TEST

Pulmonary ventilation/perfusion scan

A pulmonary ventilation/perfusion scan compares airflow and blood flow through your lungs

WHAT IT MEASURES
Airflow and blood flow through different lung regions

SAMPLE
None

FASTING NEEDED?
No

HOW LONG IT TAKES
About 45 to 60 minutes

RESULTS IN
Same day to two days, varying by imaging service

USED FOR
Diagnosing blood clots and assessing regional lung function

MAIN LIMITATION
Existing lung abnormalities can make results unclear

Overview

A pulmonary ventilation/perfusion scan is an imaging test that compares airflow with blood flow in your lungs. It is often called a V/Q scan. "V" refers to ventilation, meaning airflow. "Q" refers to perfusion, meaning blood flow.

The test usually has two parts. For the ventilation scan, you breathe in a small amount of radioactive gas or mist. For the perfusion scan, a small amount of radioactive material is injected into a vein. A special camera records where each material travels.

The images can show areas receiving air but little or no blood. This pattern may occur when a blood clot blocks an artery in the lung, known as a pulmonary embolism. Other lung or blood-vessel conditions can also cause abnormal patterns, so the scan must be interpreted with your symptoms, medical history and other test results.

Some imaging centres use three-dimensional SPECT imaging. Others use traditional flat, or planar, images. A low-dose CT scan may sometimes be added to show the structure of the lungs more clearly.

Why the test is ordered

The most common reason for a V/Q scan is to investigate a possible pulmonary embolism. Your healthcare team may consider it when symptoms, examination findings or blood tests suggest that a clot could be present.

A V/Q scan may be chosen instead of CT pulmonary angiography, or CTPA. CTPA uses an iodine-based contrast dye to show the lung arteries. A V/Q scan may be useful when that contrast is unsuitable, including for some people with reduced kidney function or a previous serious reaction to iodine-based contrast.

The test can also help:

A V/Q scan is not normally used to screen people without symptoms or another reason to suspect a lung problem.

- Look for long-term blood-flow obstruction after pulmonary embolism
- Investigate chronic thromboembolic pulmonary hypertension
- Measure how much each lung region contributes before certain operations
- Assess uncommon abnormalities of the lung's blood vessels

Who should have the test

You may be offered this test if a healthcare professional thinks a pulmonary embolism is possible and imaging is needed. The choice between V/Q scanning and CTPA is based on factors such as your chest X-ray, kidney function, previous contrast reactions, pregnancy status and local imaging expertise.

V/Q scanning can be used during pregnancy when clinically needed. The imaging team may adjust the protocol, sometimes beginning with perfusion imaging alone. The expected benefit of finding or excluding a clot is weighed against the small radiation exposure.

Tell the imaging team if you are pregnant, could be pregnant or are breastfeeding. This does not automatically mean the test cannot be done. It allows them to select the most appropriate procedure and provide any breastfeeding instructions.

How to prepare

You can usually eat and drink normally before a V/Q scan. Coffee and other non-alcoholic

drinks are generally allowed unless you have separate instructions for another test.

Continue your usual medicines unless your healthcare team tells you otherwise. Make sure they know if you have already started an anticoagulant like warfarin or apixaban , commonly called a blood thinner, because treatment can change the appearance of a clot over time.

You may have a chest X-ray before the scan. A recent X-ray helps the specialist compare blood-flow changes with pneumonia, fluid, scarring or other structural lung findings.

Before the appointment, tell the imaging service about:

Wear comfortable clothing and remove metal objects from the chest area if requested.

- Pregnancy or possible pregnancy
- Breastfeeding
- Recent nuclear medicine tests
- Difficulty lying flat or keeping still
- Severe lung disease or trouble breathing through a mask or mouthpiece

What happens during the test

For the ventilation part, you breathe through a mask or mouthpiece. Depending on the imaging service, you may inhale a radioactive gas or a fine aerosol mist. You may need several steady breaths to distribute it through your lungs.

You then lie or sit still while a gamma camera takes images from different angles. The camera detects the small amount of radiation released by the material. It does not produce radiation itself, and it does not usually enclose your whole body like an MRI scanner.

For the perfusion part, a healthcare professional places a small needle or cannula into a vein, usually in your arm. A radioactive tracer is injected while you are lying down. It travels through the bloodstream to small vessels in the lungs, and another set of images is taken.

Some centres perform perfusion imaging first or omit ventilation imaging in selected situations. SPECT imaging involves the camera moving around your chest to create three-dimensional views. The whole appointment commonly takes about 45 to 60 minutes, although the exact protocol may be shorter or longer.

Understanding your results

A specialist in nuclear medicine or radiology reviews the images. There is no numerical

reference range like there is for many blood tests.

A normal or near-normal perfusion pattern makes a clinically important pulmonary embolism unlikely. If an area receives air but has reduced blood flow, it is called a ventilation-perfusion mismatch. One or more mismatched areas in characteristic locations can support a diagnosis of pulmonary embolism.

When both ventilation and blood flow are reduced in the same area, the pattern is "matched." This may be related to pneumonia, chronic obstructive pulmonary disease, fluid around the lung, previous surgery or another lung abnormality rather than an acute clot.

Reports may describe the scan as normal, positive for pulmonary embolism or nondiagnostic. Some services use probability terms such as low, intermediate or high probability. Interpretation varies with the imaging method, laboratory or imaging service, age, sex, pregnancy status, medicines and clinical context.

