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Airway Management and Ventilation

Primary Care Paramedicine

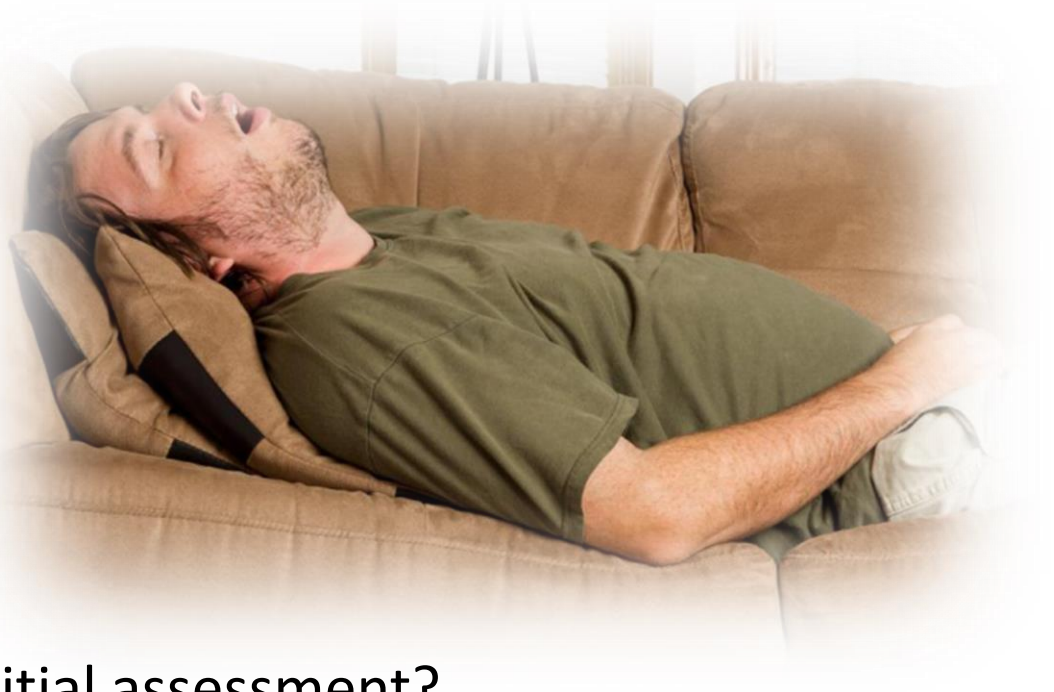
Module: 03

Section: 07

Airway Management and Ventilation

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?

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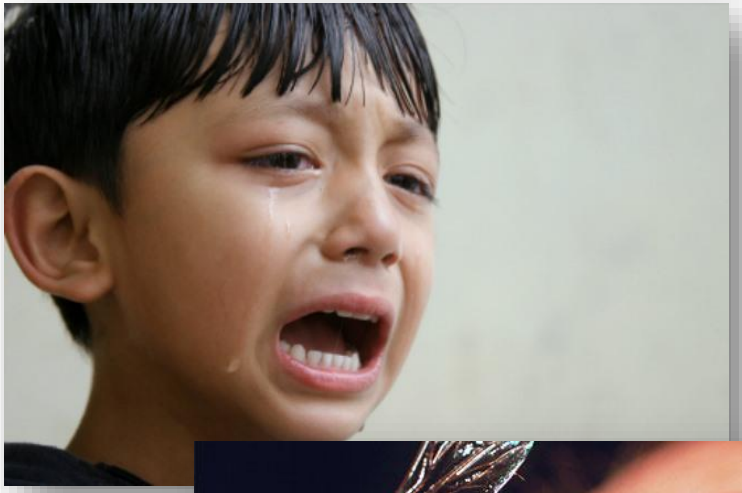
Case 02

- 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 04

- 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 Management and Ventilation

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

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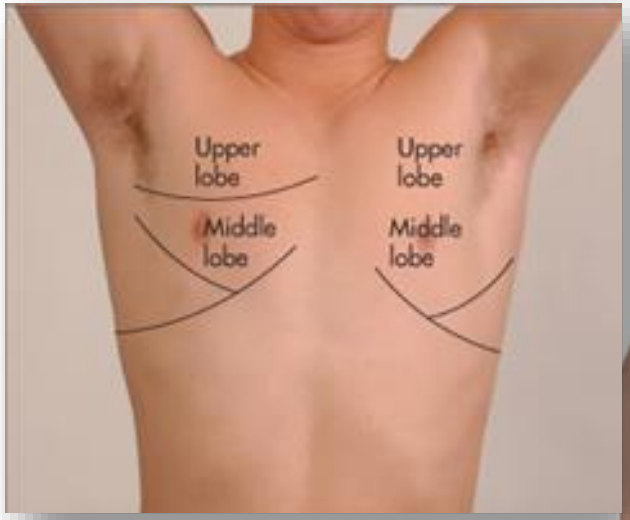
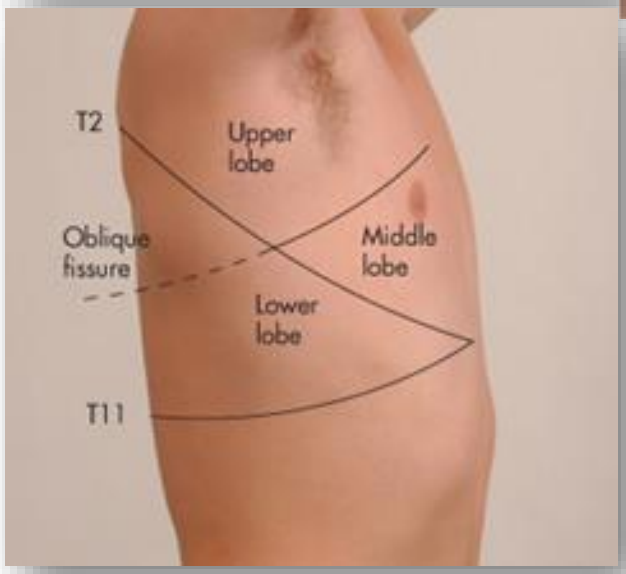
Auscultation



