^{99m}Tc Aerosols Ventilation Scintigraphy

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1. Introduction

Ventilation scintigraphy using ^{99m}Tc aerosols is always used in combination with perfusion scintigraphy. In healthy individuals the ventilation and perfusion of the lung is matched. In the event of a pulmonary embolism, ventilation is preserved wheras perfusion shows a defect. In those with parenchymal lung disease, matched ventialtion and perfusion defects occur, whereas in acute infection the ventilation defect may exceed the perfusion defect. The principle of ventilation scintigraphy with aerosols is inhalation of aerosols labeled with ^{99m}Tc.

2. Methodology

This guideline is based on available scientific literature on the subject, the previous guideline (Aanbevelingen Nucleaire Geneeskunde 2007), international guidelines from EANM and/or SNMMI if available and applicable to the Dutch situation.

3. Indications

- Ventilation scintigraphy is always used in combination with a perfusion study to determine the likelihood of pulmonary embolism
- Quantification of regional pulmonary function before oncological pulmonary surgery, lung volume reduction surgery and lung transplantation surgery

4. Relation to other diagnostic procedures

Ventilation scintigraphy can also be performed with ^{81m}Kr. In patients with pulmonary disease Technegas causes a central deposition which makes interpretation more difficult. Therefore in patients with COPD ^{81m}Kr ventilation studies are preferable. ^{133}Xe for ventilation studies is not available in the Netherlands.
In some studies perfusion scintigram showed comparible results when combined with a normal chest x-ray in stead of a normal ventilation scintigram. The introduction of the Multidetector CT angiography (MDCT) with high spatial and temporal resolution and good quality of arterial opacification has made this technology the method of choice for imaging pulmonary vasculature in lots of hospitals. It allows adequate visualisation of the pulmonary arteries up to at least segmental level. Another advantage of MDCT is the finding of an alternative diagnosis.

5. Medical information necessary for planning

- History (onset of complaints, history of VTE)
- Results of a D-dimer test
- Determination of the pretest probability of pulmonary embolism by for example the Wells-score
- A recent (within 24 h) chest X-ray
- Prior lung scintigraphy findings

6. Radiopharmaceutical

Tracer:	^{99m}Tc aerosol
Nuclide:	Technetium-99m
Activity:	1000 MBq in 4 ml saline, approximately 1% will be inhaled
Administration:	Inhalation by use of an aerosolgenerator

7. Radiation safety

In pregnant women consider reducing the administered activity of radiofarmaceuticals.
According to ICRP 106 there is no need to interrupt breastfeeding.
Adult perfusion radiation dose: 0,5-1,0 mSv

8. Patient preparation/essentials for procedure

Patient preparation

- The procedure of inhalation should be explained to the patient.

Procedure

- Technegas is administered by inhalation, at last 10 min after preparation.
- The gas is inhaled by a mouthpiece.
- The ventilation-to-perfusion count ratio should be at least 2, preferably around 4.
- To yield uniform apex-to-base deposition, administration should occur with the patient in supine position.

9. Acquisition and processing

Planar images

Energy:	^{99m}Tc setting, 140 keV
Window:	15%-20%
Collimator:	LEAP collimator
Counts:	500 K counts per view
Computer:	128x128 or 256x256 matrix

Ventilation imaging should be performed in the following directions: anterior, posterior, right posterior oblique and left posterior oblique. Upon indication right lateral, left lateral, right anterior oblique and left anterior oblique views may be obtained.

SPECT

Energy:	^{99m}Tc setting, 140 keV
Window:	15%-20%
Collimator:	LEAP collimator
Counts:	Ventilation: 10-20 s per projection
Computer:	128x128 or 64x64 matrix

10. Interpretation

Ventilation scintigraphy should be performed within 24 h after the perfusion study because perfusion defects can resolve within 24 h. The interpretation should include an overall assessment of the likelihood of pulmonary embolism based on the scintigraphy findings.
Most frequently used criteria for lung scan interpretation are the Modified PIOPED criteria

or the PISAPED criteria. Normal perfusion scintigraphy rules out pulmonary embolism (>90%), two or more segmental perfusion defect indicate a high probability of PE. (>90%).
The experienced nuclear medicine physician might be able to provide a more accurate interpretation of the lung scintigraph than is provided by criteria alone, by using a Gestalt interpretation. Such interpretation is usually based on detailed knowledge of the various, well known, lung image interpretive criteria.
In the group of high risk patients the report advise repetition of the lung scintigraphy at the end of the period of anti-coagulation therapy to evaluate the response.
Interpretation of preoperative lung scintigraphy should give the percentage of ventilation/perfusion in the rectangular lung regions or more frequently in the left and right lung (see lung perfusion scintigraphy).

11. Report

The report should be a combination of the result of the ventilation and the perfusion study (see perfusion scintigraphy)

12. Literature

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