CONDITION

Metabolic acidosis

Metabolic acidosis is an imbalance caused by excess acid or too little bicarbonate in the blood.

WHAT IT IS
Excess acid or too little bicarbonate in the blood

BODY SYSTEM
Whole body, especially kidneys, lungs, heart, and brain

MAIN SYMPTOMS
Fast deep breathing, nausea, weakness, confusion

WHAT CAUSES IT
Kidney disease, acid buildup, or bicarbonate loss

HOW IT IS DIAGNOSED
Blood electrolytes and blood gas testing

MAIN TREATMENT
Treating the cause, fluids, alkali, or dialysis

CAN IT BE CURED?
Sometimes - reversible causes can be corrected

IS IT AN EMERGENCY?
Sometimes - rapid deep breathing or confusion

LONG-TERM OUTLOOK
Often improves; chronic causes need ongoing care

Overview

Metabolic acidosis is a condition in which the body has too much acid, too little bicarbonate, or both. Bicarbonate is a substance in the blood that helps keep acidity within a safe range.

Your kidneys normally remove acids and return bicarbonate to the blood. Your lungs also help by breathing out carbon dioxide, which acts like an acid in the body. Metabolic acidosis develops when these systems cannot keep up, when the body produces a large amount of acid, or when bicarbonate is lost.

The term describes an acid-producing process, not a single disease. It can happen suddenly during a serious illness, such as diabetic ketoacidosis or severe infection. It can also develop gradually in people with chronic kidney disease or certain kidney-tubule disorders.

Metabolic acidosis is related to, but not identical to, acidemia . Acidemia means the blood pH is below its usual range. Someone can have metabolic acidosis while their pH remains near normal because faster breathing removes carbon dioxide. Other acid-base imbalances may also affect the final pH.

Mild metabolic acidosis may cause few symptoms. Severe or rapidly developing acidosis can affect breathing, circulation, heart rhythm, and brain function, so finding and treating its cause matters.

Symptoms

Symptoms depend on how quickly the acidosis develops and how severe it becomes. The underlying illness may cause more noticeable symptoms than the acid imbalance itself.

Possible symptoms include:

Very deep, laboured breathing is sometimes called Kussmaul breathing . It is the body's attempt to remove more carbon dioxide. This pattern is particularly associated with severe metabolic acidosis, including diabetic ketoacidosis.

Long-lasting acidosis may be less obvious. A person with chronic kidney disease may notice reduced energy or muscle strength, but these symptoms have many possible causes. Children with persistent acidosis may have problems with normal growth.

Symptoms alone cannot confirm metabolic acidosis. Blood testing is needed.

- Faster or deeper breathing
- Nausea, vomiting, or reduced appetite
- Tiredness, weakness, or headache
- Confusion, drowsiness, or difficulty concentrating

Causes and risk factors

Metabolic acidosis has three broad causes: the body makes or receives too much acid, the kidneys cannot remove enough acid, or the body loses too much bicarbonate.

Excess acid production can occur with:

Reduced acid removal can occur in advanced kidney disease. It can also result from renal tubular acidosis , a group of conditions in which the kidney's small tubules do not handle acid or bicarbonate normally. Some forms are inherited, while others are linked to autoimmune

conditions, medicines, or other kidney problems.

Bicarbonate can be lost through severe or prolonged diarrhoea. It may also be lost through certain intestinal or urinary drainage problems.

Risk is higher in people with kidney disease, diabetes, severe diarrhoea, major infection, poor circulation, or exposure to particular toxins. Some medicines can contribute by affecting the kidneys, bicarbonate balance, or acid production. A medicine should not be stopped based only on a test result; the full clinical situation needs to be reviewed.

- Ketoacidosis , when the body produces acidic chemicals called ketones. This can happen with uncontrolled diabetes, prolonged lack of food, or heavy alcohol use.
- Lactic acidosis , when lactic acid builds up. Possible causes include severe infection, shock, seizures, very low oxygen delivery, or certain medicines and toxins.
- Poisoning or overdose , including exposure to substances such as methanol, ethylene glycol, or salicylates. These require urgent specialist care.

Diagnosis

Diagnosis begins with blood tests. A standard electrolyte panel usually reports sodium, chloride, and total carbon dioxide. Most of the total carbon dioxide in this test represents bicarbonate, so a low result may suggest metabolic acidosis. A single low result does not always confirm it.

A blood gas test measures pH, carbon dioxide, and bicarbonate more directly. Blood may come from a vein or, in some situations, an artery.

The anion gap is a calculation made from electrolyte results. It estimates whether unmeasured acids are present. A high anion gap can point toward causes such as ketoacidosis, lactic acidosis, kidney failure, or some poisonings. A normal anion gap may be seen with diarrhoea or renal tubular acidosis. Albumin, a protein in the blood, can affect how the anion gap is interpreted.

Tests used to find the cause may include:

Results are interpreted alongside symptoms, medical history, medicines, and examination findings. More than one acid-base problem can be present at the same time.

- Blood glucose and ketone testing
- Kidney function and other electrolyte tests
- Lactate measurement

- Urine testing
- Tests for medicines, alcohols, or toxins when exposure is possible

Treatment and management

Treatment focuses on the cause and the severity of the imbalance. Correcting a laboratory number without addressing the underlying problem is not enough.

Someone with diabetic ketoacidosis usually needs hospital treatment with fluids, insulin, and close monitoring of potassium and other electrolytes. Lactic acidosis is managed by restoring circulation or oxygen delivery and treating triggers such as severe infection or seizures.