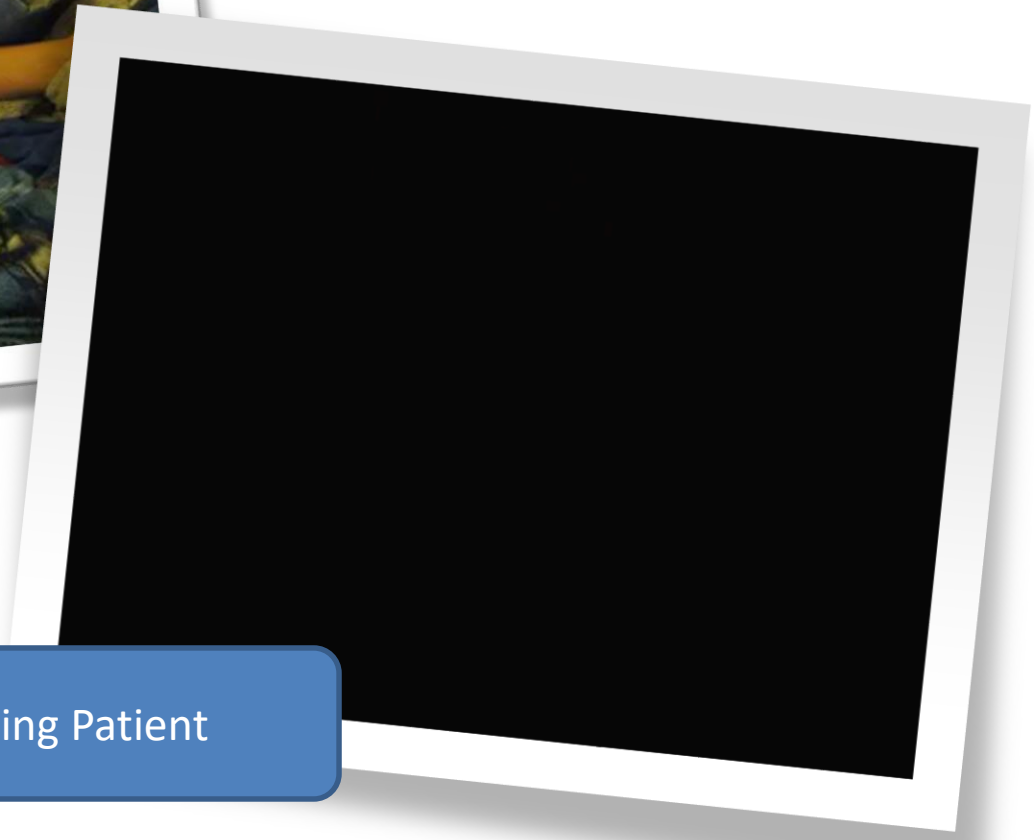


Airflow Compromise

- 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

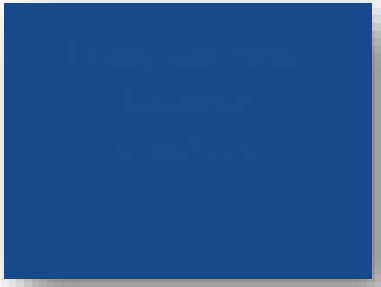
Stridor Patient



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

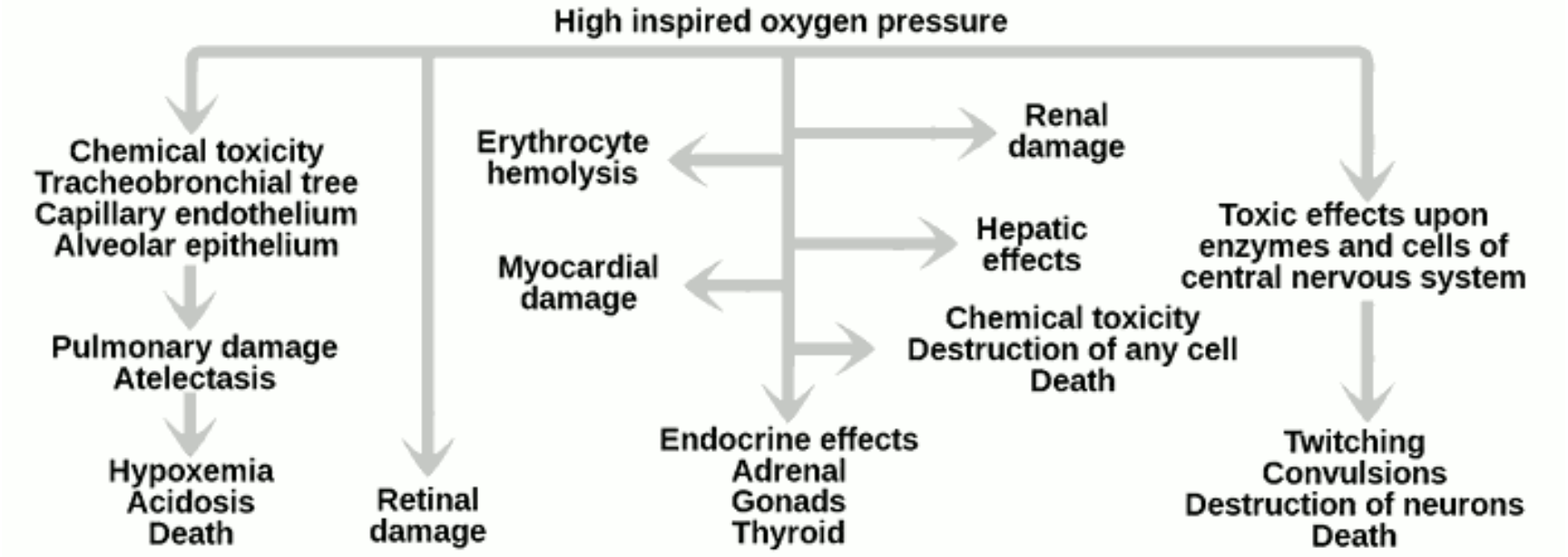
Hazards of Oxygen

- 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

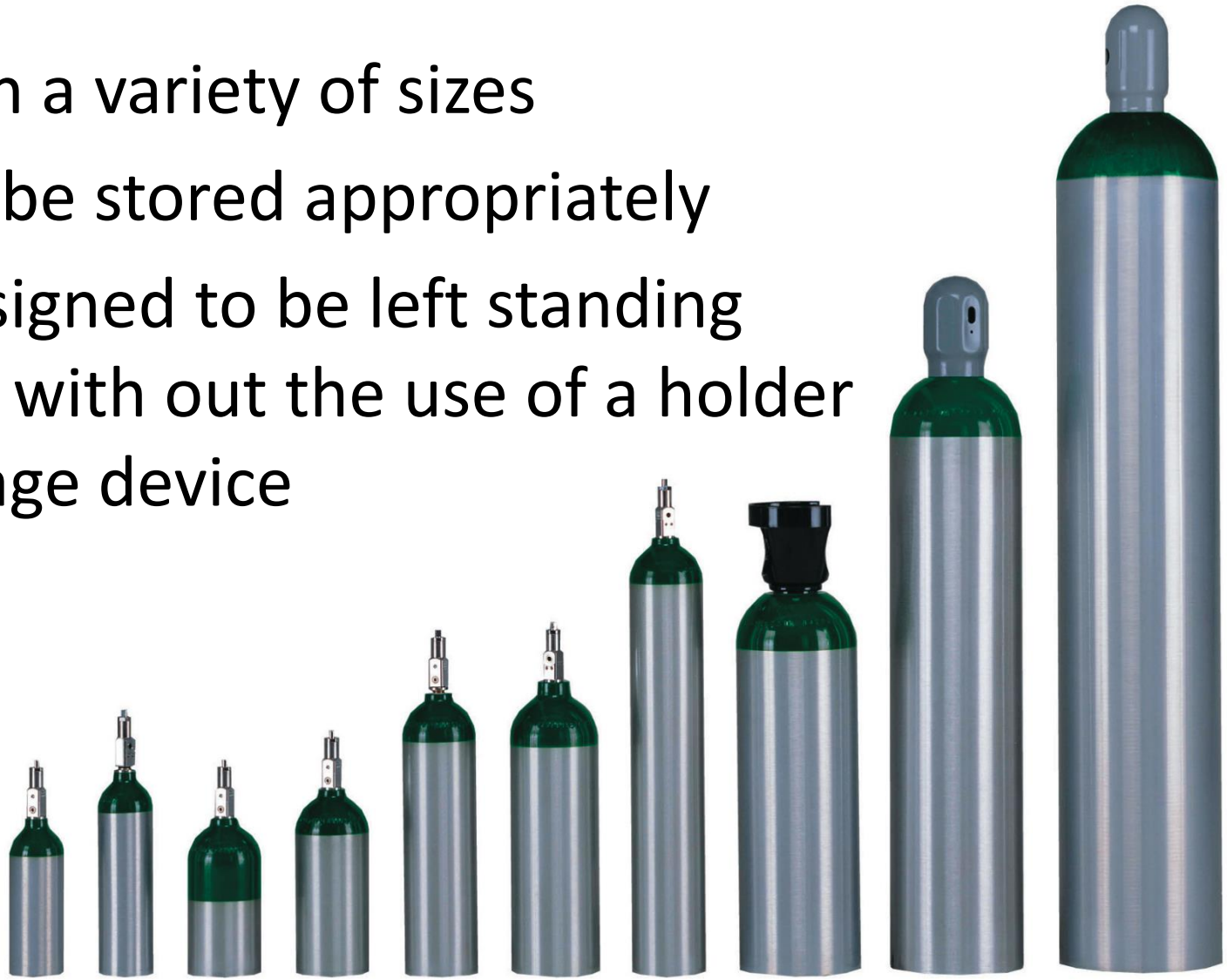
- Reduce free flow (2000 psi) to a useable 40 - 70 psi and provides control over the flow rate

