Noninvasive Ventilation

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This Presentation is Approved for
2 CRCE Credit Hours

Learning Objectives

- Explain the rationale for noninvasive ventilation
- Describe the effects, indications, advantages, disadvantages, & complications associated with negative pressure ventilation
- Describe the operation of specific negative pressure ventilators
- Describe the modes, effects, complications, indications, & contraindications associated with noninvasive positive-pressure ventilation (NPPV)
- Describe the evidence basis for NPPV for selected conditions
- Compare the interfaces used in NPPV with respect to their indications, advantages, & limitations
- Describe the issues pertaining to types of NPPV circuits & humidification systems

Learning Objectives

- Compare the ventilator types and modes applied to NPPV with respect to their advantages and disadvantages.
- Describe techniques for ventilator control adjustments for NPPV.
- Discuss clinical issues pertaining to NPPV, including aerosol delivery, heliox, clinical sites, and end-of-life care.

Negative Pressure Ventilation

Definitions

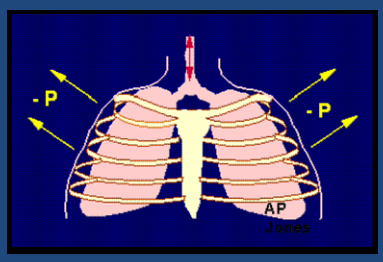
- Noninvasive ventilation: mechanical ventilation without tracheal tube
- Noninvasive positive pressure ventilation (NPPV): ventilation without tracheal tube & with positive airway pressure
- Negative pressure ventilation: ventilation with negative pressure applied to thorax

Rationale for NIV

- Ventilate patients, while avoiding the complications associated with tracheal tubes
  - Ventilator associated pneumonia
  - Airway trauma
  - Psychological trauma, due to aphonia, restraint

NPV Physiologic Effects

- Subambient pressure surrounds thorax to inflate lungs



Physiologic Effects

- Decreased work of breathing (WOB)
- Increased distribution of ventilation
- Subambient pressure inflates lungs
  - Intermittent, with passive deflation
  - Continuous negative expiratory pressure (CNEP) - maintain FRC
- Increased pulmonary blood flow
- Increased ventricular filling - increased cardiac output (cuirass)

Indications

- Unable to fit or tolerate mask for NPPV
- Neuromuscular disease
- Neurological trauma
- Intolerance of increased mean airway pressure, e.g. PEEP
- COPD - chronic state & acute exacerbations

Indications

- Post congenital heart surgery
  - Tetralogy of Fallot correction
  - Tricuspid atresia correction (Fontan)
  - Phrenic nerve injury
- Neonatal respiratory distress
- Bronchopulmonary dysplasia

FYI see links below for article on negative pressure ventilation and acute respiratory failure (interesting)

Indications

- Post emphysematous lung resection
- During microlaryngeal surgery
- Cystic fibrosis
- Weaning from PPV
- Flail chest (CNEP)
- Meconium aspiration?
- Bronchopleural fistula?

Benefits

- Avoidance of tracheal tube complications
- Avoidance of facial trauma from mask
- Reduced sedation requirements
- No ventilator-induced lung injury

Benefits

- Patient can talk
- Patient can cough
- Improved enteral nutrition - patient may be able to eat

Disadvantages

- Lack of airway protection
- Large, non-portable equipment (tanks)
- Decreased patient access (tanks)
- Cumbersome to apply to some patients (tanks, wraps)

Disadvantages

- Lack of airway protection
- Large, non-portable equipment (tanks)
- Decreased patient access (tanks)
- Cumbersome to apply to some patients (tanks, wraps)
- Difficult to maintain seal
- Difficult to monitor volumes
- Patient intolerance (varies with type)

Complications

- Peripheral venous pooling (tank shock)
- Gastrointestinal bleeding
- Dynamic upper airway collapse
- Irritation at neck seal (tanks)
- Back pain

Contraindications

- Obstructive sleep apnea
- Morbid obesity
- Severe kyphoscoliosis
- Recent abdominal surgery

