CRRN Review: Respiratory

Respiratory tract Structures
Innervation: C3-C4

Mechanics of Breathing

Phase 1: Inspiration
- Diaphragm contracts
- Draws the lungs down
- Decreases inter-thoracic pressure
- Increases abdominal pressure
- Pulls air into the lungs

Phase 2: Expiration
- Passive process
- Result of elastic lung recoil

Mechanics of Breathing

Definition

Lung Compliance:
Measurement of the lungs elasticity.

Airway Resistance:
Resistance to airflow, which is conversely linked to airway diameter.
Mechanics of Breathing: Control
- Central and peripheral neuronal areas and Chemoreceptors
  - Central
    - Medulla Oblongata
  - Chemoreceptors
    - located on the ventrolateral surface of medulla oblongata
    - aortic and carotid bodies

Mechanics of Breathing: Voluntary
- Regions of the Cerebral Cortex
  - Increase decrease respiration
    - During talking
    - Conscious effort

Gas transport and exchange
- Dependency on
  - Arterial Oxygen pressure
  - Cardiac output
  - Perfusion rates
- Affected/Hindered
  - Changes in membrane
  - Metabolic activity diet
  - Perfusion
  - position

Pediatric Respiration
- Anatomy
  - Smaller diameter airways
  - immature cartilage
  - Poor intercostal muscle support
  - Larynx further anterior than adults
  - Larger tongue
- Physiological differences
  - Immature CNS breathing control
  - Fewer Alveoli
  - Increased oxygen consumption
  - Nose breathing /obstruction
  - Higher rate of respiratory infection

Oxygen binds with Hemoglobin for transport
CRRN Review: Respiratory Patient Assessment

Subjective appraisal of respiratory complaints

• Dyspnea
  • Main Cardiopulmonary disease
  • Acute or chronic
  • Chronically present may lead to disability
  • May be assessed by modified Borg scale
    • 1-10 rating. 1=all well, 10=need help
    • Resting or with exercise
  • May be called difficulty breathing/shortness of breath

Respiratory Patient Assessment

• Cough
  • Purpose:
    • Clearing the airway
    • Protection against aspiration
  • Signs of respiratory problem
    • Unrelenting
    • Painful
    • Mucous production
    • History

Respiratory Patient Assessment

• Intolerance of activity
  • Poor indicator of respiratory compromise
  • May be reported by patient

Respiratory Patient Assessment

• Historical information about a cough
  • When it started
• Sputum Characteristics
  • Color
  • Odor
  • Amount
  • Blood present

Respiratory Patient Assessment

• 4 components of physical examination
  • Inspection
    • Chest conformity
    • Symmetrical rise and fall
    • Nail beds
  • Palpation
    • Sound transmission changes
    • A to E change
  • Percussion
    • Density changes due to disease process
  • Auscultation
    • Stethoscope

Subjective appraisal of respiratory complaints

Objective assessment
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Respiratory Patient Assessment
Abnormal Breath Sounds

• Rhonchi
• Inspiratory and expiratory
• Rales
• Inspiratory only
• Wheezes
• Inspiratory and expiratory
• Friction Rub
• Discordant or vibrating sound
• Stridor
• Upper airway not lung fields
• Inspiratory

Respiratory Patient Assessment
Diagnostic tests for pulmonary complications

• Chest X-ray
• Used to rule out the presence of:
  • Cardiac disease
  • Cancerous Lesions
  • Foreign body aspiration

Question:

• Which of the following is advised to reduce exposure to allergens to control asthma?
  • A. Maintain humidity >50%
  • B. Place air filters over all windows
  • C. Encase mattresses and pillows in allergen-proof covers
  • D. Avoid all contact with animals

Answer:

148. C. It is difficult if not impossible to control asthma without reducing or at least eliminating exposure to allergens. Measures include the following:

Encasing mattresses and pillows in allergen-proof covers to control dust mites.

Removing carpet is helpful to keep dust mites down.

Keeping humidity in the home less than 50%.

Removing the pet from the house or bedroom depends on the individual's sensitivity. Pets are now sometimes recommended for asthma patients because their availability decreases over time.

Limiting exposure to the outside environment, especially during times of high pollen counts or increased wind.