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

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

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

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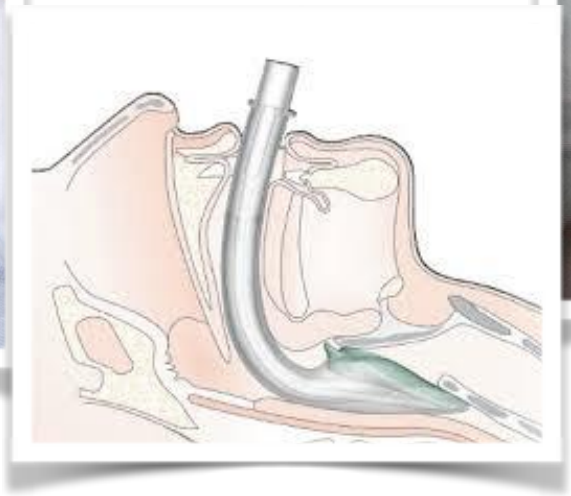
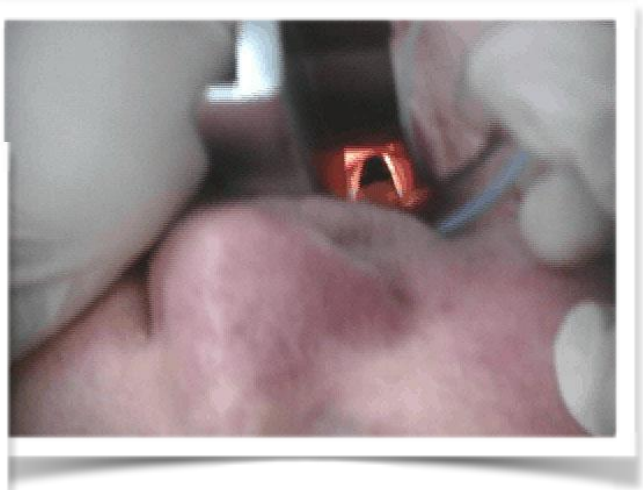
Airway Management and Ventilation

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)

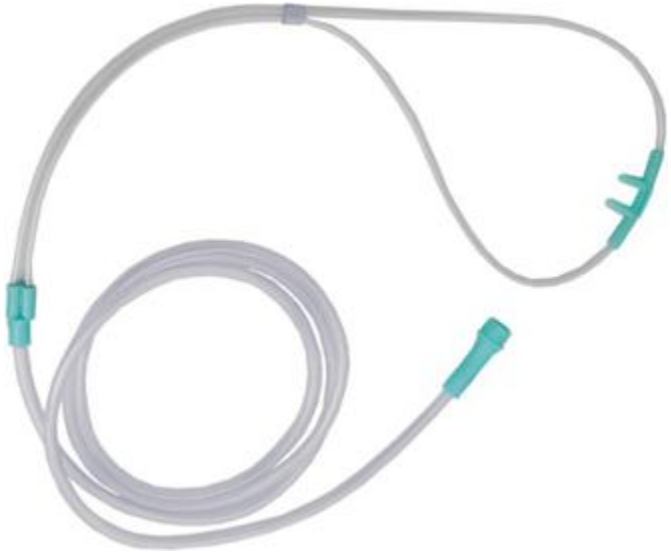
Oxygen Therapy

Low Flow Nasal Cannula (LFNC)

Type: High flow (low to medium concentration)

