ADVANCEMENTS IN PULMONARY IMAGING IT'S HERE – EXPLORING TECHNEGAS

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2024 Nuclear Pharmacy Conference
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Disclosures

- No conflicts of interest or financial relationships to disclose.

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Objectives

- Contrast the three (3) current ventilation agents FDA approved in the US including clinical advantages and disadvantages.
- Describe the protocol features of Technegas including the radiopharmaceutical, equipment, administration, and imaging protocol.
- Support nuclear medicine customers in implementing Technegas.

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Overview

- Review of ventilation agents
  1. Xe-133 gas
  2. Tc-99m DTPA aerosol
  3. Tc-99m labelled carbon nanoparticles
- Kr-81 (outside presentation scope)

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QA Time

Post your response in the Chat.

Which ventilation agents are you currently supplying to customers?

a. Xe-133 gas
b. Tc-99m DTPA
c. Tc-99m pertechnetate for Technegas
d. Tc-99m crucibles

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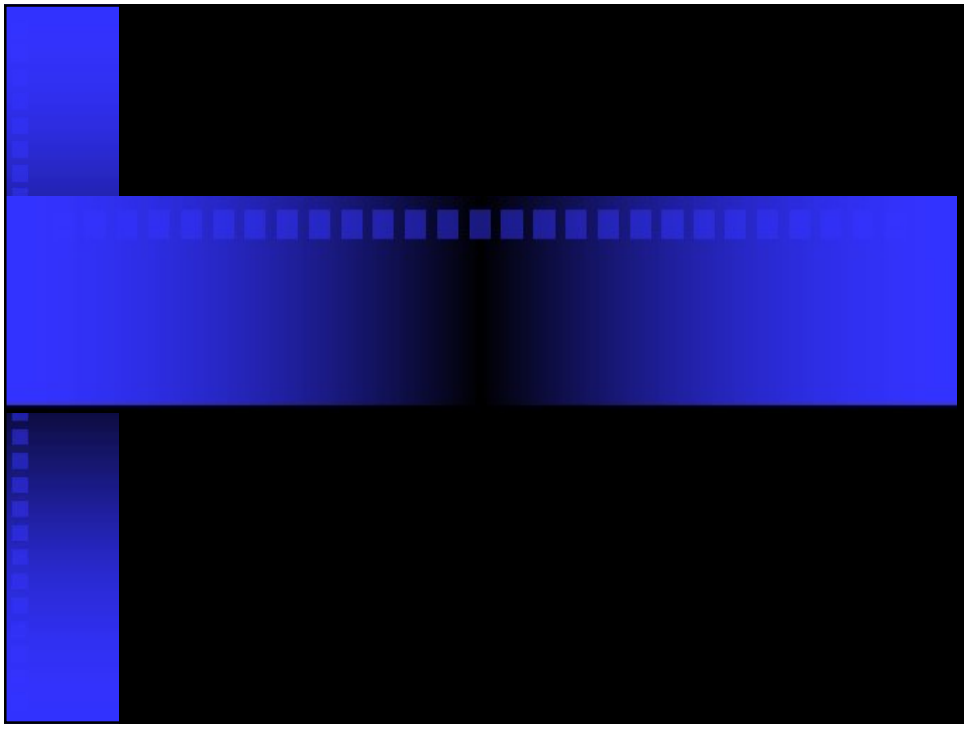

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Xe-133 Gas

- Adults: 5 – 20 mCi (185 - 740 MBq)
- Children: 0.3 mCi/kg (minimum 3.0 mCi)
- Inhalation
- Administer via gas trap machine
- Image immediately with injection

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Xenon Trap Machine

- Upright or supine
- Patient breathes in dose through nasal cannula or mask
- Three stages:
- 1. Administer dose with patient breathing in and holding breath (INHALATION)
- 2. Patient breathes in and out xenon with stored oxygen from machine (EQUILIBRIUM)
- 3. Patient breathes out xenon dose that is trapped and breaths in fresh oxygen (WASHOUT)

