TEST

Blood gases

A blood gas test measures oxygen, carbon dioxide, and acid balance in blood

WHAT IT MEASURES
Blood acidity, oxygen, carbon dioxide, and bicarbonate

SAMPLE
Arterial, venous, or capillary blood

FASTING NEEDED?
No

HOW LONG IT TAKES
Usually 5 to 10 minutes

RESULTS IN
Usually minutes to hours, varying by laboratory

USED FOR
Diagnosing and monitoring breathing or acid-base problems

MAIN LIMITATION
Sample type and handling can substantially distort results

Overview

A blood gas test measures how well your lungs and circulation are moving oxygen into your blood and removing carbon dioxide. It also shows whether your blood has the expected balance between acids and bases.

The most common version is an arterial blood gas, or ABG. Its sample usually comes from an artery at the wrist. Arterial blood gives the clearest information about oxygen and carbon dioxide exchange in the lungs.

A venous blood gas, or VBG, uses blood from a vein. It can provide useful information about acidity and carbon dioxide, but venous oxygen results cannot replace arterial oxygen measurements. Capillary samples, often collected from a heel or fingertip, may be used in babies or selected situations.

Blood gas reports commonly include:

Some analysers also report lactate, electrolytes, glucose, or forms of haemoglobin that cannot carry oxygen normally. These are additional measurements rather than part of every blood gas test.

- pH , showing how acidic or alkaline the blood is
- Partial pressure of oxygen , often called PaO2 on an arterial sample
- Partial pressure of carbon dioxide , often called PaCO2
- Bicarbonate , a substance involved in controlling acid balance
- Oxygen saturation , which may be measured or calculated

Why the test is ordered

A blood gas may be ordered when rapid information is needed about breathing, oxygen delivery, or acid balance. It is commonly used in emergency departments, intensive care units, operating rooms, and respiratory care.

The test can help assess:

Blood gases are not usually used for routine screening in someone who feels well. A pulse oximeter is simpler when only an estimate of oxygen saturation is needed, but it does not measure carbon dioxide or blood acidity.

- Serious breathing difficulty or low oxygen levels
- Possible respiratory failure, when the lungs cannot exchange gases adequately
- Severe asthma, pneumonia, or worsening long-term lung disease
- Acid-base changes caused by kidney problems, diabetes, poisoning, or severe infection
- Response to oxygen, a ventilator, or other breathing support
- Circulation and oxygen delivery during critical illness

Who should have the test

You may be offered this test if your healthcare team needs information that cannot be obtained reliably from symptoms, a pulse oximeter, or routine venous blood tests.

An arterial sample may be preferred when an accurate measurement of blood oxygen is important. A venous sample may be enough when the main question concerns pH, bicarbonate, or a broad assessment of carbon dioxide. The choice depends on your condition and how precise the oxygen measurement needs to be.[1,2]

Seek emergency care for severe difficulty breathing, new confusion, collapse, chest pain with breathlessness, or blue or grey lips or skin. Do not wait for a routine appointment or attempt to

arrange a blood gas test yourself.

How to prepare

Fasting is not normally required. You can usually eat, drink water, and take your usual medicines unless you have separate instructions for another test or procedure.

Tell the person taking the sample if you:

Your oxygen setting may need to remain stable before the sample is collected. Do not change or remove prescribed oxygen unless the healthcare team asks you to do so. Resting briefly can be helpful because recent exertion, rapid breathing, pain, or anxiety may alter the result.

- Use supplemental oxygen
- Use a ventilator, CPAP, or other breathing support
- Take medicines that increase bleeding, such as anticoagulants like warfarin or apixaban
- Have a bleeding disorder or poor circulation in your hands
- Have had surgery, a dialysis connection, or an arterial line in that arm

What happens during the test

For an arterial blood gas, you will usually sit or lie down with your wrist supported. The clinician may check circulation to your hand before cleaning the skin. Local anaesthetic may be offered because an arterial puncture can be more uncomfortable than a standard blood draw.

A small needle is inserted into an artery, usually the radial artery on the thumb side of the wrist. Blood fills a special syringe. The needle is then removed, and firm pressure is applied for several minutes. Pressure may be needed for longer if you take anticoagulants or bleed easily.[3]

A venous blood gas is collected like an ordinary blood test, commonly from a vein in the arm. A capillary sample may be obtained through a small skin puncture.

The sample must be sealed, labelled, and analysed promptly. Blood continues to use oxygen and produce carbon dioxide after collection, so delays can change the measurements.[4]

Understanding your results

Interpretation is based on the pattern of results rather than one number alone. Reference

ranges vary by laboratory, sample type, age, sex, pregnancy status, altitude, medicines, and clinical context.

A pH below the laboratory range means the sample is more acidic. A pH above the range means it is more alkaline. Carbon dioxide acts as an acid in the body and is mainly controlled by breathing. Bicarbonate is mainly regulated by the kidneys.

A high carbon dioxide level may occur when breathing does not remove enough carbon dioxide. A low level may occur with rapid or deep breathing. Changes in bicarbonate can reflect kidney regulation, fluid balance, or other metabolic processes.

The body often tries to compensate for a disturbance. For example, the kidneys may adjust bicarbonate during a long-term breathing problem. This means a pH near the expected range does not always rule out an important problem.