Percentage: 24 - 44%

Flow Rate: 1 - 6 L/min



Oxygen Therapy

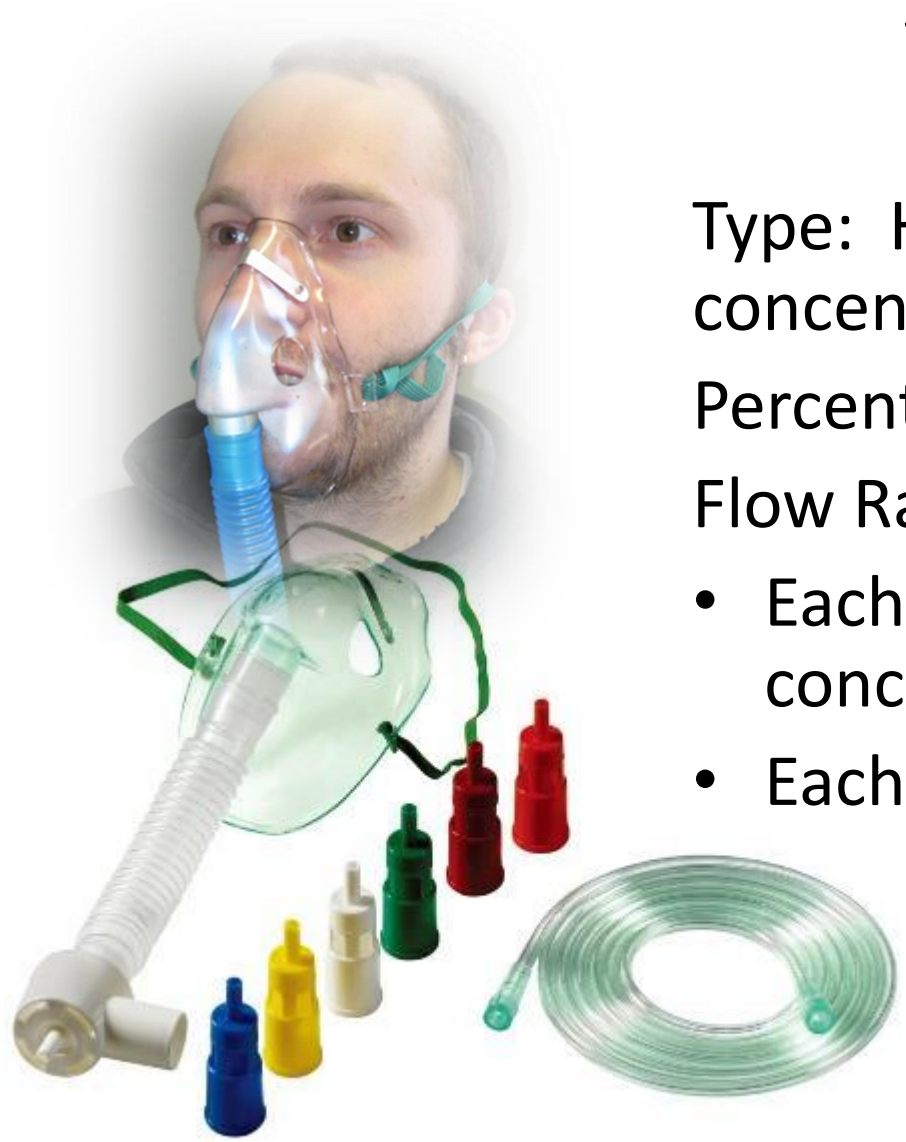
Simple Face Mask

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

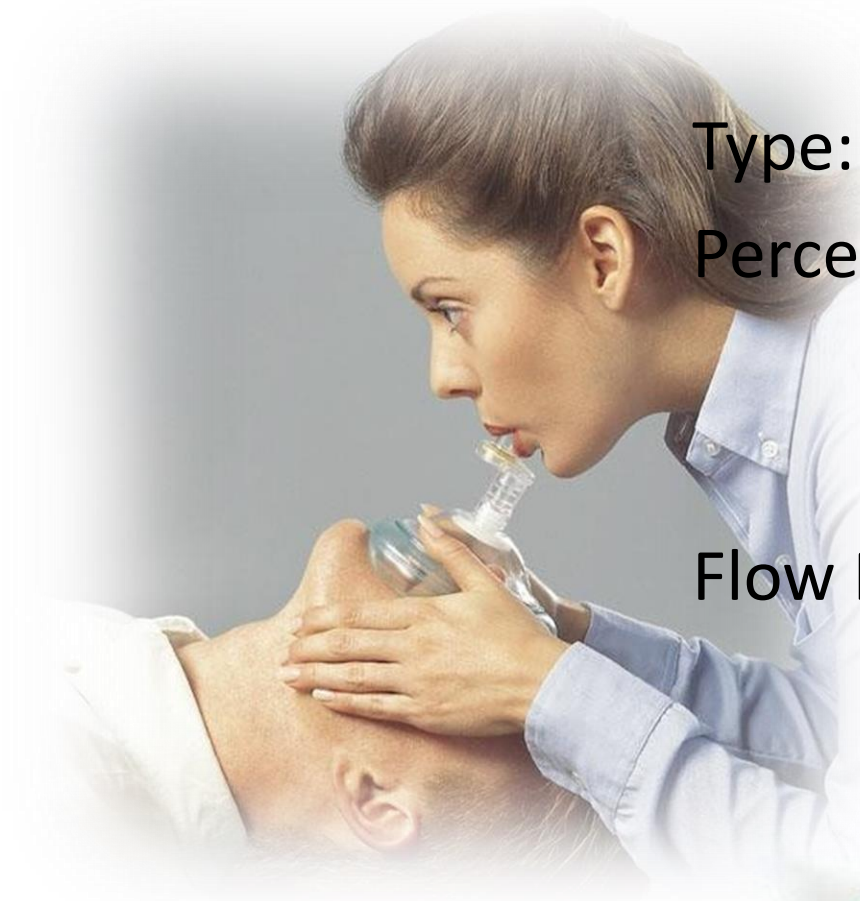
Percentage: 90 - 100%

Flow Rate: 12 - 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

