ymptoms **P**ertinent **N**egatives

Inspection (Look)

- Skin color
- Patient's position
- Dyspnea
- Modified forms of respiration
- Rate
- Pattern
- Mentation

Modified Forms of Respiration

- Coughing
  - Forceful exhalation of large volume of air from lungs
  - Protects airway from irritants
- Sneezing
  - Forceful exhalation from nose
  - Caused by nasal irritation
- Hiccoughing
  - Spasmodic contraction of diaphragm
  - Occasionally associated with inferior myocardial infarction

Modified Forms of Respiration

- Sighing
  - Slow deep involuntary inspiration and expiration
  - Re-expands the alveoli
- Grunting
  - Forceful expiration against partially closed glottis
  - Usually an indication of respiratory distress

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Respiratory Patterns

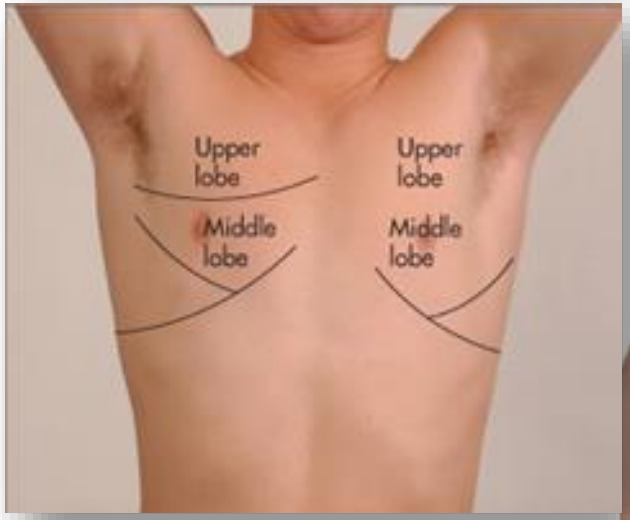
Table 2-2 Breathing Patterns

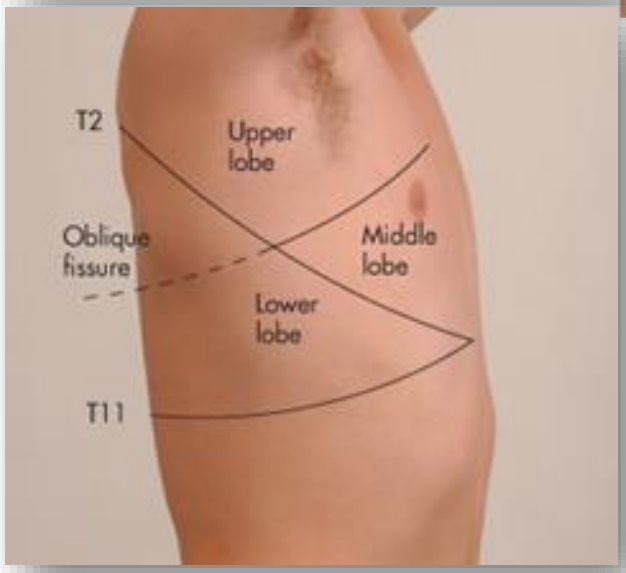
	Condition	Description	Causes
	Eupnea	Normal breathing rate and pattern	
	Tachypnea	Increased respiratory rate	Fever, anxiety, exercise, shock
	Bradypnea	Decreased respiratory rate	Sleep, drugs, metabolic disorder, head injury, stroke
	Apnea	Absence of breathing	Deceased patient, head injury, stroke
	Hyperpnea	Normal rate, but deep respirations	Emotional stress, diabetic ketoacidosis
	Cheyne-Stokes	Gradual increases and decreases in respirations with periods of apnea	Increasing intracranial pressure, brain stem injury
	Biot's	Rapid, deep respirations (gasps) with short pauses between sets	Spinal meningitis, many CNS causes, head injury
	Kussmaul's	Tachypnea and hyperpnea	Renal failure, metabolic acidosis, diabetic ketoacidosis
	Apneustic	Prolonged inspiratory phase with shortened expiratory phase	Lesion in brain stem

Auscultation (Listen)

- Listen at the mouth and nose for adequate air movement.
- Listen with a stethoscope for normal or abnormal air movement
  - Right and left apices
  - Right and left bases
  - Right and left back or midaxillary
- Posterior surface is preferable
  - Heart sounds do not interfere

Auscultation

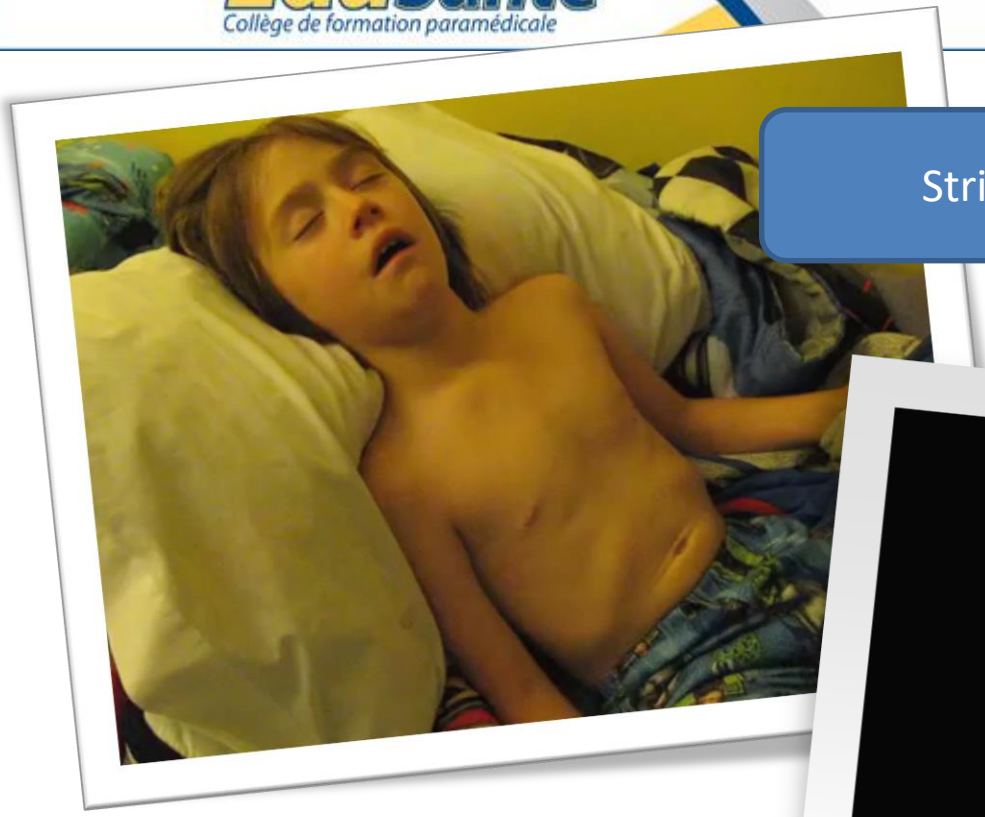




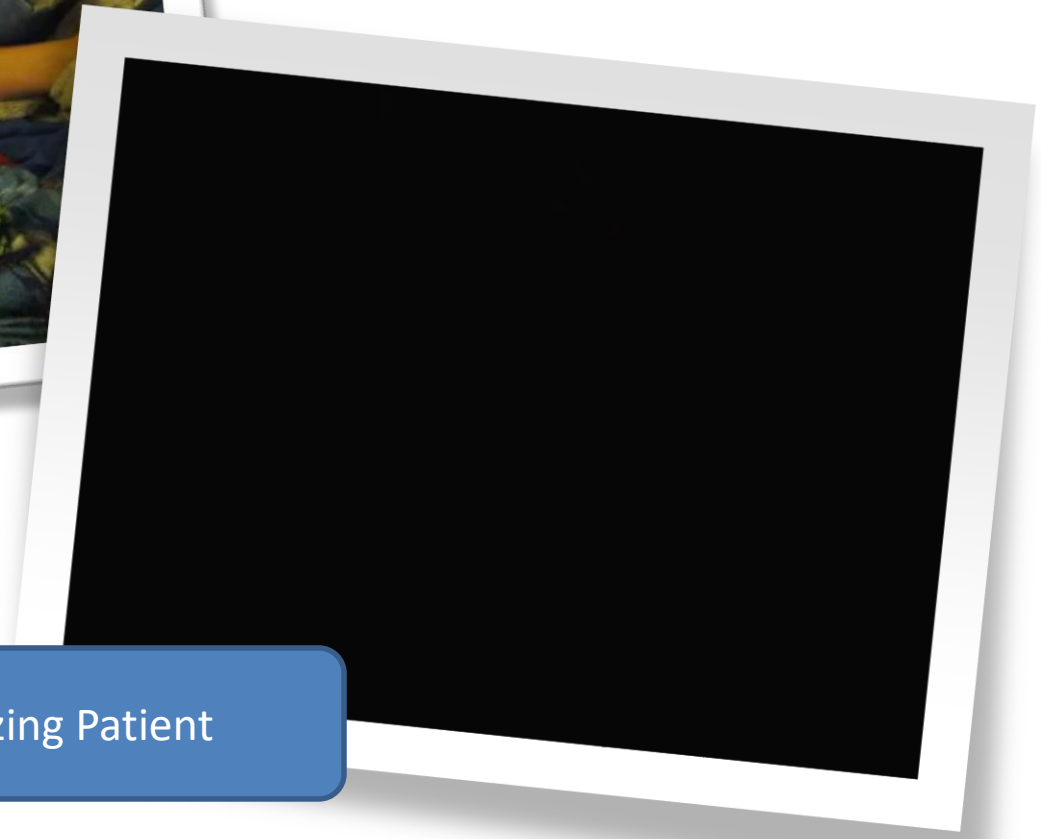
Airflow Compromise

- Snoring
  - Partial airway obstruction by the tongue
- Gurgling
  - Accumulation of fluid in airway
- Stridor
  - Associated with laryngeal edema or constriction
- Wheezing
  - Associated with bronchiolar constriction
- Quiet
  - Ominous finding indicating a serious problem

Airflow Compromise



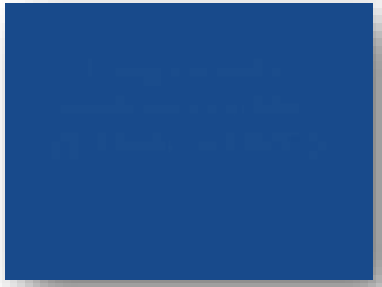
Stridor Patient



Wheezing Patient

Compromise of Gas Exchange

- Crackles
  - Fine bubbling noises heard on inspiration
  - Associated with fluid in smaller bronchioles
- Rhonchi
  - Coarse rattling noise heard on inspiration
  - Associated with inflammation, mucous or fluid in the bronchioles



Palpation (Feel)

- Air movement through mouth and nose
- Palpate chest for rise and fall
- Palpate chest wall
  - Tenderness
  - Symmetry
  - Abnormal motion
  - Crepitus
  - Subcutaneous emphysema
- Assess for compliance

Airway Management and Ventilation

OXYGEN ADMINISTRATION

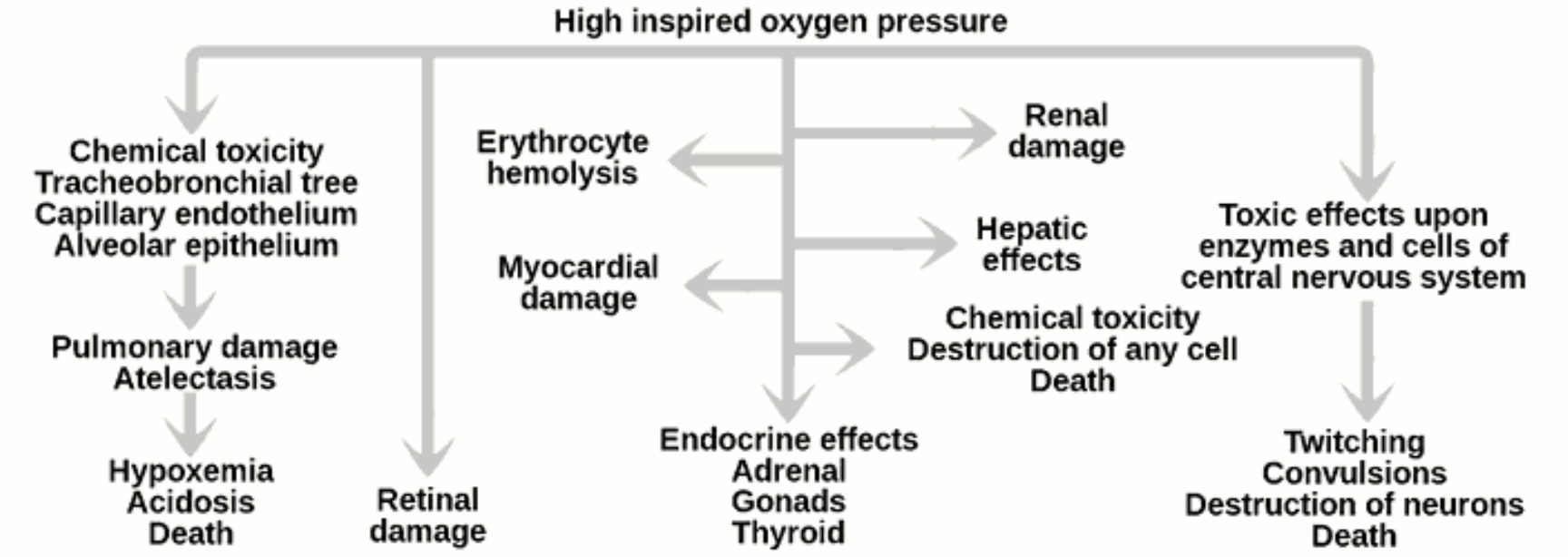
Hazards of Oxygen

- Aids in combustion
  - Explosive when mixed with petroleum
- Colorless, odorless, tasteless and dry
- Pressurized cylinders
- May depress respiratory drive in COPD Patients
- Oxygen Toxicity in divers/hyperbarics
- Free radicals/hyperoxia

Oxygen Toxicity

- Severe hyperoxia caused by breathing O_2 at elevated partial pressures and high concentrations. (FiO_2 > 50%)
- The high concentration of oxygen damages cells and causes a physiological change within the body
- Oxygen can form superoxide anions (free radicals)
- Free-radicals can harm DNA and other structures.
- Many inherent defences against such damage but at higher concentrations of free oxygen, these systems are eventually overwhelmed
- When the rate of damage to cell membranes exceeds the capacity of systems which control or repair it cell damage and cell death then results.

Oxygen Toxicity



Oxygen Regulators

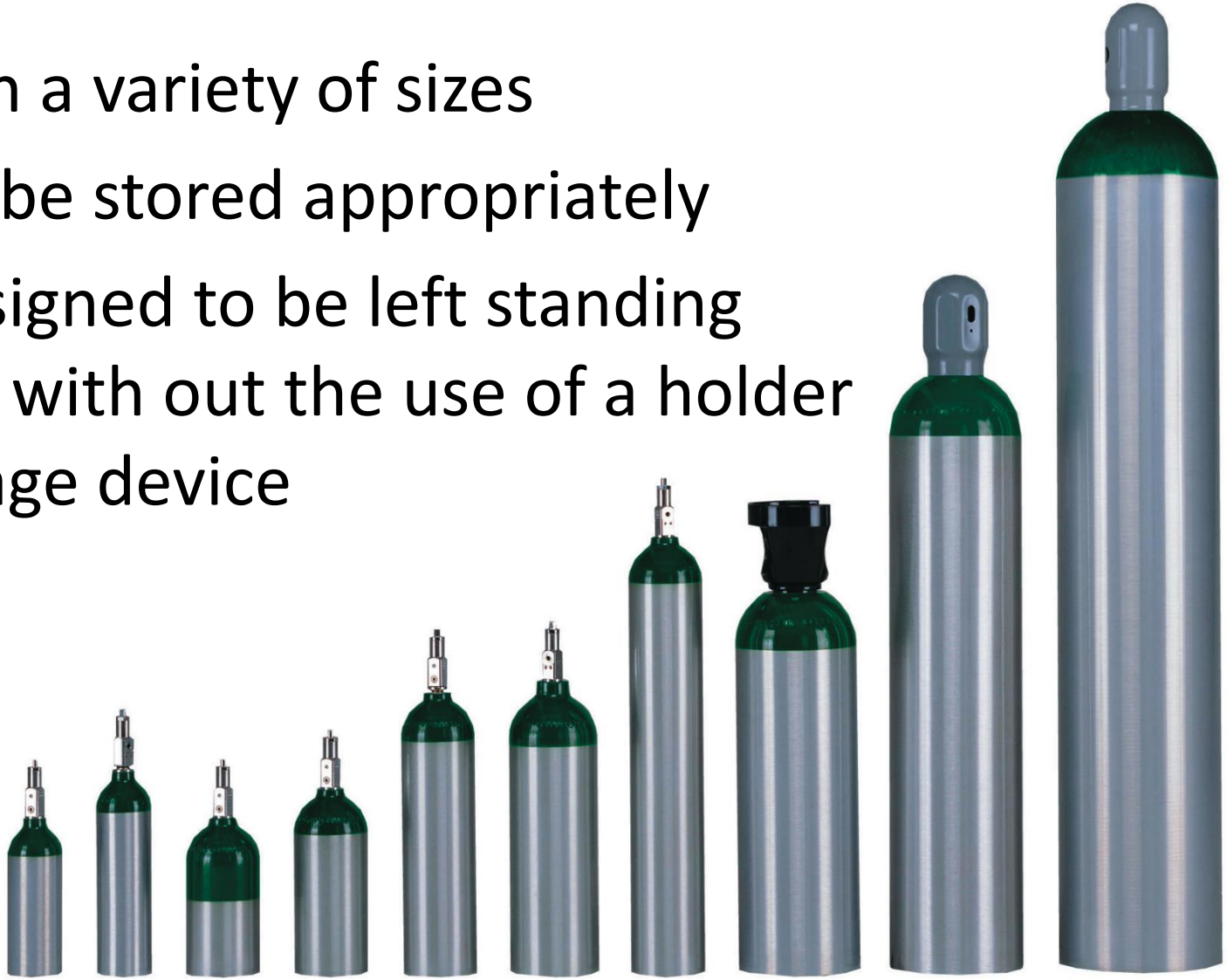
- Reduce free flow (2000 psi) to a useable 40 - 70 psi and provides control over the flow rate

Bourdon Regulator Styles

Compensated Flow

Oxygen Cylinders

- Come in a variety of sizes
- Should be stored appropriately
- Not designed to be left standing upright with out the use of a holder or storage device



Safety Systems

- P.I.N Index Safety System
  - Typically seen on the D, Super D and E

- Thread Standard
  - Usually seen on the M

Safety Systems

- Humidified Oxygen
  - Should be used when O_2 administration exceeds 30 minutes

Oxygen Tank Duration

$$Time = \frac{\left(Tank\ Pressure\ (psi) - Safe\ Residual\ (psi)\right) X\ Cylinder\ Factor\ \left(\frac{L}{psi}\right)}{Flow\ Rate\ \left(\frac{L}{min}\right)}$$

Safe Residual Volume

500 psi

Tank Cylinder Factors

D = 0.16

E = 0.28

M = 1.56

Tank Set-up

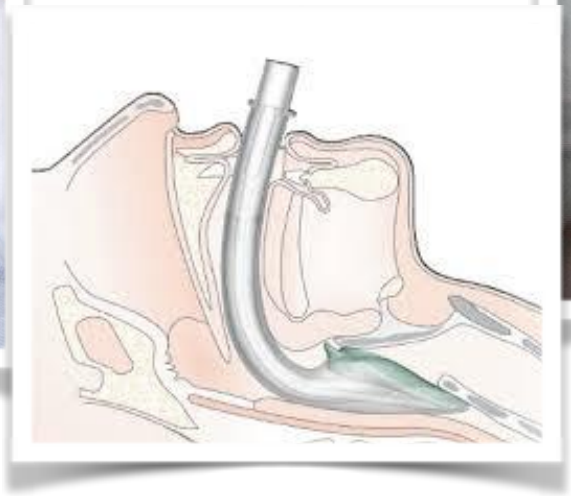
- Select tank
- Remove protective seal
- Open valve briefly to clean
- Attach regulator and tighten
- Open tank valve
- Ensure there is NO air leaking
  - Correct if present
- Attach desired oxygen delivery device
- Adjust flow rate to desired setting

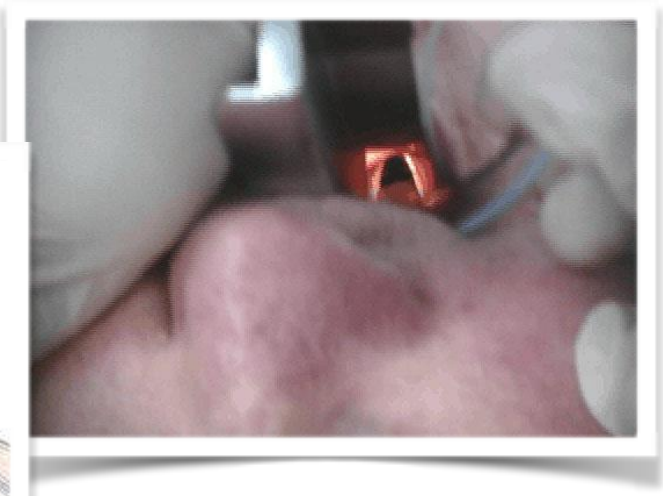
Airway Control

OXYGEN DELIVERY DEVICES

The Goal

OXYGEN DELIVERY/VENTILATION!!!





...by any means: HFO, BMV, EGD, ETT

Patients don't die from Acute Plastic Deficiency Syndrome (APDS)

Oxygen Masks

- For patients breathing on their own and able to maintain their own airway:
  - High Flow Masks
    - Requires a specific flow rate to achieve the desired concentrations (Nasal Cannula, Simple Face Mask, Venturi Mask, Nebulizer)
  - High Concentration Masks
    - Will provide the same concentration despite the flow rate (Non-Rebreather)

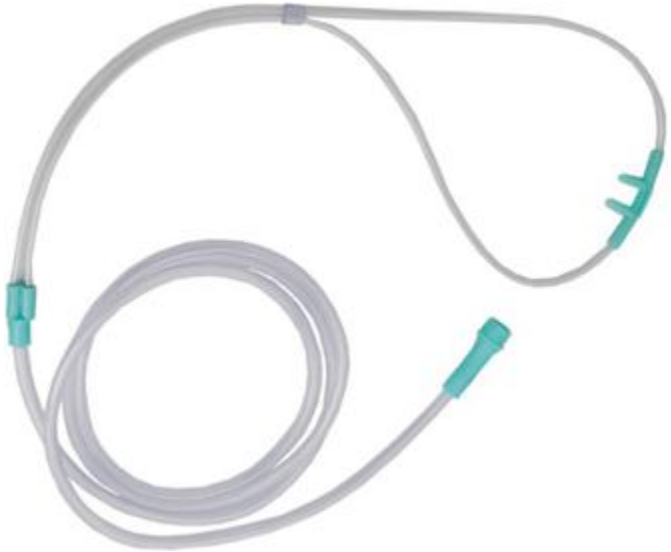
Oxygen Therapy

Low Flow Nasal Cannula (LFNC)

Type: High Flow (Low to medium concentration)

Percentage: 24 - 44%

Flow Rate: 1 - 6 L/min



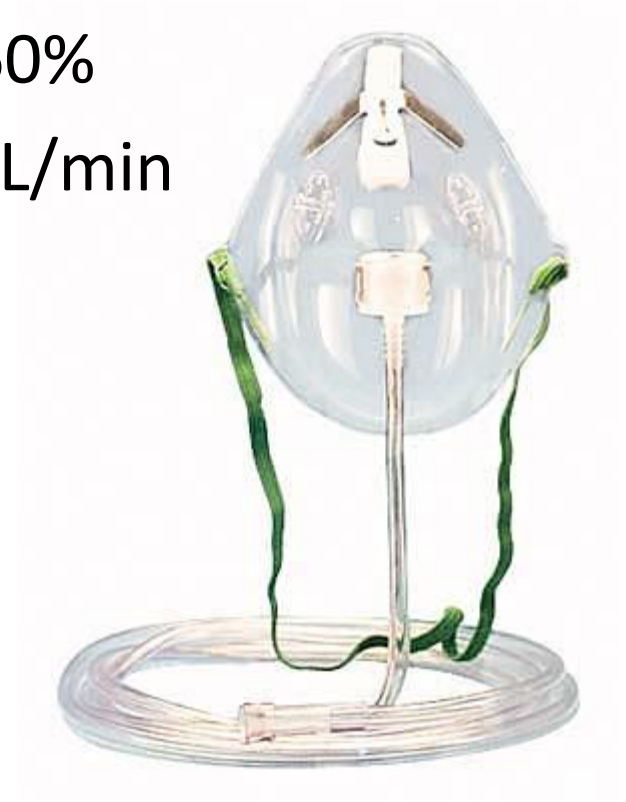
Oxygen Therapy

Simple Face Mask

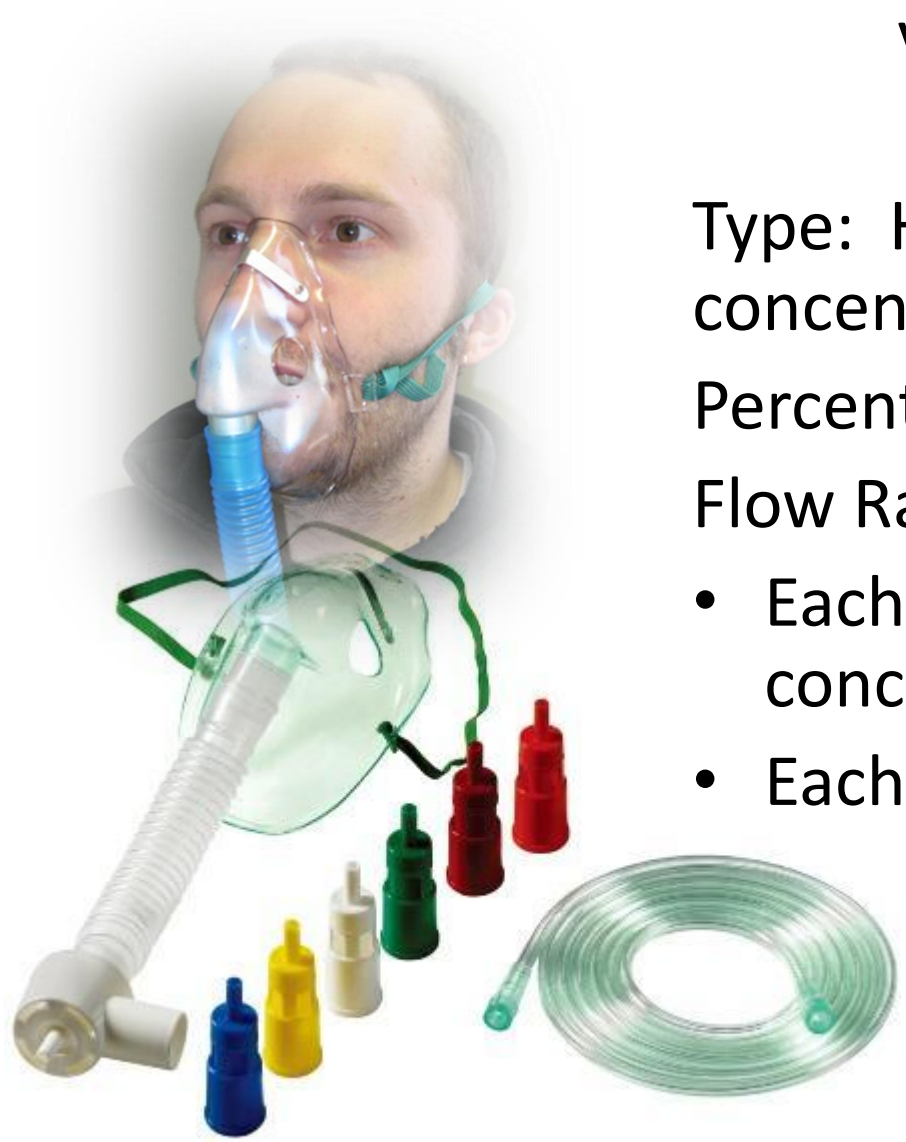
Type: High Flow (Medium concentration)

