

DISEASES ASSOCIATED WITH DISORDERS OF BLOOD ACIDITY AND ALKALINITY (ACIDOSIS AND ALKALOSIS): CAUSES OF ORIGIN

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Annotation: This article discusses the conditions associated with the disruption of the acid-base balance in the blood, namely **acidosis** and **alkalosis**. These are serious physiological disorders that occur when the pH level of the blood deviates from its normal range. **Acidosis** refers to a state where the pH of the blood drops below the normal level, indicating an increase in acidity. In contrast, **alkalosis** is a condition where the blood pH rises above the normal physiological range, indicating increased alkalinity.

There are two main types of acidosis and alkalosis: **respiratory** and **metabolic**. Respiratory acidosis and alkalosis are caused by abnormal carbon dioxide (CO₂) levels due to respiratory system dysfunctions, such as hypoventilation or hyperventilation. Metabolic acidosis and alkalosis, on the other hand, result from disturbances in the metabolic processes that affect the concentration of bicarbonate (HCO₃⁻) in the body.

The article provides a detailed overview of the **etiology** (causes), **pathophysiology** (mechanisms of development), and **clinical manifestations** (symptoms) of each type. It emphasizes the importance of timely diagnosis, which usually involves **arterial blood gas (ABG) analysis**, and other laboratory tests that help determine the origin and severity of the imbalance.

Furthermore, the article outlines therapeutic approaches based on the underlying cause. Treatment may involve managing the primary disease, administering medications to restore acid-base balance, correcting electrolyte disturbances, or providing respiratory support. Understanding and correcting acid-base disorders is crucial in clinical practice, as prolonged pH imbalance can lead to severe complications and even be life-threatening if left untreated.

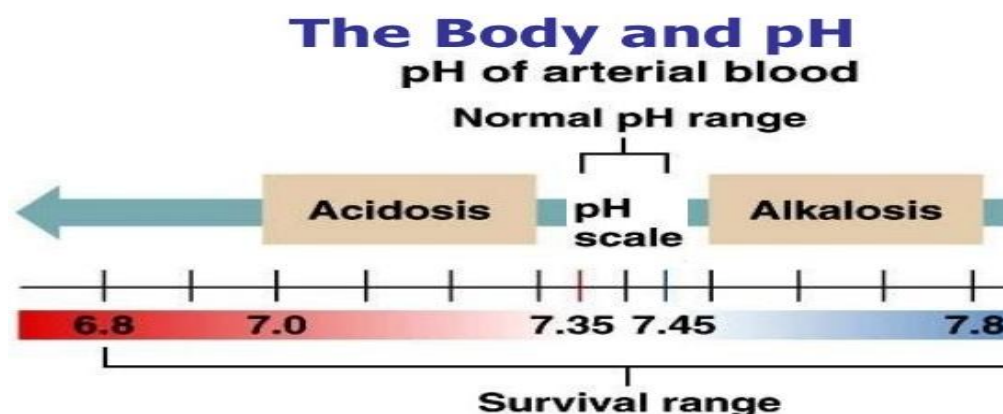
Keywords: blood pH, acid-base balance, acidic condition, alkaline condition, acidosis, alkalosis, metabolic acidosis, respiratory acidosis, metabolic alkalosis, respiratory alkalosis

Abstract: This article discusses conditions associated with disturbances in the acid-base balance of blood — acidosis and alkalosis. Acidosis is characterized by a decrease in blood pH below normal levels (increased acidity), whereas alkalosis refers to an increase in blood pH above the normal range (increased alkalinity). The article provides information on the types of these pathologies (respiratory and metabolic acidosis/alkalosis), their causes, clinical manifestations, diagnostic methods, and treatment approaches.

Keywords: blood pH, acidic state, alkaline state, acidosis, alkalosis, metabolic acidosis, respiratory acidosis, metabolic alkalosis, respiratory alkalosis.

Introduction: In order for biological processes in the human body to function properly, the pH level of the blood must be maintained within a specific range — 7.35 to 7.45. When this balance is disturbed, various pathological conditions may arise, particularly acidosis (excessive acidification of the blood) and alkalosis (excessive alkalinity of the blood). These conditions negatively affect cellular metabolism, enzyme activity, oxygen transport, and other critical physiological processes. Acidosis and alkalosis may occur not only as independent disorders but also as secondary complications of various diseases, such as those affecting the kidneys, lungs, heart, or the endocrine system. The development of these conditions typically occurs via metabolic or respiratory mechanisms. For example, metabolic acidosis often results from renal failure or diabetic ketoacidosis, while respiratory acidosis is commonly associated with decreased alveolar ventilation. Conducting research on this topic contributes not only to a deeper understanding of the pathogenesis of these conditions, but also to the development of timely diagnostic approaches and effective treatment strategies. This work focuses on identifying the underlying causes of acidosis and alkalosis, outlining their main types, and explaining their clinical and biochemical foundations.