Airway Management and Ventilation

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
  - Supraglottic 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.

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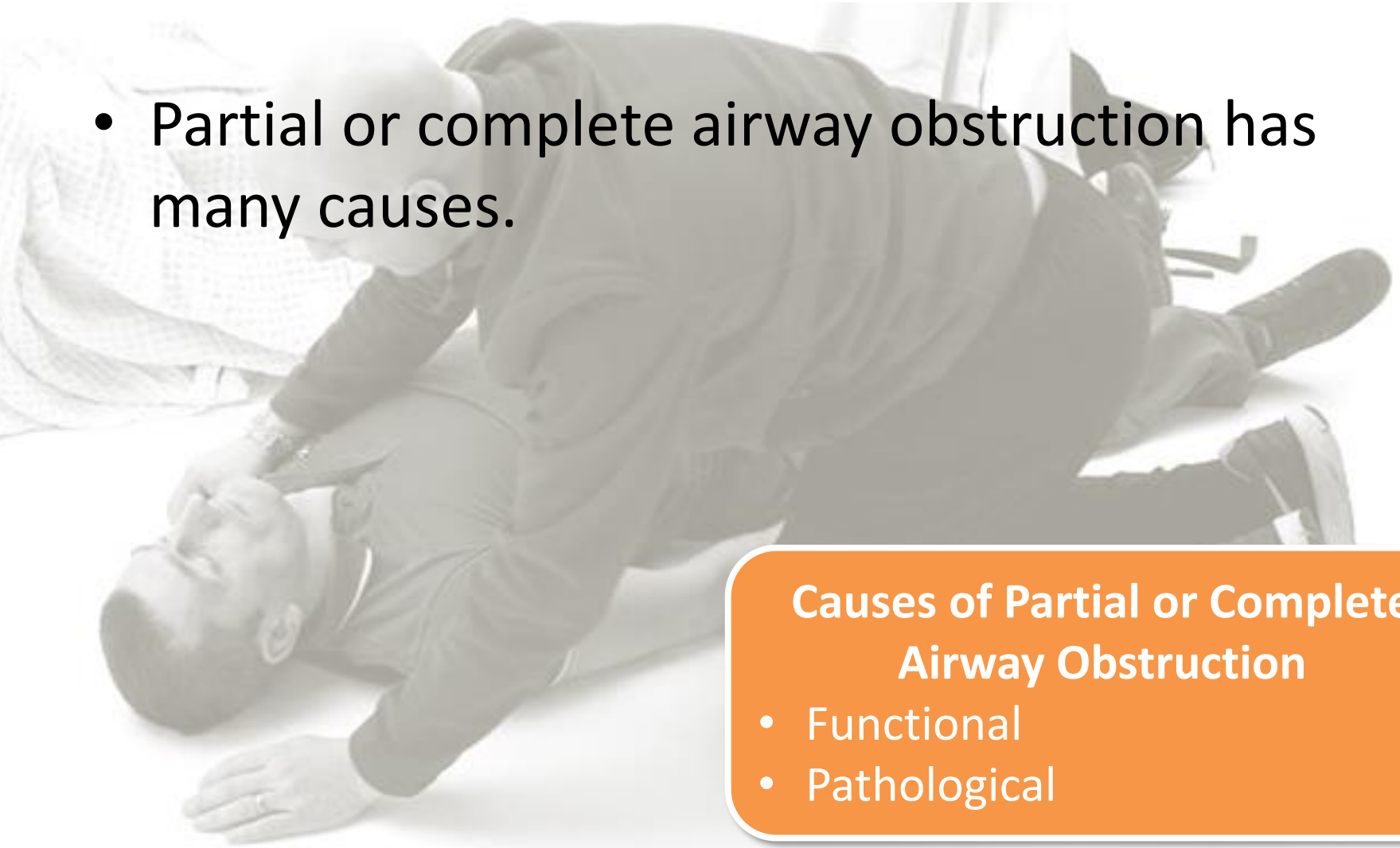
Airway Management and Ventilation