Percentage: 40 - 60%

Flow Rate: 6 - 10 L/min



Oxygen Therapy



Venturi Mask (Controlled Concentration)

Type: High flow (Low to medium concentration)

Percentage: 24, 28, 31, 35, 40, 50%

Flow Rate: 2 - 10 L/min

- Each tip has provides a different concentration
- Each tip requires a specific flow rate

Oxygen Therapy

Nebulizer (Aerosol) Mask

Type: High Flow (Medium concentration)

Percentage: 40 - 60%

Flow Rate: 6 - 10 L/min

- Has container to add saline and/or medication to become aerosolized prior to inhalation

Oxygen Therapy

Non-Rebreather Mask

Type: High concentration

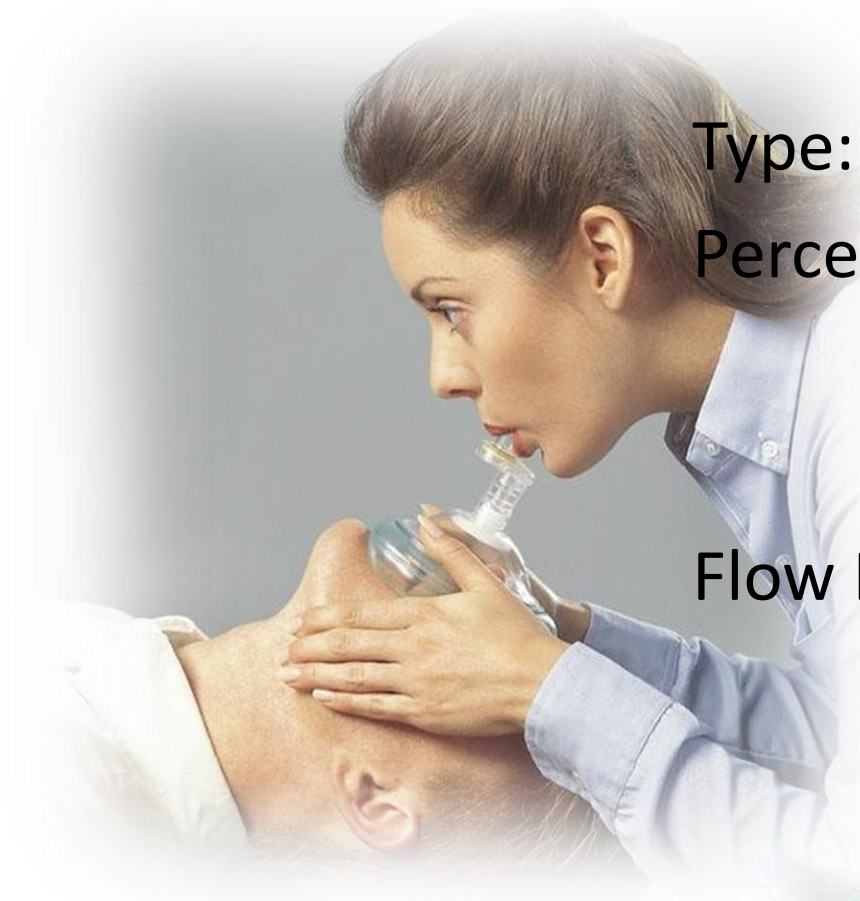
Percentage: 90 - 100%

Flow Rate: 10 - 15 L/min

Oxygen Masks

- For apneic or dyspneic (<10 or >30 bpm) patients that need assistance with ventilations:
  - Positive Pressure Aids
    - Pocket Mask (with or without Oxygen)
    - Bag Valve Mask
    - Demand valve devices
    - Transport ventilators

Oxygen Therapy



Pocket Mask

Type: Medium to high concentration

Percentage: 16% without O_2

50% @ 10 L/min

55 - 85% @ 15 L/min

Flow Rate: 10 - 15 L/min for oxygen

Oxygen Therapy

Bag Valve Mask (BVM)

Type: High concentration

Percentage: 90 - 100%

Flow Rate: 10 - 15 L/min for oxygen

Portable Mechanical Ventilator

Demand Valve Device

CARvent ALS Resuscitator

Airway Control

AIRWAY MANAGEMENT

Airway Management

- Airway preservation and restoration are essential in dealing with the critically ill patient.
- Steps to airway management
  - Patient positioning
  - Opening the airway (manual airway positions)
  - Suctioning
  - Airway adjuncts
  - Ventilation
  - Extraglottic devices

First Principles

- 25 y/o F that has OD on heroin
- You arrive to find her surrounded by bystanders
- She has sonorous respirations

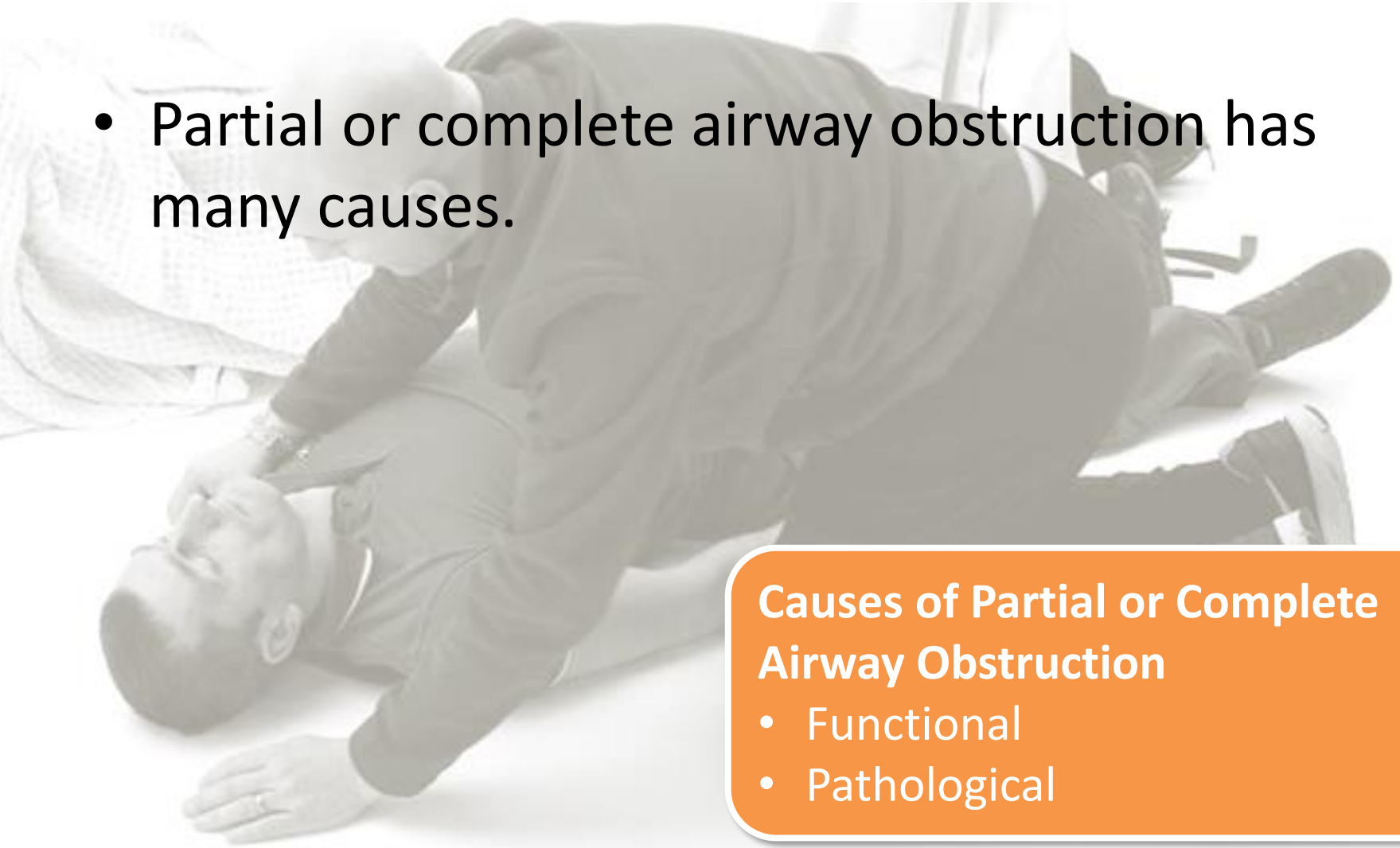
Patient Positioning

- The patient who requires basic airway maneuvers to be performed should be placed supine on the flattest surface available at the beginning of resuscitation.
- Patients who require cervical spine immobilization and are placed on a backboard should be secured to this board tightly enough so they will not slide or fall if the board is turned on its side to allow gravity to affect the drainage of vomitus or secretions.

Airway Control

MANUAL AIRWAY POSITIONS

Manual Airway Positioning



- Partial or complete airway obstruction has many causes.

Causes of Partial or Complete Airway Obstruction

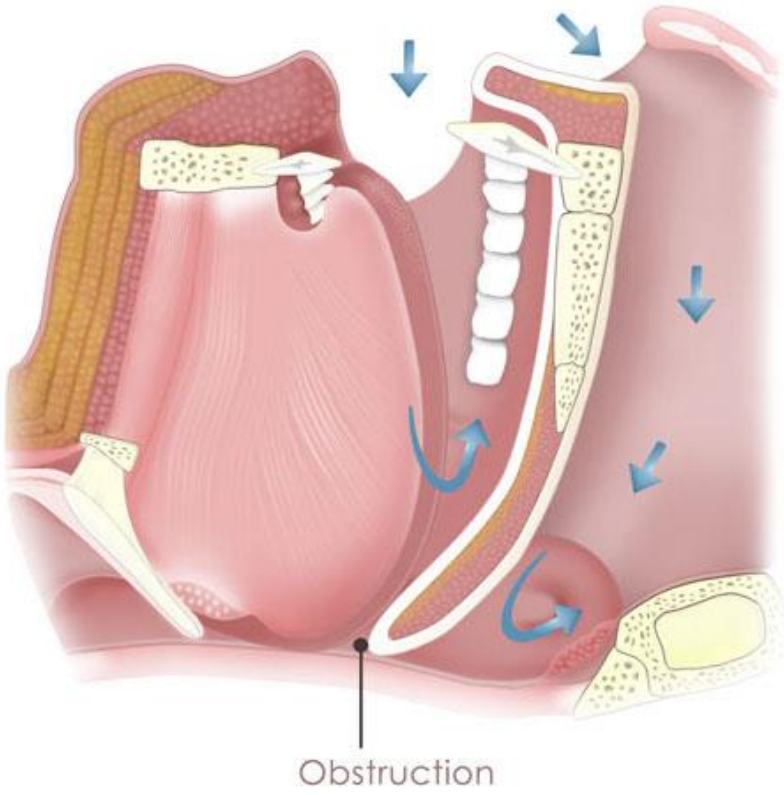
- Functional
- Pathological

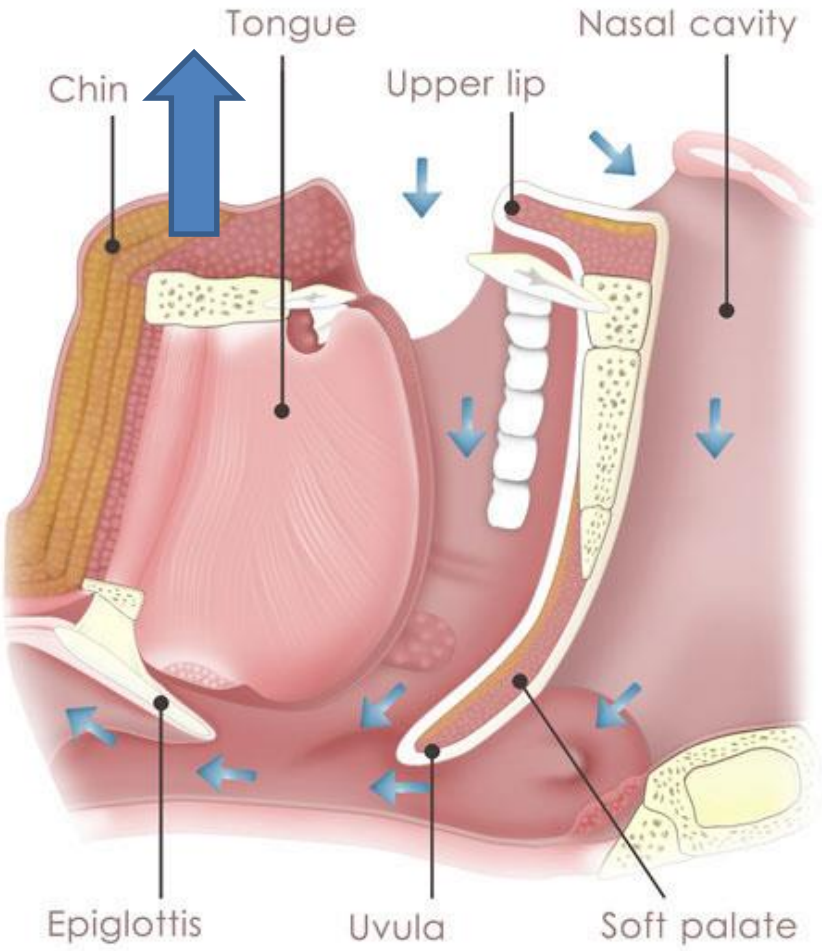
Recognition of a Functional Upper Airway Obstruction

- Snoring respiratory efforts
- Rocking, asynchronous chest/abdomen rise
- Little exhaled breath to feel
- Indrawing
- Apnea

Functional Upper Airway Obstruction

- What is the correction?





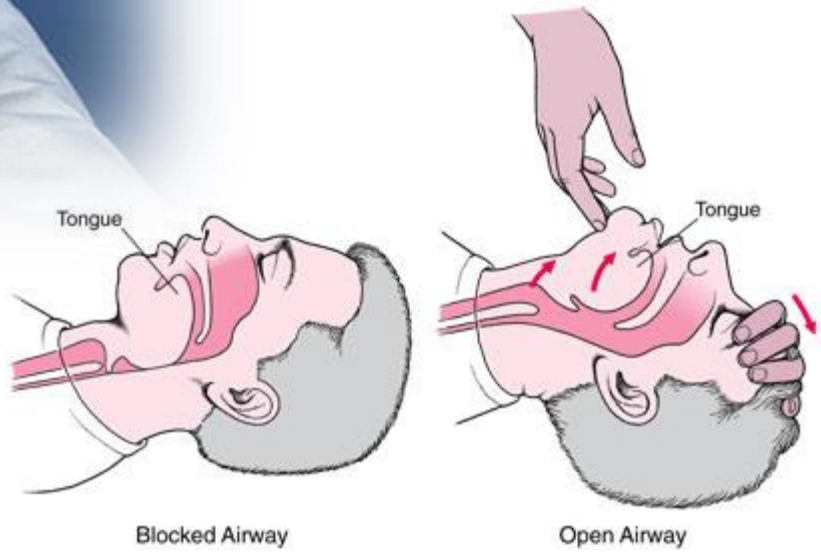
Airway opening maneuvers

- Watch for the effect of…
  - Head extension
  - Chin lift
  - Jaw thrust

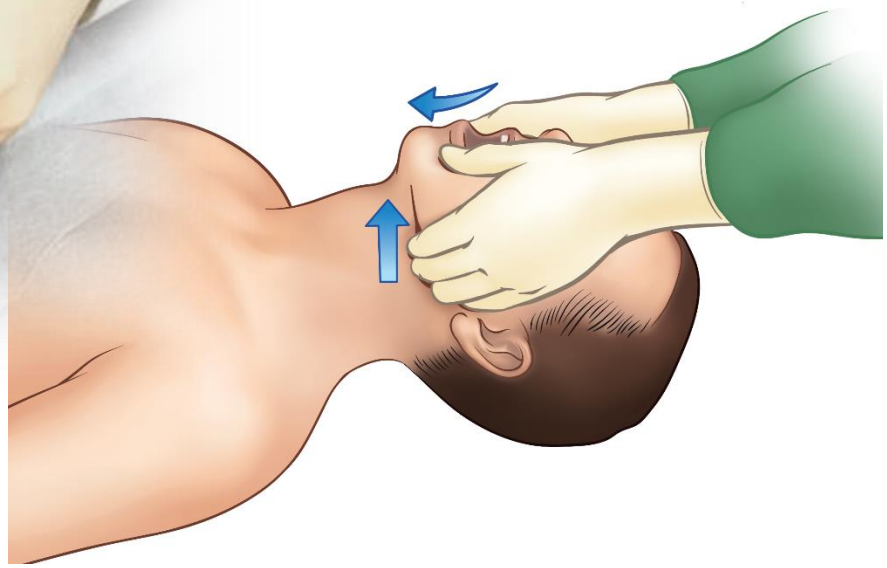
Manual Airway Positioning

- Manual airway manoeuvers are to assist in opening up and protecting a patient's airway
- Manual Airway Manoeuvers are:
  - Head-Tilt Chin Lift
  - Jaw Thrust
  - Modified Jaw Thrust
  - Jaw Lift
  - Cross Finger Technique
  - Recovery Position

Head Tilt/Chin Lift



Jaw-Thrust Maneuver



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Modified Jaw Thrust in Trauma

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Jaw-Lift Maneuver

Cross-Finger Technique

Maintaining Open Airway & Oxygenation?

- HEAD TILT, JAW THRUST, CHIN LIFT DONE!
- Apply oxygen (options?)
- Is the airway clear?
- Did she vomit?

Airway Control

SUCTIONING

Suctioning

- The physical removal of secretions and material through the use of negative pressure to maintain a patient's airway ensuring adequate ventilation
  - Upper Airway
  - Lower Airway
  - Tracheostomy

Suctioning

- Indications:
  - To remove secretions, blood or vomitus from a patient's airway
  - For standby use in preparation for endotracheal intubation
- Contraindications:
  - Nil
- Complications:
  - Airway trauma
  - Stimulate coughing or gagging
  - Hypoxia from delays in ventilation with tracheal tube suctioning
  - Vagal stimulation can result in bradycardia and hypotension

Equipment

- Suction Units
  - V-Vac
  - Wall Mount
  - Portable Battery Operated
- Suction Tips
  - Yankauer Tip (Tonsil Tickler)
  - Suction Catheter

French Catheter Sizing

- Commonly used to measure the size of a catheter (Fr)
- A measure of **external diameter** of the catheter
- 1 French has a diameter of ⅓ mm
- Therefore the diameter of a round catheter in millimeters can be determined by dividing the French size by 3:
  - D (mm) = Fr/3 *or* Fr = D (mm) × 3

Upper Airway

- Procedure:
  - Only suction as far as you can see
  - Suction for 10-15 seconds only
  - Oropharyngeal suctioning (V-Vac or Yankauer)
    - Under direct vision, insert the catheter into the oropharynx along the cheek wall
    - Yankauer: Occlude side port to commence suctioning while retracting device
    - V-Vac: Begin squeezing handle while retracting device
  - Oropharyngeal suctioning (Suction Catheter)
    - Under direct vision, gently insert the catheter into the nasopharynx/oropharynx
    - Occlude side port to commence suctioning while gently withdrawing catheter

Deep Suction

- Any suction performed past the oropharynx typically via ETT
- Indications:
  - Removal of endotracheal foreign bodies as demonstrated by fluid/obstruction visualized or increasing PiP

Equipment

- Suction Catheter (2 X ETT = size in Fr)
- Normal Saline
- Suction Unit (80-100mmHg)
- PPE

Procedure

- Pre-oxygenate
- Prepare equipment in sterile field
- NS (approx 5ml) can be instilled down ETT if thick secretions are present
- Insert catheter until pt. coughes, or resistance is met
- Apply suction and withdraw
- Procedure should last no more than 15 secs.

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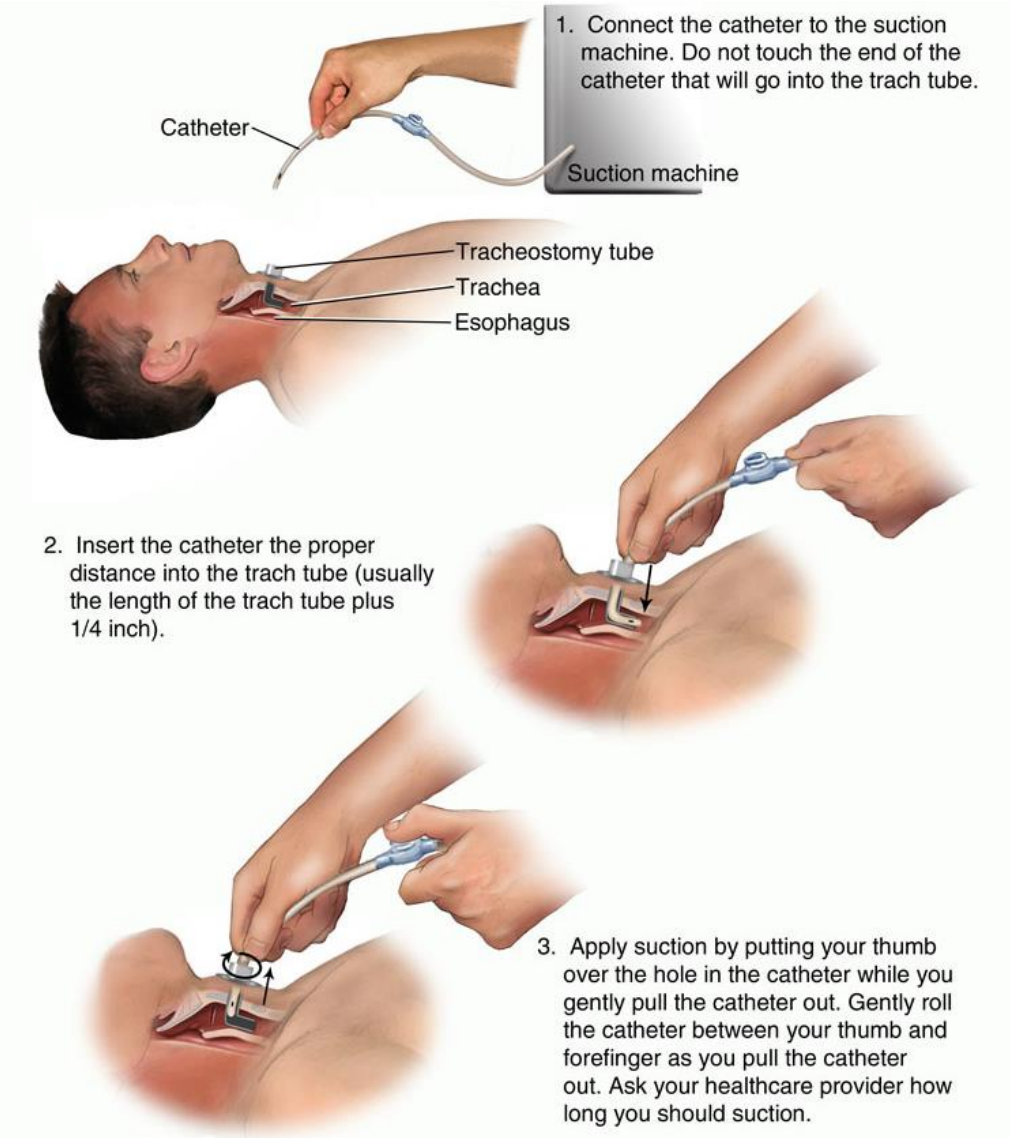
Tracheostomy Suctioning



Airway Control

AIRWAY ADJUNCTS

Maintaining Open Airway & Oxygenation?

- Airway is now clear.
- She is still not breathing effectively.
- Are there other adjuncts to assist in maintaining airway opening?

