TRAIN FOR SUCCESS INC.
RESPIRATORY ACIDOSIS AND RESPIRATORY ALKALOSIS 4HR

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PURPOSE

Purpose of this course is to reinforce the knowledge of the healthcare professionals as well as other individuals regarding Respiratory Acidosis and Respiratory Alkalosis, review of the respiratory system, sign / symptoms patients may experience, Diagnosis and testing, caring for the individuals, appropriate interventions and treatment and patient teaching for individuals who are experiencing Respiratory Acidosis or Respiratory Alkalosis.

OBJECTIVES / GOALS:

After successful completion of this course the participants will be able to:

1. Discuss the respiratory system

2. Describe Respiratory Acidosis and Respiratory Alkalosis and possible causes

3. Discuss signs and symptoms experienced by patients

4. Describe the examinations, laboratory tests and diagnostic procedures involved

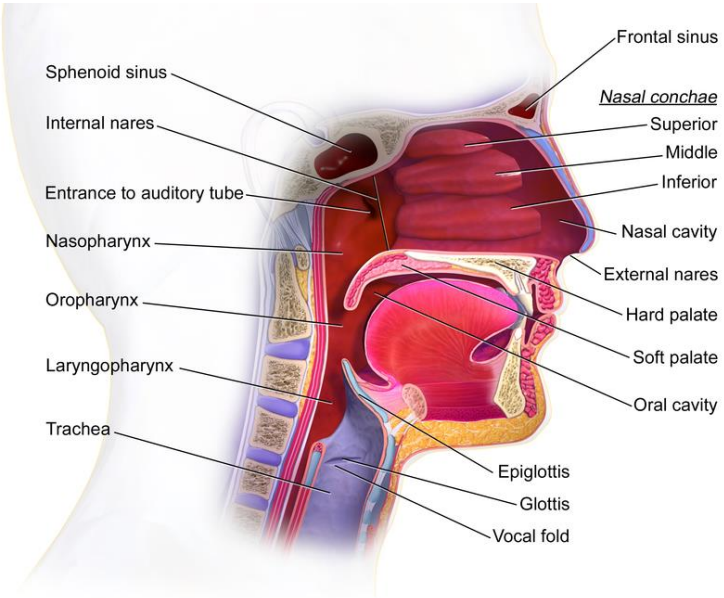
5. Detail the care, interventions and treatment for both conditions

6. Discuss appropriate patient instructions /teaching

The Respiratory System

The respiratory system is comprised of organs that are involved in breathing. These include the nose, throat, larynx, trachea, bronchi, and the lungs (the respiratory tract).

When we breathe oxygen, it goes into the lungs, then passes into the blood. The oxygen is then transported via the bloodstream, to all the cells within the body.

