NOTES

CARDIOVASCULAR REGULATION

• chronotropy (rate)
• inotropy (contractile force)
• dromotropy (speed of conduction)

PARASYMPATHETIC	SYMPATHETIC
• dominant @ rest • innervation by CN X (vagus) • Acetylcholine (Ach)	• dominant with stress • innervation @ cardiac plexus • Norepinephrine

ALPHA1	BETA1	BETA2
• PERIPHERAL EFFECTS - vasoconstriction	• CARDIAC EFFECTS - vasoconstriction - + chronotropy - + inotropy - + dromotropy	• PULMONARY EFFECTS - bronchodilation - vasodilation

SYMPATHETIC STIMULATION

• “fight or flight” response
• mediated through neurotransmitter norepinephrine
• increased heart rate
• increases bp
• increases airway diameter
• dilates the bronchi
• pupillary dilation
• inhibits digestive activity
• decreases production of salivation/secretions

PARASYMPATHETIC STIMULATION

• dominant at rest
• mediated through neurotransmitter acetylcholine (ACh)
• decreases heart rate
• decreases airway diameter
• lowers bp
• constricts the bronchi
• stimulates digestive activity
• pupillary constriction

• increases production of saliva/body secretions

ADRENAL INSUFFICIENCY

Causes:
Congenital adrenal insufficiency (CAH)
Infection
Injury
Auto-immune reaction of the adrenal gland secondary to TB, trauma or addison's disease

Signs & Symptoms:
Hypoglycemia
Dehydration
Weight loss
AMS
Weakness/lethargy
Dizziness
Hypotension
Miscle aches
N/V

CAPNOGRAPHY
Non-invasive measurement of CO2 exhaled at the airway at the end of a breath(ETCO2)

“capnos”=smoke

Normal values 33-42 mmHg

35-45 mmHg
Over 45 mmHg (more CO2, acidic) respiratory acidosis
Below 35 mmHg (less CO2, alkalitic) respiratory alkalosis

Colormetric
- disposable detector
- litmus paper
- color changes in presence of CO2

yellow (yes), purple (poor), gray (not good)

Capnogram
- graphic tracing or representation of exhaled CO2 at airway
- waveform

Capnograph
- instrument
- monitor that provides a number and a waveform

Capnography: the measure of the actual ventilation process

Oxygenation: the process of getting oxygen into the body and to the tissues for metabolism, is monitored with *pulse oximetry*

Ventilation: the process of eliminating CO2 from the body, is monitored with *capnography*
- Capnography can provide information about the profusion status

Example: low cardiac output caused by cardiogenic shock or hypovolemia won't carry as much CO2 per minutes back to the lungs. ETCO2 will be reduced. Reduced perfusion to lungs causes this phenomenon

	A-B zero baseline B-C rapid upstroke (rise in CO2, exhalation) C-D alveolar plateau phase (CO2 plateau, end of exhalation) D ETCO2 value D-E rapid downstroke (decrease in CO2, inspiration)

Phases of Exhalation

- Beginning exhalation=no CO2 in breath (due to dead air space, approx 150ml)
- Middle exhalation=rapid rise in CO2
- End exhalation=CO2 levelscontinue to gradually rise (alveolar plateau), peak just before inspiration (ETCO2)

CLINICAL APPLICATIONS

- AIRWAY
    - Required for all intubated combi-tube patients
    - Displaced intubation
    - Monitor of ventilations
- ACUTE RESPIRATORY DISEASES
    - Bronchospastic disease (asthma, COPD): diagnoses presence of bronchospasm (shark fin pattern), assesses response to treatement

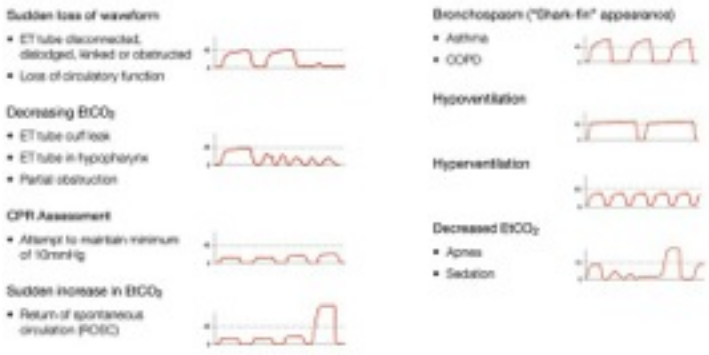
PHASES OF ACUTE ASTHMA EXACERBATION		
PHASE	CLINICAL ASSESSMENT	ETCO2 LEVELS
Mild	Hyperventilating	<35
Moderate	Tiring	40-50
Severe	Tired	>50

- BREATHING
    - Hypoventilation syndromes: drug OD, ETOH overdose, DKA, post-ictal, CVA, head trauma, neuromuscular
- SHOCK STATES
    - Precipitius drop or downward trending in the EtCO2: cardiogenic shock, septic shock, hemorrhagic shock (trauma), hypovolemic shock (heat stroke)
- PULMONARY EMBOLISM
    - Pulmonary hypo-perfusion: low EtCO2 with small waveform, low SpO2

