Acidosis is an acid-base imbalance that’s characterized by an abnormal accumulation of acid in the blood. It can also be caused by a loss of alkali in the blood, leading to an acid-base mismatch in which there’s more acid than base. Regardless of the cause, acidosis will lead to a serum pH level below 7.35. An acidic environment can be very dangerous because it alters cellular function, which in turn affects all body systems. Additionally, acidosis can alter a patient’s oxygenation by making it more difficult for hemoglobin to bind with available oxygen.

Acidosis is either respiratory or metabolic in nature. In this article, you’ll learn about both disorders, including recognition, causes, and nursing care.

**Respiratory**

As the name implies, respiratory acidosis is caused by problems with the respiratory system. In order to understand respiratory acidosis, you’ll need to have a generalized understanding of anatomy and physiology as it relates to the respiratory system, which takes oxygen from the air and transports it to the blood. Once oxygen is in the blood, it’s transported throughout the body. In addition to taking in oxygen, the lungs also remove carbon dioxide from the blood by exhaling it into the environment. When the lungs aren’t able to remove carbon dioxide effectively, the carbon dioxide that remains in the body will form an acid. This acid accumulates in the blood, causing a low serum pH and corresponding respiratory acidosis.

Respiratory acidosis can develop quickly over a short period of time or slowly over a prolonged amount of time. The speed with which respiratory acidosis develops will depend on the underlying condition causing it. Respiratory acidosis may be caused by the following:

- chronic obstructive pulmonary disease (COPD)
- pneumonia
- airway obstruction
- atelectasis
- asthma
- respiratory failure
- any disorder/condition resulting in pain with breathing
- drug overdose
- head injury
- anesthesia.

The signs and symptoms associated with respiratory acidosis are as follows:

- restlessness
- headache
- light-headedness
- decreased level of consciousness (LOC), such as confusion, lethargy, or coma
- dysrhythmias
- slow or difficult breathing
- tremor/muscular twitching
- BP changes
- cyanosis
- drowsiness
- muscle weakness.

**Metabolic**

Unlike respiratory acidosis in which the cause is a problem with the respiratory system, metabolic acidosis can be caused by a variety of problems in the body, such as tissue hypoperfusion (the tissues don’t receive enough oxygen) or a lack of oxygen to the kidneys. When the tissues in the body don’t receive enough oxygen,
anaerobic metabolism takes over and produces lactic acid, creating an acidic environment within the body. When the kidneys don’t receive enough oxygen, they lose their ability to excrete acid in the form of hydrogen ions, leading to the excess acid remaining in the body and causing an acidic environment. Metabolic acidosis can also occur as the result of excess loss of bicarbonate from the gastrointestinal (GI) tract. Patients may lose bicarbonate from the GI tract when they have excessive diarrhea or vomiting, or need to be suctioned for a prolonged period of time.

As with respiratory acidosis, metabolic acidosis can develop quickly or over a more prolonged time period. The speed with which metabolic acidosis develops is dependent on the underlying condition. Metabolic acidosis can be caused by the following:

• ketoacidosis (diabetes, starvation)
• alcoholism
• renal failure
• diarrhea
• oliguric renal disease
• poor perfusion (shock)
• diuretic use
• lactic acidosis
• isoniazid, salicylate, or iron poisoning
• methanol ingestion
• pancreatic fistula
• hypermetabolic state (burns, infection).

The signs and symptoms associated with metabolic acidosis include:

• tachypnea
• decreased LOC, such as confusion, lethargy, or coma
• abdominal pain
• dysrhythmias
• increased rate and depth of respirations (compensatory hyperventilation)
• flushed skin
• decreased BP
• muscle twitching
• Kussmaul respirations
• nausea
• vomiting
• diarrhea.

**How to use the ABG**

An arterial blood gas (ABG) test is the lab test used to diagnose and evaluate acid-base imbalances. With this test, a blood sample from an artery instead of a vein is analyzed. Arterial blood is used because it provides the most accurate picture of what’s going on with the patient. There are five components to the ABG: pH, Paco₂, Pao₂, HCO₃⁻, Sao₂ (see *Normal ABG values*).

pH is the measurement of the blood’s acidity or alkalinity. Basically, the pH is a measurement of the concentration of hydrogen ions in the blood. Increased hydrogen ions cause an acidic environment, whereas decreased hydrogen ions create an alkaline environment. Slight shifts in the pH can be very dangerous for a patient.

Paco₂ is the measurement of the partial pressure of carbon dioxide dissolved in arterial blood. The rate and depth of respirations alter Paco₂ levels. Hypoventilation causes increased Paco₂ levels and resulting respiratory acidosis.

Pao₂ is the measurement of the partial pressure of oxygen dissolved in arterial blood. Pao₂ levels that fall below 60 mm Hg cause anaerobic metabolism with resulting lactic acid production and metabolic acidosis.

HCO₃⁻ is the measurement of the concentration of bicarbonate ions. Bicarbonate levels in the blood provide a window into how the kidneys are handling metabolic acid. Low bicarbonate levels are indicative of metabolic acidosis.

Sao₂ is the measurement of the percentage of hemoglobin saturated with oxygen. Factors that can alter Sao₂ levels include temperature, pH, and Paco₂.