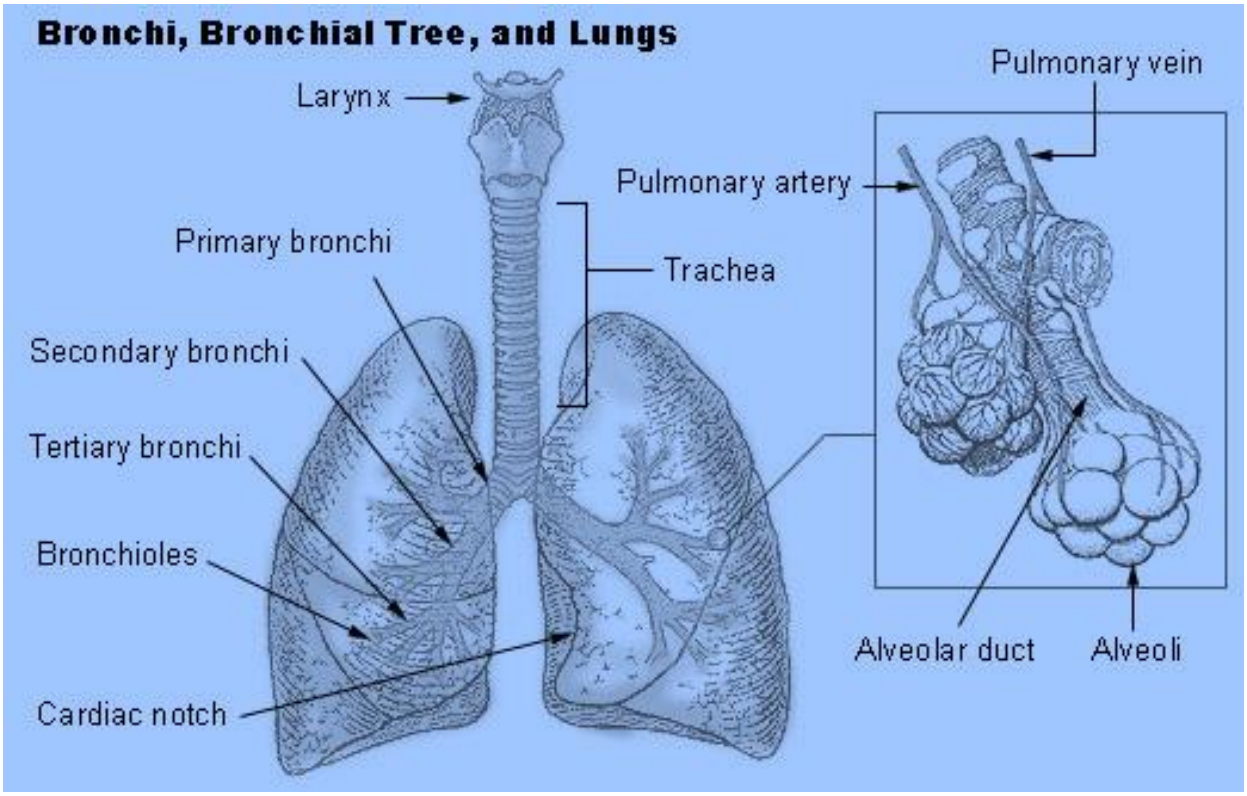


The Upper Respiratory System

By BruceBlaus. When using this image in external sources it can be cited as:Blausen.com staff (2014). "Medical gallery of Blausen Medical 2014". WikiJournal of Medicine 1 (2). DOI:10.15347/wjm/2014.010. ISSN 2002-4436. - Own work, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=27924400

The lungs

The lungs are located within the chest and are protected by the ribs (rib cage). The trachea (windpipe) branches into 2 airways called bronchi, which lead to the lungs. Within the lungs, the airways branches into narrower airways leading to the air sacs, called alveoli. The alveoli look like tiny grapes at the end of the bronchial branches. Each air sac is surrounded by a network of capillaries (fine blood vessels). The air sacs are responsible for gas exchange.



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Inhalation

When we inhale or breathe in, air which contains oxygen enters the windpipe, the air/oxygen then passes through the bronchi and eventually reaches the alveoli (air sacs).

The oxygen then passes across the thin lining of the alveoli and into the blood vessels. The blood then carries the oxygen around the body in the bloodstream, allowing it to reach each cell.

Exhalation

When we breathe out, Carbon dioxide (CO_2) is exhaled. Carbon dioxide is a waste product of cellular metabolism.

Carbon dioxide (CO_2) passes from the bloodstream (across the lining of the air sacs) into the lungs and then it is exhaled.

Respiration is stimulated by high levels of pCO2 in the blood. The primary cause of high pCO2 levels is hypoventilation.

Hypoventilation

Hypoventilation (respiratory depression) occurs when ventilation is not adequate to perform necessary gas exchange. This leads to an increased concentration of carbon dioxide (hypercapnia) and respiratory acidosis.

Hypoventilation may be caused by:

Pneumonia,

Chest Injury,

Atelectasis,

Pneumothorax,

Pulmonary Embolus,

Central Nervous System Depression,

Failure of The Respiratory Muscles.