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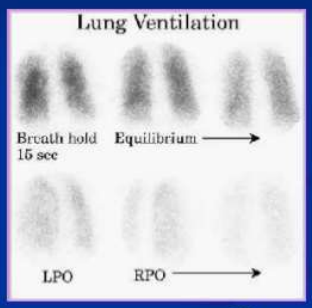
Xe-133 Ventilation Lung Scan



Single view-3 phases: Washin-Equilibrium-Washout

Part 1-Lung Scan_J SRIPRAPAPORN

Source unknown

9

Xenon Trap Machine

Mirion.com

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Dose Incorporation

- Passive Diffusion
- Gas incorporates very little
- Breathes in and out

Mirion.com

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Imaging Procedure

- LEHR collimator
- 81 keV peak, 20% window
- **POST only**
- 1 min inhalation/ breath hold: dose adm
- 1 min equilibrium: rebreathing exhaled xenon/ oxygen
- 1 min/view: washout: breaths in fresh air/ xenon trapped

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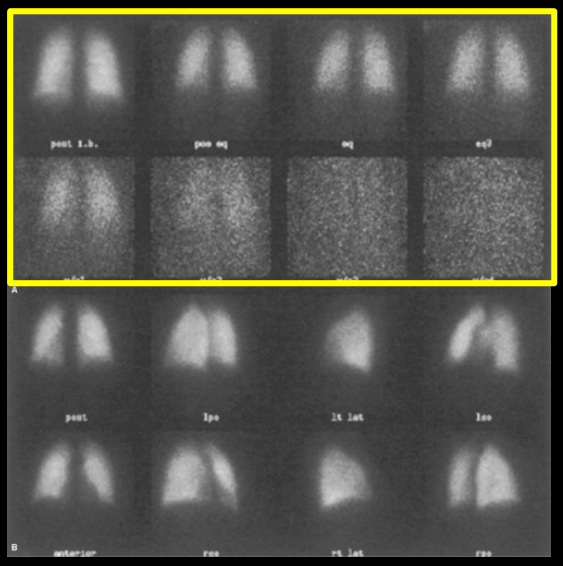
Normal



https://radiologykey.com/pulmonary-scintigraphy/

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QA Time

Post your response in the Chat.

What are disadvantages of Xe-133 gas in clinical application?

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2. TC-99M DTPA AEROSOL

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Tc-99m DTPA Aerosol

- Adults: 25 – 35 mCi (925 - 1295 MBq)
  - patient receives 10% of dose
  - 0.5 – 1.0 mCi
- Inhalation
- Administered via aerosol nebulizer
- Image immediately with inhalation

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Aerosol Nebulizer

- Upright or supine
- Liquid dose transferred to aerosol by combining with oxygen in nebulizer
- Patient breathes from nebulizer 5 – 7 minutes with lips tightly sealed
- Nose pinched
- Loss of dose in system