Respiratory Patient Assessment
Diagnostic tests for pulmonary complications

• Pulmonary Function Testing – (PFT’s)
• Measures
  • Capacity
    • Vital Capacity (VC)
    • Forced Expiratory Volume 1 second (FEV1)
  • Forced Residual Capacity (FRC)
  • Total Lung Capacity (TLC)
  • Residual Volume (RV)
• Flows
  • Forced expiratory Volume 1 second (FEV12)
• PFT Machine (Spirometer)
Respiratory Patient Assessment
Diagnostic tests for pulmonary complications

- Arterial Blood Gases (ABG)
  - Measures
    - pH
    - Acid base balance
    - pO2
    - Pressure of oxygen Arterial
    - pCO2
    - Pressure Carbon Dioxide Arterial
    - Hco3
    - Bicarbonate levels Arterial
    - SpO2
    - Saturation of oxygen with hemoglobin

- Pulse Oximetry
  - SpO2
    - Percentage value
    - Non-invasive
    - Correct sensor for the correct sight
      - May be up to 20% off dependent on manufacturer
    - Not accurate with SpO2 < 70%
    - Correlate Heart rate with reading

Scenario

- Mr. Jones a patient with a history of CHF, has been complaining of insomnia, daytime sleepiness and falling asleep for brief periods. Mr. Jones’ S.O. states that he snores lightly on occasion but wakes up a lot. She describes his breathing as periods of not breathing, then breathing really fast followed by more not breathing.
- Mr. Jones does not appear to be moving his chest or abdomen during the apnea periods. Mr. Jones is normal weight.

Question:

- Based on the symptom profile, what is the most likely cause of Mr. Jones’ problem?
  - A. Central sleep apnea
  - B. Narcolepsy
  - C. Obstructive Sleep Apnea
  - D. Central alveolar hypoventilation syndrome

Answer:

15. A. Central sleep apnea involves apneic and hypopneic episodes without obstructive and usually results from cardiac or neurological disorders that cause impairment of ventilation. Snoring is usually mild, and individuals may complain of insomnia because they awaken frequently. Chest wall and abdominal movements do not occur during apneic periods with this breathing-related sleep disorder. Cheyne-Stokes respiration may be present (apnea, 10 to 60 seconds of hyperventilation, followed by another period of apnea). Nocturnal polysomnography shows decreased respiratory effort associated with decreased oxygen saturation.

Question:

- Mr. Jones is scheduled for a Polysomnogram (PSG), he must keep a sleep diary prior to the test. Which of the following is assessed with a sleep diary?
  - A. Hours of sleep and hours awake
  - B. Number of arousals during the night and hours of total sleep
  - C. Mood before sleep and on awakening and estimate of time of onset of sleep and number of arousals
  - D. Mood on awakening and number of arousals during the sleep period
Airway Clearance

**Effective airway clearance**

- Normal cough
  - Patient takes a large breath
  - Closes vocal cords
  - Contracts muscles of breathing to increase intra-thoracic pressure
  - Opens vocal cords for cough
    - Flow greater than 270 lpm

**Ineffective airway clearance**

- Causes
  - Neuromuscular disease
  - Excessive secretions
  - Foreign body aspiration
- Complaints
  - Chest congestion
  - Inability to cough up secretions
  - Shortness of breath
  - Tiredness
  - Anxiety

**Physical examination findings**

- Abnormal breath sounds
  - Wheezing
  - Rhonchi
  - Sputum may have changes
    - Thick
    - Color
    - Odor

**Pharmacological**

- Bronchodilators
  - Beta2-agonists - used to control bronchospasm (Albuterol)
  - Anti-cholinergic – prevent contraction of respiratory smooth muscle and suppress over secretion (Atrovent)
  - Methylxanthines – improve diaphragm function and dilation of local blood vessels
  - Corticosteroids - Anti-inflammatory (Mometasone)
Airway Clearance

Airway clearance treatment

• Mucolytic
  • N-Acetylcysteine (Mucomyst)
  • Sodium bicarbonate
  • Guafenisen
  • Pulmozyme

• Pharmacological cont.
  • Antibiotics
  • Vaccination
    • Influenza
    • Pneumococcus

• Cough techniques
  • Quad coughing (manual cough assist)
  • Like the Heimlich
  • Huff cough
    • Patient independent
    • Expire while saying "Huff"
    • May be done with three short coughs called pump coughing.