RESPIRATORY ACIDOSIS

Respiratory acidosis is a condition that occurs when the lungs cannot remove enough of the ***carbon dioxide (CO2)*** that is produced by the body. The excess carbon dioxide (CO2) causes the pH of blood and other body fluids to decrease, making them acidic.

Under normal conditions, the lungs take in oxygen (02) and exhale carbon Dioxide (CO2). The oxygen is passed from the lungs into the blood. The carbon dioxide (CO2) is passed from the blood into the lungs.

When the lungs cannot remove enough CO2, this leads to respiratory acidosis.

Respiratory acidosis means that there is an increase in:

PaCO2 level.

The normal reference range for PaC02 is:

35 – 45 mm Hg

Respiratory acidosis is caused by hypoventilation which results in:

Excess carbonic acid (acidosis), increased PaC02.

Respiratory acidosis can be due to or associated with primary defects in lung function or changes in normal respiratory pattern.

Under normal condition, the body is able to balance the ions that control acidity. The balance is measured on the pH scale which ranges from 0 to 14. Normal blood pH is between 7.35 and 7.45.

Acidosis takes place when the pH of the blood falls below 7.35.

Respiratory acidosis can be acute or chronic.

Acute respiratory acidosis

In acute respiratory acidosis, the **PaCO2** is increased above the upper limit of the reference range; greater than 45 mm Hg (>45 mm Hg) and the pH of the blood becomes acidic (acidemia pH < 7.35).

Acute respiratory acidosis is present when a sudden /abrupt failure of ventilation happens.

The failure in ventilation may be caused by depression of the central respiratory center due to:

Central nervous system disease,

Drug-induced respiratory depression,

Airway obstruction,

Patient may be unable to ventilate adequately, due to a neuromuscular condition or paralysis such as muscular dystrophy, myasthenia gravis, amyotrophic lateral sclerosis (ALS), or Guillain-Barré syndrome).

Pneumonia,

Other lung or airway diseases.

Chronic respiratory acidosis

In chronic respiratory acidosis, the PaCO2 is increased above the upper limit of the reference range >45 mm Hg, with a normal or near normal pH due to renal compensation and an increase in serum ***bicarbonate*** levels (>30 mEq/L).

Chronic respiratory acidosis may be secondary to other disorders such as:

Chronic Obstructive Pulmonary Disease (COPD),

Hypoventilation in COPD may involve decreased responsiveness to decrease oxygen (hypoxia) and increased carbon dioxide (hypercapnia),

Reduced function of the diaphragm due to fatigue, and hyperinflation,

Asthma,

Sleep apnea,

Severe obesity can interfere with the expansion of the lungs.

Caring for the Patient

When alveolar hypoventilation occurs, two features are commonly seen: Respiratory acidosis and hypercapnia (increased CO2).

The body tries to compensate for the disturbance in the balance between the carbon dioxide (CO2) and the bicarbonate (HCO3-), the kidneys begin to excrete more acid in the forms of hydrogen and ammonium and reabsorb more base in the form of bicarbonate. This compensation helps to normalize the Ph (nih.gov 2018).

The patients may experience sign/symptoms such as:

Dyspnea / Shortness of breath on exertion,

Tachypnea - increased respirations,

Tachycardia - increased heart rate,

Changes in mentation (may be irritability)

Decreased oxygenation - hypoxia,

Increased C02 – hypercapnia.

DIAGNOSIS

Some tests that may be done include:

- Arterial blood gas (ABG),
- Chest x-ray,
- Electrolytes, basic metabolic panel,
- CT scan of the chest,
- Pulmonary function test to measure breathing and how well the lungs are functioning.

Arterial blood gas (ABG)

Arterial Blood gas is a series of tests used to measure the following:

pH the amount of free hydrogen ions (H+) in the arterial blood,

PaO2 the partial pressure of oxygen,

PaCO2 the partial pressure of carbon dioxide,

$HCO3^{-}$ the concentration of bicarbonate,

SaO2 the percentage of oxygen bound to hemoglobin (Hgb) as compared with the entire amount that can be carried,

Arterial Blood gas can be collected through an arterial line or by an arterial puncture.