A result does not confirm or exclude every possible cause of chest symptoms. Your healthcare team combines it with your clinical assessment and other tests.

What affects the results

Existing lung disease is one of the main influences. Emphysema, asthma with air trapping, pneumonia, lung scarring, tumours and fluid around the lungs can alter ventilation or perfusion. A chest X-ray or low-dose CT can help explain these changes.

Previous lung surgery, radiotherapy, pulmonary embolism or abnormalities of the lung's blood vessels may produce persistent defects. These are not laboratory errors, but they can resemble or hide a new clot.

Other factors include:

Meals, coffee, time of day and ordinary exercise do not usually change the result in a meaningful way. Kidney function does not generally distort the scan, although it may influence why V/Q scanning is chosen instead of contrast-enhanced CT. Most medicines have no direct effect, and a recent blood transfusion is not usually relevant.

Pregnancy changes circulation and affects how the imaging protocol is selected, but it does not automatically make the scan inaccurate.

- Shallow or uneven breathing during the ventilation scan
- Coughing while inhaling the aerosol
- Movement while images are being taken

- A problem with the intravenous injection
- Starting anticoagulant treatment before imaging
- Residual tracer from a recent nuclear medicine procedure

Accuracy and limitations

A normal V/Q scan is strong evidence against a clinically important pulmonary embolism. However, no imaging test detects every clot. Very small clots may be missed, and image quality can be reduced by movement, poor inhalation or extensive underlying lung disease.

An abnormal scan can sometimes suggest a clot when none is present. Previous embolism, narrowed blood vessels, external pressure on an artery or uncommon congenital blood-vessel differences can create a similar mismatch.

Some scans are nondiagnostic, meaning the pattern does not clearly answer the question. This is more likely when a chest X-ray is abnormal or several lung conditions affect airflow and blood flow. Further testing may then be needed.

SPECT V/Q imaging generally provides clearer three-dimensional information than planar imaging. CTPA may be the better test when direct images of the lung arteries or alternative causes of symptoms are needed. V/Q scanning is particularly useful when iodine-based contrast is unsuitable and when investigating chronic clot-related obstruction.

The chance of a missed clot or a false-positive result varies with the imaging technique, interpretation criteria and the likelihood of pulmonary embolism before testing. Results should not be interpreted in isolation.

Risks and complications

The radiation dose is kept as low as reasonably achievable. The radioactive materials lose activity and leave the body over time, mainly through breathing or urine. Drinking normally and emptying your bladder regularly may be advised after the test.

The injection can cause a small bruise or brief discomfort. Some people feel faint during needle procedures.

Significant reactions to the radioactive materials are uncommon. The ventilation part may occasionally trigger coughing or feel uncomfortable if you are already short of breath.

What happens next

If the result is normal and your clinical assessment also suggests a low likelihood of pulmonary embolism, no further clot imaging may be needed. Your healthcare team may still investigate other causes of your symptoms.

A positive result is reviewed promptly so that appropriate treatment can be discussed. A nondiagnostic result may lead to CTPA, ultrasound of the leg veins, repeat imaging or another test chosen for your circumstances.

Arrange routine follow-up if you have not received your result within the timeframe given by the imaging service or if you need help understanding the report.

Seek urgent medical help for new or worsening shortness of breath, chest pain, coughing up blood or fainting. These symptoms relate to the condition being investigated, not usually to the scan itself. Call emergency services for severe breathing difficulty, collapse, or signs of a serious allergic reaction such as swelling of the face or throat.

Common questions

Can I drink coffee before a V/Q scan?

Usually, yes. Fasting is not normally required, so coffee and food are generally allowed. Follow any different instructions given for another test scheduled on the same day.

Does the time of day matter?

No. V/Q scan results are not normally affected by the time of day. Appointment timing mainly reflects scanner availability and whether another image, such as a chest X-ray, is needed.

Can I exercise beforehand?

Ordinary activity does not usually affect the images. Avoid exercise that leaves you unusually breathless if it would make lying still or breathing through a mouthpiece difficult.

Can I drive home afterward?

Most people can drive and return to normal activities immediately. If you have been given a sedative for another procedure, follow the separate driving restrictions for that medicine.

Will I be radioactive afterward?

A small amount of radioactive material remains briefly in your body. The imaging service may provide short-term precautions, particularly around pregnant people or young children. Instructions depend on the tracer and dose used.

Can I have the scan while breastfeeding?

Yes, when medically needed, but temporary changes to breastfeeding may be recommended for some tracers. Tell the nuclear medicine team before the scan and follow the tracer-specific instructions they provide.

Sources

- Society of Nuclear Medicine and Molecular Imaging: SNM Practice Guideline for Lung Scintigraphy 4.0 , Journal of Nuclear Medicine Technology , 2012
- European Association of Nuclear Medicine: EANM guideline for ventilation/perfusion SPECT for diagnosis of pulmonary embolism and beyond , European Journal of Nuclear Medicine and Molecular Imaging , 2019
- European Society of Cardiology: 2019 guidelines for diagnosis and management of acute pulmonary embolism , European Heart Journal , 2020
- American College of Radiology and Radiological Society of North America: Lung Ventilation/Perfusion Scan , RadiologyInfo.org
- American Thoracic Society and Society of Thoracic Radiology: Evaluation of suspected pulmonary embolism in pregnancy , American Journal of Respiratory and Critical Care Medicine , 2011