Lung Ventilation Scan (DTPA)

Updated 9/8/2024

- **Indications**
  - To assess the likelihood of pulmonary embolism, document the degree of resolution of pulmonary embolism, evaluate the cause of pulmonary HTN, quantify differential pulmonary function, evaluate chronic pulmonary parenchymal disorders, evaluate lung transplants, confirm the presence of bronchopleural fistula and evaluate congenital heart or lung disease.
- **Radiopharmaceuticals:**
  - Ventilation imaging must be performed prior to perfusion imaging when using DTPA for ventilation imaging.
  - 25-35 mCi Tc-99m DTPA aerosol administered via nebulizer with appropriate mouthpiece and nose clamped (delivers approximately 0.5-1.0 mCi Tc-99m to the lungs)
- **Patient Preparation:**
  - The patient must have a chest radiograph or CT/CTA chest within 24 hrs prior to the exam. If chest imaging is not available, order a chest radiograph(s) (two view preferred over one view) to be performed concurrent with the VQ scan. Sign the order for the radiograph(s) back to whomever ordered the VQ scan.
  - Have the patient cough and take several deep breaths prior to the administration of radionuclides.
- **Conflicting Examinations/Medications:**
  - No Nuclear Medicine exams within the previous 24 hrs.
- **Pregnancy/Lactation:**
  - Pregnancy testing is only needed in potentially pregnant patients who state they could be pregnant. See Pregnant, Potentially Pregnant and Lactating Patients policy for specifics.
  - Breast feeding mothers should discard breast milk for 24 hrs following Tc-99m MAA and DTPA administration.
- **Imaging Technique:**
  - Collimator - LEHR or LEAP
  - Photopeak - 140 keV 20% window for Tc-99m
  - Image Preset Counts - 100k counts/image or 3 mins/image
  - Matrix Size - 128 x 128
  - Zoom - 1.23
  - Patient Positioning - upright preferred over supine with arms out of field-of-view (if possible)
- **Images/Views:**
  - Begin imaging immediately after radionuclide administration.
  - Obtain anterior, posterior, RAO, RPA, LAO, LPO and both lateral images.
- **Notes:**
  - The most common causes of ventilation-perfusion mismatch include acute pulmonary embolism, old pulmonary embolism, obstruction of a pulmonary artery by tumor and radiation therapy.
  - Diagnostic Criteria (see tables below)
    - Modified PIOPED II - used for ventilation-perfusion exams.
    - PISAPED - used for perfusion only exams.
  - Defects related to prior pulmonary emboli do not always completely resolve.
  - The stripe sign (activity at the periphery of a perfusion defect) lowers the likelihood that a defect reflects a pulmonary embolism.
  - Triple matches in the lower lobes are more likely to be due to a pulmonary embolism than triple matches in the upper lobes.
  - A positive VQ scan is not specific for acute PE and can also be seen with chronic PE.
  - A VQ scan is more appropriate than CTA for detecting chronic thromboembolic pulmonary disease as cause of pulmonary HTN.
  - The presence of a right-to-left shunt is identified by visualizing activity in the systemic vascular beds. An image of the head provides the most accurate method to detect small shunts.
  - Perfusion images can demonstrate hot spots in the lung if clotting of blood occurs in the syringe during the injection or if the injection is made through an indwelling catheter that is not flushed well prior to administration.
  - Injection of Tc-99m MAA through a central line can result in inadequate mixing of activity in the pulmonary arteries.

- Activity in the thyroid is often used as an indicator of the presence of free pertechnetate. However the thyroid is also a high-flow organ and may be visualized in the case of a right-to-left shunt.
- Xe-133 activity can be visualized in the liver in the setting of hepatic steatosis.

Table 3: Modified PIOPED II Criteria

Interpretation	Imaging Findings*
High probability (PE present)	≥two large segmental mismatched defects (two moderate defects = one large defect)
Normal perfusion or very low probability (PE absent)	Nonsegmental perfusion defects Perfusion defect smaller than corresponding CXR finding One to three small segmental defects ≥matched V/Q defects with regionally normal CXR and areas of normal perfusion elsewhere in lung Solitary triple-matched defect in mid and upper lung zone confined to a single segment Stripe sign Pleural effusion of one-third or more of pleural cavity with no other perfusion defect in either lung
Low or intermediate probability (nondiagnostic)	All other findings Per PIOPED I, low probability: Nonsegmental perfusion defects (reclassified into very low probability) Single moderate mismatched segmental perfusion defect with normal CXR Any perfusion defect with substantially larger CXR abnormality Large or moderate segmental perfusion defects (≤four segments in one lung and ≤three segments in one lung region) with matching or larger ventilation defects, with or without CXR abnormalities (substantially smaller than perfusion defects) >three small segmental perfusion defects with normal CXR

*CXR = chest radiography.

Table 4: PISAPED Criteria

Interpretation	Imaging Findings*
Normal	No perfusion defects of any kind
Near normal	Perfusion defects smaller or equal in size and shape to the following CXR abnormalities: cardiomegaly; enlarged aorta, hila, and mediastinum; elevated diaphragm; blunting of costophrenic angle; pleural thickening; intrafissural collection of liquid
Abnormal (PE positive)	Single or multiple wedge-shaped perfusion defects with or without matching CXR abnormalities; wedge-shaped areas of overperfusion usually coexist
Abnormal (PE negative)	Single or multiple perfusion defects other than wedge shaped, with or without matching CXR abnormalities; wedge-shaped areas of overperfusion usually not seen

*CXR = chest radiography.