• Chest Physiotherapy
  • Chest percussion
    • Localized in area effected
    • May include positioning
  • Vest therapy
  • Mechanical percussor
    • Pneumatic
    • Electric

• Hydration
  • Free water, drinking water
  • Humidifiers
  • HME – Heat Moisture Exchangers
  • Incentive Spirometry
    • 10 breaths per hour
    • Breath hold up to 5 sec
    • Cough!

• Tracheotomy
  • Types of tubes
    • Uncuffed
    • Cuffed
    • Fenestrated
  • Plastic
    • Silicone
    • PVC
    • Metal
Airway Clearance
Airway clearance treatment

- Tracheotomy continued
  - Cleaning
    - Old method included hydrogen peroxide
    - Saline
    - Every eight hours
    - Humidification required
    - Patient will require suction

Airway Clearance
Airway clearance treatment

- Tracheotomy continued
  - Placed for
    - Secretion management
    - Airway protection
  - Myth: protect against aspiration

CRRN Review: Respiratory
Impaired Gas exchange

Impaired Gas Exchange

Impaired gas exchange

Definition:

- Altered ability to exchange O2 and CO2 in the lungs or intercellularly
  - Hypoxemia – low blood oxygen levels
  - Hypercarbia – increased levels of CO2

Impaired Gas Exchange

Two basic classifications of lung disease

- Obstructive
  - Patient can get air into his lungs, difficult to effectively exhale
  - COPD, Asthma, emphysema, chronic bronchitis, BPD and Cystic Fibrosis

- Restrictive
  - Poor lung expansion, can not get air into his lungs, increased ability to exhale
  - Neuromuscular disease, SCI/D, Pulmonary Fibrosis

Impaired Gas Exchange

Interventions

- Oxygen therapy
  - May help lessen cardiopulmonary workload
  - May improve:
    - Exercise tolerance
    - Mental sharpness
    - Blood levels
Impaired Gas Exchange

**Oxygen therapy**
- **Goal:**
  - Pao₂ > 60 mmHg
  - SpO₂ 90% or greater
- May be given at home or in the health care setting

**Impaired Gas Exchange**

**Oxygen therapy**
- **Qualification:**
  - SpO₂ < 89% on room air
  - PaO₂ ≤ 55 mm Hg on room air
  - Evidence of Congestive Heart Failure (CHF), enlarge Right ventricle (Cor-pulmonale), Hematocrit >55%
- **Sleep**
  - PaCO₂ < 55 mmHg or an incremental drop of at least 10 minutes
  - SpO₂ < 85%

**Impaired Gas Exchange**

**Oxygen therapy**
- **Prescription requirements**
  - Method of delivery (Nasal cannula)
  - Rate or setting required
  - Evidence that setting is effective for patient
  - Minimum daily usage (hours a day)
  - Portability requirements (works 8 hours a day)

**Impaired Gas Exchange**

**Ineffective breathing patterns**
- Metabolically costly pattern of breathing requiring more energy to produce than O₂, CO₂ exchange occurs
  - Combined Obstructive/Restrictive disorder
  - Alveolar Hypoventilation as seen in severe COPD or with children having BPD

**Question:**

A 65 y.o. female with COPD is prescribed low-flow oxygen at 2 lpm via nasal cannula. She has recently increased the flow rate to 3 lpm due to increased dyspnea. She is complaining of nasal congestion, sore throat, restlessness, a non-productive cough, headache, substernal pain, increasing fatigue and nausea. What is the MOST likely cause of these symptoms?

- A. Oxygen Toxicity
- B. Respiratory infection
- C. Prescribed oxygen flow is too low
- D. Gastroesophageal reflux disorder

**Answer:**

A. Oxygen Toxicity

119. A. Oxygen toxicity can occur if the concentration of oxygen is too high and it is administered over extended durations. Patients may exhibit nasal congestion and sore throat, restlessness, non-productive cough, headache, substernal pain, increasing fatigue, nausea, and occasional vomiting. Arterial blood gases (ABG) show refractory hypoxemia, resulting in increasing dyspnea. With oxygen toxicity, oxygen free radicals (by-products of cell metabolism) are overproduced and can damage healthy cells. Patients must be cautioned to use oxygen as prescribed. A diet high in antioxidants, such as vitamins E and C and beta-carotene, may be advised.
Impaired Gas Exchange
Respiratory Diseases