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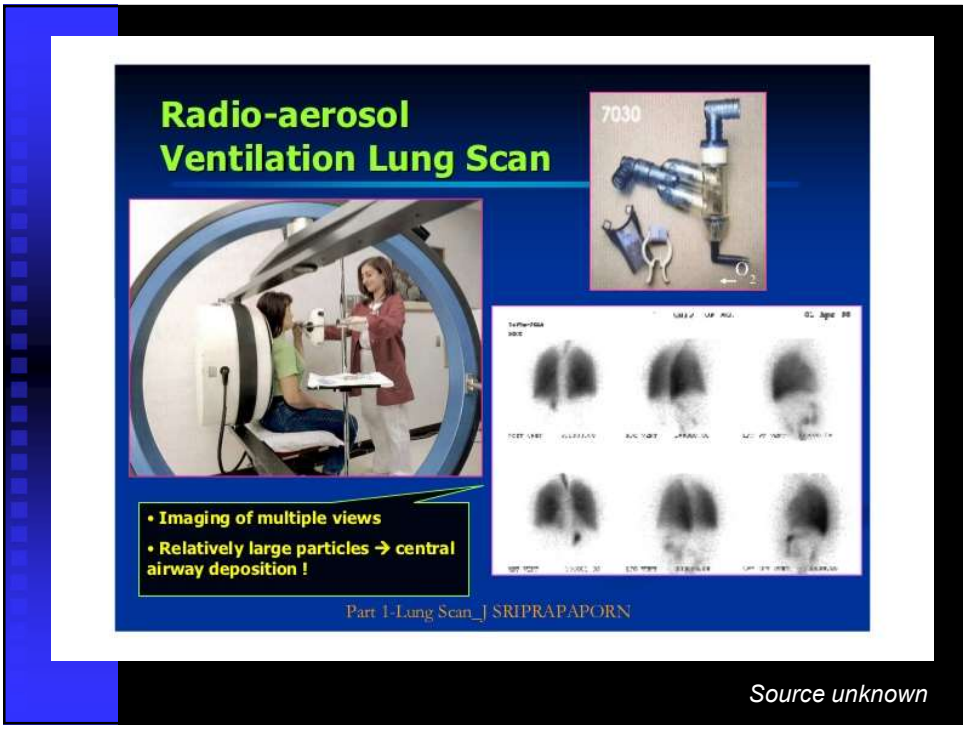

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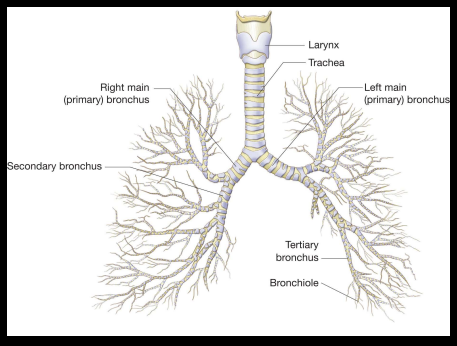
Dose Incorporation

- Compartmentalization
- Aerosolized DTPA adheres to the airway lining



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Imaging Procedure

- LEHR collimator
- 140 keV peak, 20% window
- 500K per static
- ANT, POST, RAO, LAO, RPO, LPO, RLAT, LLAT
- Supine or upright with lungs in FOV
- SPECT

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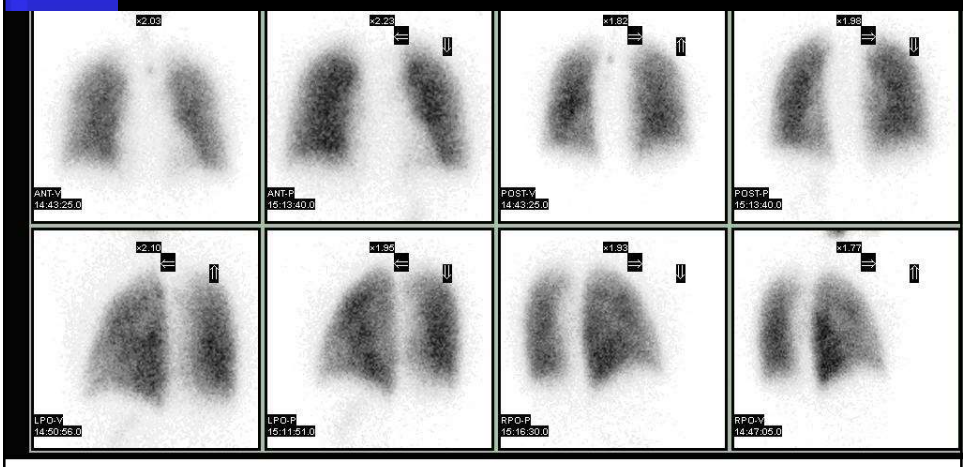
Normal



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QA Time

Post your response in the Chat.

What are disadvantages of DTPA aerosol in clinical application?