Airway reflexes intact

No airway reflexes

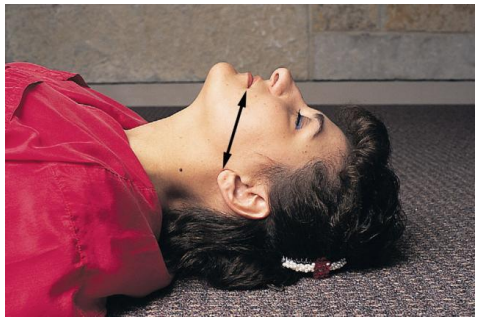
Oropharyngeal Airway (OPA)

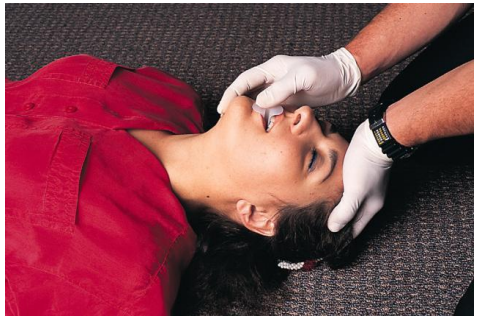
- Indications: Unresponsive patients to assist in maintaining patency of the airway by lifting the tongue off of the posterior pharyngeal wall and epiglottis
  - May also be used as a bite block
- Contraindications: Gag reflex, FBAO

COMPLICATIONS

- Gagging, vomiting and aspiration
- Soft tissue trauma to the tongue, palate and pharynx
- Biting down on the hard surface can injure the teeth

Oropharyngeal Airway (OPA)





- Procedure:
  - Position the patient in the supine position
  - Place in “sniffing” position
  - Measure the OPA
    - Measured from earlobe to corner of mouth
    - May also be measured from the center of mouth to the angle of the jaw
  - Open airway with jaw lift or cross finger techniques
  - Insert the OPA
    - Adult: Inserted upside down and rotated 180° down behind the tongue
    - Ped: Insert directly over the tongue
  - Flange of OPA should sit on patients lips

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OP Airway: Insertion

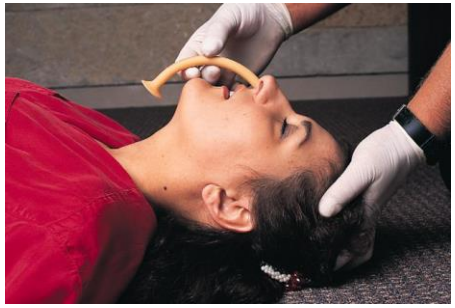
Nasopharyngeal Airway (NPA)

- Indications: Conscious or unresponsive patients to assist in maintaining patency of the airway by lifting the tongue off of the posterior pharyngeal wall and epiglottis
- Contraindications: Basal or nasal fractures

COMPLICATIONS

- Epistaxis and aspiration
- Ulceration
- Insertion through the cribriform plate into the brain

Airway Management



- Procedure:
  - Position the patient in the supine position
  - Place in “sniffing” position
  - Measure the NPA
    - Measuring from patients nostril to the meatus of the ear
  - Lubricate the NPA with jell
  - Insert the NPA with bevel of airway facing the septum of the patient’s nose
    - Right nostril: inserted directly into the airway
    - Left nostril: insert and twist 180° as it enters the airway
    - If resistance is felt remove and attempt other nostril
  - Flange of NPA should sit at patients nostril

Approach to Functional Airway Obstruction

- OPA/NPA, jaw thrust, oxygen, +/- BMV
- Then consider, is there a quick intervention that would make the patient conscious and able to maintain airway?
  - Cardiac rhythm issue? – put on monitor to see if needs electrical intervention with ALS
  - Check for +/- treat low glucose
  - Possible narcotic overdose? (narcan®)
- If no readily reversible cause found, extraglottic device (BLS) or intubation (ALS) are then considered as options.

Airway Control

VENTILATION

Bag Valve Mask (BVM)

- Bag-valve-mask (BVM) ventilation is an essential emergency skill.
- This technique allows for oxygenation and ventilation of patients until a more definitive airway can be established and in cases where endotracheal intubation or other definitive control of the airway is not possible.
- Requires a good seal and a patent airway.
- Practice with this important skill increases the clinician's ability to provide effective ventilation.
- Adjuncts such as oral and nasal airways can aid with ventilation by relieving physiologic obstruction and by opening up the hypopharynx.

Bag Valve Mask (BVM)

- Masks and bags come in many sizes
- The bag may be equipped with a pressure valve.

Bag Valve Mask (BVM)

Bag Valve Mask (BVM)

- Indications:
  - Respiratory failure (failure of ventilation and/or oxygenation)
- Contraindications:
  - FBAO
- Complications:
  - Gastric distention
    - Vomiting secondary to gastric distention Hyperinflation or over inflation
  - Barotrauma (pneumothorax, etc.)
  - Air trapping (auto peep)
  - Hypoxia due to inadequate minute volume
  - Equipment failure or empty supplemental oxygen source

Bag Valve Mask (BVM)

- Prepares BVM
- Select appropriate size mask for patient
- Create proper mask to face seal (C-K method)
- Ventilate patient at a rate of 12 – 20 bpm
  - Gentle slow ventilations (over 1 sec)
  - Allow for passive exhalation
- Ensure adequate chest rise (no more than 600 ml)
  - Note the average adult tidal volume is 6 – 7 ml/kg of oxygen)
- Connects oxygen to BVM and adjusts flow rate to 15 lpm
- Continue to ventilate at selected rate

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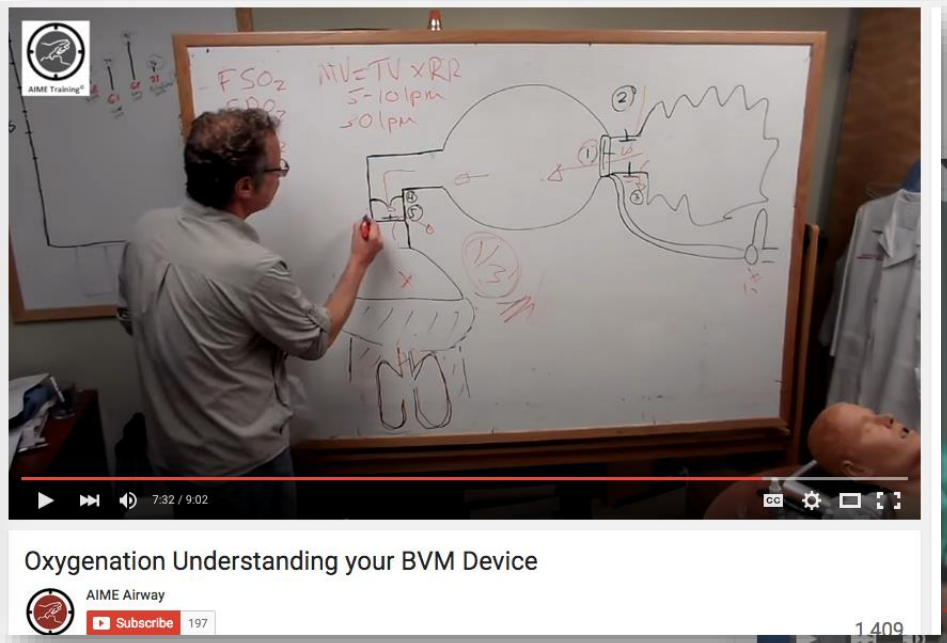
Understanding Your Gear



www.aimeairway.ca

BVM Ventilation

Difficulties

- Contributory Factors to Improperly Performed Artificial Ventilation
  - Inadequate mask seal
    - Wrong mask size for patient
    - Single rescuer
  - Inadequate minute ventilation
    - Inadequate tidal volume (should be at least 10 ml/kg)
    - Inadequate respiratory rate(hyperventilation is the norm)

Difficulties

- Contributory Factors to Improperly Performed Artificial Ventilation
  - Inadequate oxygen delivery
    - Failure to ensure patent airway prior to ventilation
    - Failure to deliver enough supplemental oxygen (at least 15 liters/minute)
  - Gastric distention
    - Prevents ability to deliver adequate tidal volume
    - Increases risk of vomiting, which impedes ability to properly ventilate

Predicting Difficult Mask Ventilation

- The goal of the airway assessment is to identify patients who may be difficult to ventilate and/or require alternate approaches to airway management
- Airway assessment and prediction of the difficult ventilation is an inexact science, particularly in the critically ill and in emergency situations

Predicting Difficult Mask Ventilation

- There is no method of prediction that is both highly sensitive and highly specific
- Always be prepared to manage an unanticipated difficult airway
- Airway assessment is valuable as it helps the clinician the mindset of anticipating difficulties and planning appropriately

Predicting a Difficult Mask Ventilation

- Beard
- Obese
- Older
- Teeth
- Snoring

Adjusting for the Difficult Ventilation

- Beard
  - use of jelly to improve seal or remove beard
- Obese
  - use of pillows to “ramp” patient’s head upward so the ears are in line with the sternal notch
- Older
  - pillows may be used if kyphosis is present or using alternative manual airway maneuvers
- Teeth
  - may require alternative manual airway maneuvers or use of alternative airway adjuncts
- Snoring
  - Alternative airway adjuncts may be used or repositioning of the patient

Adjusting for the Difficult Ventilation

Difficult Mask Ventilation Identified

Optimise Patient Position and Airway Manoeuvres

Airway adjuncts

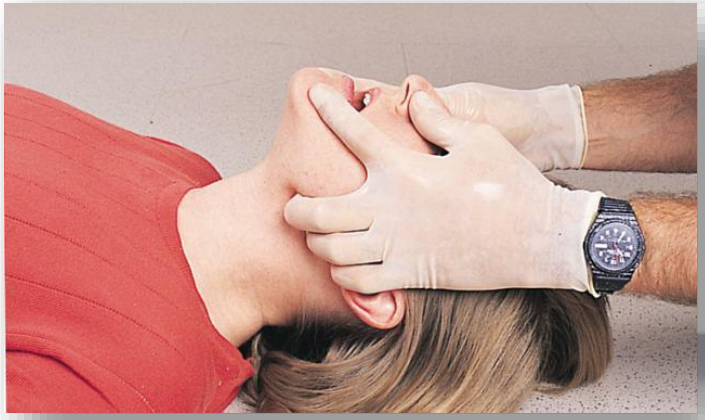
2 person/4 hand technique (or change operator)

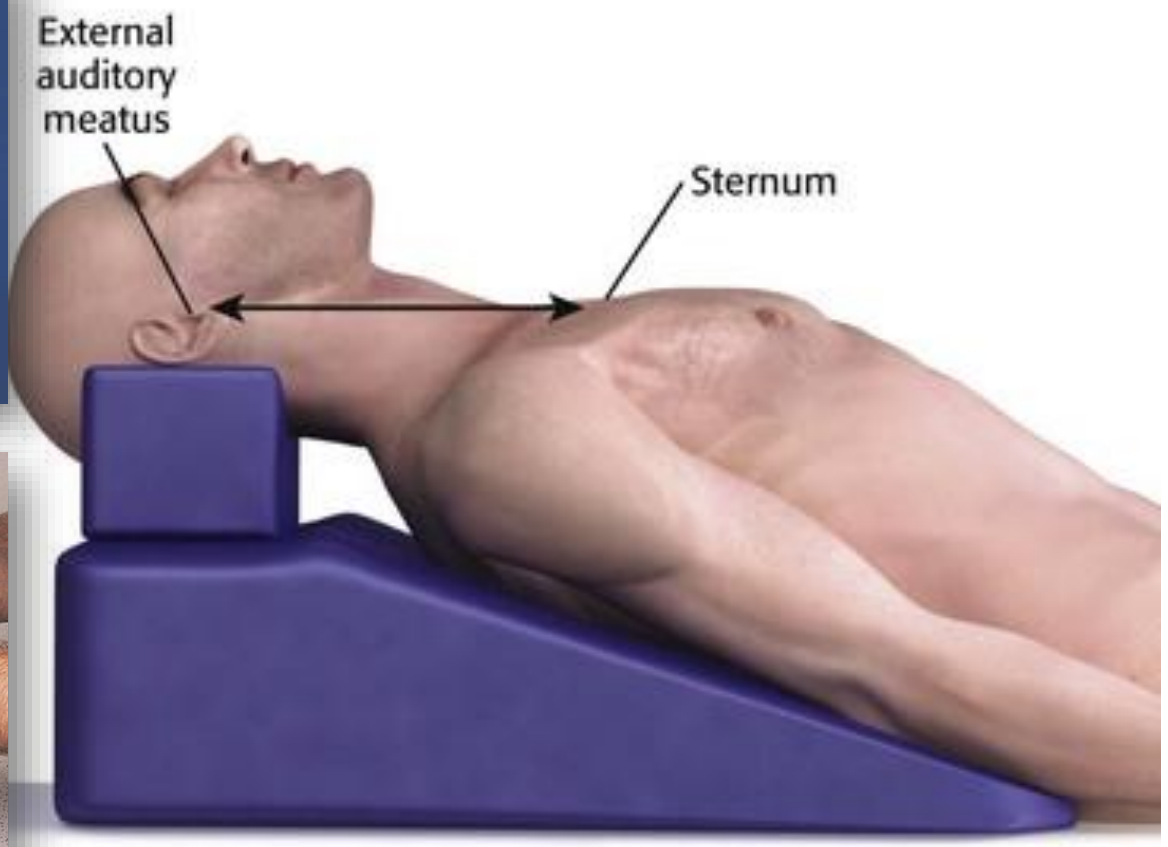
Consider obstruction (FBAO, cricoid pressure)

Attempt Extraglottic Airway Device insertion

Adjusting for the Difficult Ventilation

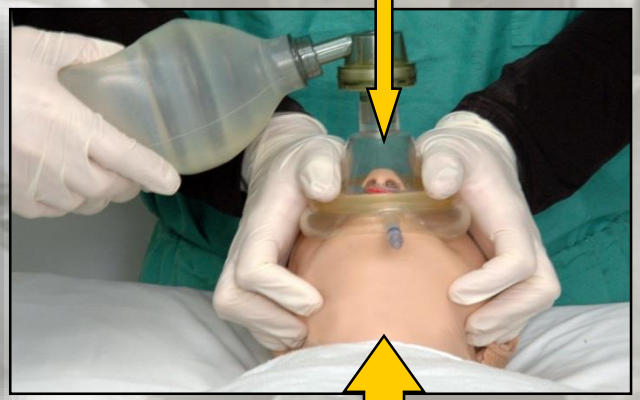
- Patient Positioning





Adjusting for the Difficult Ventilation

- Two Person/Four Hand Technique



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Difficult BMV

Airway Control

PATIENT POSITIONS

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Recovery Position

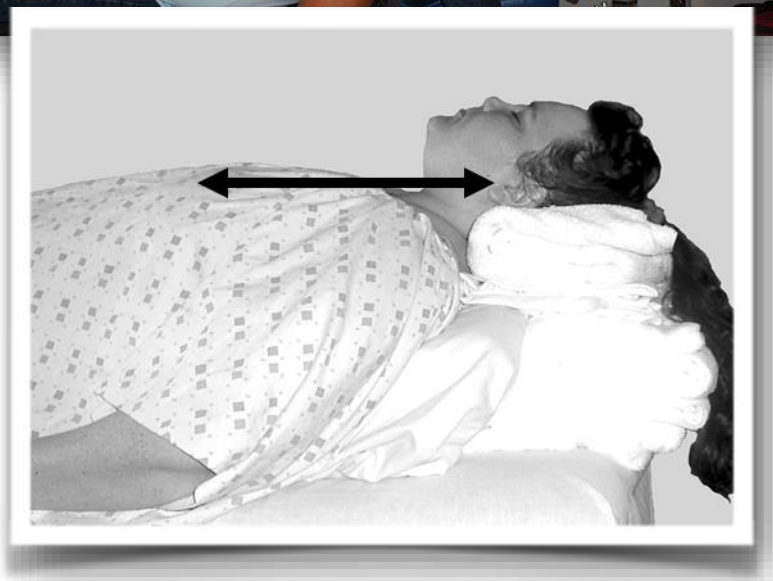
What about C-Collar in Trauma?

- **Take the collar off for airway management!!!**
- Common error to leave on, it is impossible to do proper jaw thrust and BMV with it on!
- Replace with in-line immobilization done by human, as shown, from below, out of the way of the airway manager.

What about lying down/sitting up?

- Common error is to "lie patients down" when they are awake and in severe SOB.
- These patients will ventilate better sitting up, don't fight them.

Bagging the Obese Patient



- As discussed already, elevate the head to displace the weight of the abdomen off the chest, allowing easier chest expansion!
- “Ramping” for intubation of obese patients is more specific in terms of bringing pt into sniffing position.

Airway Control

EXTRAGLOTTIC DEVICES

Extraglottic Airway Devices (EAD)

- Previously referred to as supraglottic devices.
- Defined as an airway that controls below the level of the oropharynx but does not enter the trachea
- Directly or indirectly oxygenates the trachea
- Requires additional training in usage and skills maintenance

Extraglottic Airway Devices (EAD)

- These “rescue airways” were initially designed for use during “can’t intubate/can’t ventilate” emergencies.
- Placed without direct visualization of the trachea
- Due to the usefulness and success of these airways, they are now considered a back-up airway, or have replaced orotracheal intubation in some prehospital areas.

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Supraglottic Airway Devices (SAD)

Laryngeal Mask Airways

King LTS-D Airway

i-Gel Airway

Airway Control

KING LTS-D

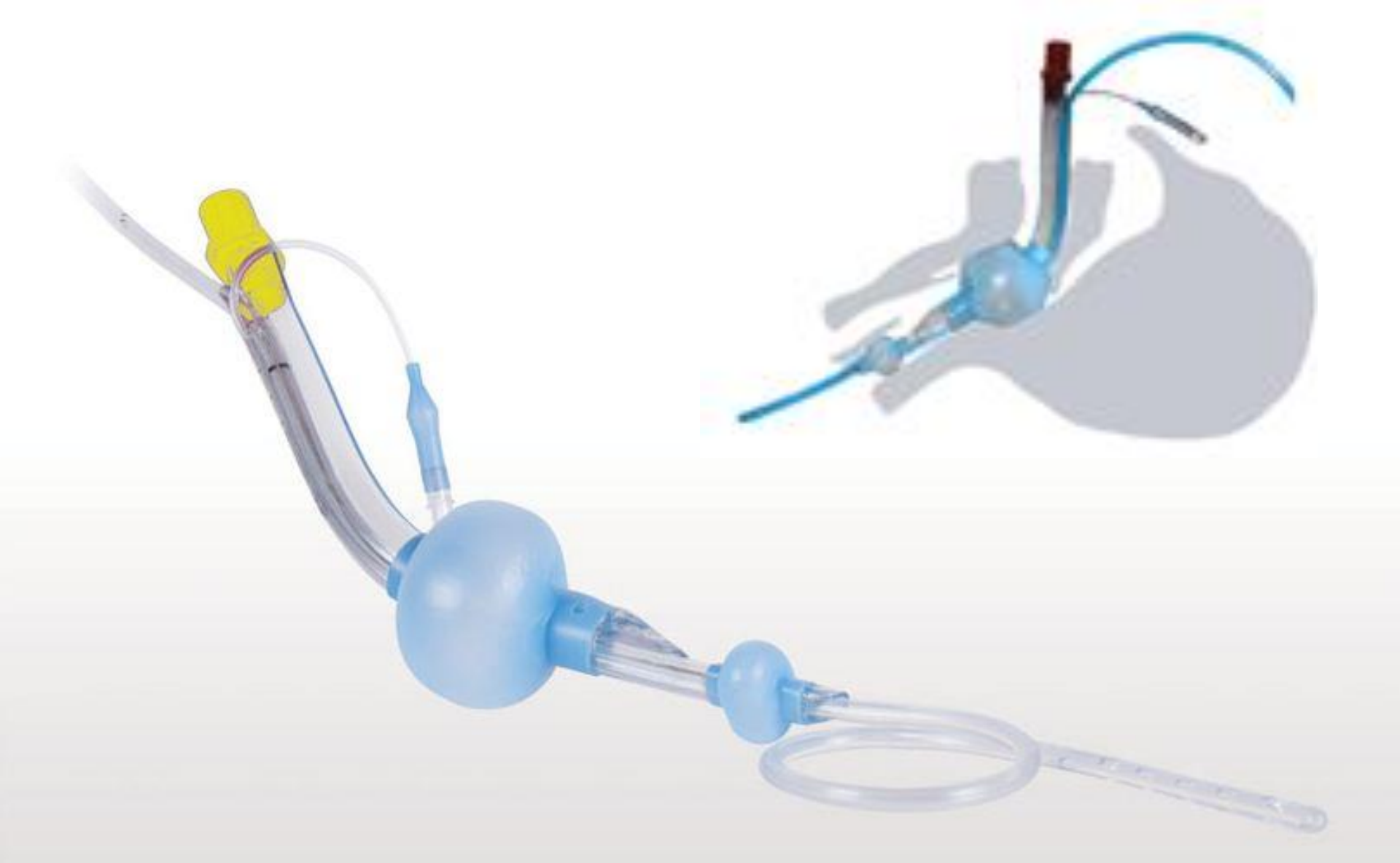
King LT

- Designed for hospital use.
- Can be autoclaved up to fifty times

King LT-D (disposable)

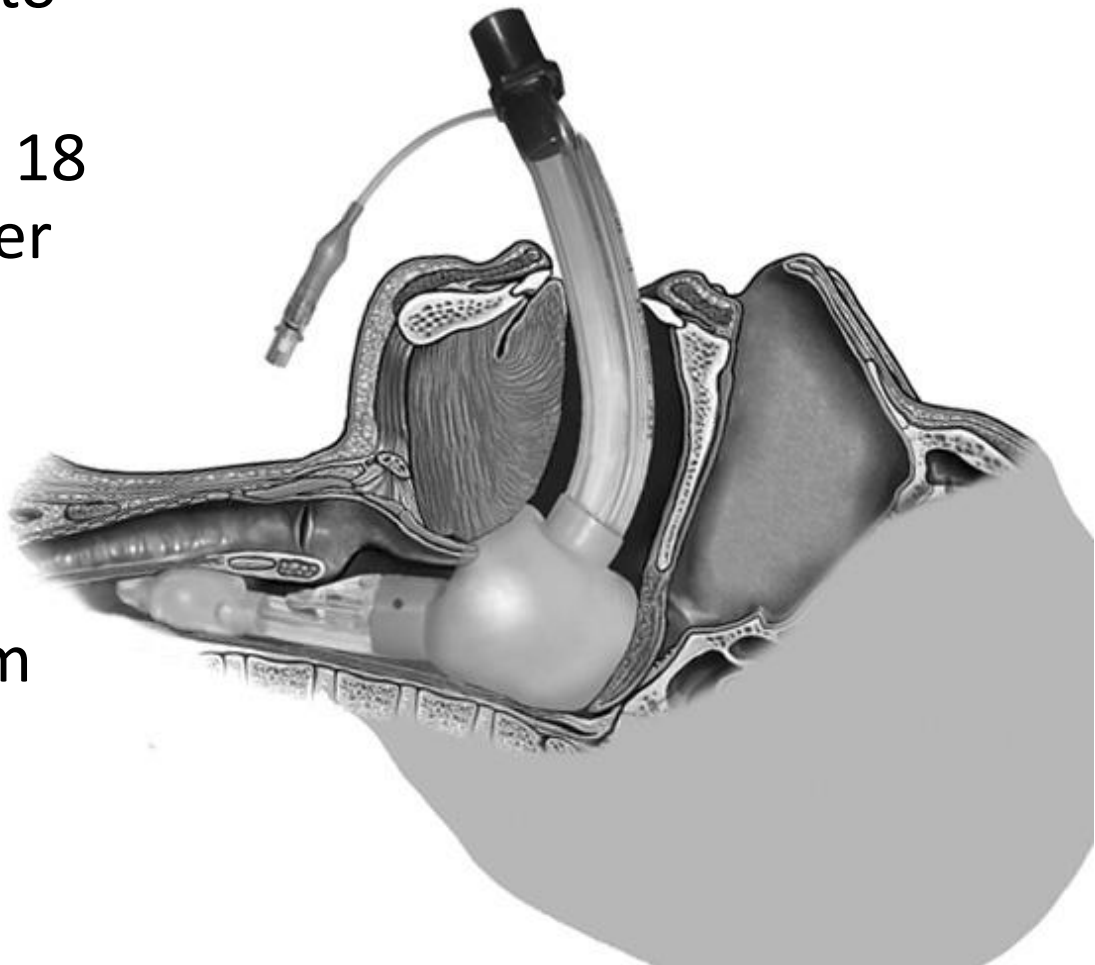
- The disposable version of the King LT Airway
- Single use device
- Partially occludes esophagus to limit gastric distention and aspiration

King LTS-D (suction-disposable)



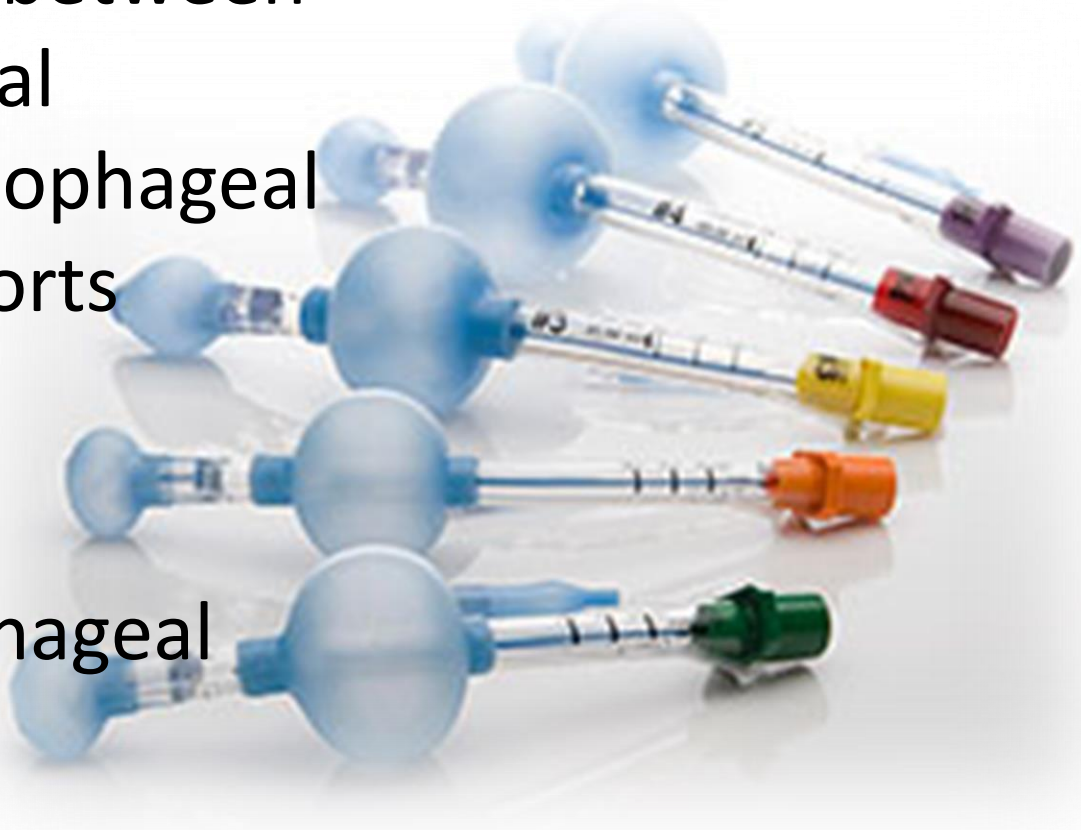
King LTS-D

- Has a second lumen that allows direct passage to the esophagus
- Will accommodate an 18 French suction catheter
- Allows for decompression of the stomach
- Can accommodate a tube exchanger system



King LTS-D

- Available in 5 sizes
- Ventilation occurs between the hypopharyngeal balloon and the esophageal balloon through ports along the tube.
- Latex free
- Designed for esophageal placement



Indications

- Unresponsive breathing or non-breathing patient in need of ventilation
- Absence of a gag reflex must be confirmed prior to use
  - Only tolerated in patients who are deeply unconscious or in cardiac arrest

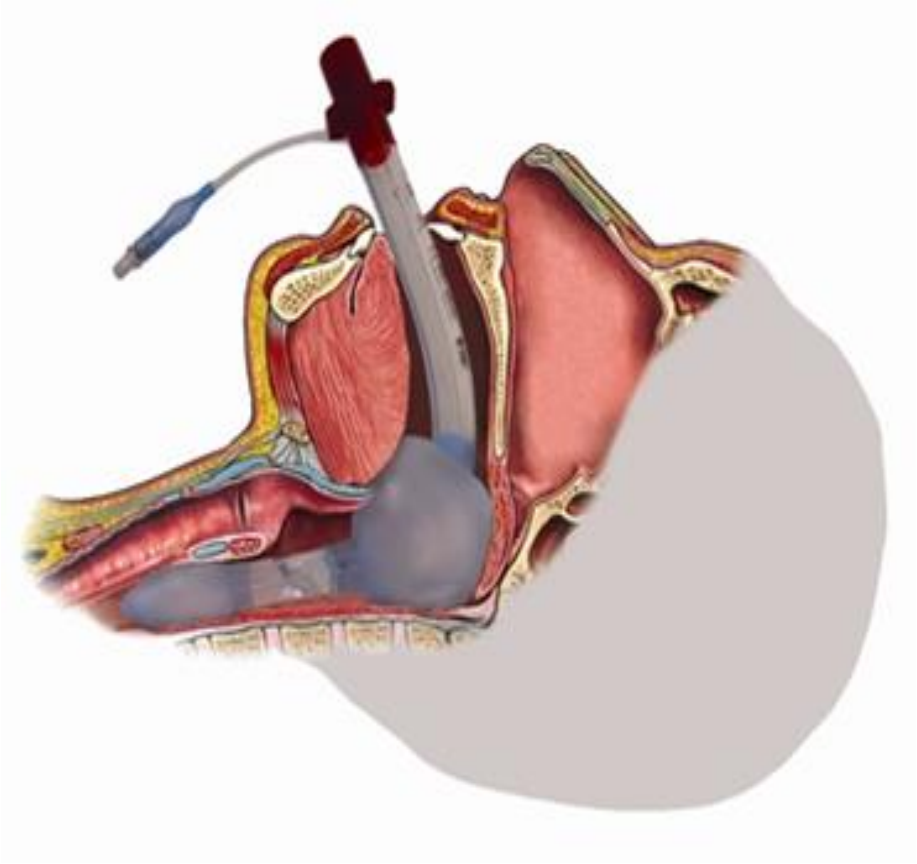
Contraindications

- Intact gag reflex
- Known esophageal disease
- Known caustic substance ingestion

Warnings/Precautions

- Does not protect from aspiration
- Is not tolerated unless deeply unconscious
- Not useful for upper airway pathology (burns, angioedema, epiglottitis)
- Can be accidentally placed in the trachea, must be removed and repositioned in the esophagus
- Must be properly sized to avoid esophageal damage or air leakage

Limitation of the Upper Airway Pathology



- Note where bulbs are sitting in relation to the glottic opening.
- You can see if there is upper airway swelling (burn, epiglottitis, allergic reaction), abscess, mass, foreign body, this adjunct will not be helpful.