MANUAL AIRWAY POSITIONS

Manual Airway Positioning



- Partial or complete airway obstruction has many causes.

Causes of Partial or Complete Airway Obstruction

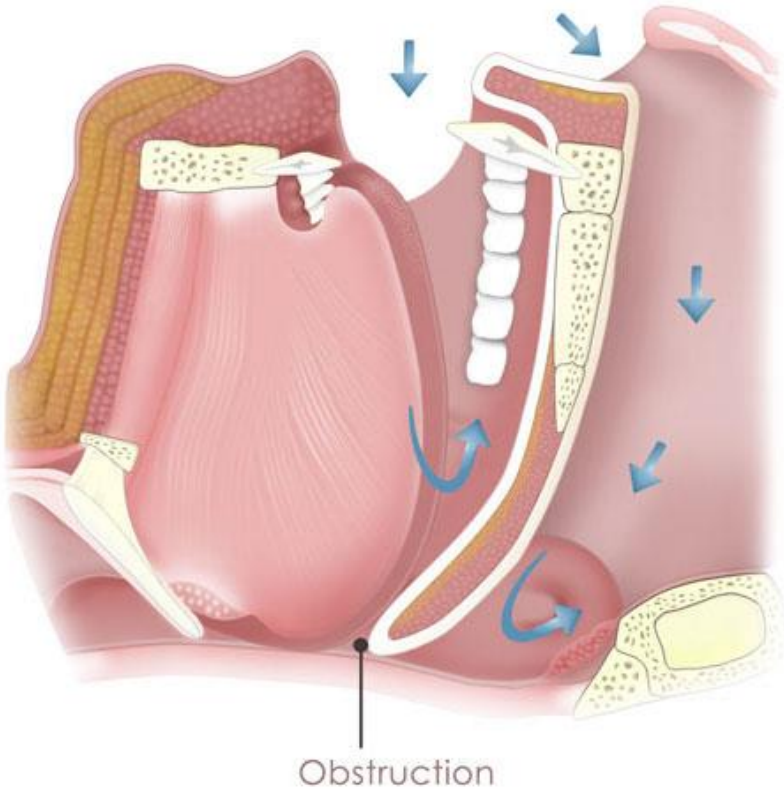
- Functional
- Pathological

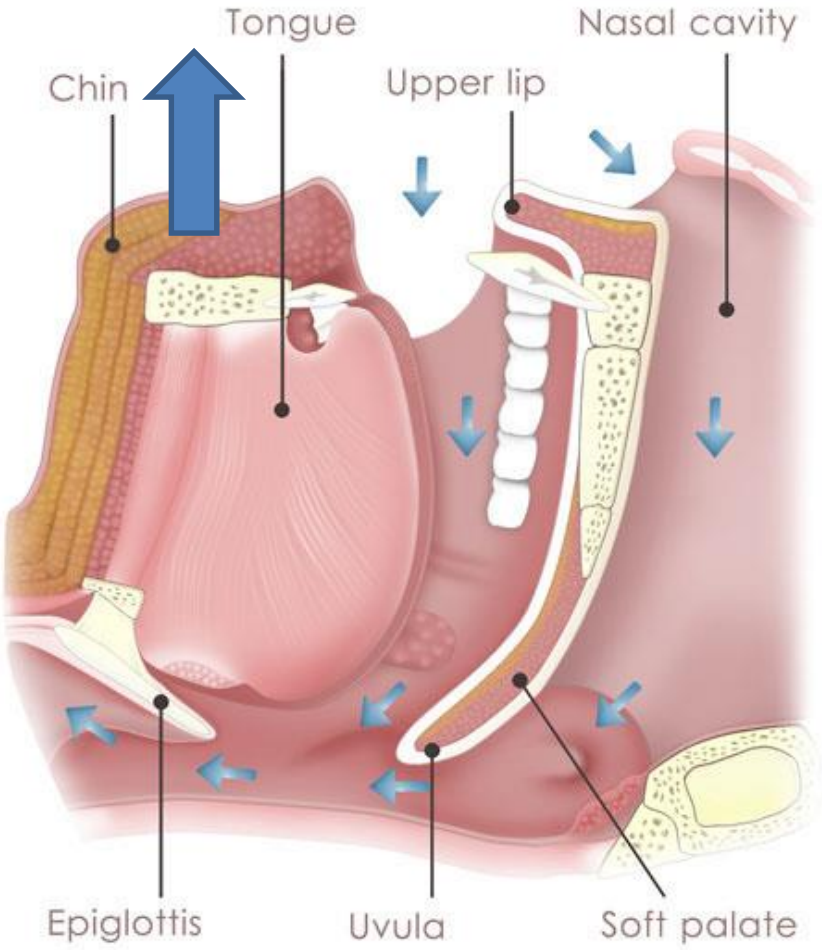
Recognition of a Functional Upper Airway Obstruction