When analyzing ABG test results for acid-base imbalances, you should do the following:

**consider this**

A 22-year-old female patient with diabetes is admitted to your ED with lethargy, headache, abdominal pain, and tachypnea. Her mother, who’s present at the time of admission, reports that the symptoms began yesterday. Upon admission, the patient’s blood glucose level is 500. An ABG test is obtained with the following results: pH, 7.31; Paco₂, 45; Pao₂, 85%; HCO₃⁻, 20; and SaO₂, 90%. The diagnostic results indicate metabolic acidosis.
1. Review the pH to determine if it’s high, low, or normal. When pH levels are high, hydrogen ion concentration is low; if pH levels are low, hydrogen ion concentration is high. A high pH and low hydrogen ion concentration corresponds to an alkaline environment, whereas a low pH and high hydrogen ion concentration corresponds to an acidic environment. This step won’t identify respiratory versus metabolic disturbances, but it will provide information about acidity versus alkalinity.

2. Look at the PaCO₂ and SaO₂ values to determine the patient’s oxygenation status.

3. Examine the PaCO₂ and HCO₃ levels to determine if the problem is respiratory or metabolic in nature. If the problem is respiratory, the PaCO₂ will be elevated and the HCO₃ will be normal. If the problem is metabolic, the PaCO₂ will be normal and the HCO₃ will be decreased.

Keep in mind that with respiratory imbalances, the pH and PaCO₂ will be abnormal in opposite directions. With metabolic imbalances, the pH and HCO₃ will be abnormal in the same direction.

### The body tries to compensate

It’s important to be aware that the body will attempt to compensate for acid-base imbalances when they occur. The body attempts to compensate to normalize the serum pH and return itself to a state of homeostasis. The lungs will try to compensate for metabolic problems and the kidneys will try to compensate for respiratory problems. This makes sense because the lungs aren’t functioning well when respiratory acidosis has occurred and the kidneys may not be functioning correctly when metabolic acidosis has occurred.

The body compensates for respiratory acidosis by increasing HCO₃; it compensates for metabolic acidosis by hyperventilating and decreasing PaCO₂. It may help to remember that CO₂ levels are controlled by the respiratory system and bicarbonate levels are controlled by the renal system. Basically, when one system becomes acidic, the other will compensate by trying to become alkalotic.

### Management

Respiratory acidosis is treated by correcting or managing the underlying respiratory cause. When addressed quickly, the treatment of acute conditions will usually lead to no long-term effects. Left untreated, patients with respiratory acidosis may become comatose or die.

Corticosteroids, bronchodilators, noninvasive positive-pressure ventilation, mechanical ventilation, and oxygen administration are all potential treatment options for a patient with respiratory acidosis.

Corticosteroids and bronchodilators may be used to decrease airway inflammation and resistance in patients with breathing difficulties. When administering these medications, it’s important to educate your patient regarding the reason for their use and potential adverse reactions.

Noninvasive positive-pressure ventilation may be utilized to assist patients with breathing. This treatment involves the use of a continuous positive airway pressure or bilevel positive airway pressure machine.

In some cases, you may need to assist your patient with ventilation. If the underlying cause is a chronic breathing condition, the patient may need to be placed on a ventilator.

Low oxygen levels may need to be treated with oxygen administration. When administering oxygen, you’ll want...
to make sure that you’re aware of your patient’s underlying respiratory condition. For example, if your patient has COPD and is a CO2 retainer, you’ll want to administer oxygen cautiously and monitor your patient closely to ensure that you aren’t administering oxygen at a level that’s too high. In addition to these interventions, you’ll want to educate patients regarding the importance of smoking cessation because smoking can increase your patient’s risk for respiratory problems.

As with respiratory acidosis, the treatment for metabolic acidosis focuses on correcting the underlying cause. Treatments that may be used for a patient with metabolic acidosis include detoxification for drug and/or alcohol poisoning, insulin for diabetic ketoacidosis (DKA), I.V. fluids, and sodium bicarbonate.

If drug and/or alcohol poisoning is causing the acidosis, detoxification will bring about a reversal. Always make sure to follow facility protocols for drug and/or alcohol detoxification.

With DKA, the body becomes acidic as the result of an inability to produce enough insulin. The administration of insulin will reverse the acidic state. When administering insulin, always monitor for and be aware of the signs and symptoms of hypoglycemia.

When administering I.V. fluids, ensure that you’re administering the correct fluids because incorrect I.V. fluid administration can be harmful for your patient. Additionally, you should monitor any patient receiving fluids for fluid overload.

The administration of sodium bicarbonate can correct pH and avoid complications associated with acidosis. It’s important to remember that bicarbonate won’t fix the underlying cause, but it will help reduce acid in the blood. Bicarbonate is typically administered to maintain a serum pH above 7.2. In many cases, bicarbonate will only be administered when the serum pH is 7.0 or below. When administering sodium bicarbonate, a potential complication is alkalosis, so patient monitoring is essential.

**Interpretation skills needed**

When caring for patients with respiratory or metabolic acidosis, one of the most important aspects is the ability to interpret the ABG test. An inability to do so may delay treatment and negatively affect patient outcomes. Being knowledgeable about the causes of both respiratory and metabolic acidosis is also an important factor to keep patients safe and promote positive outcomes. Patients who are at risk for acidosis should be monitored closely and treated promptly if signs and symptoms develop.

Stay tuned next issue where we’ll take a look at respiratory and metabolic alkalosis.

**REFERENCES**


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