Sizing

- King LTD #2 (no suction)
  - Green
- King LTD #2.5 (no suction)
  - Orange
- King LTS-D #3
  - Yellow
- King LTS-D #4
  - Red
- King LTS-D #5
  - Purple

- 35 – 45 inches (12 – 25 kg)
  - 25 – 35 ml inflation
- 41 – 51 inches (25 – 35 kg)
  - 30 – 40 ml inflation
- 4-5 Feet Tall
  - 45 – 60 ml inflation
- 5-6 Feet Tall
  - 60 – 80 ml inflation
- Above 6 Feet Tall
  - 70 – 90 ml inflation

Insertion

- Pre-oxygenate with BVM to ensure airway is patent
- Correctly size tube based on patient height.
- Test cuffs by inflating with maximum amount of air (remove all air before insertion)
- Apply a water soluble lubricant to the posterior side of the tube (not on cuffs)

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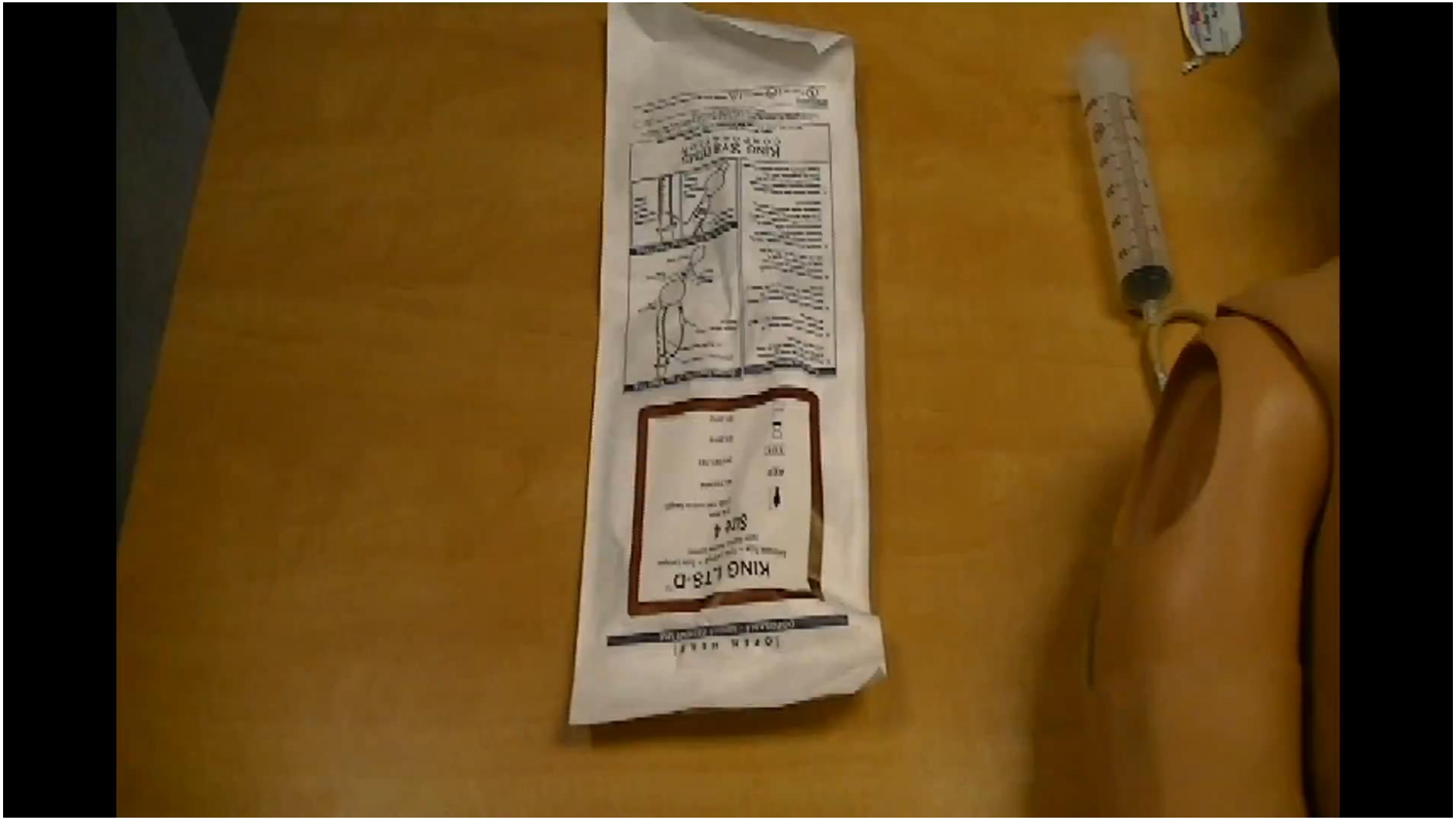
Preparing the King LTS-D



Insertion

- Place patient neutral or in the sniffing position.
- Ensure the absence of a gag reflex
- Open the mouth and lift the chin (or cross finger technique)
- Place the airway to the corner of the right side of the mouth (blue orientation line should be in line with the mouth)

Insertion

- As the tube passes under the tongue, rotate the tube to align the blue guideline with the chin

Insertion

- Without exerting excessive force, advance the airway until the teeth or gums are aligned with the connector

Insertion

- Inflate cuffs to the maximum pressures indicated by the size of the tube
- While ventilating, withdraw the tube until ventilation is easy and unobstructed (maximum chest rise)
- Auscultate for bilateral breath sounds
- If necessary, add additional volume to cuffs to maximize seal of the airway

Airway Obstruction

Insertion

- Note the depth of insertion
- Secure the tube to the patient using tape or other acceptable method
- Apply capnography to ensure tube placement and ventilation

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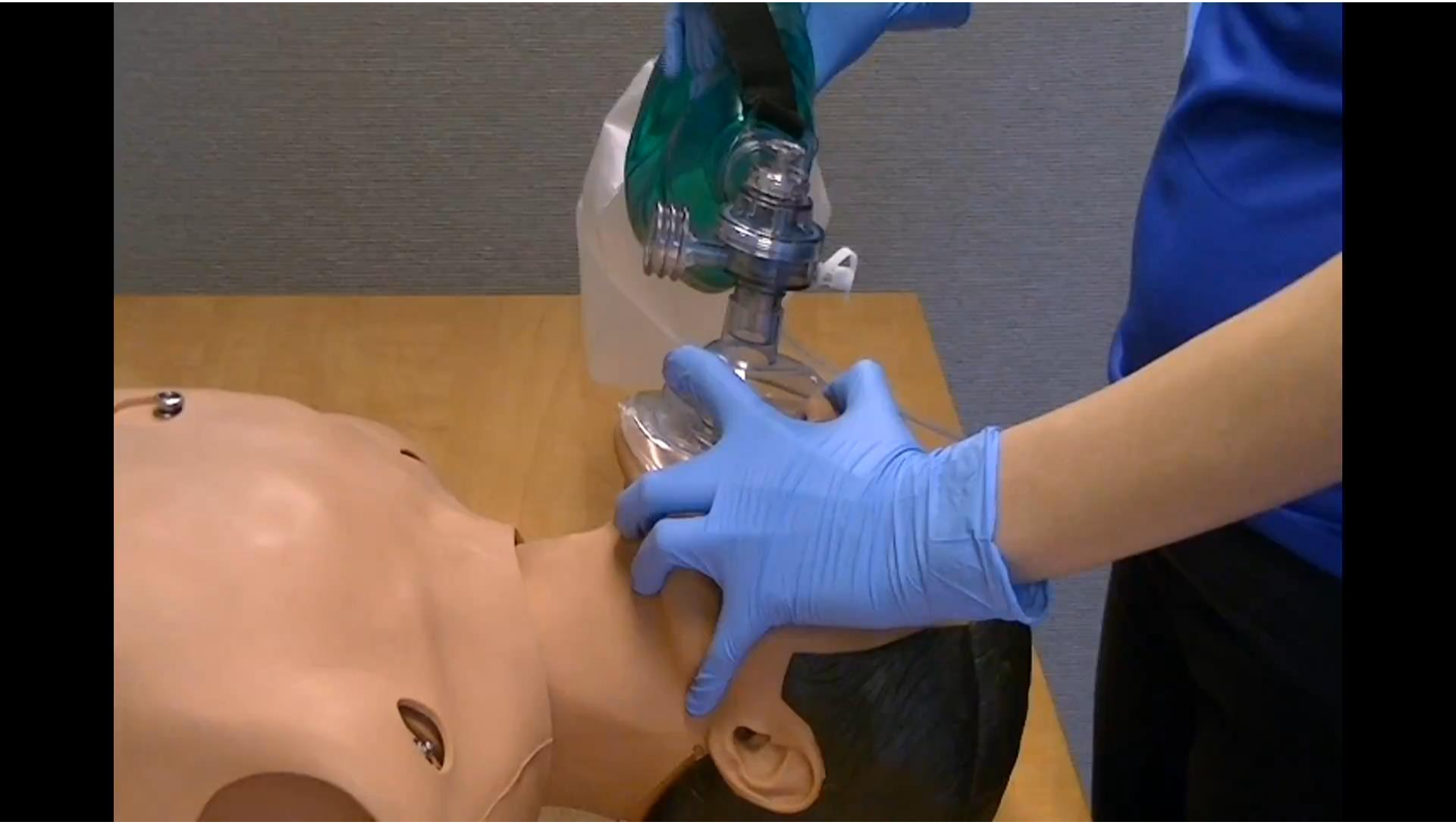
Insertion the King LTS-D



Removal

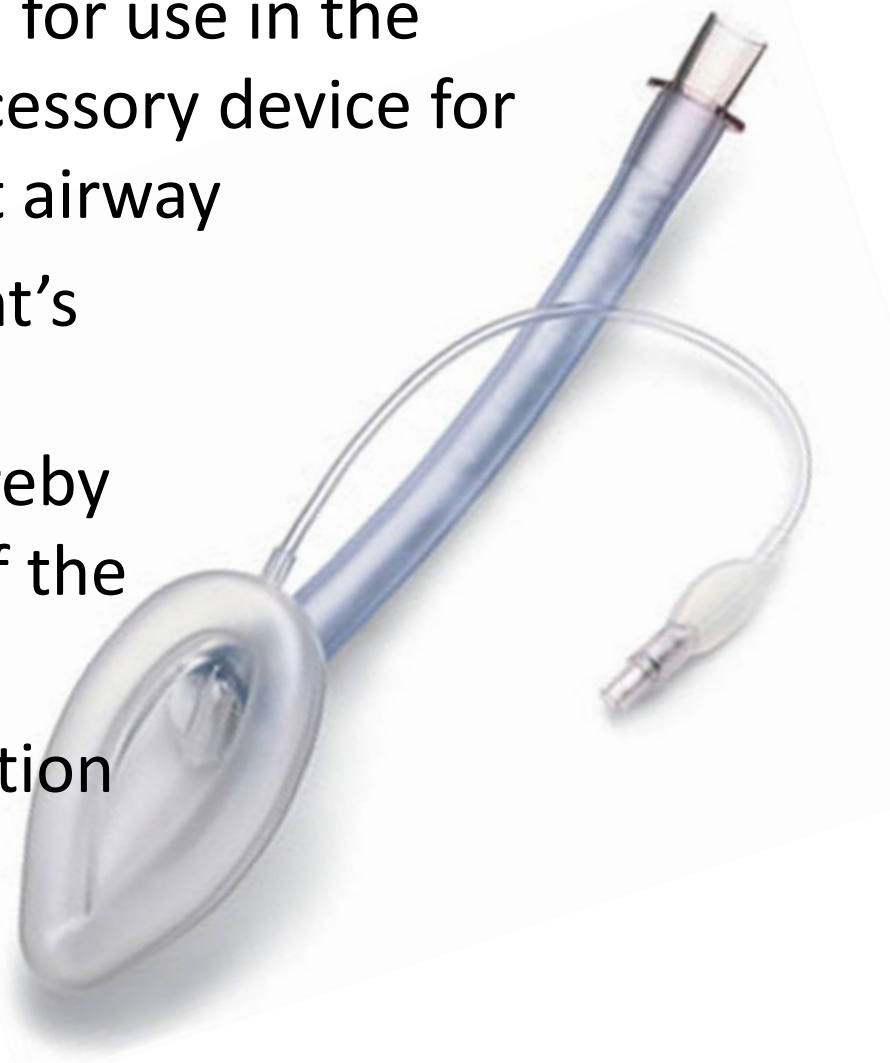
- If there is a return of gag reflex, it may become necessary to remove the device.
- Have suction ready
- Deflate the cuffs fully
- Withdraw the tube
- Suction if required

Airway Control

LMA

Laryngeal Mask Airway (LMA)

- A supraglottic airway device for use in the emergency setting as an accessory device for management of the difficult airway
- Designed to sit in the patient's hypopharynx and cover the supraglottic structures, thereby allowing relative isolation of the trachea
- Results in less gastric distention than with bag-valve-mask ventilation alone



Sizing

LMA Size	Patient Size
1	< 5 kg
1.5	5 – 10 kg
2	10 – 20 kg
2.5	20 – 30 kg
3	30 kg to small adult
4	Adult
5	Large adult (poor seal with size 4)

Indications

- Patients in cardiac arrest.
- Ventilation in normal/abnormal airways
- Failed intubation
- Unconscious patients without a gag reflex, and in need of ventilator support.
  - Patients in irreversible respiratory arrest (i.e. narcotic overdose, hypoglycemia).

Contraindications

- Intact gag reflex
- Conscious – arouseable patient
- Partial or complete FBAO
- Upper airway pathology (burn, epiglottitis, abscess, angioedema)
  - LMA has same issue as King LT in that it is not a definitive airway secured through the vocal cords.
- Mask sits above the glottis, therefore pathology here may still obstruct ventilation.

Insertion

- Inflate cuff checking for leaks
- Patient in supine position
- Open airway using jaw lift
- Inserted to such a depth that resistance is felt
- Inflate the distal cuff with air
- Ventilate listen for gurgling sounds over the epigastrium or breath sounds over the lungs and watches for chest rise
- Secure airway

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Insertion

Airway Control

I-GEL

i-Gel

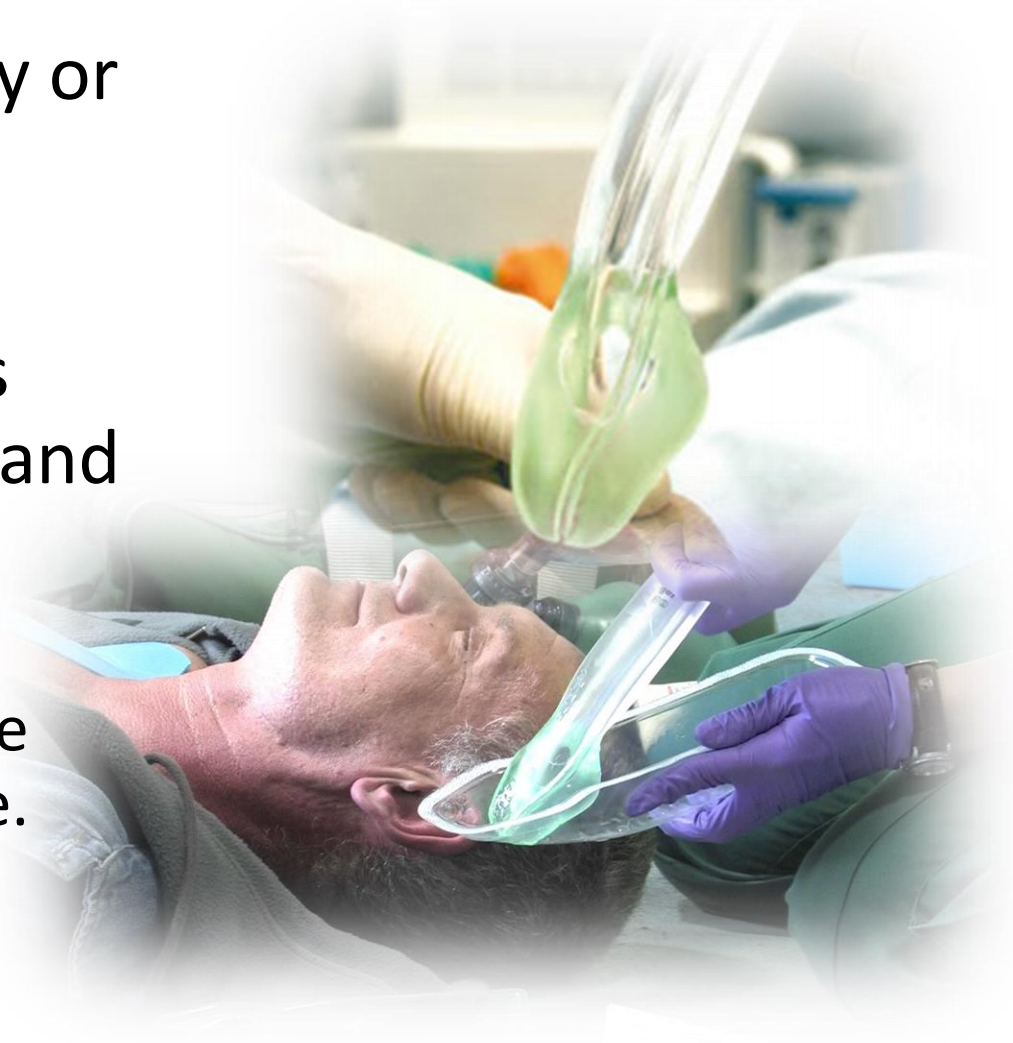
- A extraglottic airway device for use in the emergency setting as an accessory device for management of the difficult airway
- Designed to mirror the shape and contours of the airway
- Non-inflating cuff made of soft gel-like material reducing trauma
- Gaining traction as a preferred option in prehospital systems

Sizing

Patient	Weight	i-Gel Size	Colour
Newborn	2 – 5 kg	1	Pink
Infant	5 – 12 kg	1.5	Blue
Small child	10 – 25 kg	2	Grey
Large child	25 – 35 kg	2.5	White
Small adult	30 – 60 kg	3	Yellow
Medium adult	50 – 90 kg	4	Green
Large adult	> 70 kg	5	Orange

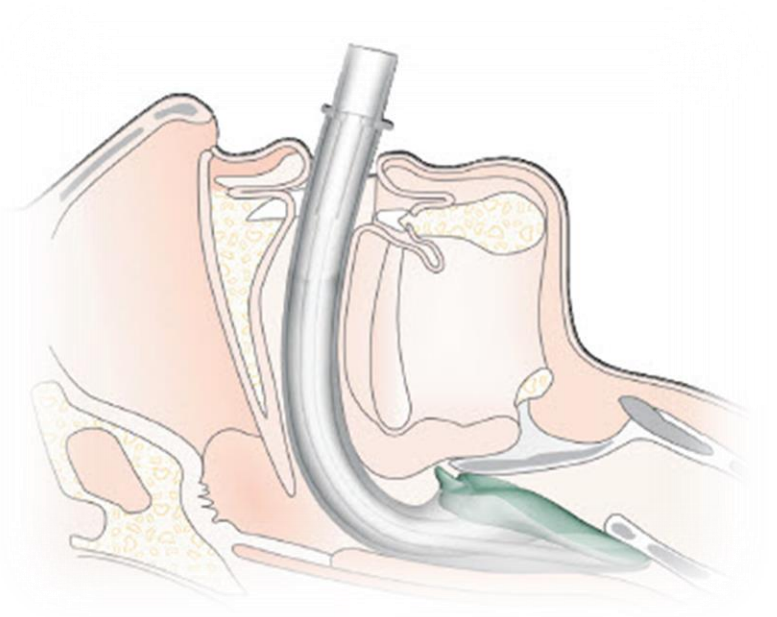
Indications

- Patients in respiratory or cardiac arrest.
- Failed intubation
- Unconscious patients without a gag reflex, and in need of ventilator support.
  - Patients in irreversible respiratory arrest (i.e. narcotic overdose, hypoglycemia).



Contraindications

- Intact gag reflex
- Conscious – arouseable patient
- Partial or complete FBAO
- As with any extraglottic device, low utility with upper airway pathology



Insertion

- Chooses correct size based on pt weight
- Check the device for integrity
- Assess for gag reflux
- Remove i-Gel from protective cradle and transfer to cover insuring not to touch the cuffed end of the i-Gel
- Place small bolus of lubricant onto the cradle
- Grasp the i-Gel with free hand along the integral bite block and lubricate the back, sides and front of the cuff
- Patient placed in head extended and neck flexed position (sniffing position) unless patient condition does not permit it, in this case a neutral position will work

Insertion

- Open patient mouth by pressing down on the chin
- Introduce the leading soft tip of the i-Gel into the mouth of the patient in a direction towards the hard palate
- Glide the device downward and backwards along the hard palate with a continuous but gentle push until a definitive resistance is felt
- Notes the incisors resting on the integral bite-block at about the level of the horizontal black line
- Maintains position of the device by hand until secured with restraint device
- Confirms placement by auscultating over epigastrium and lungs, $ETCO_2$ detector, pulse oximetry
- Confirms chest rise
- Secures device with restraining device

Insertion

Airway Control

CPAP

CPAP

- What is it?
- What does it do?
- How may it help patients?
- Which patients may benefit from it in the emergency setting?
- Has any one seen it or tried it?

Continuous Positive Airway Pressure (CPAP)

- To maintain a continuous level of positive airway pressure in a spontaneous breathing patient
  - Baseline pressure is higher then atmospheric pressure
  - Similar to PEEP though the pressure is during inspiration and expiration versus just during the expiratory phase with PEEP
- Pt still able to inspire/expire normally
- Decreases the work of breathing by expanding the alveoli and increasing compliance
- May cause over distention if too much CPAP is applied decreasing compliance

Further Evidence

Out-of-Hospital Continuous Positive Airway Pressure Ventilation Versus Usual Care in Acute Respiratory Failure: A Randomized Controlled Trial

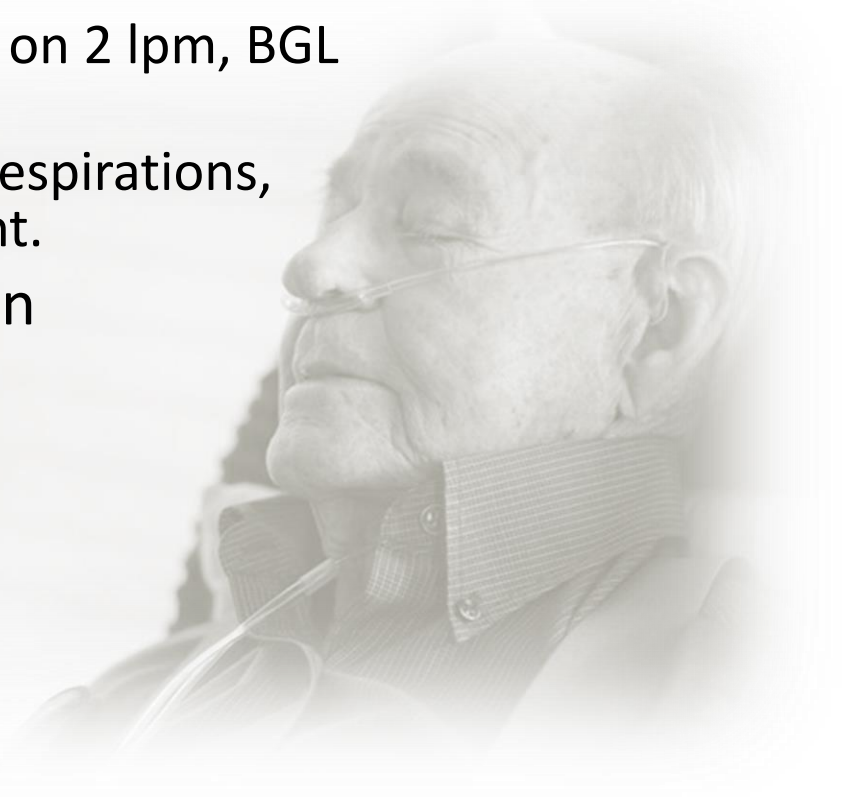
Presented at the International Congress of Emergency Medicine, June 2006, Halifax, Nova Scotia, Canada.