Analysis

Arterial blood gas (ABG) analysis is necessary in the evaluation of a patient with suspected respiratory acidosis or other acid-base imbalance or disorders.

Normal Results

Values at sea level:

Partial pressure of oxygen (PaO2): 80 to 100 mm Hg

Partial pressure of carbon dioxide (PaCO2): 38 to 42 mm Hg

Arterial blood pH: 7.38 to 7.42

Oxygen saturation (SaO2): 95% to 100%

Bicarbonate - (HCO3): 22 to 28 mEq/L.

(At altitudes of 3,000 feet (900 meters) and higher, the oxygen value is lower).

Normal value ranges vary slightly among different laboratories.

Chest x Ray

Chest x ray can be performed to help rule out pulmonary disease as a cause of increased carbon dioxide (hypercapnia) and respiratory acidosis. Findings on chest x ray may help to determine the etiology of respiratory acidosis.

Electrolyte

Electrolytes are present within the human body, and the balance of the electrolytes in the body is needed for the body to maintain normal function of the cells and organs.

Electrolyte testing is performed by collecting blood sample. Common electrolytes that are tested includes:

Na+ (sodium),

K+ (potassium),

Cl- (chloride), and

bicarbonate.

CT scan of the chest

CT Scan of the chest can be performed to help rule out pulmonary disease as a cause of increased carbon dioxide (hypercapnia) and respiratory acidosis.

Pulmonary function test

Pulmonary function test to measure breathing and how well the lungs are working, how well the patient is able to breathe and how effective the lungs can send oxygen to the rest of the body.

Precautions

When the diagnosis has been made, the underlying cause of respiratory acidosis needs to be treated. The hypercapnia (increased carbon Dioxide) should be corrected gradually because quick alkalization of the cerebrospinal fluid may lead to seizures.

Therefore, seizure precautions should be implemented for the patients.

Treatment

When planning treatment for acute respiratory acidosis, interventions are focused on treating the underlying cause such as the patient with occlusion in the airway, the airway needs to be cleared.

Pharmacologic / medication therapy can be used to help improve ventilation;

Bronchodilators such as beta agonists, anticholinergic medications, and methylxanthines can be used in treating patients with obstructive airway diseases (nih.gov 2018).

Naloxone can also be administered to patients who overdosed on opioid use.

For chronic respiratory acidosis, the treatment will focus on managing the underlying conditions and improving airway function.

Some treatment may include:

- Corticosteroids may be administered to reduce inflammation,
- Diuretics – may be used to decrease the excess fluid affecting the heart and the lungs,
- Antibiotics - may be used to treat an infection,
- Bronchodilators – may be used to expand /open the airways,
- Teach /instruct patient to stop smoking,
- Oxygen if the blood oxygen level is low,
- Mechanical ventilation for severe cases,
- Noninvasive positive-pressure ventilation (CPAP or BiPAP) or a breathing machine.

Noninvasive positive-pressure ventilation (CPAP or BiPAP):

Continuous positive airway pressure (CPAP)

Continuous positive airway pressure (CPAP) is a form of positive airway pressure ventilator, which applies mild air pressure on a continuous basis to keep the airways continuously open in patients who are able to breathe spontaneously on their own.

Bilevel Positive Airway Pressure (BiPAP)

Bilevel Positive Airway Pressure (BiPAP) machines have two pressure settings: the prescribed pressure for inhalation (ipap), and a lower pressure for exhalation (epap). The dual settings allow the patients to get more air in and out of their lungs.

Patient teaching

Instruct patients not to eat or drink while using the CPAP/BIPAP. Patient may inhale the food or drink into the lungs. Also teach patients to avoid eating large meals 1 to 2 hours prior to using the CPAP/BIPAP.