What is acid-base balance in the blood? The blood maintains a relatively constant pH level, which is vitally important for the proper functioning of all biological processes in the body. Even slight deviations from the normal pH range can have serious physiological consequences.



pH normasi: 7.35 – 7.45

If pH < 7.35 – this is acidosis (a condition of increased acidity)

If pH > 7.45 – this is alkalosis (a condition of increased alkalinity)

What is an alkali? Which substance maintains alkalinity in the blood?

In the blood, the main alkaline substance is **bicarbonate** (HCO_3^-). Bicarbonate acts as a **buffer**, a protective mechanism that neutralizes excess acidity. It binds with hydrogen ions (H^+) and neutralizes them:



This means that excess acidity (H^+) is converted into carbonic acid, which then breaks down into water and carbon dioxide (CO_2). The CO_2 is expelled through the lungs.

There are three main mechanisms that regulate blood pH:

1. **Buffer systems** – the first line of defense
 - **Bicarbonate buffer** (the most important one)
 - **Phosphate buffer**



- **Protein buffers** (e.g., hemoglobin)
These substances act quickly to stabilize pH levels.
- 2. **Respiratory system (lungs)** – the second line of defense
 - CO₂ increases blood acidity.
 - If acidity increases, breathing becomes faster to expel CO₂.
 - If alkalinity increases, breathing slows down to retain CO₂.This mechanism operates within minutes.
- 3. **Kidneys** – the third and most powerful regulatory system
 - They excrete excess H⁺ ions.
 - They reabsorb necessary HCO₃⁻.Although this process is slower, it provides long-term and stable pH regulation.

Diseases resulting from pH imbalance:

1. Metabolic Acidosis

This condition occurs when the body produces too much acidic substance or loses too much alkaline substance, resulting in a drop in blood pH (increased acidity).

Causes include:

1. Diabetic ketoacidosis (the most common cause).

In individuals with diabetes, if there is insufficient insulin, cells cannot absorb glucose. The body.....begins to burn fats for energy. When fats are broken down, ketone bodies are produced — which are strong acids. These accumulate in the blood and increase acidity.

2. Kidney failure: Healthy kidneys excrete acids through urine. In kidney dysfunction, acidic substances accumulate in the body.

3. Diarrhea: In diarrhea, a large amount of alkaline substance (bicarbonate) is lost. This leads to increased acidity.

4. Poisoning with toxic substances (e.g., methanol, ethylene glycol): These substances are metabolized into acids in the body, leading to acidosis.

Types of acid-base imbalances: Causes and Effects

1. Metabolic Acidosis

Causes:

- Diabetic ketoacidosis: In insulin deficiency, the body breaks down fat for energy, producing acids.
- Kidney failure: Reduced excretion of H⁺ ions.
- Severe poisoning: e.g., with aspirin or methanol.
- Diarrhea or excessive diuretic use: Loss of bicarbonate (alkaline substances).

Clinical symptoms:

- Rapid breathing (Kussmaul respiration)
- Fatigue, dizziness
- Irregular heartbeat
- Blood pH drops below 7.35

2. Metabolic Alkalosis

In metabolic alkalosis, the amount of alkaline substances in the blood (e.g., bicarbonate) increases, or acids are lost. As a result, blood pH rises above 7.45.

Causes:

1. Frequent vomiting: Stomach acid (HCl) is lost, increasing alkalinity.



2. Diuretics (e.g., furosemide, hydrochlorothiazide): These drugs cause loss of potassium and hydrogen ions, enhancing alkalinity.
3. Potassium deficiency (hypokalemia): When potassium is low, cells take in hydrogen ions, leaving the blood more alkaline.

Symptoms:

- Tremors in hands and feet
- Muscle cramps
- Dizziness
- Slow heart rate
- Slow breathing
- In severe cases — loss of consciousness

Conclusion:

Maintaining pH balance in the blood is crucial for human health. Acidosis and alkalosis are conditions where the body's pH shifts outside the normal range. These imbalances may result from various diseases or disruptions in metabolic or respiratory function. Medical professionals should constantly monitor blood pH balance, especially in critically ill patients, those in intensive care, or those with chronic diseases. Early diagnosis and proper treatment play a crucial role in preventing complications. Students and medical trainees are advised to thoroughly understand this topic, as acid–base balance forms the foundation for interpreting many pathological processes.

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