James Thompson, MD, FRCPC, David A. Petrie, MD, FRCPC, Stacy Ackroyd-Stolarz, PhD (C), Darrell J. Bardua, ACP

PEEP

Case

- 72 y/o M SOB
- Worsening for 5 hrs
- PMHx includes COPD, CHF, HTN, DMII, GERD.
- O/E:
  - SBP 160, HR 100, RR 40, Sats 82% on 2 lpm, BGL 11, Temp 38.
  - Alert, protecting airway, gasping respirations, too SOB to talk. Sitting bolt upright.
- Crackles and wheezes diffusely on auscultation.
- Approach?
  - Role for CPAP?
  - Indications?
  - Contraindications?



Continuous Positive Airway Pressure (CPAP)

- Indications:
  - Patent A/W
  - Cooperative patient (Not altered)
    - Must be able to follow directions
  - Acute SOB with evidence of CHF, COPD, Asthma, Pneumonia, etc…
- And…
  - Any 2 of the following:
    - RR > 24
    - SpO2 < 90%
    - Skin signs
    - Adventitious sounds

Continuous Positive Airway Pressure (CPAP)

- Contraindications:
  - Unconscious or GCS < 12
  - SBP < 90
  - Hypoventilation
  - Chest trauma
  - Facial trauma/deformity/burns that inhibit proper mask fit
  - High risk aspiration or active vomiting
  - Tracheostomy
  - Pneumothorax

Continuous Positive Airway Pressure (CPAP)

- Application:
  - Explain procedure to pt and obtain consent
  - Place pt in high fowlers position, monitor, SpO_2
    - Ensure appropriate amount of oxygen in tank prior to starting
  - Place mask on face and attach straps ensuring a proper seal
  - Initiate CPAP with 15 lpm (3 - 4 cmH_2O)
  - Coach pt on breathing (in through nose out through mouth)
  - Titrate up to max of 25 lpm (8.5 – 10 cmH_2O)
  - Watch for non-tolerance, respiratory failure or change in LOC
  - BP should be assessed q 5 mins

Airway Control

REVIEW

Providing Supplemental Oxygen

- What are our options for airway management?
- What about a combination?
- How do you choose?
- How much FiO_2 does each deliver?

High Flow Nasal Prong (HFNP)?

- What happens if you combine HFNP with NRB or BMV?
- How many liters can you administer?

Maintaining/Improving Oxygenation

- Optimizing Oxygenation with 2 Sources
- Insert OPA/NPA and apply 2 sources of high flow O_2 (+ maintain jaw thrust)

2 Sources/minimize RA entrainment

Maintaining/Improving Oxygenation

Maintaining Oxygenation

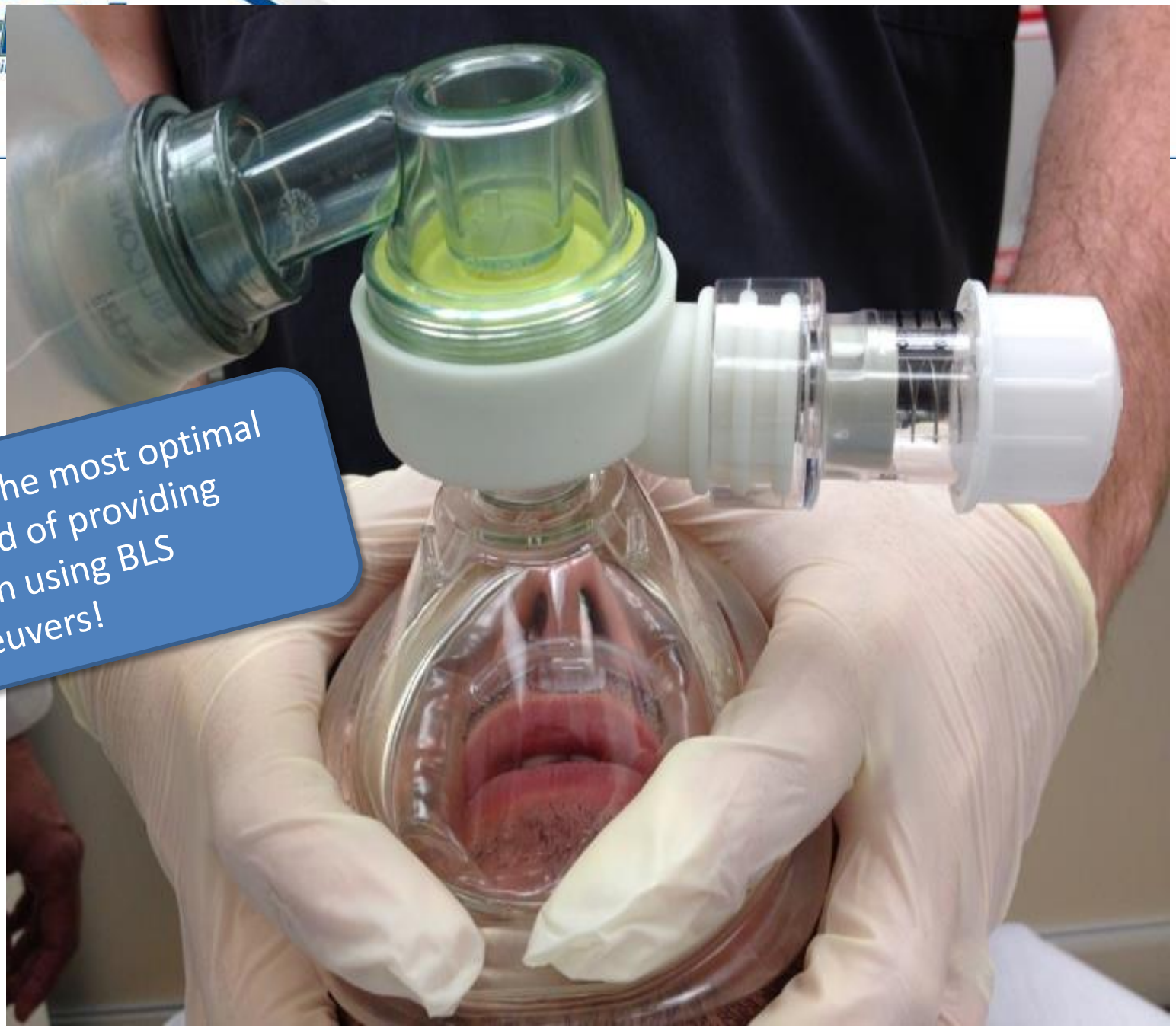
- Insert OPA/NPA AND apply high flow O_2
- Maintain jaw thrust +/- assisted oxygenation/ventilation

THE NEW ENGLAND JOURNAL of MEDICINE

EDITORIAL

Saving Lives with High-Flow Nasal Oxygen

Michael A. Matthay, M.D.


This is the most optimal method of providing oxygen using BLS maneuvers!

Airway Control

NON-INVASIVE MONITORING

Airway Control

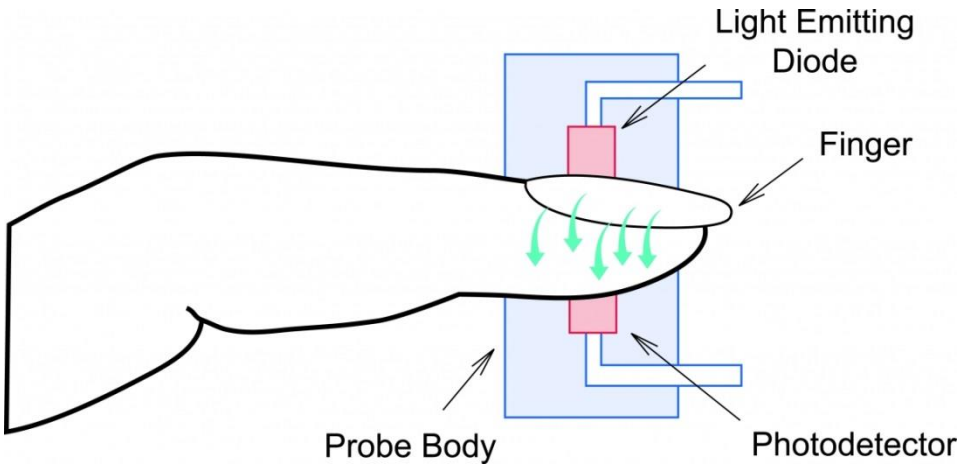
PULSE OXIMETRY

Pulse Oximetry

- Pulse Oximetry is a method to measure hemoglobin saturation in arterial blood

Pulse Oximetry

- Sensor can be placed on finger, toes or earlobes
- Light emitting diode (LED) containing red and infrared wavelengths passed from one side to the other
- Changing absorbance of each of the two wavelengths is measured, allowing determination of the absorbance due to the pulsing arterial blood.
- Ratio of changing absorbance of the red and infrared light given as a percentage.
- Measures the amount of saturated versus unsaturated hemoglobin

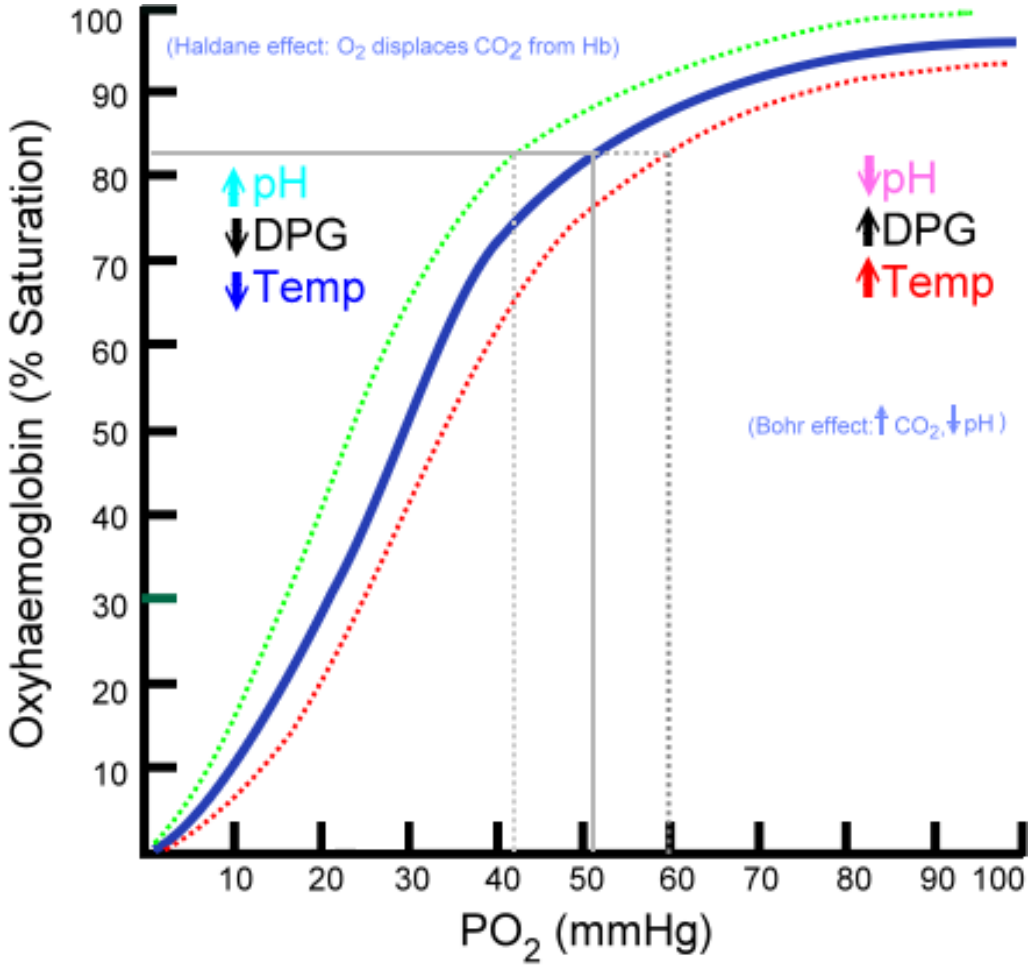


Pulse Oximetry

- What is it saturated with?

Definitions

- What is the difference?
  - Hypoxia
  - Hypoxemia
  - Cyanosis



Pulse Oximetry

- Hypoxemia
  - Lack of oxygen in the blood
  - May be caused by
    - CO_2Poisons
    - Infections (Gangrene)
    - $\downarrow O_2$ in atmosphere
    - COPD
    - Hypoperfusion (MI, CHF…)
    - Hypovolemia (Anemia, blood loss…)
    - Hypothermia

Pulse Oximetry

- Hypoxia
  - Lack of oxygen to the tissue caused by hypoxemia
- Cyanosis
  - The external sign of hypoxia characterized by the appearance of ‘blue’ tissue

Pulse Oximetry

- Conditions that affect the readings
  - Lack of hemoglobin
  - COPD
  - Hypovolemia
  - Anemia
  - CO, CO_2
  - Hypothermia
  - Bright light
  - Vasoconstriction (↑cap refill)
  - Fingernail polish

Pulse Oximetry

- Use SpO_2 as a guide
- Use clinical judgment/patient presentation as a more accurate guide to need for supplemental oxygen

Treat the patient, Not the monitor!

- SpO_2 and SaO_2 are only accurate when compared to ABG's

Pulse Oximetry

- Is it possible to show 100 % SpO_2 and still be hypoxic?

Airway Control

CAPNOGRAPHY

Capnography

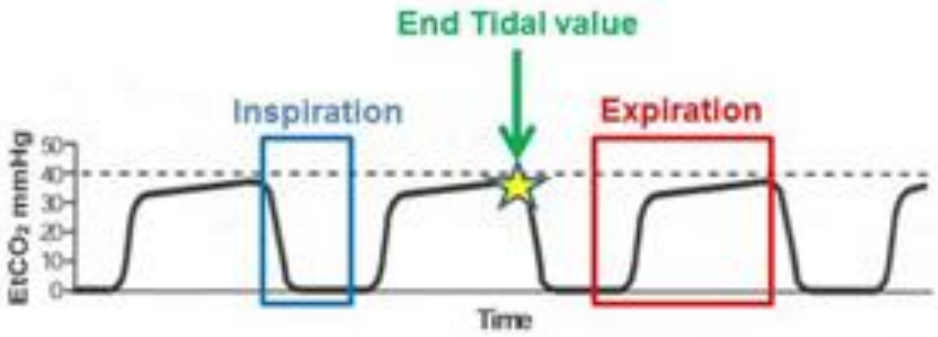
- Capnography is the vital sign of ventilation
- Tracking the CO_2 in a patient's exhaled breath, capnography enables paramedics to objectively evaluate a patient's ventilatory status (and indirectly circulatory and metabolic status)
- A capnograph measures how much carbon dioxide is present in the patients breath

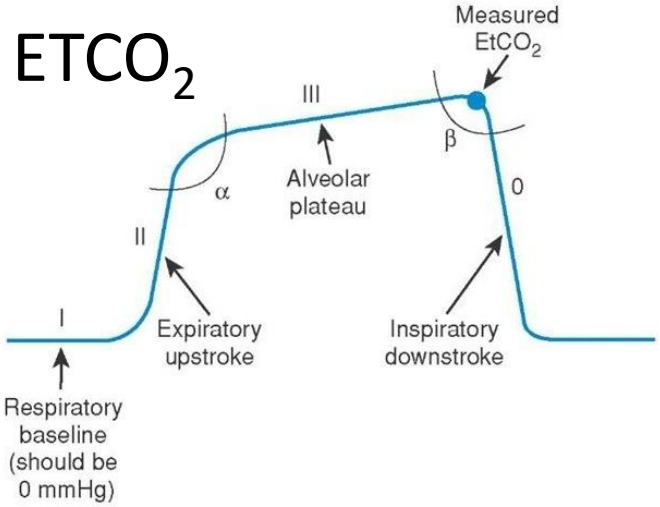
Definitions

- Capnography
  - Measurement of CO_2 in exhaled breath
- Capnometry
  - Measurement of partial pressure of expired CO_2
- Capnometer
  - Numeric measurement of CO_2

Definitions

- Capnogram
  - "Real-time" visual waveform of $ETCO_2$





- End Tidal CO_2 ($ETCO_2$ or $P_{ET}CO_2$)
  - Level of (partial pressure of) carbon dioxide released at end of expiration
  - Normal value: 35 – 45 mmHg

Capnography

Colorimetric Devices

- Disposable
- Detect exhaled CO_2 with litmus paper
  - H^+ ions in CO_2 cause change in color
  - of paper
    - Color change present between each breath
  - Manufactured in protective plastic housing
  - Placed between vent circuit and endotracheal tube
- Not useful in detecting hyper/hypocarbia

Electronic Devices

- CO_2 absorbs light at specific wavelength
  - Allows for measurement
- Can be qualitative or quantitative
  - Qualitative
    - Detect presence of CO_2
  - Quantitative
    - Determine how much CO_2 is present

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Mainstream vs Sidestream

MAINSTREAM

SIDESTREAM

Mainstream (Inline)

- Most commonly used for mechanically ventilated patients and intubated patients who require intensive monitoring.
- Can also be used on non-intubated patients (but require a mouthpiece or a mask)
- Sensor is placed directly in the breathing circuit in between the ventilator and the intubation tube
  - CO2 is measured as the exhaled air passes through the sensor
  - Because the sensor is not in direct contact with the patient, it cannot be contaminated by moisture or secretions

Mainstream (Inline)

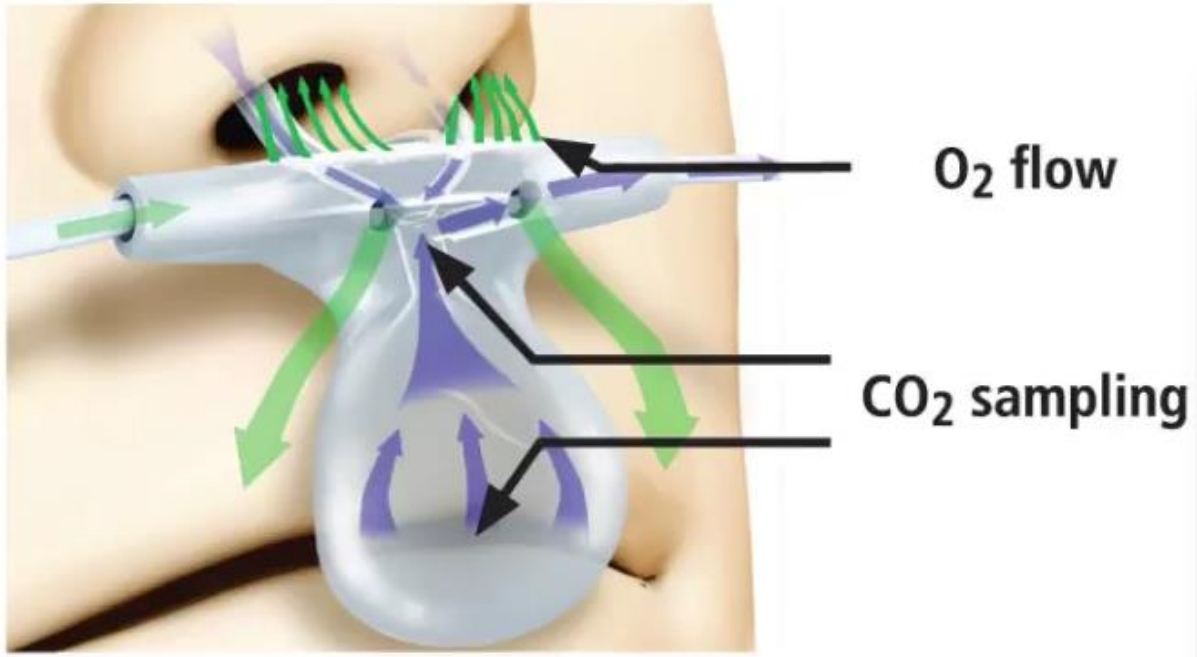
- The inline end-tidal CO_2 device can also be used with extraglottic devices and BVM.
- Considered the standard of care and provides important feedback throughout all stages of airway management
  - Should be used, if possible throughout airway management.
- CO_2 may be present in the stomach from PPV or a previously consumed carbonated beverage.
  - 6 breaths must be administered in order to eliminate the false CO_2 reading prior to relying on the $ETCO_2$ value.

Sidestream

- Sidestream, on the other hand, is non-invasive and diverting.
- This means that the gas sample is transported from the sample site through a plastic tube and analyzed in a sample cell.

Microstream

- Can be used in conjunction with other airway devices (NRB, NC, CPAP)



Sidestream

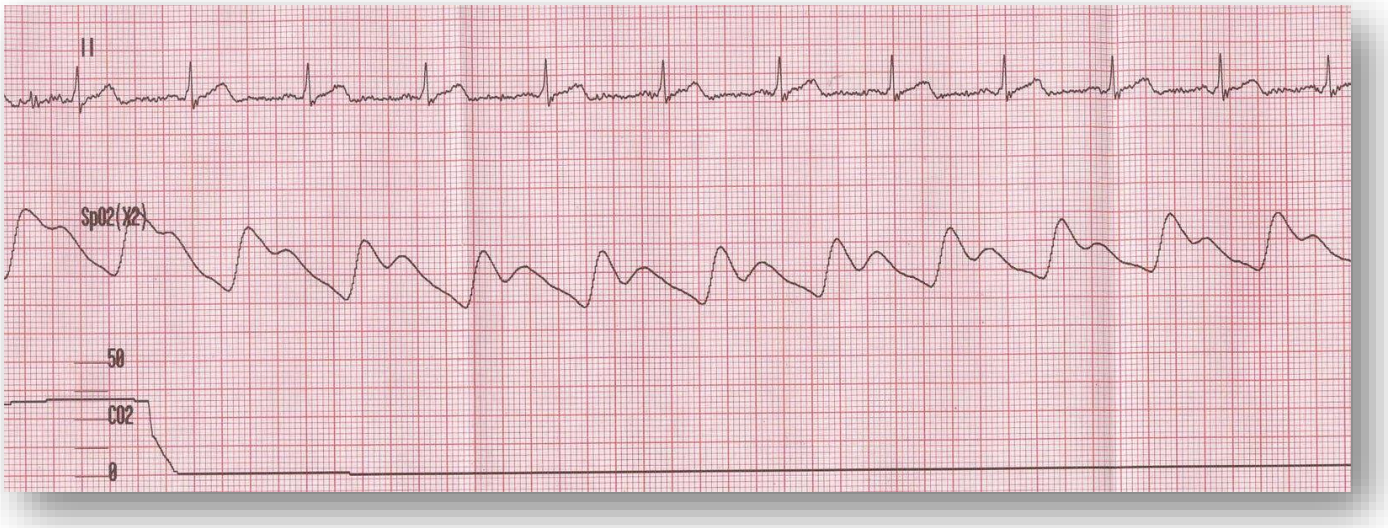
- Be careful of mouth breathers since the expired air to bypass the device
- Does not replace the nasal cannula and should only be considered as a tool to be used during treatment as a means of trending the patients condition.

Oxygenation versus Ventilation

- Oxygenation
  - Oxygen is inhaled into the lungs where gas exchange occurs at the capillary-alveolar membrane
  - Oxygen is transported to the tissues through the blood stream
  - Pulse oximetry measures oxygenation
- Ventilation
  - CO_2 is carried back through the blood and exhaled by the lungs through the alveoli
  - Capnography measures ventilation

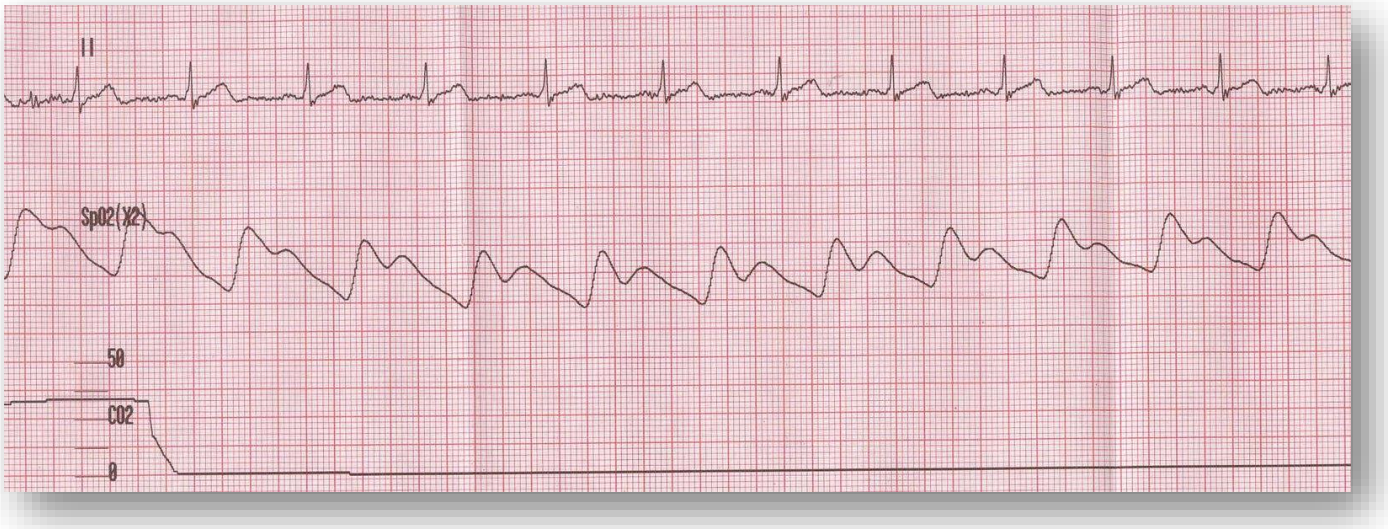
Capnography versus Pulse Oximetry

- Capnography provides an immediate picture of patient condition.
- Capnography will show immediate apnea
- Capnography is not affected by decreased perfusion or dysrhythmias



Capnography versus Pulse Oximetry

- Pulse oximetry is delayed.
- Pulse oximetry will show a high saturation for several minutes.