Diarrhoea-related bicarbonate loss may improve when fluid and electrolyte losses are replaced and the cause of the diarrhoea is managed. Poisoning may require an antidote, specialist toxicology care, or dialysis.

People with chronic kidney disease or renal tubular acidosis may be given an alkali treatment, such as a prescribed bicarbonate or citrate preparation. This replaces base and helps balance acid. The choice and amount require monitoring because these products can affect sodium, potassium, fluid balance, and blood pressure.

Dialysis can remove acids and certain toxins when kidney function is severely reduced or when an imbalance does not respond to other treatment.

Intravenous bicarbonate is used only in selected situations. It is not automatically helpful for every form of metabolic acidosis and can cause complications if used inappropriately. Taking baking soda or over-the-counter alkali without medical guidance is not a safe substitute for diagnosis and treatment.

Follow-up blood tests may be needed to check bicarbonate, potassium, kidney function, and the response to treatment.

Complications

Severe acute metabolic acidosis can reduce the heart's ability to pump effectively and may contribute to low blood pressure or an abnormal heart rhythm. It can also cause worsening confusion, reduced consciousness, and breathing difficulty.

Potassium levels may become dangerously high or low, depending on the cause and treatment. Both can affect heart rhythm and muscle function.

Persistent metabolic acidosis may contribute to loss of muscle, weaker bones, and poor

growth in children. In chronic kidney disease, ongoing acidosis is also associated with worsening kidney health.

The overall risk depends heavily on the cause. A short episode caused by a reversible illness is different from acidosis linked to advanced kidney failure, shock, or poisoning.

Prevention

Metabolic acidosis cannot always be prevented. Inherited renal tubular disorders and some causes of kidney failure are not preventable.

When diabetes is the cause, taking diabetes treatment as directed, monitoring glucose or ketones according to an established sick-day plan, and seeking early help during illness can lower the risk of ketoacidosis.

Regular follow-up for chronic kidney disease can identify falling bicarbonate levels before severe symptoms develop. Prescribed treatment should be taken as directed, with planned blood tests.

Promptly replacing fluids during diarrhoea may help prevent dehydration, but persistent or severe diarrhoea still needs medical assessment. Keep antifreeze, solvents, salicylates, and other potentially toxic substances secured and in their original containers.

Diet alone cannot reliably prevent or correct metabolic acidosis. People with kidney disease may receive tailored dietary advice, but major restrictions should not be started without considering nutrition, potassium levels, and kidney function.

Living with it and what to expect

Acute metabolic acidosis may resolve over hours or days when its cause is corrected. Recovery time depends on the illness involved. Follow-up may include repeat blood tests to confirm that bicarbonate, pH, kidney function, and electrolytes have returned toward their usual levels.

Chronic metabolic acidosis may continue for months or years when it is caused by long-term kidney disease or a renal tubular disorder. Treatment can often improve the acid balance, but ongoing monitoring is usually needed. Doses or treatment types may change as kidney function, diet, medicines, or other health conditions change.

Most day-to-day care involves managing the underlying condition, taking prescribed treatment, and attending blood-test appointments. If kidney disease is present, monitoring

may also include blood pressure, potassium, nutrition, bone health, and muscle strength.

A previous episode does not mean that another episode is certain. Risk is influenced by whether the cause was temporary, remains active, or can be controlled. Knowing the trigger and having a clear plan for illness or recurring symptoms can make future episodes easier to recognise.

When to get medical help

Call emergency services for:

People with diabetes need urgent assessment for vomiting, abdominal pain, deep breathing, confusion, or high glucose with raised ketones. These can be signs of diabetic ketoacidosis.

Seek prompt medical advice for persistent vomiting or diarrhoea, reduced urine output, worsening weakness, or inability to keep fluids down. A low bicarbonate or total carbon dioxide result also needs timely review, especially if it is new or accompanied by symptoms.

Routine follow-up is appropriate for stable chronic acidosis when you feel well and have an established monitoring plan. Attend scheduled blood tests and arrange an earlier review if symptoms change or prescribed treatment becomes difficult to take.

- Rapid, deep, or laboured breathing
- New confusion, extreme drowsiness, collapse, or loss of consciousness
- Suspected ingestion of antifreeze, methanol, or another toxic substance
- Severe illness with breathing difficulty, very low blood pressure symptoms, or rapidly worsening weakness

Common questions

Is metabolic acidosis the same as acid reflux?

No. Acid reflux involves stomach contents moving into the food pipe. Metabolic acidosis is an imbalance in the blood and body tissues.

Does a low carbon dioxide result mean I have metabolic acidosis?

Not always. On a standard electrolyte panel, total carbon dioxide mainly reflects bicarbonate, and a low value can suggest metabolic acidosis. Sample handling, breathing-related disorders, and other acid-base problems can also affect the result. Interpretation may require repeat testing or a blood gas.

Can dehydration cause metabolic acidosis?

Severe dehydration can contribute by reducing blood flow to tissues and kidneys. Diarrhoea can also cause dehydration while directly removing bicarbonate from the body. Mild dehydration alone does not always cause acidosis.

Why does metabolic acidosis make breathing faster?

The lungs try to compensate by removing more carbon dioxide. Breathing becomes faster or deeper, which helps reduce acidity but does not remove the original cause.

Can diet fix metabolic acidosis?

Diet is not a safe replacement for medical treatment. Dietary changes may support care for some people with chronic kidney disease, but they must account for potassium, protein, calories, and other health needs.

Can metabolic acidosis go away completely?

Sometimes. It may resolve when a temporary cause, such as ketoacidosis, severe diarrhoea, or another acute illness, is treated. Acidosis caused by chronic kidney disease or an inherited kidney disorder may require long-term management.

Sources

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