What should you do with bagging?
if you have low CO2, you should slow down your ventilations

if you have high CO2, you should speed up your ventilations
you can use waveform to guide your ventilations

CAPNOGRAPHY WAVEFORM PATTERNS



SUDDEN LOSS OF WAVEFORM

- Apnea
- Airway obstruction
- Dislodged airway (esophageal)
- Airway disconnection
- Ventilator malfunction
- Cardiac arrest

INCREASING ETCO2 (*increasing waveform trend)*

- Decrease in respiratory rate (hypoventilation)
- Decrease in tidal volume
- Increase in metabolic rate
- Rapid rise in body temperature (hyperthermia)

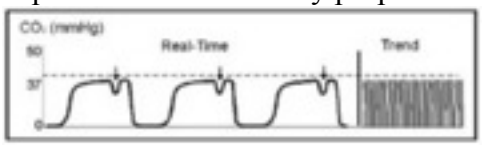
REBREATHING (*upside-down trend with increasing baseline)*
- Faulty expiratory valve
- Inadequate inspiratory flow
- Insufficient expiratory flow

INADEQUATE SEAL AROUND ETT (*backwards shark fin)*
- Leaky or deflated endotracheal or tracheostomy cuff
- Artificial airway too small for the patient

DECREASING ETCO2 (*decreasing waveform trend)*
- Increase in respiratory rate (hyperventilation)
- Increase in tidal volume
- Decrease in metabolic rate
- Fall in body temperature (hypothermia)

OBSTRUCTION *(slurring of plateau phase/shark fin)*
- Partially kinked or occluded artificial airway
- Presence of foreign body in the airway
- Obstruction in expiratory limb of breathing circuit
- bronchospasm

CURARE CLEFT
- appears when muscle relaxants begin to subside (pt starting to breathe)
- depth of cleft is inversely proportional to degree of drug activity



CPAP *(continuous positive airway pressure)*
Positive end-expiratory pressure (PEEP)=CPAP

PRACTICAL APPLICATION OF THE FLOW-SAFE DISPOSABLE CPAP DEVICE
- Patient could throw up into mask, try to avoid that situation
- Straps slide into pins on the mask.
- Comfort is important, hair could get pulled-Carefully pull straps over back of head
- You can always change the mask size any time during the treatment to assure a good fit
- Flow-safe clinicians can add an in-line nebulizer mask and filter without removing the mask

HEART FAILURE PATIENT
- Start out at 15lpm (5cm of water pressure)
- May have to titrate based on how patient performs
- Don’t cover open end of flow-save device

D cylinder=15lmp
1 minute for every 100 liters in the tank

When you get to between 400-500psi prep to change tanks. It is a good idea to carry a minimum of 2,000 liters in tanks which will allow 20 minutes

when applying the CPAP mask, if possible, have the patient hold the mask to their face for the first few breaths to avoid having the patient pull of the mask and anxiety

BPAP *(non-invasive positive pressure ventilation)*

WHAT IS NPPV?

- A means to support failing respiratory function by delivering oxygen-enriched gas under pressure without requiring endotracheal intubation
- Best used as a short-term strategy to "buy time" for medical therapy to treat rapidly reversible causes of respiratory failure

TYPES OF NPPV MASKS:

- Nasal mask (best tolerated by patient, but pressure may escape through mouth)
- Full face mask
- Total face mask aka total full face mask

BENEFITS OF NPPV OVER INVASIVE MEDICAL VENTILATION:

- Avoids potential for trauma secondary to endotraceal intubation (ex. Vocal cord dysfunction)
- Avoids need for sedation
- Allow patient to maintain ability to communicate
- Allow for intermittent eating/drinking if mask can be briefly removed and if aspiration risk is felt to be sufficiently low
- Avoids risk of ventilator-associated pneumonia

CONTRAINDICATIONS FOR NPPV

- Cardiac or respiratory arrest
- Hemodynamic or arrhythmic instability
- Facial trauma or deformity
- Severe upper GI bleed
- Severe encephalopathy
- Inability to cooperate and/or protect airway
- Inability to clear secretions
- Upper airway obstruction
- High risk for aspiration

CPAP vs BPAP			
Mode	Intraalveolar Pressure	Typical Settings (cmH2O)	Indications
CPAP	Positive pressure that is continuous throughout both phases of respiration	Start: 5 Range: 5-12	Hypoxic Failure (ex. CHF)
BPAP	Two different levels of positive pressure with a higher level of pressure during inspiration	Start: 10/5 Range: 10-20/5-12	Hypercapnic Failure (ex. COPD) Mixed Failure

EZ-IO

INDICATIONS:

- IV cannot be established
- Severe hypoprofusion
- Cardiac arrest

CONTRAINDICATIONS AT LOCATION:

- Fracture of bone
- Excessive tissue
- Previous orthopedic procedures
- Infection

LOCATIONS:

- Proximal tibia*
- Distal tibia
- Proximal humerous