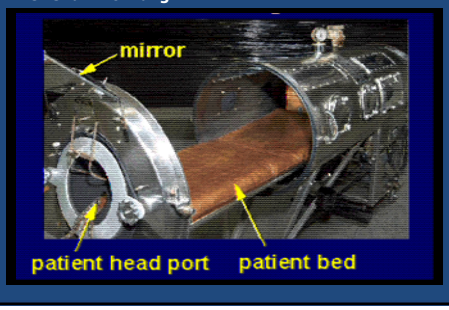
Negative Pressure Ventilators

- Drinker-Shaw iron lung
- Emerson iron lung
- Porta-Lung™ (tank only)
- Coppa iron lung & cuirass
  - Microprocessor-based
  - Not available in the US

See links below to view Emerson Iron Lung & Porta-Lung™

Negative Pressure Ventilators

- Drinker-Shaw iron lung



Negative Pressure Ventilators

- Ventilators
  - Emerson U-Cyclit™ (not available)
  - LifeCare NEV 100™ (not available)
  - Pegaso V™
  - Hayek RTX™
  - Hayek MRTX™ - portable
  - Hayek MRITX™ - MRI compatible

See links below for information on the Pegaso V™ ventilator & to view infant negative pressure ventilator

Negative Pressure Ventilators

- Body wraps
  - Nu-Mo suit™
  - Pulmo Wrap™
  - Poncho Wrap™

See links below to view Pulmo Wrap™ & a vintage cuirass

Negative Pressure Ventilators

- Hayek RTX™ cuirass ventilator
  - Biphasic cuirass ventilation - inspiratory & expiratory pressure
  - Easy to apply
  - Modes
    - High-frequency chest oscillation
    - Secretions mode - oscillation, cough
    - Continuous negative expiratory pressure

Up next: Video of Hayek Ventilator

Negative Pressure Ventilators

- Hayek RTX™ cuirass ventilator
  - Modes
    - High-frequency chest oscillation
    - Secretions mode - oscillations, cough
    - Continuous negative expiratory pressure
    - Control mode
    - Respiratory triggered
    - Respiratory synchronized

FYI see links below for information on the Hayek™

Negative Pressure Ventilators

- Hayek RTX™ cuirass ventilator
  - Specifications
    - 6 - 1200 cycles per minute
    - I:E Ratio: 1:6 - 6:1
    - Maximum inspiratory pressure: -50 cm H_20
    - Maximum expiratory pressure: +50 cm H_20
    - Power unit weight: 9 kg
    - Four adult size cuirasses
    - Seven pediatric size cuirasses

Ventilator Operation

- Settings
  - Peak inspiratory pressure: adjusts tidal volume
  - Peak expiratory pressure: active exhalation, cough assistance
  - Continuous negative expiratory pressure
    - Maintains FRC
    - Balances intrinsic PEEP for patient triggering

Ventilator Operation

- Settings
  - Rate
  - I:E ratio
  - Trigger sensitivity
    - Sensed at nares
    - Sensed in cuirass (Hayek™)
  - FiO_2 - mask or nasal cannula

Monitoring

- Blood gases
  - Baseline & PRN arterial sampling
  - Pulse oximetry
  - End-tidal CO_2 monitoring
- Volumes
  - Spirometry with mask?
  - Respiratory inductive plethysmography?

Sites for NPV

- Intensive care units
- Intermediate care units
- Long-term care facilities
- Homes

Patient Transpot

- Portable positive pressure ventilation
  - Mouthpiece
  - Mask
- Iron lung - can be manually operated
- Battery-powered negative pressure ventilators, like Hayek MRTX™

Summary & Review

- Rationale for NIV: ventilate without intubate
- Physiologic effects of NPV vs. PPV: cardiovascular
- NPV indications
  - Mask intolerance
  - Need to increase pulmonary perfusion

Summary & Review

- NPV benefits: no ventilator-induced lung injury
- Complications: tank shock
- Contraindications: upper airway obstruction
- NPV enclosure types
  - Tank
  - Cuirass
  - Wrap

Summary & Review

- Ventilator operation
  - Pressure controlled ventilation with supplemental mask or nasal O_2
  - Limited monitoring capabilities

Noninvasive Positive Pressure Ventilation (NPPV)

Attributes

- Noninvasive positive pressure ventilation: PPV without tracheal tube
- Important attribute of NPPV: existence of a mask leak that affects
  - Volume delivered (volume control)
  - Ventilator triggering to inspiration
  - Ventilator cycling to expiration