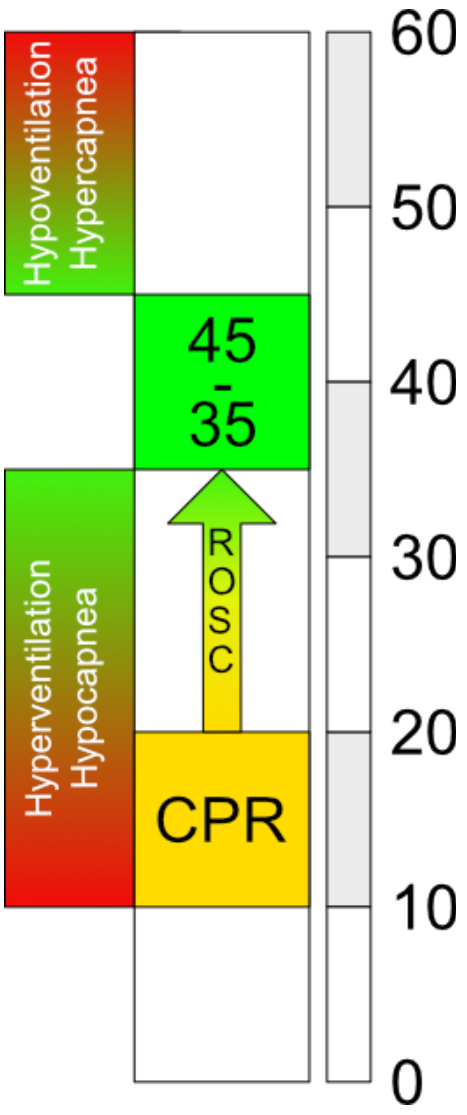
Circulation and Metabolism

- Capnography is a direct measurement of ventilation in the lungs, it also indirectly measures metabolism and circulation
  - Increased metabolism will increase the production of carbon dioxide increasing the $ETCO_2$
  - Decrease in cardiac output will lower the delivery of carbon dioxide to the lungs decreasing the $ETCO_2$
  - $ETCO_2$ reflects changes in cardiac output and pulmonary blood, not ventilation

Values

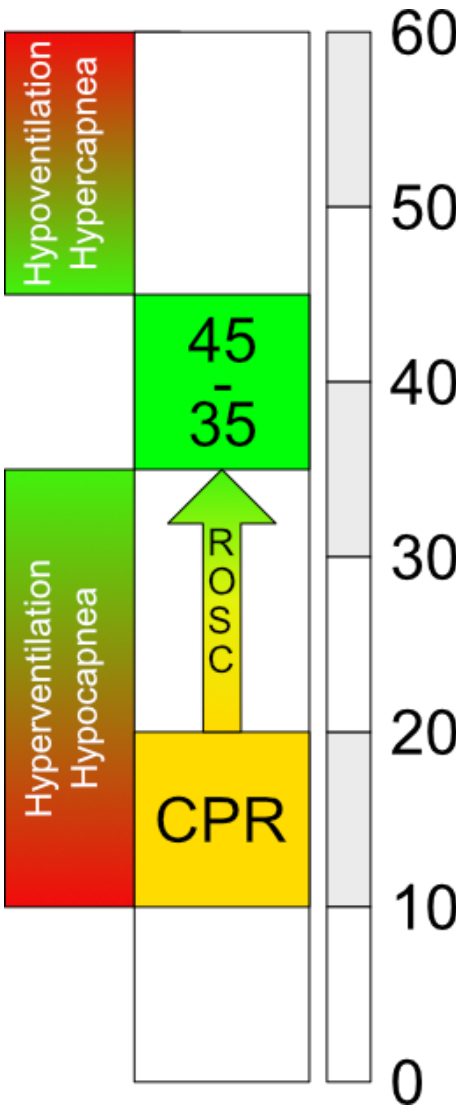
- Normal
  - $ETCO_2$ 35 – 45 mmHg
  - During CPR 10 – 20 mmHg

- If ROSC is achieved you should see a sudden increase to normal or above normal

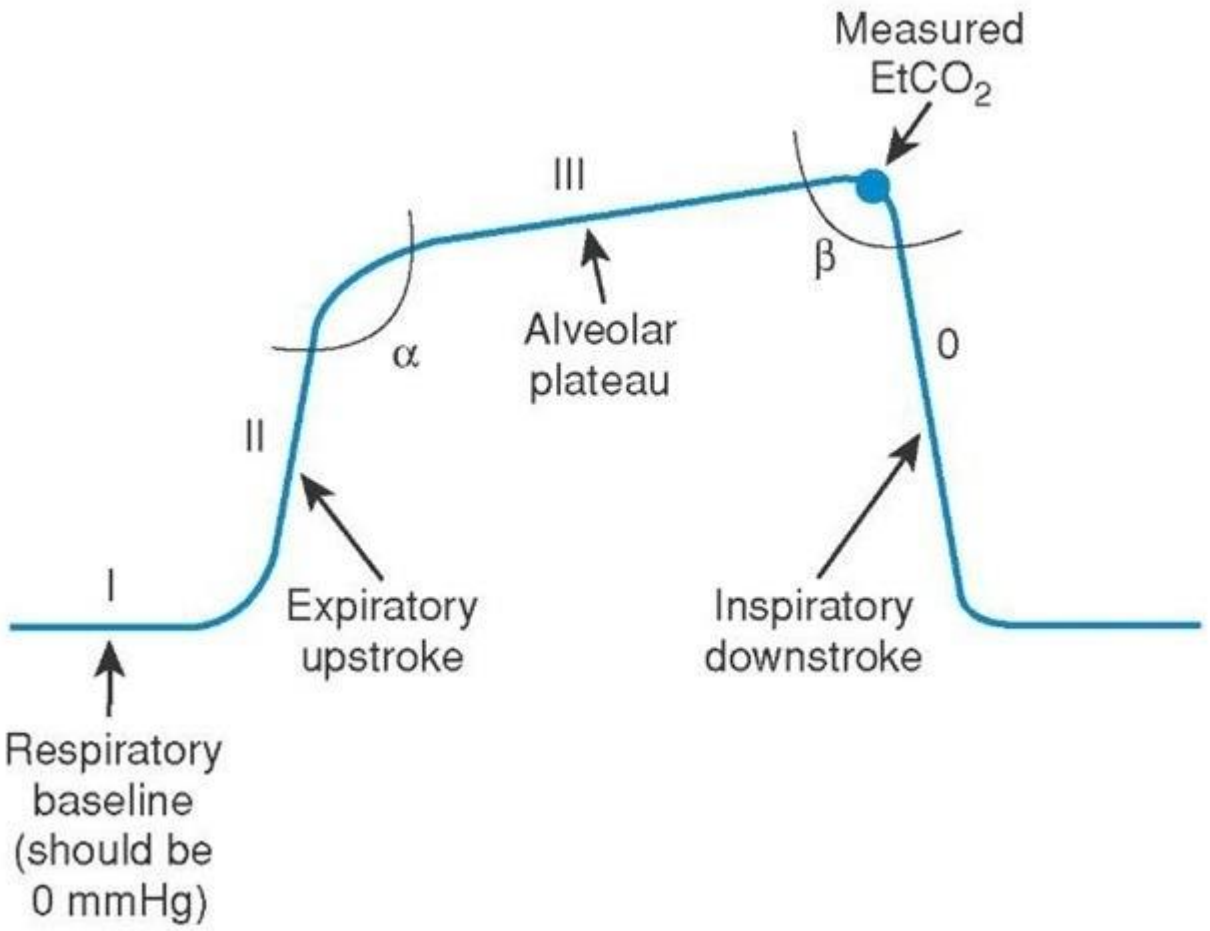


Values

- Abnormal
  - < 30 mmHg — hyperventilation hypocapnea
  - > 30 mmHg — hypoventilation hypercapnia



The Wave Form



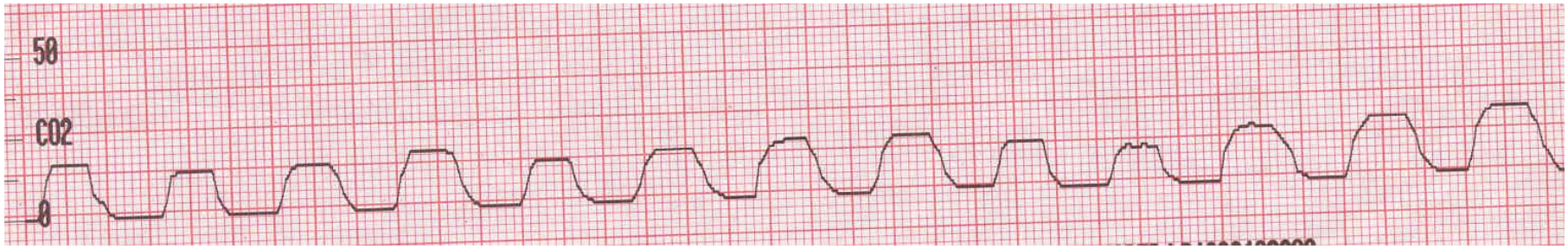
Inspiration	Expiration	Inspiration

Clinical Uses

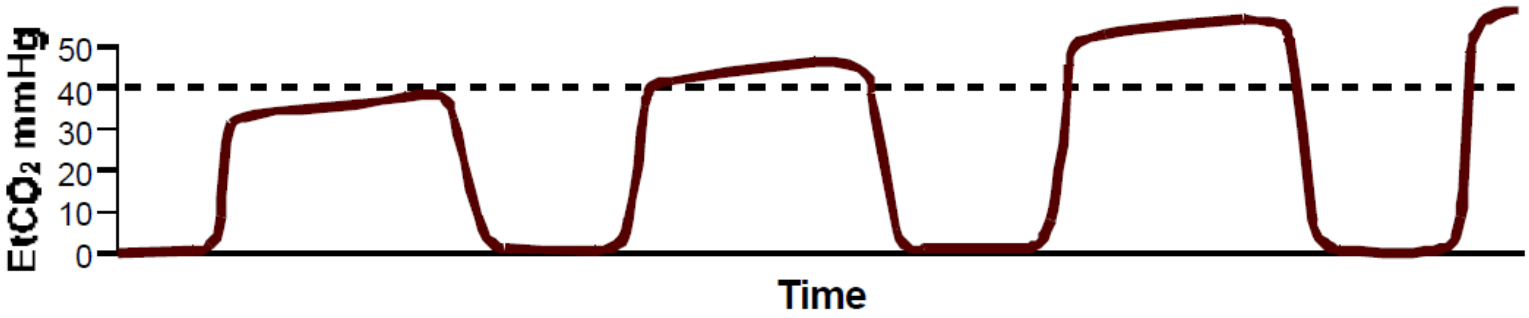
- Monitoring ventilation
- Confirming, maintaining, and assisting intubation
- Measuring cardiac output during CPR
- End-tidal CO_2 as predictor of resuscitation outcome
- $ETCO_2$ in asthma/COPD
- Troubleshooting

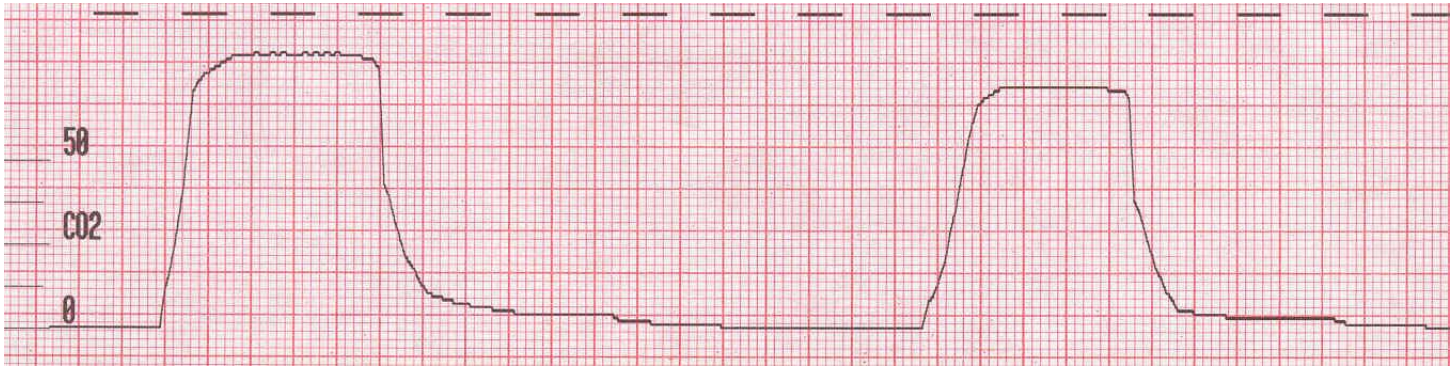
Hyperventilation

- Capnography monitors patient ventilation, providing a breath by breath trend of respirations and an early warning system of impending respiratory crisis.



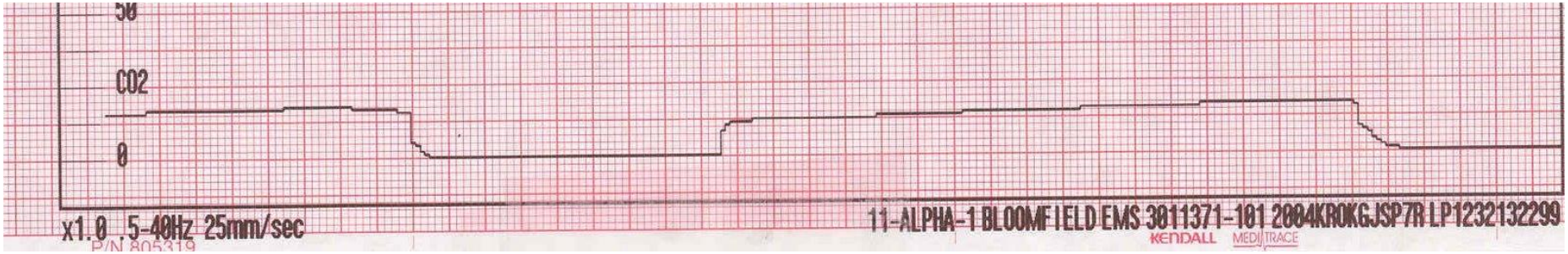
Hypoventilation

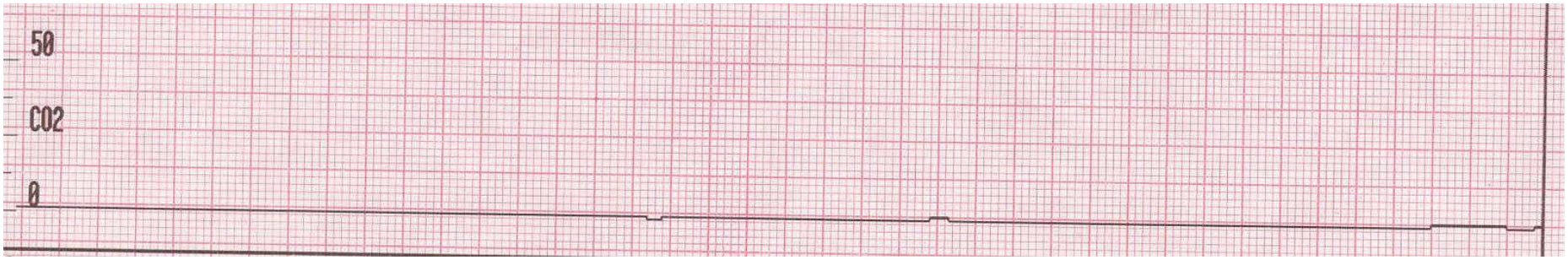




ET Confirmation

- Continuous end-tidal CO_2 monitoring can confirm a tracheal intubation.
- A good wave form indicating the presence of CO_2 ensures the ET tube is in the trachea.





During CPR

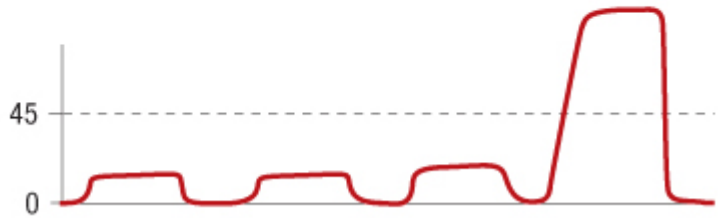
- The capnograph of an intubated cardiac arrest patient is a direct correlation to cardiac
- Increase in CO_2 during CPR can be an early indicator of ROSC output.

Return of Spontaneous Circulation (ROSC)

- $ETCO_2$ can be the first sign of return of spontaneous circulation (ROSC).
- Don't stop compressions until you have completed the current cycle of CPR to assess for a pulse

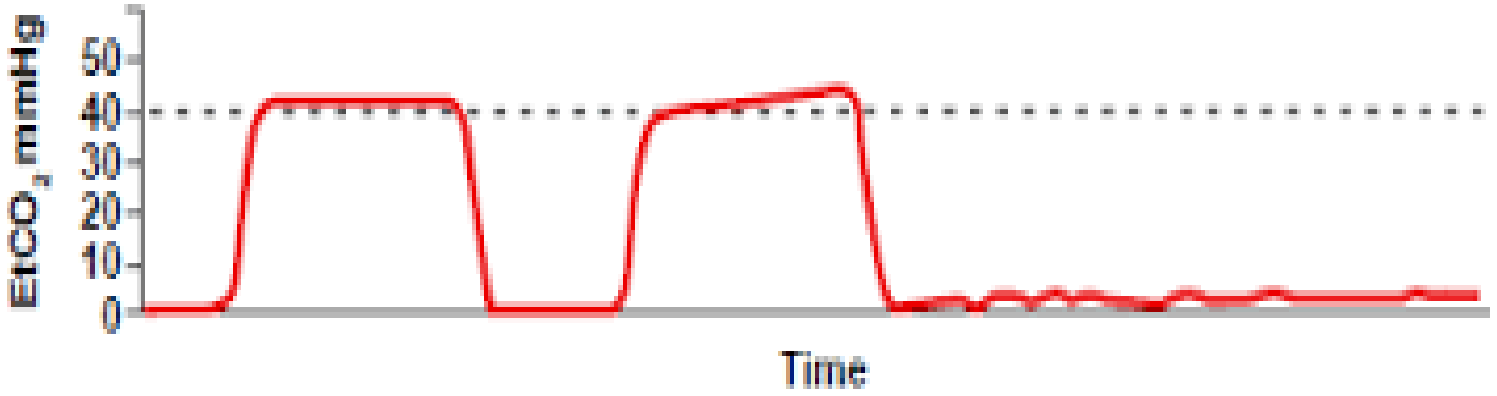
Sudden increase in $EtCO_2$

- Return of spontaneous circulation (ROSC)



Apnea

- A sudden drop in $ETCO_2$ may indicate
  - Displaced ET
  - Respiratory arrest
  - Cardiac arrest
  - Equipment malfunction



Predictor of Resuscitation Outcome

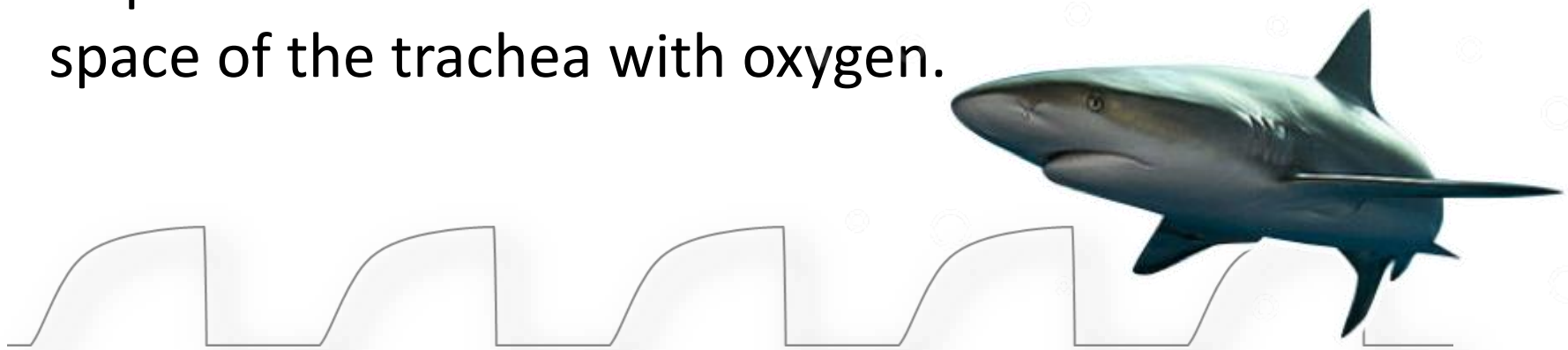
- $ETCO_2$ measurements during a resuscitation give you an accurate indicator of survivability for patients.
  - Survivors >30 mmHg
  - Non-survivors <10 mmHg

Capnography

WAVE FORM SHAPES

Bronchospasm

- Bronchospasm will produce a characteristic “shark fin” wave form as the patient has to struggle to exhale
- Caused by uneven alveolar emptying
- Down stroke remains the same as the patient begins inspiration and fills the unrestricted anatomical dead space of the trachea with oxygen.



Inadequate Seal

- As air escapes around the cuff during ventilation the waveform will distort

Obstruction

- An obstruction in the ETT may cause an irregular wave form

Elevated Baseline

- A capnogram that does not touch the baseline is indicative of a patient who is rebreathing CO_2 through insufficient inspiratory or expiratory flow.

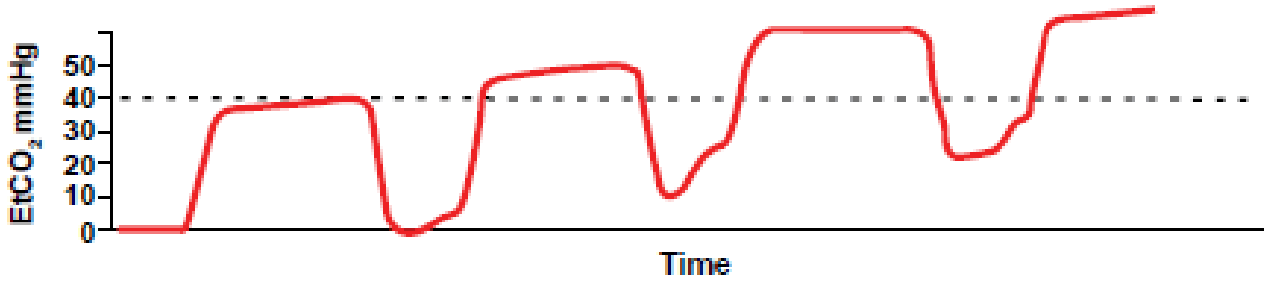


Figure 13: Capnogram illustrating incomplete inhalation and/or exhalation.

Good Videos to View

- Lesson 2 (https://youtu.be/rsd5C7FLXXo)
- Lesson 3 (https://youtu.be/GUV7BTlGLeM)

Airway Control

ADVANCED AIRWAY MANAGEMENT

Endotracheal intubation
is clearly the preferred method
of advanced airway management in
prehospital emergency care.

Advantages

- Isolates trachea and permits complete control of airway.
- Impedes gastric distention.
- Eliminates need to maintain a mask seal.
- Offers direct route for suctioning.
- Permits administration of some medications.

Disadvantages

- Requires considerable training and experience.
- Requires specialized equipment.
- Requires direct visualization of vocal cords.
- Bypasses upper airway's functions of warming, filtering, and humidifying the inhaled air.

Indications

- Obtain and Maintain
- Correction
- Protection
- Predicted Course

Contraindications

- Patients with an intact gag reflex (Relative)
- Patients likely to react with laryngospasm to an intubation attempt.
  - e.g. Children with epiglottitis.
- Basilar skull fracture
  - avoid naso-tracheal intubation and nasogastric/pharyngeal tube.

Complications

- Trauma of the teeth, vocal cords, arytenoid cartilages, larynx and related structures.
- Hypertension and tachycardia can occur from the intense stimulation of intubation
  - This is potentially dangerous in the patient with coronary heart disease.
- Transient cardiac arrhythmias related to vagal stimulation or sympathetic nerve traffic may occur

Complications

- Damage to the endotracheal tube cuff, resulting in a cuff leak and poor seal.
- Intubation of the esophagus, resulting in gastric distention and regurgitation upon attempting ventilation.
- Baro-trauma resulting from over ventilating with a bag without a pressure release valve (pneumothorax).

Complications

- Over stimulation of the larynx resulting in laryngospasm, causing a complete airway obstruction.
- Inserting the tube to deep resulting in unilateral intubation (right bronchus).
- Tube obstruction due to foreign material, dried respiratory secretion and/or blood.