- 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

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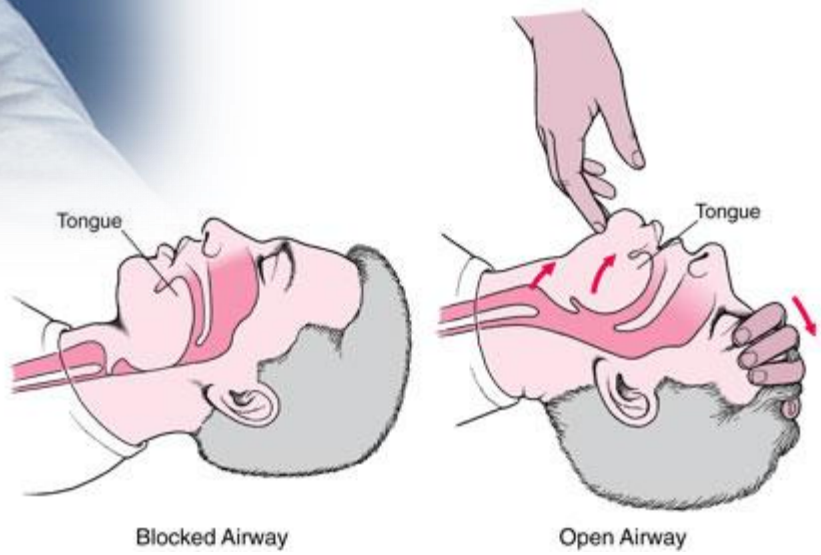
Head Tilt/Chin Lift



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Jaw Thrust Maneuver

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Modified Jaw Thrust in Trauma

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Jaw Lift Maneuver

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Cross Finger Technique

Maintaining Open Airway and Oxygenation?

- Head tilt, jaw thrust, chin lift.
- Apply oxygen (options?)
- Is the airway clear?
- Did she vomit?

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Airway Management and Ventilation

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

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

Maintaining Open Airway and 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

Airway Management and Ventilation

AIRWAY ADJUNCTS

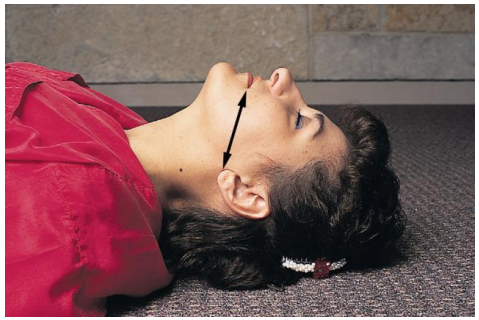
Oropharyngeal Airway (OPA)

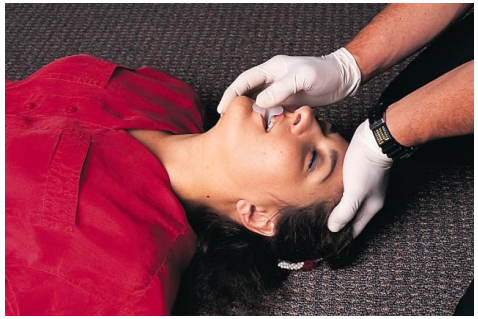
- Indications: Unresponsive patients to assist in maintaining patency of the airway by lifting the tongue off of the posterior pharyngeal wall and epiglottis
  - May also be used as a bite block
- Contraindications: gag reflex, FBAO

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

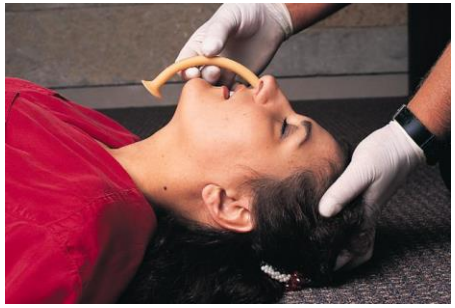
Nasopharyngeal Airway (NPA)

- 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 skull 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
  - 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 Management and Ventilation

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.

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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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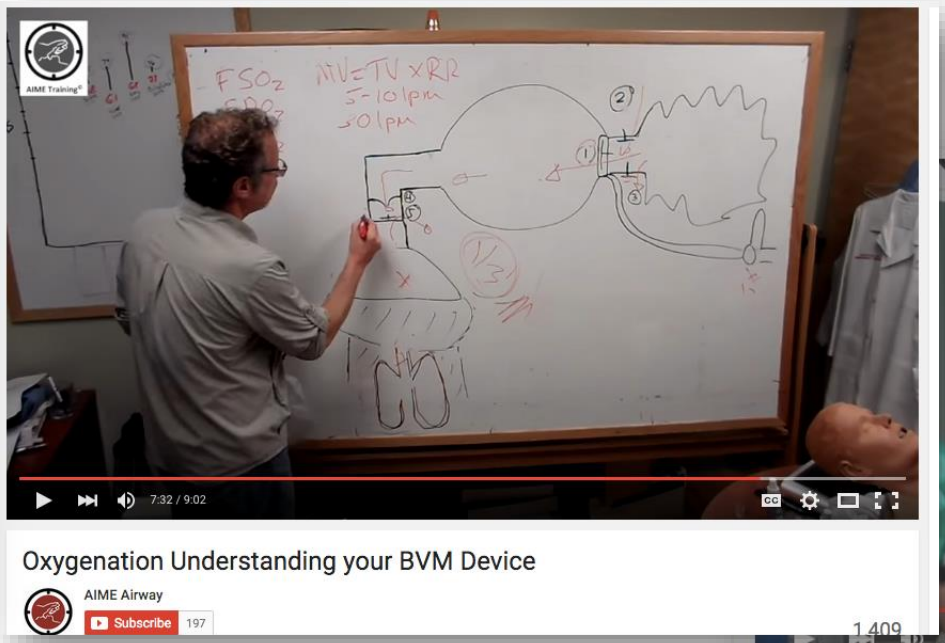
Understanding Your Gear