Modes

- Continuous positive airway pressure
- Bilevel positive airway pressure
- Pressure support
- Pressure control
- Volume control
- Proportional assist

Physiologic Effects

- Decreased WOB
- Increased dynamic lung compliance
- Increased tidal volume
- Increased inspiratory capacity (CPAP & COPD patients)

Physiologic Effects

- Improved blood gases
  - Oxygenation increased by end-expiratory pressure
  - Hypercapnea decreased with inspiratory pressure
- Cardiac output
  - Normal & COPD patients - decreased
  - Some CHF patients - increased

Benefits

- Prevention of ETT complications
- Reduction in sedation requirements
- Prevention of tracheotomy
- Reduction in ICU length-of-stay (LOS)

Complications

- Delayed intubation
- Patient intolerance, anxiety
- Facial ulcers
- Ear, sinus pain
- Increased WOB - patient-ventilator dyssynchrony, due to inappropriate device &/or control settings

Complications

- Pneumothorax
- Gastric insufflation - high pressures
- Aspiration
- Mucus plugging
- Hemodynamic compromise

Contraindications

- Unable to fit or tolerate interface
- Facial trauma or surgery
- Active vomiting
- Acute abdominal process - risk for vomiting, aspiration

Contraindications

- Apnea
- Cardiovascular instability
- Excessive &/or viscous secretions
- Recent gastro-oesophageal surgery
- Severely impaired mental status

Indications

- COPD
- Acute cardiogenic pulmonary edema (ACCPE)
- Blunt thoracic trauma
- Postoperative respiratory failure
- Weaning from invasive ventilation
- Miscellaneous conditions
- Neuromuscular conditions - separate lesson
- Obstructive sleep apnea - separate lesson

Questionable Indications

- ARDS/ALI: may harm by delaying intubation
- Pneumonia: no evidence of benefit
- Asthma: no evidence of benefit

"NPPV should be tried very cautiously or not at all in patients with ALI who have shock, metabolic acidosis or profound hypoxemia." Rana S, et al. 2006.

NPPV & COPD Exacerbations

- First line treatment for exacerbations
- Strong evidence for efficacy in hypercapneic failure
- Effects
  - Decreased WOB
  - Reversal of ventilatory muscle fatigue
  - Decreased $PaCO_2$
  - Decreased risk for intubation
  - Decreased mortality

NPPV & Stable COPD

- Many COPD patients also have sleep apnea (overlap), with greater risk for hypercapneic failure
- Effects
  - Decreased air trapping (TLC)
  - Increased CO_2 response
  - Stabilizes heart rhythm by reducing vagal activity

NPPV & Stable COPD

- Situations
  - Home: longer survival for adherent patients (Budweiser)
  - Rehabilitation: may increase exercise tolerance, except for backpack study
  - Therapy ceiling for end-stage

NPPV for ACCPE

- First line treatment - strong evidence
- Effects - CPAP & bilevel NPPV equally
  - Increased FRC
  - Increased lung compliance
  - Decreased WOB
  - Decreased dyspnea & respiratory rate

NPPV for ACCPE

- Effects - CPAP & bilevel NPPV equally
  - Decreased intrapulmonary shunt
  - Decreased heart rate
  - Increased cardiac output
  - Decreased intubation rate
  - May decrease mortality (meta-analysis)
- Bilevel NPPV may not be more effective than CPAP (statistical analysis)

NPPV & Blunt Thoracic Trauma (Flail)

- CPAP & bilevel NPPV studied - weak evidence
- Excluded patients
  - Emergent intubations
  - Injuries to head, face, or neck
- Effects
  - Decreased rate of pneumonia
  - Decreased mortality
- More trials needed

NPPV & Post-Op Respiratory Failure

- CPAP & bilevel NPPV studied - weak evidence
- Postoperative upper abdominal & thoracic surgical patients studied
- Effects
  - Decreased intubation, reintubation rate
  - Decreased pneumonia, sepsis
  - Decreased mortality
  - Decreased length of hospitalization
- CPAP & bilevel NPPV may be equally effective (need more trials)