Equipment

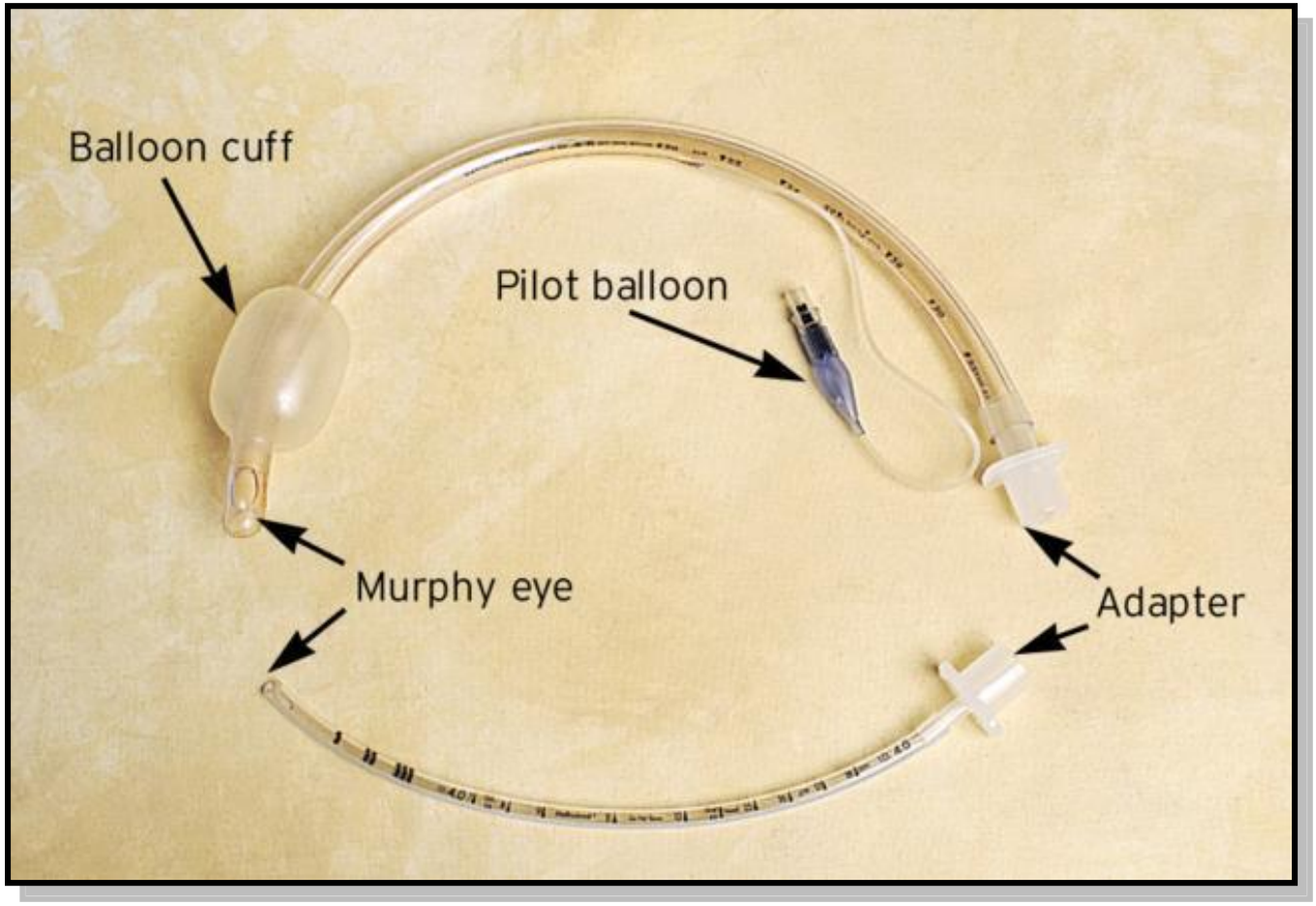
- Suction
- Laryngoscope
  - Blades
- Oxygen (BVM)
- Pillow
- Endotracheal Tube
- Stylet
- Spare endotracheal tubes
- Securing tape/twill
- Syringe

- End-tidal CO_2 Detector
- Toomey Syringe

- Rescue Airways
  - Bougie
  - Surgical

Laryngoscope Blades

ET tube



ET tube with malleable Stylet

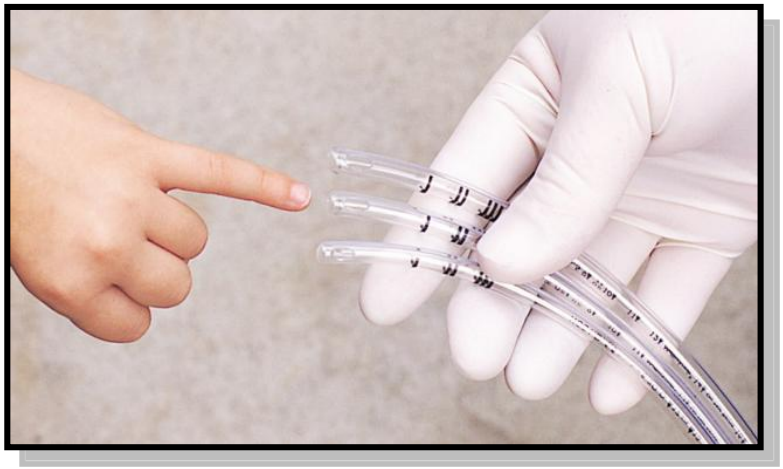
Magill forceps

Tube Sizes

- 9 - 11 years 28-36 kg 7.0 mm (cuffed)
- 12 to adults (>46kg) 7.0 – 8.0 mm (cuffed)
- Adult female 7.0 – 8.0mm (cuffed)
- Adult male 7.5 – 8.5 mm (cuffed)

- Use the formula:
  - (Age + 16)/4 or (Age/4) + 4
  - May also be determined by the size of the patients little finger

Note: Patients below the age of 8 require uncuffed ETT due to damage caused by the cuff in younger patients. Always monitor the ECG activity during intubation.



Tube sizes

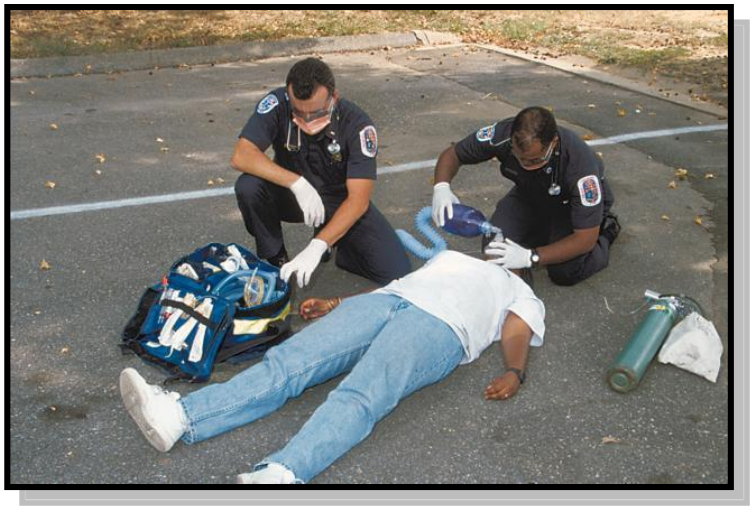
• Newborn	4 kg	2.5 mm (Uncuffed)
• 1-6 months	4 - 6 kg	3.5 mm (Uncuffed)
• 7-12 months	6 - 9 kg	4.0 mm (Uncuffed)
• 1 year	9 kg	4.5 mm (Uncuffed)
• 2 years	11 kg	5.0 mm (Uncuffed)
• 3 - 4 years	14 - 6 kg	5.5 mm (Uncuffed)
• 5 - 6 years	18 - 21 kg	6.0 mm (Uncuffed)
• 7 - 8 years	22 - 27 kg	6.5 mm (Uncuffed)

Airway Control

OROTRACHEAL INTUBATION

Procedure for Intubation

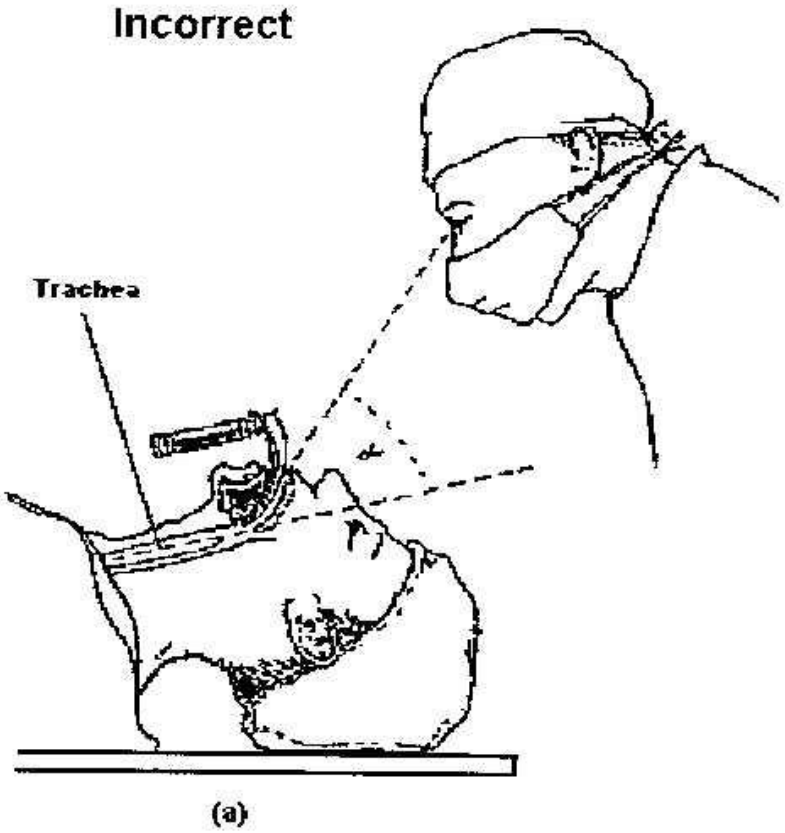
- Position yourself at the patient's head
- Inspect the oral cavity for secretions and foreign material
  - Suction if needed
- Put patient into “sniffing” position
  - Open the patient's mouth with the fingers of your right hand
- Grasp the lower jaw with your right hand
  - Draw it forward and upward
  - Remove any dentures

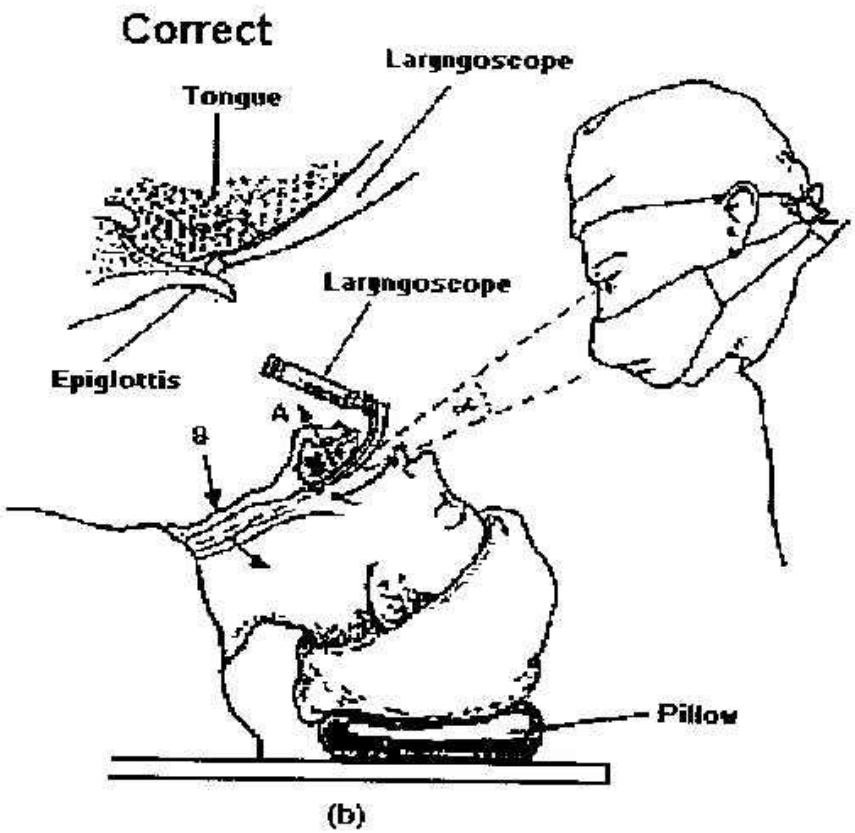


Procedure for Intubation

- Hold the laryngoscope in your left hand
- Insert the blade in the right side of the patient's mouth, displacing the tongue to the left
- Identify the uvula
  - Avoid any pressure on the lips or teeth

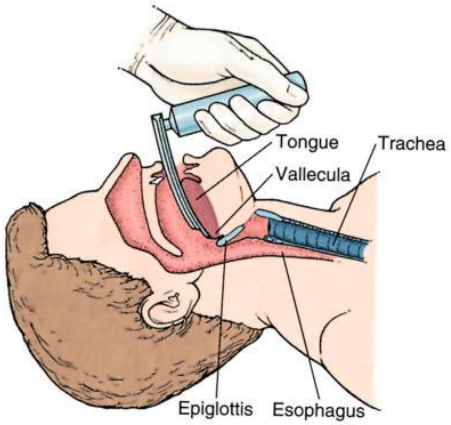
Technique


Incorrect
Trachea
(a)

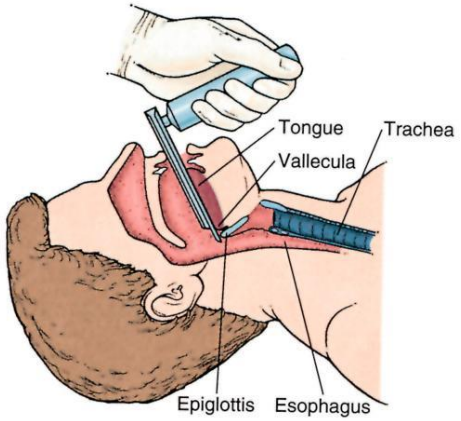

Correct
Laryngoscope
Tongue
Laryngoscope
Epiglottis
A
B
Pillow
(b)

Procedure for Intubation

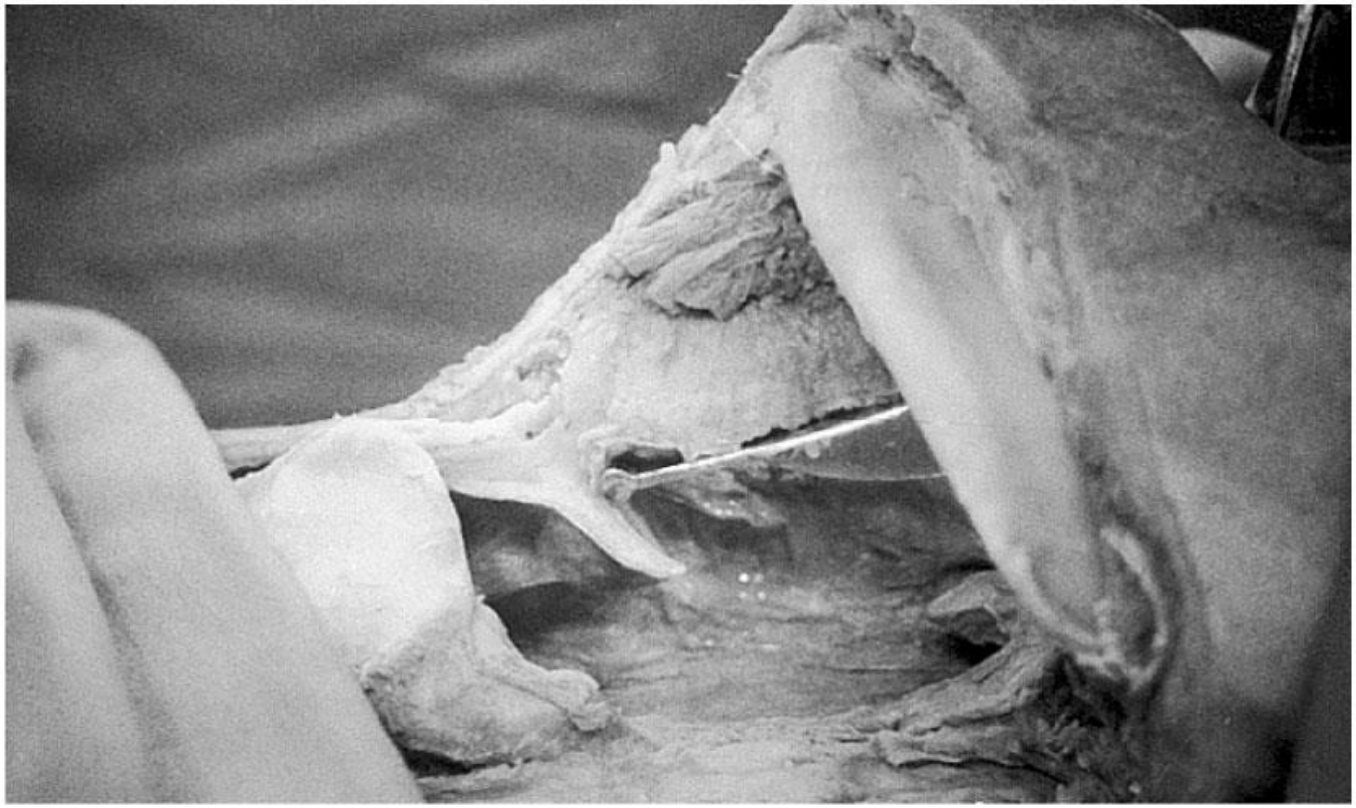
- If using a curved blade, advance the tip of blade into the vallecula



- If using a straight blade, insert the tip of blade under the epiglottis



Tip of blade is inserted into vallecula

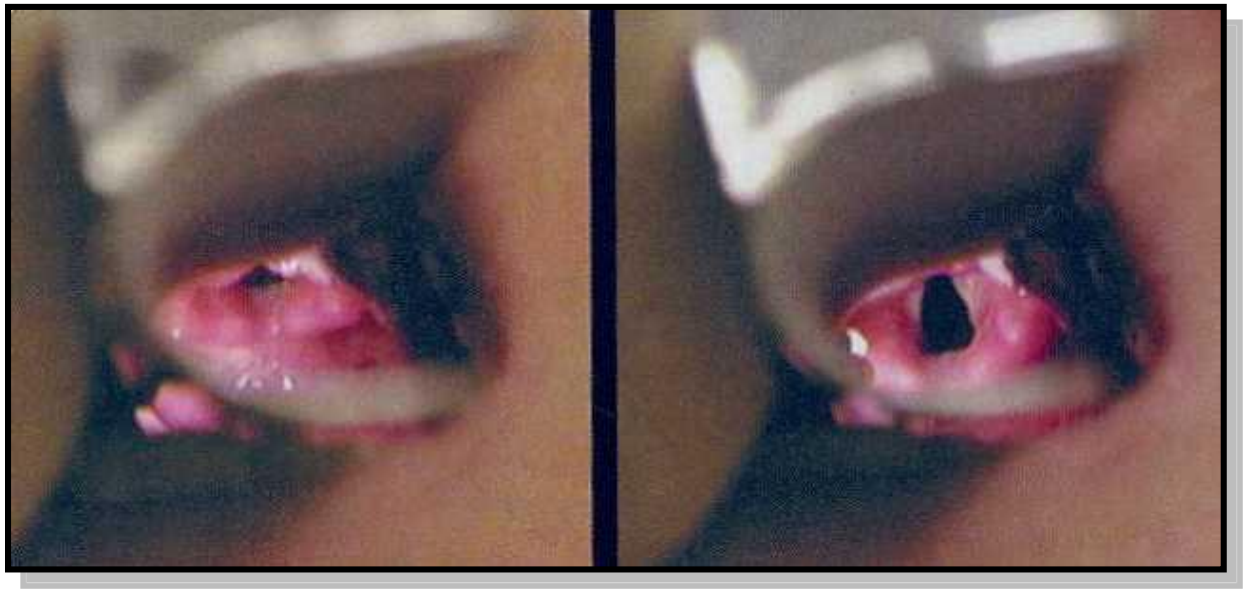


Lifting to expose vocal cords

Use blade to lift epiglottis

Procedure for Intubation

- Expose the glottic opening by exerting upward traction on the handle
  - Do not use a prying motion with the handle
  - Do not use the teeth as a fulcrum

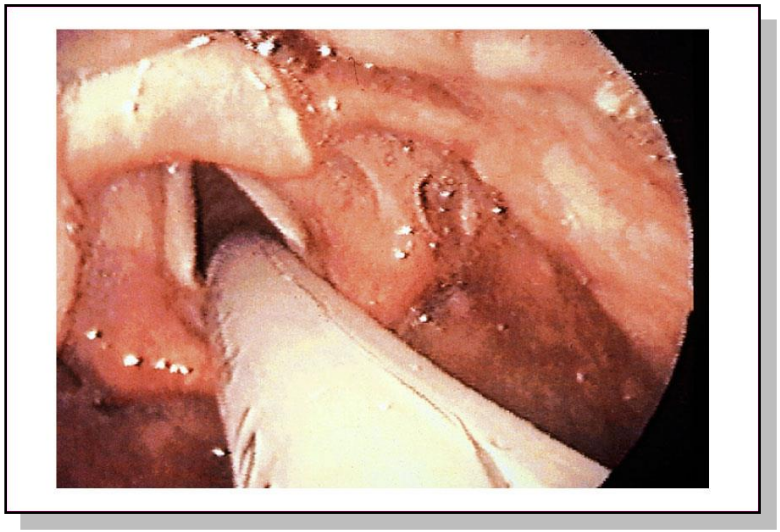


Procedure for Intubation

- Advance the ET tube through the right corner of the patient's mouth, and under direct vision, through the vocal cords
  - Remove the stylet (if used)

Procedure for Intubation

- Ensure that the proximal end of the cuffed tube has advanced past the cords about 1 to 2.5 cm (½ to 1 inch)
  - Observe depth markings on the ET tube during intubation
  - Inflate the cuff and remove syringe
  - Attach the tube to a mechanical airway device
  - Confirm placement
  - Begin ventilation and oxygenation



Depth of insertion in Children

- For children over the age of 2 can use:

$$\text{Depth} = \frac{\text{Age (years)}}{2} + 12$$

- Or may use:

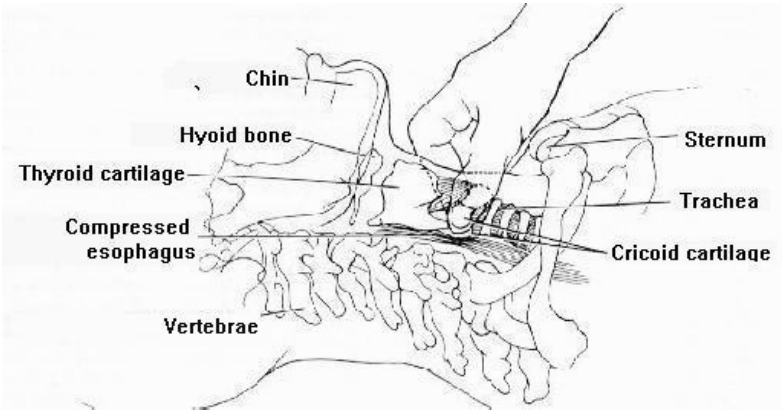
Depth = internal diameter X 3

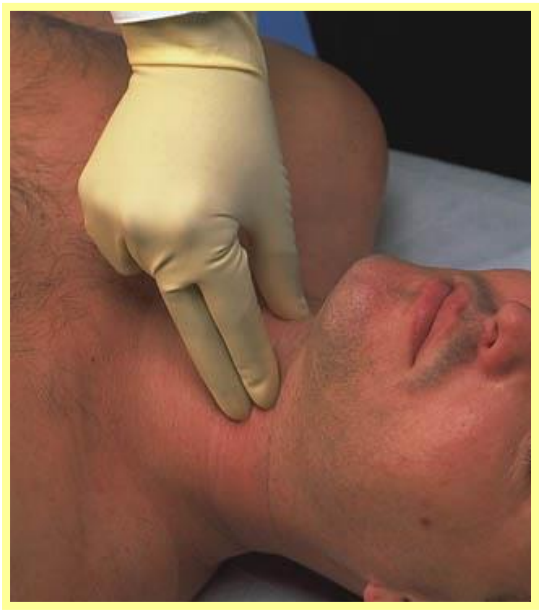
Confirming Tube Placement

- Direct re-visualization
- Auscultation
  - Epigastric area
  - Bilateral bases
  - Apices
- End tidal CO_2
- Esophageal detector device (EDD)
- Condensation inside the ETT
- Absence of vomitus in the tube
- Absence of vocal sounds

Extra help

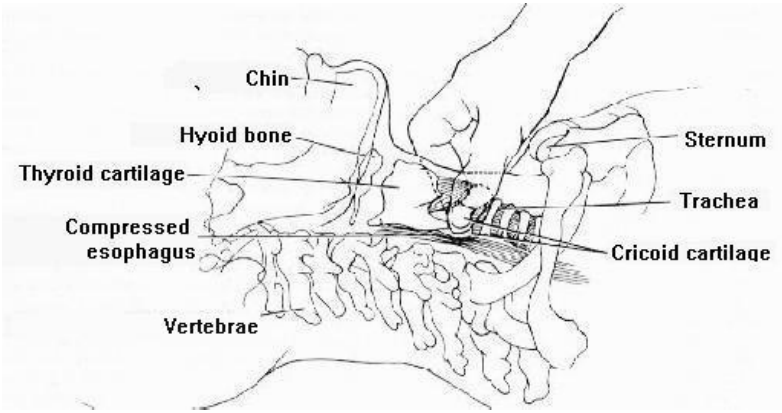
- Sellick's Maneuver
  - Helps displace the larynx posteriorly for a better view
  - This pressure also prevents gastric contents from leaking into the pharynx by extrinsic obstruction of the esophagus.

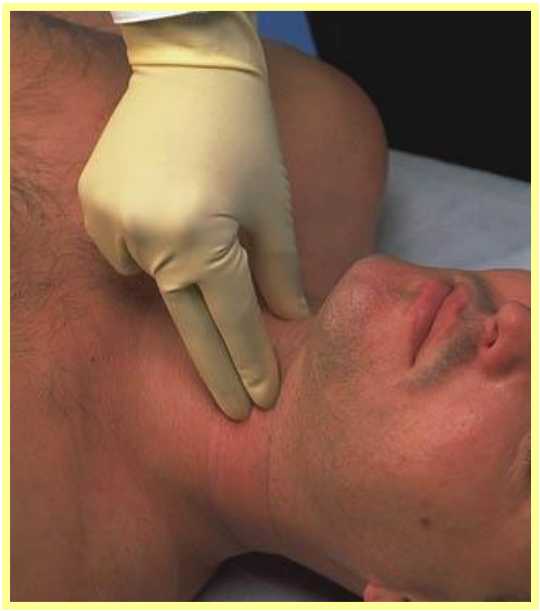




Extra help

- External Laryngeal Manipulation (ELM)
- BURP
  - Brings the larynx into view to ease intubation
    - “Back”
    - “Up”
    - “Right”
    - “Pressure”





Continuously recheck
and reconfirm the placement of
the endotracheal tube.