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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

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Predicting a Difficult Mask Ventilation

- Beard
- Obese
- Older
- Teeth
- Snoring

Adjusting for the Difficult Ventilation

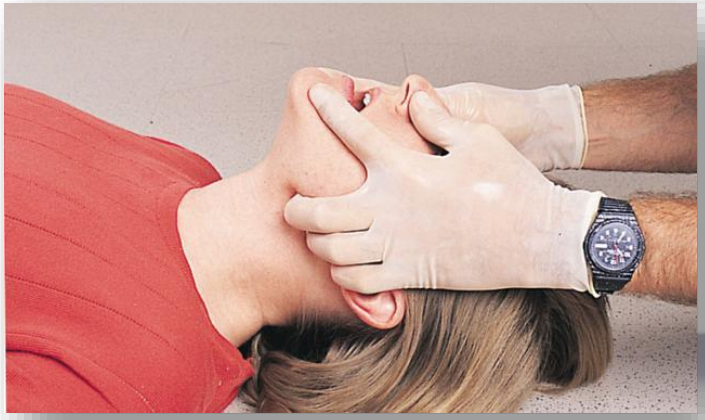
- Beard
  - Use of jelly to improve seal or remove beard
- Obese
  - Use of pillows to “ramp” patient’s head upward so the ears are in line with the sternal notch
- Older
  - Pillows may be used if kyphosis is present or using alternative manual airway maneuvers
- Teeth
  - May require alternative manual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

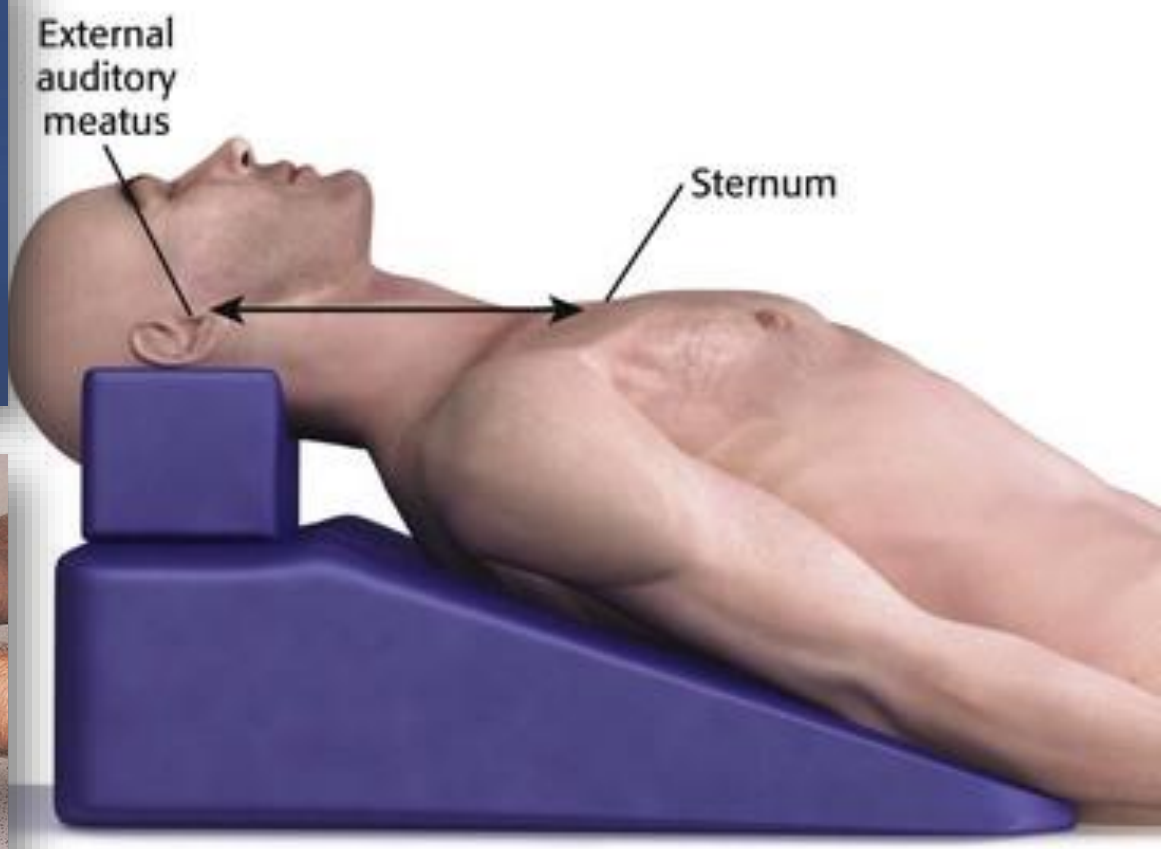
Adjusting for the Difficult Ventilation

- 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