See links below for abstract on nasal vs. FFM postoperative NPPV

NPPV & Ventilator Weaning

- Rationales
  - Shorten intubation time
    - Decreased sedation
    - Decrease infection
    - Decrease ICU & hospital length-of-stay (LOS)
  - Prevent reintubation
  - Prevent tracheotomy

NPPV & Ventilator Weaning

- Supportive evidence is moderate, when applied to selected patients, who
  - Meet criteria to initiate spontaneous breathing trial
  - Meet criteria for extubation
    - Do not have excessive secretions
    - Have an effective cough
    - Have acceptable mental status
    - Are not a difficult intubation

NPPV & Ventilator Weaning

- Supportive evidence is moderate, when applied to selected patients, who
  - Have no impediments for interface
  - Tolerate short term spontaneous breathing for mask adjustments, etc.

NPPV & Post-Extubation Failure

- Evidence does not support efficacy of NPPV in treating post-extubation respiratory failure
- Evidence supports that NPPV may be effective in preventing post-extubation respiratory failure where high-risk patients are identified in advance
- NPPV not recommended as a routine intervention for post-extubation situations

NPPV - Miscellaneous Indications

- During bronchoscopy to offset increased WOB & hypoxemia
- Severe bronchiolitis
- Cystic fibrosis - adults with hypercapneic exacerbations
- Immunocompromised patients - prevents ventilator - associated pneumonia
- Pandemic respiratory infections, e.g. SARS - to prevent infection of caregivers during intubations

Summary & Review

- NPPV physiologic effects - may increase cardiac output in CHF
- NPPV benefits - prevent intubation
- NPPV complications - delayed intubation
- NPPV contraindications - mask intolerance
- NPPV indications - cautious application to hypoxemic failure

NPPV Interfaces & Humidification

Issues With Interfaces

- Comfort
- Allowance for patient movement
- Weight
- Allergenicity
- Pressure applied to tissues → skin ulceration

Issues With Interfaces

- Internal volume
  - Dead space (V_{Dnb}) - rebreathed volume
  - Gas compression, decompression volume
- Leaks - mask seal = 2 cm → negligible leaks
- Multiple sizes available

See links below to hear possible mask leak & to view Respironics leak chart

Issues With Interfaces

- Securing system (headgear)
  - Comfort
  - Stability
  - Ease of use
  - Washable for home use
  - Disposable for hospital use

See links below for various brands of headgear, with prices

Interfaces

- Mouthpiece
- Nasal mask
- Nasal pillows
- Oronasal mask
- Total face mask
- Helmet

Mouthpiece Interface

- Primarily for daytime use for patients with
  - Neuromuscular disease
  - COPD
  - Cystic fibrosis

Nasal Interfaces

- Indications
  - Primary interface for obstructive sleep apnea
  - Good starting interface in mild acute respiratory failure, with limitations
  - Postoperative atelectasis (see lung clearance lesson)

Nasal Interfaces

- Advantages
  - Enables speech, eating, coughing
  - Less risk for aspiration, gastric distension
  - Less claustrophobia

Nasal Interfaces

- Limitations
  - Erroneous monitoring of exhaled TV
  - Nasal resistance limits effectiveness
  - Mouth breathing limits effectiveness & patients with ARF tend to mouth-breathe
  - Lesser pressure can be administered

Nasal Interfaces

- Types
  - Masks
  - Pillows

Respironics Curve™ nasal mask (courtesy Respironics)

See links below for various brands of nasal masks & pillows, with prices

Oronasal (Full Face) Mask

- Most common for bilevel NPPV
- Advantages
  - Less leakage
  - More stable pressures
  - Less patient cooperation
- Limitations
  - Claustrophobia
  - Aspiration

Oronasal (Full Face) Mask

Respironics ComfortGel™ mask (courtesy Respironics)

See links below for various brands of full face masks, with prices

Total Face Mask

- Most effective NPPV interface for acute respiratory failure
- Minimal leaks - accommodates greatest pressure
- Less discomfort
- Less pressure injury - larger area of contact
- Does not increase V_{Drb}
- May increase claustrophobia

Total Face Mask

Respironics Total Face Mask™ (courtesy Respironics)

Respironics Performax™ (courtesy Respironics)

See links below to view all Respironics masks, etc.