Intubation with Spinal Precautions

- Requires a minimum of two rescuers
- Procedure
  - Prone position method

Airway Control

NASOTRACHEAL INTUBATION

Indications for Nasotracheal Intubation

- Nasotracheal intubation may the airway of choice in patients with:
  - Spontaneous respirations
  - Cervical spine compromise
- Examples:
  - Medication OD
  - Asthma/COPD
  - Stroke
  - Status Epilepticus
  - Altered LOC

Complications

- Epistaxis
- Vagal stimulation
- Damage to turbinates or septum
- Laceration in the retropharyngeal
- Vocal cord injury
- Damage to the arytenoids
- Esophageal placement
- Intracranial placement (basil skull)

Procedure

- Prepare equipment as in orotracheal intubation (Select ET 1 mm smaller – No Stylet)
- Pre-oxygenate the patient
- Lubricate the ET tube with water soluble or lidocaine jel
- Insert the tube into the nasal cavity along the floor of the nostril
  - If resistance, attempt other nostril
  - If still unsuccessful consider a tube 0.5 mm smaller
- Provide cricoid pressure and advance the ETT until maximum airflow is heard
- Gently and swiftly advance ETT during inspiration
- Inflate cuff and Verify tube placement
- If intubation fails retract ETT, reoxygenate and reattempt

Airway Control

DIGITAL INTUBATION

Indications for Digital Intubation

- Though not common practice, may be useful in patients:
  - Entrapment where view of airway is compromised
  - Large amounts of fluid or secretions hampering a good view
  - Equipment failure

Procedure

- Prepare equipment as in orotracheal intubation (stylet may be used)
- Preoxygenate the patient and insert bite stick to protect yourself
- Insert index and middle finger into pt's mouth and 'walk' fingers over tongue pulling it and the epiglottis away from glottic opening
- Once the epiglottis has been located maintain control with middle finger
- Using the index finger as a guide, insert the ETT into the airway
- A Sellick's maneuver may be helpful at this point
- Inflate cuff and Verify tube placement

Airway Control

DIFFICULT AIRWAY

Goals

- Predict a difficult airway based on clinical criteria
- Plan for appropriate action in the difficult airway
- Initiate appropriate plans of attack with confidence

“Can’t Ventilate/Can't Intubate”

Ideal conditions for intubation

- Ideal Lighting, positioning, etc.
- Plenty of assistance
- Time to prepare, plan, discuss
- Option to Abort
- Empty Stomach
- Back up available

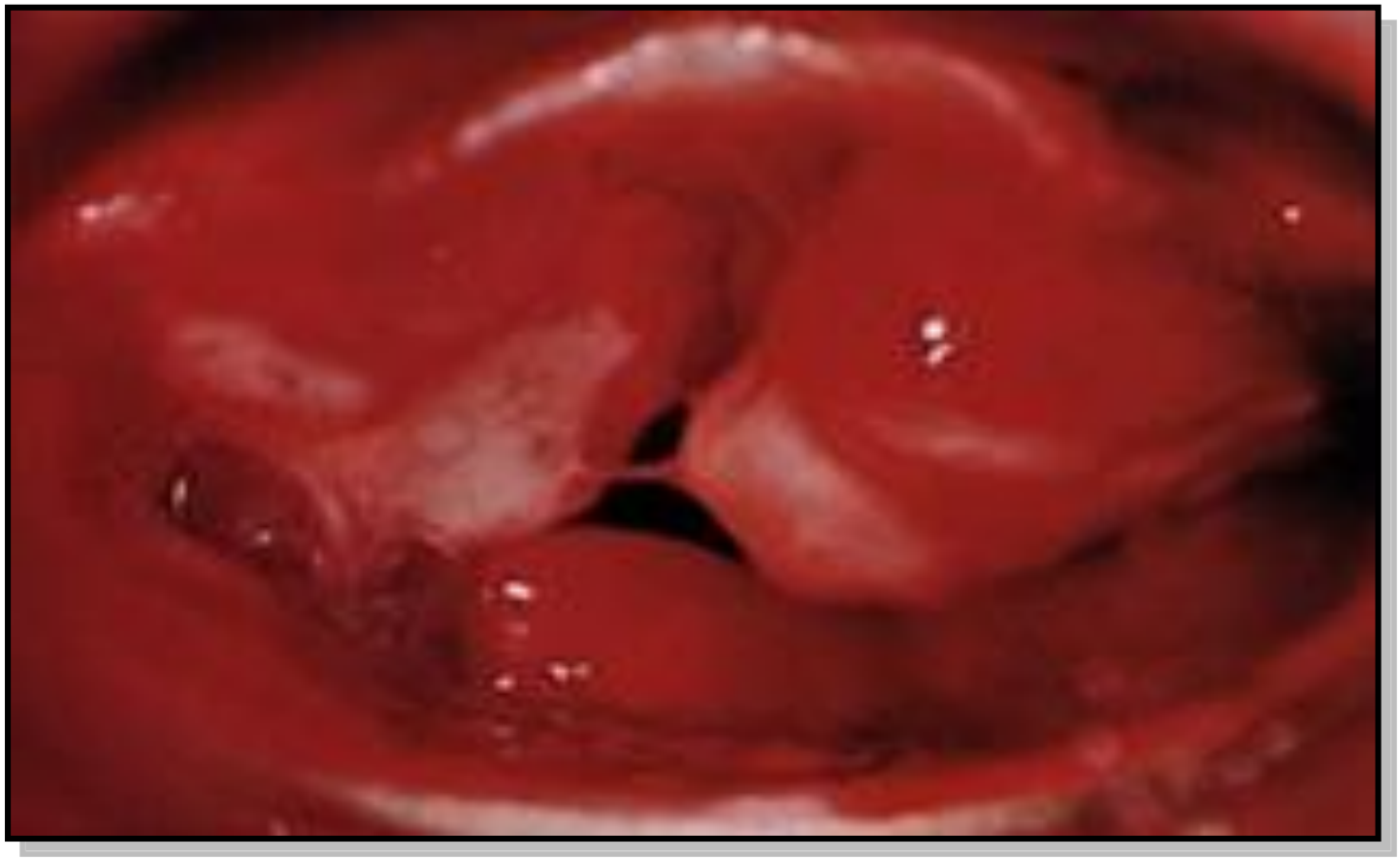
Ideal Pt. for intubation

- Intact, clear airway
- Wide open mouth
- Pre-Oxygenated
- Intact respiratory drive
- Normal dentition/good oral hygiene
- Clearly identifiable and intact Neck and Face
- Big open Nostrils
- Good Neck Mobility
- Greater than 90 KG, Less than 110 kg.

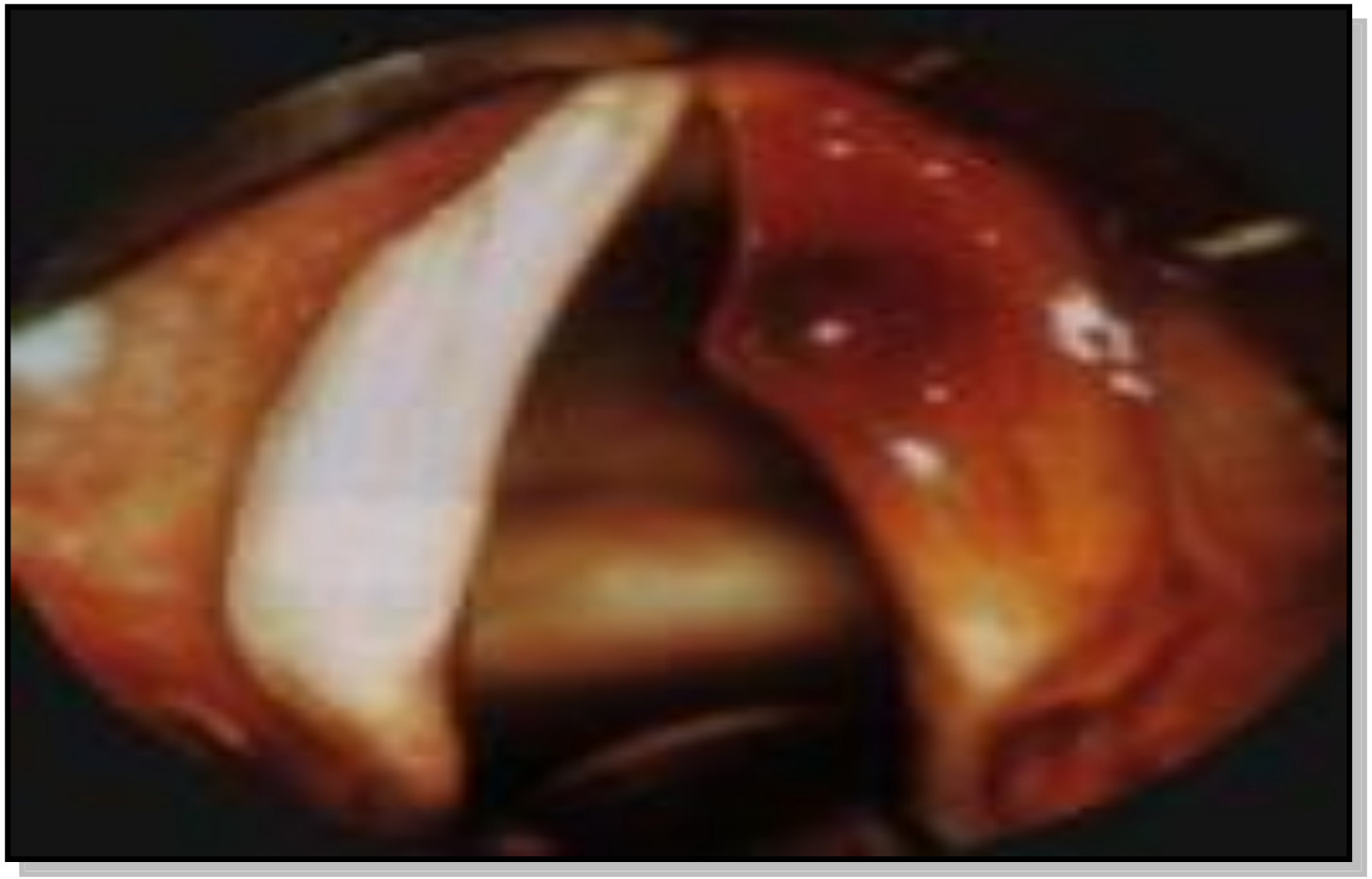
Ped and Adult Normal Trachea

They Tend to look like this

And This:



And This..
(after failed ETT attempt)



- Most of our Patients are already “difficult airways” by “OR” Standards. Why should EMS personnel try to further identify a difficult airway?

AMA

- The American Society of Anesthesiology (AMA) has noted:
  - "… there is strong agreement among consultants that preparatory efforts enhance success and minimize risk."
  - And "…The literature provides strong evidence that specific strategies facilitate the management of the difficult airway "
  - Thus Identifying a potentially difficult airway is essential to preparation and developing a strategy.

What does this mean to us?

- Well, many Anesthesiologist have the option to “Abort” induction, or to work through a problem with as much assistance as needed.
- In the REAL WORLD of EMS that is seldom the case for Paramedics.
- However many of the BASIC principles are valid in the clinical evaluation of Patients, and thus valuable in our education as medics.
- Knowing these principles will improve our decision making process and Patient Care;.

The Difficult Airway

- A patient may be difficult to:
  - Ventilate (Remember BOOTS)
  - Intubate (LEMON or MMAP)

Lemon Law

LEMON Law

- Look externally.
- Evaluate the 3-3-2 rule.
- Mallampati.
- Obstruction?
- Neck mobility

MMAP

- Mallampati
- Measure 3-3-1
- A-O extension
- Pathologic obstruction

L: Look Externally

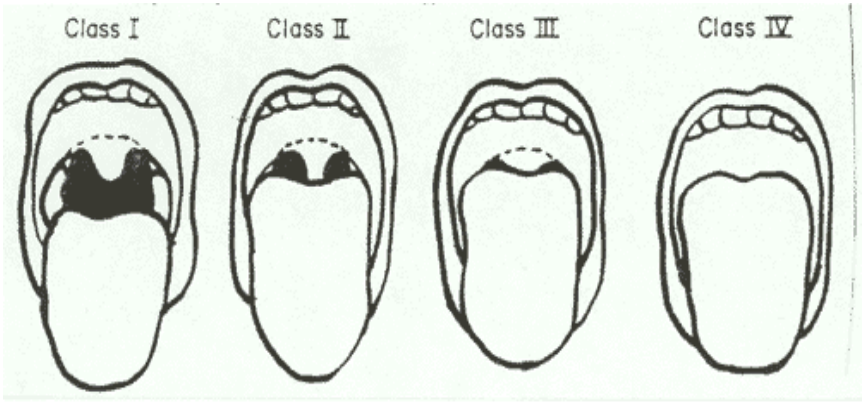
- Obesity or very small.
- Short Muscular neck
- Prominent Upper Incisors (Buck Teeth)
- Receding Jaw (Dentures)
- Burns
- Facial Trauma
- S/S of Anaphylaxis
- Stridor
- FBAO

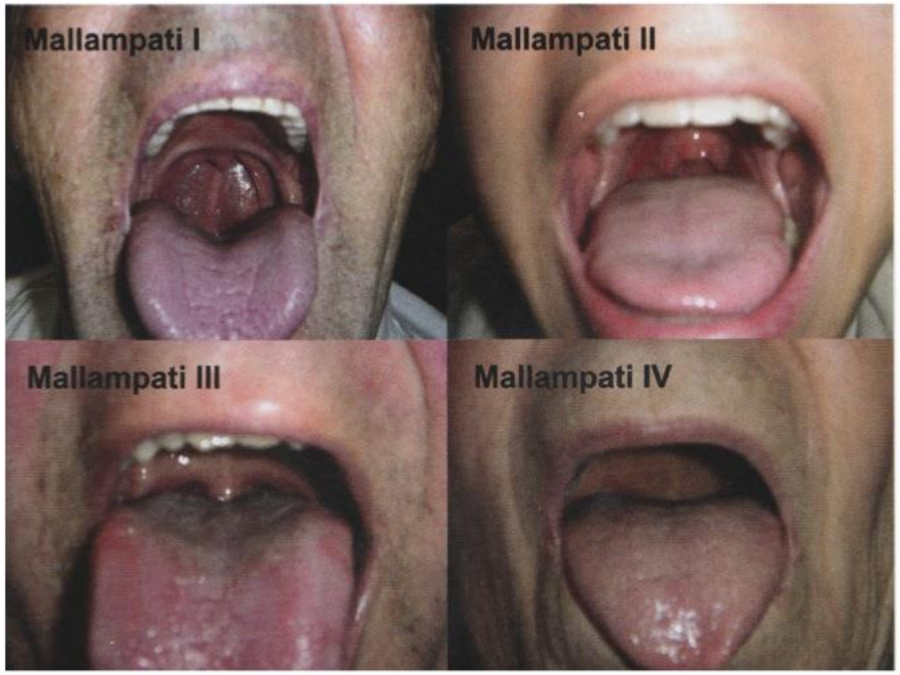
E: Evaluate the 3-3-2 rule

- 3 finger breadths of mouth opening
- 3 finger breadths from Front of Chin to Hyoid
- 2 finger breadths from mandible to thyroid cartilage

M: Mallampati Classification

- A Method used by Anesthesiologist
- Open mouth and view oral cavity
  - Class I: Faucial pillars, soft palate and uvula visualized
  - Class II: Faucial pillars and soft palate visualized, but uvula masked by the base of the tongue
  - Class III: Only soft palate visualized
  - Class IV: Soft palate not seen Blood





O: Obstruction?

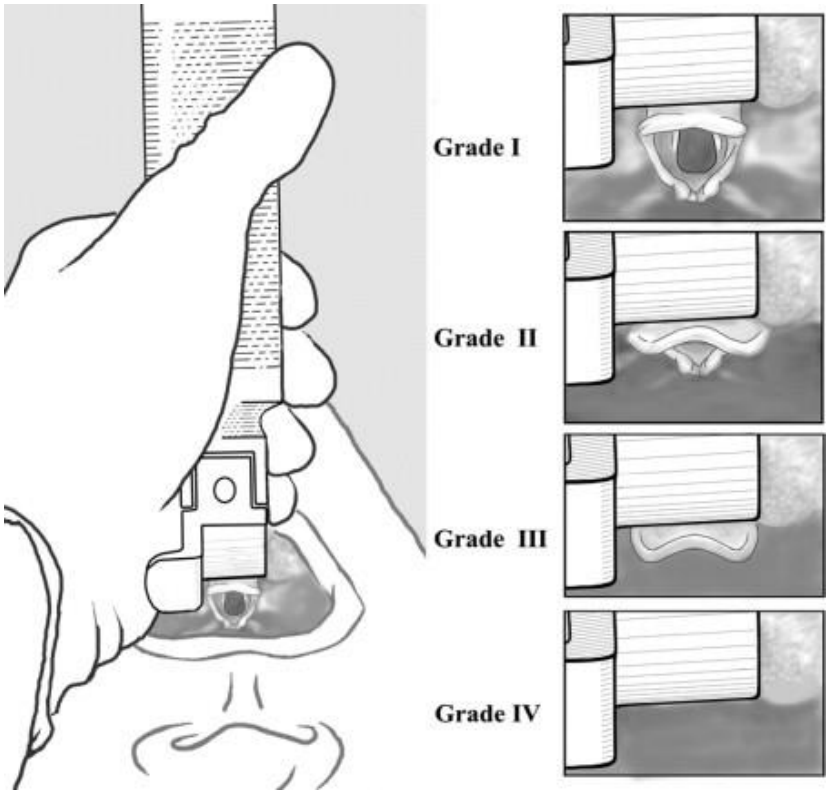
- Blood
- Vomitus
- Teeth (“chicklets”)
- Epiglottis
- Dentures
- Tumors
- Impaled Objects

N: Neck Mobility

- Spinal Precautions
- Impaled Objects
- Lack of access
- See PMHx for others.

Cormack & Lehane Grading

- Another method which involves direct laryngoscopic view of the larynx
  - Reliable to predict difficult direct Laryngoscopy
  - A Class I view is a Grade I Intubation 99% of the time
  - A Class IV view is a Grade III or IV intubation 99% of the time
- Grade I: the vocal cords are visible
- Grade II: the vocals cords are only partly visible
- Grade III: only the epiglottis is seen
- Grade IV: the epiglottis cannot be seen



What do we do when we have a difficult airway?

- The AMA calls a Failed/Difficult Laryngoscopy a:
  - Any airway that takes more than 3 attempts
  - Any airway that takes more than 10 minutes to secure an airway
  - No wonder they say they have a 90 % success rate
  - If we had those standards our Pt's would be dead.

A little pre-planning goes a long way…

Before intubation

- Is there another means of getting our desired results BEFORE we attempt Direct Oral ETT? (Especially if we RSI)
- CPAP?
- PPV with BVM or Demand Valve?
- Nasal ETT?
- Do we have all the help we need, all Airway equipment with us? (Suction?)

What are we going to do if we don't get the Tube?

- Plans "A", "B" and "C"
- Know this answer before you tube.

Plan “A”: (ALTERNATE)

- Different Length of blade
- Different Type of Blade
- Different Position

Plan "B": (BVM and BLIND INTUBATION Techniques)

- Can you Ventilate with a BVM? (Consider two NPA's and a OPA, gentile Ventilation)
- Combi-Tube? PTLA (No Longer produced)
- EOA?
- LMA an Option?
- Retrograde Intubation?

Plan “C”

- What do we do when faced with a Can’t Intubate Can’t Ventilate situation?
  - Plan “C”: (CRIC) Needle, Surgical

?

- Do YOU feel ready to enact Plans A, B, C at a drop of a hat?
- Feel familiar with all those tools and techniques?

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Airway Management and Ventilation

FOREIGN BODY

Case

- You are called out for a 55 y/o F who is choking on a piece of steak.
- As you are pulling up to the scene, you review your approach.
- How does it differ if the patient is sitting up coughing?
  - If she is silent/unable to cough?
  - If she is unconscious in the floor?
  - When do you attempt to remove a FB from an airway?

Foreign Body Removal

- Initiate treatment measures for FBO
- Check to see if the obstruction was relieved.
- If obstruction is not relieved consider the following…

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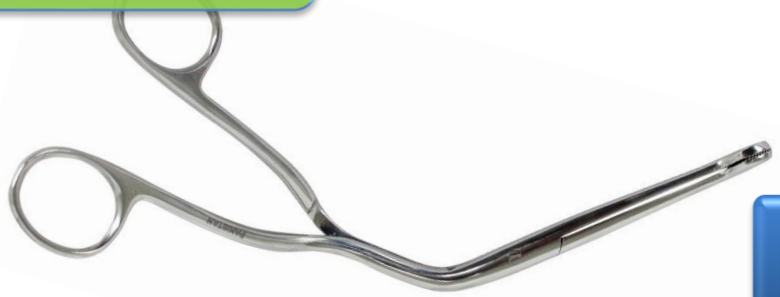
Foreign Body Removal

- FBO removed?
  - Yes
    - Reassess patient (assist ventilations if req'd)
  - No
    - Visible in oropharynx
      - Remove with Magill
    - NOT visible in oropharynx
      - Attempt direct laryngoscopic view
        - Visible
          - Remove with Magill
        - Not Visible
          - FBAO Tx, Call for ALS



Airway Control

PERCUTANEOUS CRICOTHYROIDOTOMY

Percutaneous Cricothyroidotomy

- Necessary equipment
  - 12 or 14 gauge needle
  - 10 ml syringe
  - Alcohol or betadine swabs
  - Adhesive tape
  - Oxygen tubing and oxygen supply

Percutaneous Cricothyroidotomy

- Indications
  - CVCI patient < 12 y/o

Percutaneous Cricothyroidotomy

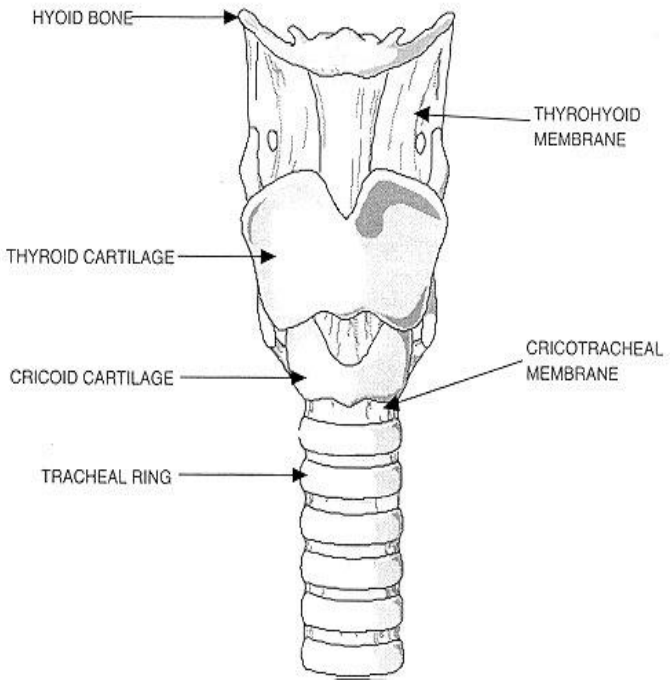
- Advantages
  - Simple to perform
  - Effective airway
  - Minimal spinal manipulation
  - Can be done quickly
- Disadvantages
  - Invasive technique
  - Requires constant monitoring
  - Does not protect the airway
  - Does not allow for efficient CO_2 elimination
  - Time restraints (30 – 45 minutes of good ventilation)

Percutaneous Cricothyroidotomy

- Complications
  - May cause Pneumothorax with high pressures
  - Hemorrhage at site of insertion
  - Perforation of the thyroid and/or esophagus
  - Does not allow for direct access for suctioning
  - May result in SubQ Emphysema

Percutaneous Cricothyroidotomy

- Procedure
  - Attach needle to the syringe
  - Place pt in the supine position
  - Identify the cricothyroid membrane
  - Stabilize larynx with one hand
  - With other hand, insert the needle through the membrane at a 45° angle towards the carina applying negative pressure to the syringe during insertion
  - Advance the catheter over the needle and remove needle/syringe holding the hub of the catheter
  - Attempt ventilations



Airway Control

SURGICAL CRICOTHYROIDOTOMY

Surgical Cricothyroidotomy

- Necessary equipment
  - Scalpel blade
  - 6.0 or 7.0 ET Tube
  - Antiseptic solution
  - Oxygen
  - Suction device
  - BVM

Surgical Cricothyroidotomy

- Contraindications
  - Inability to identify landmarks
    - Underlying anatomical abnormality (tumor, sub-glottic stenosis)
  - Tracheal transection
  - Acute laryngeal disease/trauma
  - Child under 10 y/o

Surgical Cricothyroidotomy

- Complications
  - Prolonged execution time
  - Hemorrhage
  - Perforation of the thyroid and/or esophagus
  - Injury to vocal cords
  - Injury to carotid and jugular vessels
  - May result in SubQ Emphysema

Surgical Cricothyroidotomy

- Procedure
  - Place pt in the supine position
  - Identify the cricothyroid membrane
    - Make a 2” horizontal incision through skin
    - Make a vertical incision through the membrane or open membrane incision with scalpel handle and rotate 90°

      Or

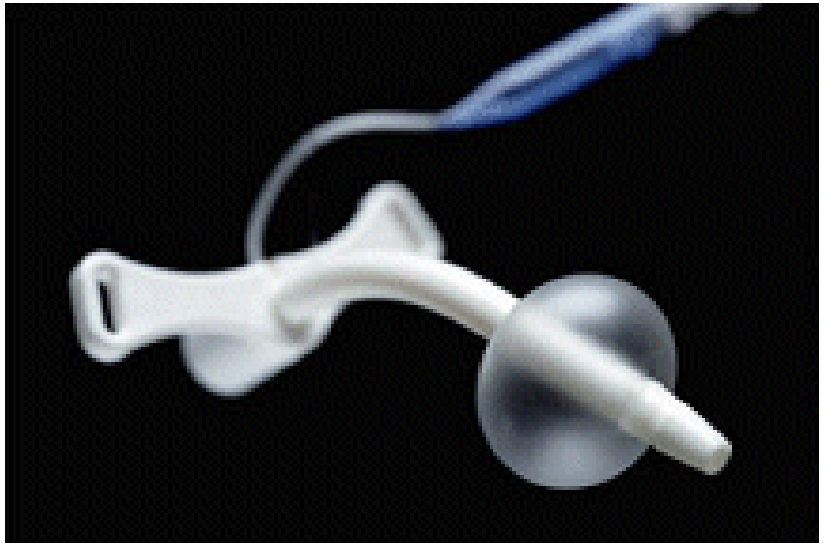
    - Make a 2” vertical incision through skin/membrane
    - Make a horizontal incision through the membrane or open membrane incision with scalpel handle and rotate 90°
  - Insert ETT and inflate cuff
  - Provide ventilation
  - Confirm placement

Airway Control

MELKER AIRWAY

Melker

- Necessary equipment
  - Antiseptic solution
  - Scalpel blade
  - Needle/Syringe
  - Guide wire
  - Introducer
  - Tracheal Airway
  - Oxygen
  - Suction device
  - BVM



Surgical Cricothyroidotomy

- Contraindications
  - Inability to identify landmarks
    - Underlying anatomical abnormality (tumor, sub-glottic stenosis)
  - Cardiac Arrest (opposed to Traumatic Arrests)
  - Child under 12 y/o

Surgical Cricothyroidotomy

- Procedure
  - Place pt in the supine position
  - Identify the cricothyroid membrane
  - Prepare the insertion site with Betadine
  - Make a small vertical mid-line skin incision over the cricothyroid membrane with the scalpel
  - With the syringe attached, the introducer needle is inserted into the cricothyroid membrane, aspirate as you advance
  - Leaving the catheter in place and insert the guide wire through the catheter and then remove the catheter over the guide wire. Maintain control of the guide wire at all times.
  - Ensuring that the dilator is in the airway device, insert the device over the guide wire into the trachea
  - When the device is in place, the wire and dilator can be removed.
  - Verify tube placement.