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3. TC-99M LABELED CARBON NANOPARTICLES

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Overview

- History
- Manufacturer
- Radiopharmaceutical
- Equipment/ Supplies
- Dose preparation
- Dose administration
- Dose incorporation
- Imaging protocols
- Images

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History

- 1984 Developed Australia
- 4.7 M patients across 64 countries
- Modifications/ improvements
- 2023 FDA approval in US
  - Drug-device Combination Product
- First US sale to Duke University Hospital

https://www.aumanufacturing.com.au/cyclopharm-makes-historic-first-us-sale

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Manufacturer

- Cyclomedica
- Cyclopharm
- $7,000 charge for installation and training
- $7,000 ongoing annual technology fee
- $11,500 50 patient box of consumables required for imaging

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US Subsidiary

Cyclomedica USA LLC
5126 South Royal Atlanta Drive
Tucker
GA 30084
United States

—

1600 Parkwood Cir, Suite 200
Atlanta, GA 30339
United States

+1 888 858 6439
info@technegas.com

https://www.cyclomedica.com/company/locations/

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Current Status

- Contracts
  - Feb 2024 80/ 280 institutions
  - March 2024 136/ 400 institutions
- Goal is 4,000 institutions
- World's largest potential market
- Quadruple size of Cyclopharm's existing PE market

https://www.aumanufacturing.com.au/cyclopharm-achieves-streamlined-reimbursement-for-technegas-in-the-us

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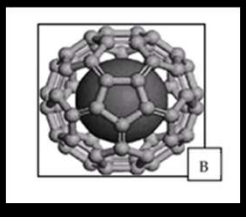
Radiopharmaceutical

- Tc-99m carbon nanoparticles
- Technegas
- Hexagonal graphite capsule
- Traps Tc-99m pertechnetate
- Adults: 10 – 27 mCi (400 – 1000 MBq)



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Tc-99m Carbon Nanoparticles

- Inhalation
- Administer via technegas generator
- Image immediately after administration

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Equipment/ Supplies

- Tc-99m pertechnetate
- Argon gas supply
- Technegas System/ Generator
- Patient Administration Set
- Additional Supplies
  - Disposable gloves
  - 1 mL needless syringes (135 – 300 uL)
  - Ethanol (≥95%)
  - Forceps

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Argon Gas Supply

- Pure argon gas (≥99.997%)
- Existing medical uses
  - Endoscopic procedures
  - Retinal detachment surgeries
  - Cryoablation
  - Tissue preservation

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Technegas System

Khatib I, Young PM. Technegas, a universal technique for lung imaging in nuclear medicine: technology, physiochemical properties, and clinical applications. Pharmaceutics. 2023, 15, 1108.

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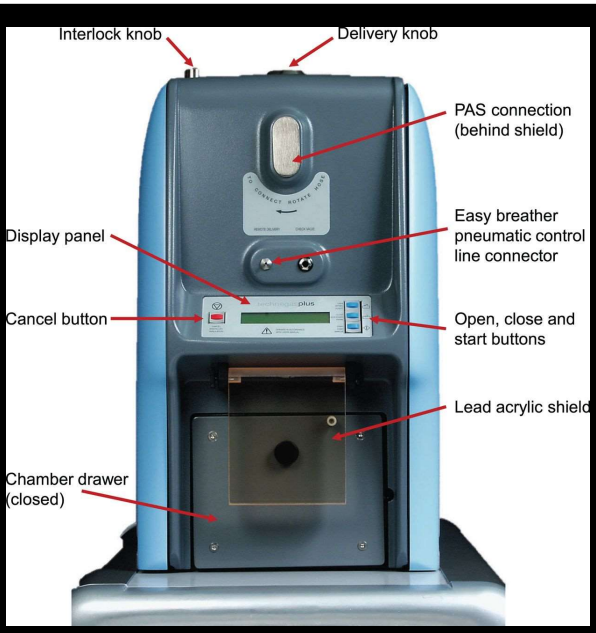

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Patient Administration Set

- PAS
- Sets supplied for 50 patients
  - Single-use breathing accessories with HEPA filters
  - Crucibles in 135 uL or 300 uL
- 50 nose clips – separate