If respiratory acidosis is not treated, further complications can arise such as:

Respiratory failure,

Poor organ function,

Shock,

Death.

Some interventions for the patient experiencing respiratory acidosis include:

Monitor respiratory rate, depth, effort,

Auscultate breath sounds,

Observe skin color, skin temperature and moisture,

Monitor pulse oximetry readings,

Monitor labs: serum electrolyte levels,

Monitor for decline in level of consciousness,

Restrict use of or tranquilizers or hypnotic sedatives (respiratory depression may develop),

Monitor heart rate and rhythm,

Administer oxygen as indicated.

Prevention

Patient teaching

Remind patient to avoid smoking because smoking leads to the development of multiple severe lung diseases that can lead to respiratory acidosis.

Instruct patients to be careful about taking sedating medications, and not to combine these medications with alcohol.

Encourage patients to eat nutritious meals and maintain a healthy body weight. Lose weight as needed, as obesity may lead to respiratory acidosis (obesity-hypoventilation syndrome). Obesity hypoventilation syndrome (OHS) is a breathing disorder that affects some obese people. In Obesity hypoventilation syndrome, poor breathing results in too much carbon dioxide due to hypoventilation and too little oxygen in the blood (hypoxemia).

Instruct patients to use the CPAP device regularly if it's been prescribed.

Respiratory alkalosis

Respiratory alkalosis is a condition marked by a decreased level of carbon dioxide (Co2) in the blood due to hyperventilation (breathing excessively).

Respiratory alkalosis occurs when the patient is breathing too fast or too deep and carbon dioxide levels drop too low. This also causes the pH of the blood to rise and become too alkaline.

Causes of Respiratory Alkalosis

Some of the common causes include:

- Anxiety
- Stress
- Panic
- Fever
- Hyperventilation
- Pain.

Any lung disease that leads to dyspnea /shortness of breath can also cause respiratory alkalosis, for example pulmonary embolism.

Symptoms of respiratory alkalosis

Some of the signs /symptoms include:

- Lightheadedness
- Dizziness
- Sweating
- Palpitation
- Tetany
- Convulsion
- Numbness of the feet
- Numbness of the hands.

DIAGNOSIS / TESTS

Some Tests that may be performed include:

- Physical examination,
- Arterial blood gas (ABG),
- Basic metabolic panel
- Chest x-ray
- Pulmonary function tests.

Treatment

Treatment is aimed at the condition that is causing the respiratory alkalosis for example breathing into a paper bag or use a rebreathing mask that causes the patient to re-breathe carbon dioxide, this may help reduce the symptoms when anxiety is the main cause of the condition.

Inadequate sedation and inadequate pain control can contribute to respiratory alkalosis in patients who are breathing over the set ventilator rate. Therefore, treatment should ensure adequate pain management and sedation.

Some interventions include:

Frequently monitoring of the patient's respiratory rate, depth, and effort.

Determine the cause of hyperventilation; is it caused by anxiety, pain, or improper ventilator settings?

Encourage the patient to breathe slowly, deeply.

Speak with patient in a calm, low, tone of voice, as this will help to reassure and calm the patient, therefore helping to reduce the respiratory rate.

Assess the patient's level of awareness or cognition and assess the neuromuscular status. Check strength, reflexes, tone and sensation.

Instruct patient and demonstrate appropriate breathing patterns, if indicated, and help with respiratory aids or rebreathing mask/bag.

Help to promotes relaxation and reduce stress by providing comfort measures, encourage use of meditation and visualization.

Control and reduce fever (use tepid sponge bath or cool cloth) which will reduce the potential for seizures and also helps to decrease respiration rate.

Assist with providing safety and seizure precautions. Place the patient's bed in low position, pad the side rails and frequently observe the patient because changes in mentation, central nervous system, and neuromuscular hyperirritability can occur and result in harm to the patient if tetany or convulsions happen.

Assist in providing pain medication/ management or sedation, as indicated, as this may be required to reduce the cause of hyperventilation.

TAKE EXAM

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