LUNG AEROSOL STUDY

(Tc-99m-DTPA Aerosol)

Overview

- The Lung Aerosol Study demonstrates the distribution of ventilation within the lungs in multiple projections. The quality of the study can be degraded if some of the aerosol deposits on the bronchi and does not reach the alveoli.

Indications

- Diagnosis of pulmonary embolism, particularly when helical CT is contraindicated because of renal insufficiency or a history of a bona fide contrast reaction (1-4).
- Evaluation of ventilation (5).

Examination Time

- 45 minutes.

Patient Preparation

- The aerosol ventilation study is usually performed after the perfusion study (3). This allows the aerosol study to be omitted when the perfusion study is normal. (However, the aerosol study may be performed before the perfusion study.)
- Rehearse the breathing procedure to assure optimal patient cooperation; instruct the patient to breathe by mouth.
- Pretreatment of asthmatic patients with a bronchodilator may improve the quality of the study (6).

Equipment & Energy Windows

- Gamma camera: Large field of view, preferably a dual head camera.
- Collimator: Low energy, high resolution, parallel hole.
- Energy window: 20% window centered at 140 keV.

Radiopharmaceutical, Dose, & Technique of Administration

- Radiopharmaceutical: Tc-99m-DTPA aerosol (1-3,7,8):
  - ❑ Technegas (actually a fine aerosol) is preferred if available (9-11).
- Dose: Approximately 6 mCi (222 MBq) to the patient (5).
- Technique of administration: Via a positive pressure nebulizer (5,7,12):
  1. Use a relatively small baffle to minimize bronchial deposition of the aerosol.
  2. Drive the nebulizer with compressed air or oxygen at a flow rate of 11-15 L/min.
  3. Fit the patient with a tightly fitting mask or a mouth piece and nose clamp.
  4. Slowly introduce 50-75 mCi (1,850 MBq) Tc-99m-DTPA in 3-4 mL into

the nebulizer (5).

5. Instruct the patient to breathe at a normal rate for 10-12 minutes (13).
6. Turn off the gas flow to the nebulizer.
7. Wipe any aerosol from the patient's face and have the patient expel any saliva which may result in activity in the stomach.

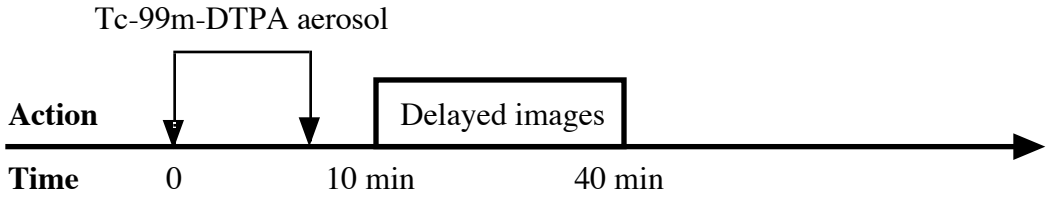
Patient Position & Imaging Field

- Patient position: Sitting (supine if the patient is unable to sit).
- Imaging field: Entire lungs.

Acquisition Protocol

- Measure the count rate from the perfusion image in the POST projection.
- Then monitor the count rate as the patient inhales the aerosol and continue until the count rate equals 3-4 times the base count rate (5).
- Acquire the aerosol ventilation images for the same times as the corresponding perfusion images.
- Image acquisition:
  - > Acquire perfusion images in the POST, LPO, L LAT, ANT, R LAT, and RPO projections. (If a dual head camera is used, acquire RAO and LAO projections as well.)
  - ❑ SPECT images of perfusion and ventilation may be substituted for planar imaging (4,14).

Protocol Summary Diagram



Data Processing

- None.

Optional Maneuvers

- Planar images from SPECT images: Planar images can be reconstructed from SPECT images (4).
- Quantitation of homogeneity of ventilation: The homogeneity of bronchopulmonary distribution may be quantitated (4).
- Functional perfusion/ventilation images: Functional or parametric images of perfusion and ventilation information combined may be generated (15).

- Quantitation of clearance: Clearance of Tc-DTPA aerosol from the lungs can be quantitatively evaluated (4,16,17).

Principle Radiation Emission Data - Tc-99m (18)

- Physical half-life = 6.01 hours.