Arterial oxygen results are interpreted alongside your oxygen treatment, pulse oximeter reading, haemoglobin level, circulation, symptoms, and reason for testing. A result marked outside the laboratory range is not automatically an emergency. However, laboratories and clinical teams generally act promptly on results that are critically abnormal in context.

What affects the results

Collection and handling can change blood gas values even when the analyser is working correctly. This is one of the test's most important limitations.

Air bubbles in the syringe allow gases to move between the sample and room air. This can make oxygen and carbon dioxide results misleading. Delayed analysis also matters because blood cells continue to consume oxygen and release carbon dioxide and acid.[4]

Other influences include:

A recent transfusion may change haemoglobin-related measurements, including oxygen content or co-oximetry results. It does not usually make a properly collected pH or gas-pressure measurement unusable, but it should be considered when the full report is interpreted.

- Drawing venous blood when an arterial sample was intended
- Too much liquid heparin in the syringe, which can dilute the sample
- Changing oxygen flow or ventilator settings shortly before collection
- Recent exercise, crying, pain, anxiety, or rapid breathing
- Fever or low body temperature

- High altitude
- Pregnancy, which normally changes breathing and carbon dioxide levels
- Medicines that suppress or stimulate breathing
- Very high white blood cell or platelet counts, which can lower oxygen in a delayed sample
- Poor local circulation, especially with capillary sampling

Accuracy and limitations

When correctly collected and analysed, an arterial sample is the standard blood test for directly assessing oxygen pressure, carbon dioxide, and pH. Most important errors happen before analysis, particularly through air exposure, delay, dilution, or collection from the wrong site.[2,4]

Venous pH often follows arterial pH closely enough for selected clinical decisions. Venous carbon dioxide can help identify or monitor a problem, but the difference from arterial carbon dioxide is not perfectly predictable. Venous oxygen pressure does not reliably show how well the lungs are oxygenating the blood.[5]

Capillary results may be useful for pH and carbon dioxide in some settings, but oxygen measurements are less dependable, especially when circulation to the skin is poor.

There is no single percentage describing how often blood gases miss a problem or falsely suggest one. Accuracy changes with the sample type, condition being assessed, collection quality, and result threshold. A repeat arterial sample may be better when the result conflicts with your condition or when an exact oxygen measurement would change care.

Pulse oximetry is usually better for continuous, non-invasive monitoring of oxygen saturation. It cannot measure pH or carbon dioxide. Standard blood gas calculations can also be misleading in carbon monoxide exposure or abnormal haemoglobin states; direct co-oximetry is the better test in those situations.[2]

Risks and complications

A venous blood draw may cause brief discomfort, bruising, or light-headedness. These effects are usually minor.

An arterial puncture is often more painful and may leave a bruise. Prolonged bleeding, infection, nerve irritation, or reduced blood flow beyond the puncture site can occur but are uncommon. Tell staff promptly if pain, swelling, numbness, bleeding, or colour change in the

hand develops after the test.

What happens next

Blood gas results are often available quickly because they may guide immediate treatment. Your healthcare team will interpret them with your symptoms, oxygen treatment, pulse oximeter reading, and other tests.

A result may lead to changes in oxygen or breathing support, treatment of an underlying cause, or repeat testing to check the trend. A single unusual result may be repeated if collection or handling could have affected it.

For planned monitoring, follow-up usually happens through the team that ordered the test. Seek urgent help rather than waiting for routine follow-up if you develop severe breathlessness, new confusion, fainting, blue or grey skin, or rapidly worsening symptoms.

Common questions

Can I drink coffee before a blood gas test?

Usually, yes. Fasting is not required. However, caffeine may briefly affect breathing, heart rate, or anxiety, so follow any instructions given for your specific appointment.

Does the time of day matter?

Not usually. Your breathing support, oxygen setting, activity, and current condition generally matter more than the time of day. Repeat tests may be timed consistently when clinicians are following a trend.

Can I exercise beforehand?

Avoid strenuous exercise immediately beforehand unless the test is specifically assessing exercise. Exercise changes oxygen use, carbon dioxide production, lactate, and breathing rate. Rest as directed before collection.

Should I remove my oxygen first?

No. Do not remove or change prescribed oxygen unless instructed. The oxygen flow and delivery method should be recorded because they are essential for interpreting the result.

Is an arterial blood gas more painful than a normal blood test?

It can be. Arteries lie deeper and have more sensitive tissue around them than veins. Local anaesthetic and careful pressure afterward may reduce discomfort.

Why not just use a pulse oximeter?

A pulse oximeter estimates oxygen saturation without a needle, but it does not measure blood acidity or carbon dioxide. It may also be inaccurate with poor circulation, movement, nail products, or abnormal forms of haemoglobin.

Sources

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- [2] American Association for Respiratory Care. Blood Gas Analysis and Hemoximetry: 2013 . Respiratory Care. 2013;58(10):1694-1703
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- [5] Byrne AL, Bennett M, Chatterji R, Symons R, Pace NL, Thomas PS. Peripheral venous and arterial blood gas analysis in adults: are they comparable? A systematic review and meta-analysis . Respirology. 2014;19(2):168-175