Helmet

- Advantages
  - Overcomes mask-fit problems
  - More comfortable
  - No facial pressure injury
  - Less need for patient cooperation
  - Allows speaking, coughing

Helmet

- Disadvantages
  - Not currently FDA-approved
  - May decrease cerebral blood flow in infants
  - Impedes patient triggering - decompression volume
  - No capability for volume monitoring
  - Humidification may fog the helmet

See links below to view neonatal & adult CPAP helmets

Helmet

Designer CPAP helmet

FYI See links below to hear helmet voice distortion

Ventilator Circuit

- Single-limbed
  - Original BiPAP circuit
  - Incorporates variable flow leak port
  - Requires EPAP > 4 cm H_2O to minimize rebreathing

Ventilator Circuit

- Double-limbed
  - ICU ventilators & recent bilevel ventilators
  - Eliminates rebreathing
- The circuit & interface must be used for the specified ventilator

Humidification

- None - OK for short-term ventilation
  - Humidification ability of mucosa can be overwhelmed
  - Desiccated mucosa releases inflammatory mediators
  - Possible mucus plugging
  - Absence of humidification can impede adherence to therapy

Humidification

- Heat & moisture exchanger
  - Can increase resistance
  - Increase V_{Drb} →
    - Hypercapnea
    - Increased minute ventilation
    - Increased WOB

Humidification

- Heat & moisture exchanger
  - Increase V_{Drb}
  - Can increase resistance
- Heated humidification
  - No effect on V_{Drb}
  - No effect on resistance
- Ambient temperature passive humidification increases comfort for some patients

Summary & Review

- Issues with NPPV interfaces comfort, pressure injury, leaks
- Specific interfaces
  - Mouthpiece
  - Nasal mask, pillow
  - Oronasal mask
  - Total face mask
  - Helmet - not FDA-approved

Summary & Review

- NPPV circuits - single vs. double-limbed
- Humidification - HMEs & V_{Drb}

NPPV Devices & Controls

Institutional Bilevel Ventilators

- Desirable features
  - Built-in blender
  - Leak compensation
  - Trigger compensation
  - Backup rate
  - Rise time adjustment
  - Graphic display
  - Alarms
  - Battery power supply

Institutional Bilevel Ventilators

- Respironics
  - BiPAP S/T™ - no blender
  - Focus™ - no blender
  - Vision™
  - V60™

Institutional Bilevel Ventilators

- Respironics Vision™
  - Acute care bilevel ventilation
  - Blender - adjustable FiO_2
  - Auto-Track™ trigger
  - Rise time adjustable
  - Graphic display
  - Alarms
  - No battery backup

Institutional Bilevel Ventilators

- Respironics V60™
  - Acute care bilevel ventilation
  - Average volume-assured pressure support
  - Auto-adaptive leak compensation
  - Inspiratory triggering
  - Expiratory cycling
  - Adjustable ramp time
  - Built-in blender
  - Battery back-up – 6 hours

ICU Ventilators

- With NIV mode - provide leak compensation
- Without NIV mode - no leak compensation
  - Impedes patient triggering
  - Impedes cycling to expiration in PSV mode
  - Can be used, but could lead to problems (injury, litigation)

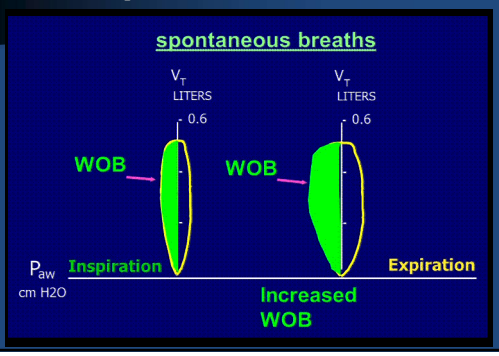
ICU Ventilators

- ICU ventilators with noninvasive modes (examples)
  - Maquet Servoi™
  - Drager Evita XL™
  - Newport e500™ & HT50™ (transport)
  - Viasys Vela™ & Avea™
  - Hamilton Raphael™ & C-2™
  - GE Engstrom Carestation™
  - Puritan-Bennett 840™

ICU Ventilators

- Advantages
  - Graphics to show
    - Triggering
    - Cycling
    - Intrinsic PEEP (PEEPi)
    - Work of breathing (WOB)