Radiation	Mean % per disintegration	Mean energy (keV)
Gamma-2	89.07	140.5

Dosimetry - Tc-99m-DTPA Aerosol (19)

Organ	rads/6 mCi	mGy/222 MBq
Bladder wall	0.60	6.0
Lungs	0.30	3.0
Kidneys	0.12	1.2
Total body	0.12	1.2

References

1. Coche E, Verschuren F, Keyeux A, et al: Diagnosis of acute pulmonary embolism in outpatients: Comparison of thin-collimation multi-detector row spiral CT and planar ventilation-perfusion scintigraphy. Radiology 229757-765, 2003.
2. Ramanna L, Alderson PO, Waxman AD, et al: Regional comparison of technetium-99m DTPA aerosol and radioactive gas ventilation (xenon and krypton) studies in patients with suspected pulmonary embolism. J Nucl Med 27;1391-1396, 1986.
3. Kohn H, Mostbeck A, Bachmayr S, et al: Tc-99m-DTPA aerosol for same-day post-perfusion ventilation imaging: Results of a muticentre study. Eur J Nucl Med 20:4-9, 1992.
4. Reinartz P, Wildberger JE, Schaefer W, et al: tomographic imaging in the diagnosis of pulmonary embolism: A comparison between V/Q lung scintigraphy in sPECT technique and multislice spiral CT. J Nucl Med 45:1501-1508, 2004.
5. Laube BL, Links JM, Wagner HN, et al: Simplified assessment of fine aerosol distribution in human airways. J Nucl Med 29:1057-1065, 1988.
6. Roach PJ, Treves ST: The value of bronchodilator administration in asthmatic patients before lung imaging. Clin Nucl Med 20:491-493, 1995.
7. Sirr SA, Juenemann PJ, Tom H, et al: Effect of ethanol on droplet size, efficiency of delivery, and clearance characteristics of technetium-99m DTPA aerosol. J Nucl Med 26:643-646, 1985.
8. Waldman DL, Weber DA, Oberdoester G, et al: Chemical breakdown of technetium-99m DTPA during nebulization. J Nucl Med 28:378-382, 1987.
9. Isawa T, Teshima T, Anazawa Y, et al: Technegas versus krypton-81m gas as an inhalation agent: Comparison of pulmonary distribution at total lung capacity. Clin Nucl Med 19:1085-1090, 1994.
10. Senden TJ, Moock KH, Gerald JF, et al: The physical and chemical nature of technegas. J Nucl Med 38:1327-1333, 1997.
11. Vanbilloen HP, Bauwens J, Mortelmans L, et al: Reduction of contamination risks during clinical studies with Technegas. Eur J Nucl Med 26:1349-1352.
12. Chan HK, Daviskas E, Eberl S, et al: Deposition of aqueous aerosol of technetium-99m diethylene triamine penta-acetic acid generated and delivered by a novel system (AERx) in healthy subjects. Eur J Nucl Med 26:320-327, 1999.
13. Kim CK, Webner P, Pandit N: Is there any difference in central and peripheral distribution of the radioaerosol between normal and deep breathing? J Nucl Med

36:34P, 1995.
14. Isitman AT, Collier BD, Palmer DW, et al: Comparison of technetium-99m pyrophosphate and technetium-99m DTPA aerosols for SPECT ventilation lung imaging. J Nucl Med 29:1761-1767, 1988.
15. Miron SD, Wiesen EJ, Feiglin DH, et al: Generation of parametric images during routine Tc-99m PYP inhalation/Tc-99m MAA perfusion lung scintigraphy: Technical note. Clin Nucl Med 16:501-505, 1991.
16. Van der Wall H, Murray PC, Jones PD, et al: Optimising technetium 99m diethylene triamine penta-acetate lung clearance in patients with the acquired immunodeficiency syndrome. Eur J Nucl Med 18:235-240, 1991.
17. Rosso J, Guillon JM, Parrot A, et al: Technetium-99m-DTPA aerosol and gallium-67 scanning in pulmonary complications of human immunodeficiency virus infection. J Nucl Med 33:81-87, 1992.
18. 43-Tc-99m: In MIRD: Radionuclide Data and Decay Schemes, DA Weber, KF Eckerman, AT Dillman, JC Ryman, eds, Society of Nuclear Medicine, New York, 1989, pp 178-179.
19. Atkins HL, Weber DA, Susskind H, et al: MIRD dose estimate report no. 16: Radiation absorbed dose from technetium-99m-diethylenetriaminepentaacetic acid aerosol. J Nucl Med 33:1717-1719, 1992.

Normal Findings

> Taplin GV, Chopra SK: Lung perfusion-inhalation scintigraphy in obstructive airway disease and pulmonary embolism. Radiol Clin N Am 16:491-513, 1978.
> Crawford ABH, Davison A, Amis TC, et al: Intrapulmonary distribution of 99m-technetium labelled ultrafine carbon aerosol (Technegas) in normal subjects. Eur Respir J 3:6792, 1990.

Return to Table of Content