Clinical Protocol: LUNG VENTILATION and/or PERFUSION STUDY

Responsible Division: Division of Nuclear Medicine, Department of Radiology, UT Southwestern

Policy Basis for Procedure
To establish the clinical protocol for ventilation and /or perfusion study

Overview:

- Ventilation and perfusion scans are a useful way to examine the physiology of air and blood distribution in the lungs.
- In a number of conditions, such as pulmonary embolism and parenchymal lung abnormalities, there can be derangements of the distribution of ventilation and perfusion that can be used for diagnosing those conditions

Description of Standard Procedure
Indications:

- Diagnosis of pulmonary embolism (1-2)
- Evaluation of regional ventilation and/or perfusion (1-2)
- Diagnosis of chronic thromboembolic disease as a cause of pulmonary hypertension and for the evaluation of right to lung shunt (3-4)
- Evaluation for patients that are candidates for a lung transplant or have received a lung transplant (5-6)
- Evaluation of regional pulmonary perfusion prior to lung reduction surgery (7-8)

Examination Time:

- 30 – 40 minutes.

Equipment & Energy Windows:

- Gamma camera: Large field of view, preferably a dual head SPECT camera
- Collimator: Low energy, high resolution, parallel hole
- Energy window: 20% window centered at 80 keV for Xe 133 and 20% window centered at 140 keV for Tc 99m MAA.

Scans:

➢ *Ventilation Scan:*

- **Examination Time:**
  - 10 minutes

- **Radiopharmaceutical and Route of Administration:**
  - Xenon 133 gas 10-30 mCi (370 MBq – 1110MBq) +/- 20% administered via inhalation.

- **Patient Preparation:**
  - With patient in a supine position on imaging table:

- Fit the patient with a tightly fitting mask or a mouth piece. Rehearse patient with the breathing technique to be used during acquisition of single breath, equilibrium and washout images.

- Attach the xenon delivery system for injection of Xe-133 gas and collection of exhaled Xe-133 gas. Be sure that a new filter has been placed on the xenon deliver system.
- Set the valves so the patient is breathing from and into the xenon system; i.e. closed system.
- When ready to acquire images, insert Xe-133 vial

- **Image Acquisition:**
  - Acquire images in the RPO/LPO projection.
  - Acquire single breath digital image:
    - Instruct the patient to take a deep breath as the Xe-133 gas bolus is injected into the delivery system and then hold the breath as long as possible.
    - Acquire a 100 K count image.

- **Acquire equilibrium images:**
  - Equilibrate the concentration of Xe-133 gas within the patient's lungs.
  - Have the patient breathe normally for 3 minutes.
  - Acquire an approximately 300K image

- **Acquire washout images**:
  - Change the system valve so that the patient breathes room air in and exhales Xe-133 into the system trap.
  - Beginning immediately, acquire dynamic 30 second digital images until the Xe-133 gas is gone as judged from the persistence scope. Acquire a minimum of 4 images.

- **Close the xenon delivery system and remove the mask from the patient's face.**

➢ *Perfusion Study*

- **Examination Time:**
  - 20 – 30 minutes.

- **Radiopharmaceutical and Route of Administration:**
  - Radiopharmaceutical: Tc 99m MAA (macroaggregated albumin)
  - Dose: 3-5 mCi (111MBq – 185 MBq)
  - Route: Intravenous. Inject patient in the supine position.

- **Image Acquisition:**
  - Inject patient in supine position. Imaging may begin immediately.
  - Acquire images on a 128 x128 or 256 x 256 matrix.

- Acquire images in the POST, LPO, L LAT, LAO, ANT, RAO, R LAT, and RPO projections.

- Acquire each image for approximately 700 K or five minutes.

- SPECT images of perfusion and ventilation may be in addition or substituted for static imaging (5).
  - Matrix 128 X 128
  - Seconds per stop 10 -15
  - Care dose CT

- Check if there is an available comparison chest radiograph within 24 hours of the examination. If none available, ask radiologist if they would like to order one.

> ### *Optional Images (Perfusion)*
> Unilateral or regional pulmonary function may be quantified in the anterior and posterior projections using the geometric mean. (Indications: pre-surgical evaluation such as lung transplant or lung resection).

- Images over the brain and kidneys may be obtained in patients with suspected right to left shunt. (Indications: pulmonary hypertension, concern for right to left shunt, paradoxical embolus, septic emboli, brain abscess).

- In patients who cannot tolerate ventilation portion of scan, perfusion only images may be obtained.

- In pregnant patients with clear chest radiograph, perfusion only images should be obtained. (9)

Principle Radiation Emission Data – Xe-133:

- Physical half-life = 5.25 days.
- Radiation: gamma

Principle Radiation Emission Data – Tc-99m

- Physical half-life = 6.01hours
- Radiation: gamma

Dosimetry information available via references below (10).

Definitions:

- **MAA:** Macro-Aggregated Albumin
- **RAO:** Right Anterior Oblique
- **LAO:** Left Anterior Oblique
- **RPO:** Right Posterior Oblique
- **LPO:** Left Posterior Oblique

- **POST:** Posterior
- **L LAT:** Left Lateral
- **ANT**: Anterior
- **R LAT:** Right Lateral

References:

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Approval: William A. Moore, M.D., Associate Professor, Division of Nuclear Medicine, UT Southwestern. Date: 10/10/2022.