Spontaneous WOB



ICU Ventilators

- Advantages
  - Graphics
  - Exhaled volume monitoring
  - Expiratory cycle adjustment
  - Rise time adjustment
  - Invasive ventilation capability - easier to switch over
- Disadvantage - expense

Modes Applied to NIV

- Volume control
  - Identical success rate, compared to pressure control
  - Stable volumes in face of changing lung mechanics
  - Higher peak airway pressures that caused flatulence in two patients that sounded like a mask leak
  - Common in home NIV (Europe)

Modes Applied to NIV

- Pressure control ventilation (PCV)
  - Stable volume delivery in face of leaks
  - Flow variable with patient demands
  - Trial results - PCV may be more effective than PSV for COPD exacerbations

Modes Applied to NIV

- Pressure support
  - Most common mode for NIV
  - Some ventilators do not include backup rate - apnea adjustment is important

Modes Applied to NIV

- Pressure support
  - Appropriate expiratory cycle adjustment is important
  - Appropriate rise time adjustment is important
  - Observe inspiratory time & I:E ratio - may require inspiratory time limit adjustment

Modes Applied to NIV

- Proportional assist ventilation (PAV)
  - Delivers flow proportional to patient's inspiratory effort
  - Terminates flow in response to cessation of inspiratory effort

Modes Applied to NIV

- Proportional assist ventilation (PAV)
  - Clinical trials conclude that it is better tolerated than PSV, but PSV was delivered with PB 7200ae?
  - Respironics Vision - PAV mode not available in U.S.
  - Puritan-Bennett 840 - company does not support use of PAV with NIV

Ventilation Modes & NIV

- Pressure support with volume guarantee (VSV)?
  - No NIV with VSV trials located
  - Problem with VSV - patient distress & hyperpnea causes ventilator to decrease support

Ventilation Modes & NIV

- Neurally adjusted ventilatory assist (Maquet NAVA™)
  - Flow delivery in response to diaphragmatic electrical activity
  - Eliminates leaks as a triggering & cycling factor
  - Need human trials on NAVA & NIV
  - It works on rabbits

Ventilation Settings

- PEEP 4 - 10 (ideally)
- PSV, IPAP - exhaled tidal volume > 5 ml/kg IBW
- Reasonable starting pressures - PEEP = 5; PSV = 10
- FiO_2 for desired SPO_2

Ventilation Settings

- Expiratory flow cycling adjustment
  - Patient comfort
  - Ventilator graphics
  - Inspiratory time, I:E ratio
  - To eliminate PEEPi

Expiratory Flow-Cycling (PSV)

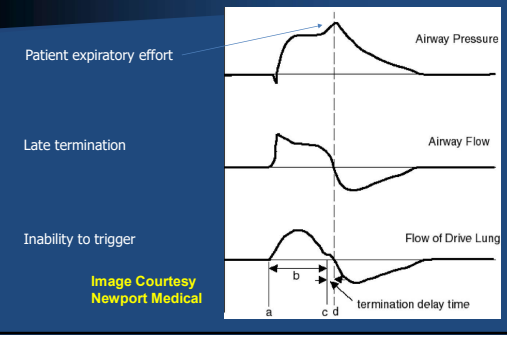


Image Courtesy Newport Medical

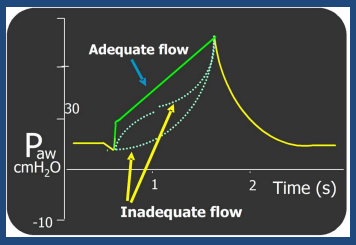
Ventilation Settings

- Rise time adjustment
  - ❖ Patient comfort
  - ❖ Ventilator graphics

Inspiratory Flow/Rise - Pressure Wave

Linear or bowed upward rise in pressure after trigger on the pressure wave

Slow rise in pressure, concave shape of the pressure wave



Courtesy Newport Medical

Summary & Review

- Types of ventilators used for NPPV
- Specific bilevel & ICU ventilators
- ICU ventilator advantages
- NPPV modes
- Ventilation settings