• Breath training
  • Retrain the patient to breath in a less costly pattern
  • Pursed lip breathing
  • Diaphragmatic breathing
  • Glossal pharyngeal breathing

Impaired Gas Exchange
Respiratory Diseases

• Exercise and Pulmonary rehabilitation
  • Use of exercise programs to improve endurance to exercise
  • Inspiratory muscle trainers
  • Used to strengthen the muscles used for breathing
  • Energy conservation techniques
  • Clustering activities
  • Sitting rather than standing when possible

CRRN Review: Respiratory Ventilatory Support Devices

• Non-invasive systems
  • Rocking beds
  • Pneumo belts
  • Chest shells
  • Pneumo Jackets

Ventilatory Support Devices
Ventilators

• Modern positive pressure ventilators
  • Volume ventilators
    • Most common
    • Pre-set volume
    • Invasive (to trach)
    • Non-invasive (mask)
    • Portable
      • Battery operated
      • Self contained

Ventilatory Support Devices
Ventilators

CPAP vs BIPAP

CPAP
• Continuous Positive Airway Pressure
  • Single set pressure, always constant

BIPAP/Bi-level
• Two levels of positive airway pressure
  • IPAP: Inspiratory Positive Airway Pressure
  • EPAP: Expiratory Positive Airway Pressure
  • May have a backup respiratory rate
Ventilatory Support Devices

- Stimulators
  - Provide electronic signal to stimulate breathing
  - Different approaches
    - Phrenic nerve stimulator
    - Diaphragmatic stimulator

Question:

- Which of the following conditions is usually treated with Continuous Positive Airway Pressure (CPAP) instead of Bilevel Positive Airway Pressure (BiPAP)?
  - A. Obstructive Sleep Apnea (OSA)
  - B. Central Sleep Apnea
  - C. Chronic Obstructive Pulmonary Disease (COPD)
  - D. Obesity hypoventilation syndrome

Answer:

28. A. Continuous positive airway pressure (CPAP) is indicated for obstructive sleep apnea (OSA), whereas central sleep apnea, chronic obstructive pulmonary disease (COPD), and obesity hypoventilation syndrome are usually treated with bilevel positive airway pressure (BiPAP). Most patients with OSA are initially treated with CPAP, but if the pressure needed to control OSA is high, the patient may have difficulty with expiratory (auto-CPAP) and may have air leaks, mouth leaks, and difficulty tolerating treatment. Some patients have difficulty if the expiratory positive airway pressure (EPAP) is set too high. Patients who cannot control OSA with CPAP may achieve control with BiPAP.

Question:

- When treating a patient with Bilevel Positive Airway Pressure (BiPAP), how is the Inspiratory Positive Airway Pressure (IPAP) set in relation to the Expiratory Positive Airway Pressure (EPAP)?
  - A. IPAP and EPAP must have the same setting
  - B. IPAP is set higher than EPAP
  - C. EPAP is set higher than IPAP
  - D. IPAP may be higher or lower than EPAP, depending on the patient's needs

Answer:

78. BiPAP devices deliver two levels of pressure, which can be preset. Inspiratory positive airway pressure (IPAP) is set at a higher level than expiratory positive airway pressure (EPAP). This allows for the pressure needed to open the airway during inspiration but reduces pressure to facilitate expiratory effort. BiPAP spontaneous (BiPAP S) devices have two pressure settings for each breath as well as settings for the number of respirations so that they can trigger inspiration if the respiratory rate falls below a preset level, an important consideration for central sleep apnea and other autonomic disorders.
Respiratory Functional Goals

- Injury higher than C4
- Typically ventilator dependant
- Although respiratory is affected C2-T12 to some degree.
- C4 and lower injury
- Develop a plan to care for the respiratory system using the appropriate therapies to promote good bronchial hygiene.
- If possible liberation from ventilation

Interventions to Promote Cardiovascular Health

- Eat healthy balanced diet
- Maintain ideal body weight
- Weight loss of even 10% promotes health
- Control diabetes and other chronic conditions
- Do not smoke
- Exercise
- Be active
- Be involved

CRRN Review: Respiratory

Questions

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