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Patient Administration Set

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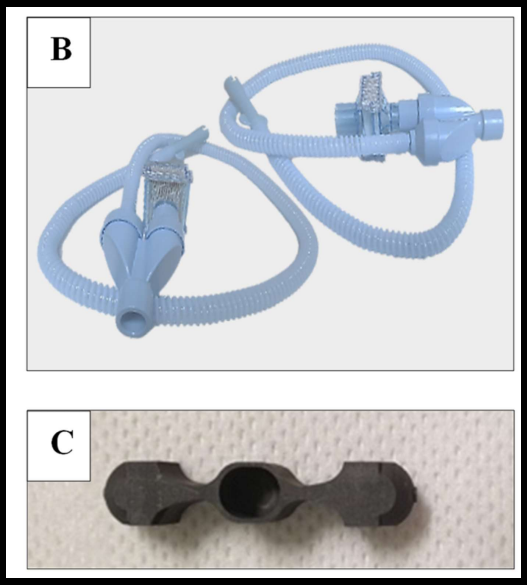

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QA Time

Post your response in the Chat.

The Technegas Generator uses what type of gas to produce the RP?

a. oxygen
b. nitrogen
c. helium
d. argon

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Dose Preparation

- Patient preparation
- Connect gas and power
- Crucible preparation
- Generator Simmer
- Generator Burn
- Dose administration

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Dose Preparation Details

- Ethanol added to graphite crucible
- Tc-99m sodium pertechnetate added to graphite crucible (0.135 mL)
- Liquid is evaporated 'simmer' 70C (158F) for 6 min in ultrapure argon env.
- Combustion cycle initiated 'burn' with alternating current between the crucible contacts to ablate graphite and Tc-99m
- Produces temps 2750C (4982F) for 15 sec in ultrapure argon env.
- Produces carbon nanoparticles

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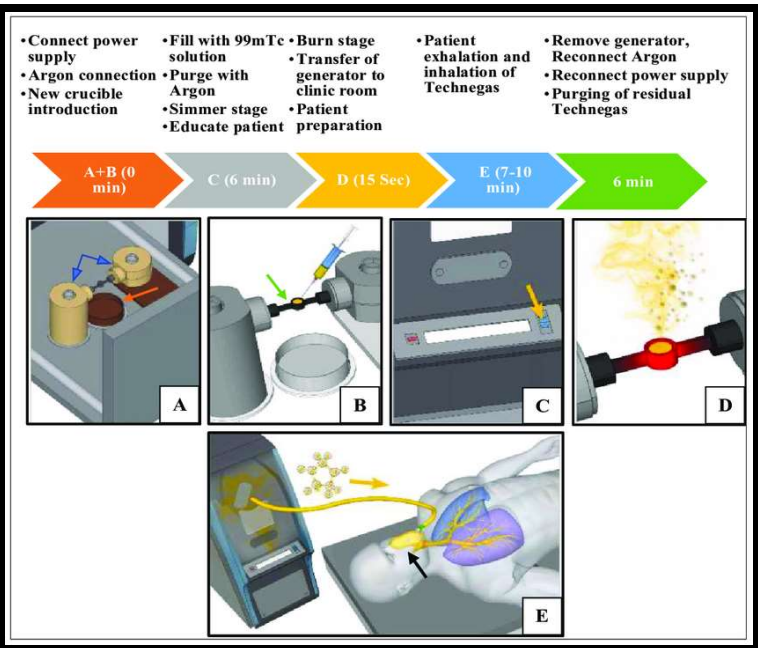