NPPV Clinical Issues

Clinical Indicators of Successful NIV

- Favorable response in first 2 hours of NPPV
- APACHE II score < 29
- pH > 7.30
- Glasgow coma score ≥ 15

FYI see links below for APACHE II calculator

Clinical Indicators of Successful NIV

- Favorable response in first 2 hours of NPPV
- APACHE II score < 29
- pH > 7.30
- Glasgow coma score ≥ 15
- Absence of pneumonia or ARDS
- Minimal interface air leaks
- Patient-ventilator synchrony

FYI see links below for article on NIV & critical care

Aerosol Delivery

- Remove NIV interface & administer, if safe & feasible
- Aerosol medications are effective with NIV via all types of devices
- Aerosols are effectively delivered via nasal interface
- Increased dosage may be necessary because of leaks, nasal deposition

Aerosol Delivery

- Aerosol delivery devices
  - Pneumatic nebulizer
    - Place proximal to patient
    - Place between patient & leak valve
  - Vibrating mesh (Aeroneb Pro™) - does not add flow to circuit
  - MDI & spacer - coordinate with inspiration

Up next: Video of Aeroneb Pro™

Aerosol Delivery

- Total face masks allow medications to enter eyes - especially problematic with ipratropium
- More research is needed to generate specific recommendations
- Regardless of device, it's a good idea to place aerosol generator between the HME & the patient

Heliox Therapy

- Meta-analyses on routine use of heliox for asthma & COPD do not support routine use
- Heliox decreases PEEPi & WOB in ventilated patients with COPD exacerbations

Heliox Therapy

- Problems
  - Heliox can not be used in hypoxemic patients
  - Heliox causes errors in TV & FiO_2 measurement & delivery
  - Only FDA-approved ventilator is the Viasys Avea™
  - Heliox is expensive
  - Helium causes vocal distortion

See links below to hear vocal distortion with helium

Sites for NPPV Administration

- Factors
  - Acuity of patient
  - Expertise of personnel
  - Availability of physical resources
- Monitoring capabilities
  - Personal (skilled)
  - Electronic

Sites for NPPV Administration

- Pre-hospital - EMS
  - For some conditions, the sooner the better for NPPV
  - Avoids emergency intubations
  - Especially applicable to ACCPE & COPD
- Emergency room
  - Early initiation of NPPV
  - Advanced resources, including RTs

Sites for NPPV Administration

- Intensive care
  - Best site for sickest patients
  - Intensive monitoring
  - Extensive physical resources
  - Personnel resources
    - Respiratory therapists
    - Critical care nurses

Sites for NPPV Administration

- Intermediate care (step-down)
  - Usually telemetric monitoring
  - Personnel resources varies
    - Respiratory therapists
    - Patient:nurse ratio
  - Stable patients

Sites for NPPV Administration

- General ward
  - Telemetry - maybe
  - More patients per nurses, who may be unfamiliar with NPPV
  - Respiratory therapy coverage varies
  - Intermittent NPPV, as for
    - Sleep apnea
    - Stable COPD
    - Stable neuromuscular disease

Sites for NPPV Administration

- Long-term care facilities
  - Chronic care
    - COPD
    - Failure to wean from ventilation
  - Monitoring varies by units
  - Usually have skilled respiratory therapy staff

Sites for NPPV Administration

- Home
  - Chronic conditions
  - End-of-life care
  - Requires education of patient & caregivers

NPPV & End-of-Life Care

- Patient choices
  - Do not intubate (DNI)
  - Comfort measures only (CMO)
- Informed consent of patient &/or family is needed - NIV is life support
- Common conditions
  - COPD
  - Cancer
  - Neuromuscular diseases
  - Chronic heart failure

NPPV & End-of-Life Care

- Goals of NIV for terminal patients
  - Delay death
    - To go home
    - To settle personal issues
    - To see a person
  - Provide comfort - to whom?
    - Decrease dyspnea
    - Comfort is not provided when a patient is resisting the treatment

NPPV & End-of-Life Care

- Ethical controversy exists over whether NIV ought to be used at end-of-life
- The decision should rest with the patient (author's opinion)

Summary & Review

- Indicators for successful NPPV
- Aerosol delivery - does work with NPPV
- Heliox - may decrease WOB for COPD
- Sites for NPPV delivery
- NPPV for end-of-life care

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