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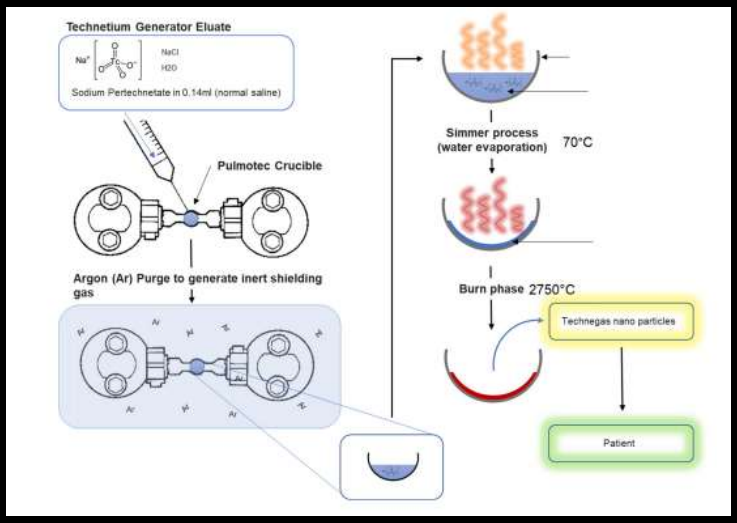
Dose Preparation – Crucible Level



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QA Time

Post your response in the Chat.

This is the stage that the pertechnetate is 'incorporated' into the graphite capsule

a. Addition of ethanol
b. Burn
c. Simmer
d. Final administration

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Dose Administration

- Explain the administration procedure to the patient
- Administer as soon as possible after being generated/ prepared (within 10 minutes)
- Position the patient supine or upright
  - Recommended patients should be supine
- Have patient breath in dose through tubing set
- Three strategies:
  - Strategy 1: Slow deep breaths with 5-sec hold
  - Strategy 2: Normal breathing with deep inhalation
  - Strategy 3: Rapid/ deep breathing with 5-sec hold

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Dose Administration

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Dose Incorporation

- **Passive diffusion**
- Hydrophobic
- Gas like distribution
- Particle like retention

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Clinical Procedure

- **Technegas clinical procedure video**
  - https://www.youtube.com/watch?v=1NNju164eZk (12.41 m)
- **SNMMI Webinar**
  - Currie G. The Technegas System. https://snmmi-video.s3.amazonaws.com/snmmi/Webinars/The+Technegas+System.html

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QA Time

Post your response in the Chat.

A customer calls and is interested in implementing Technegas in their department. What is one appropriate question or consideration that should be discussed in your consultation?

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Imaging Protocol

- SPECT or SPECT/CT
- LEHR collimator
- 140 keV peak, 20% window
- 360 degrees
- 120 stops
- 10 – 12 sec/stop
- 128x128

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Imaging Protocol

- Statics
- LEHR collimator
- 140 keV peak, 20% window
- 500K per static
- ANT, POST, RAO, LAO, RPO, LPO, RLAT, LLAT
- Supine or upright with lungs in FOV

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QA Time

Post your response in the Chat.

What are advantages of Technegas in clinical application?

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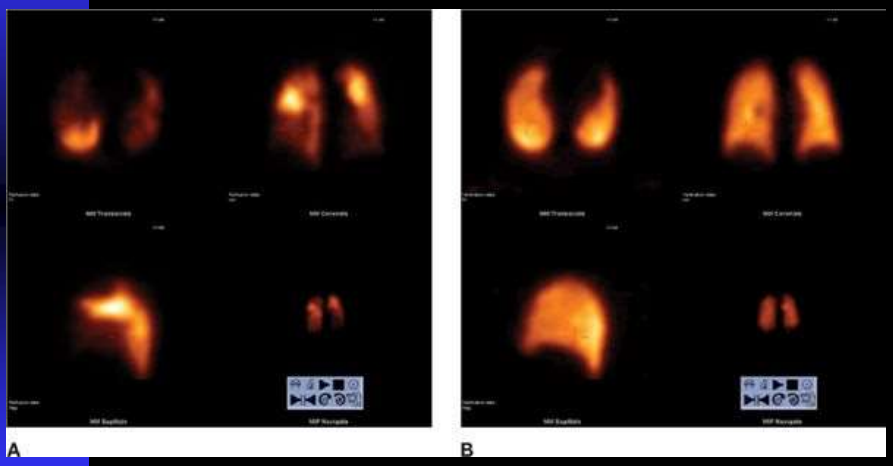
Images



https://thoracickey.com/physiologic-and-metabolic-study-of-pulmonary-disorders-using-conventional-imaging-techniques-and-positron-emission-tomography/

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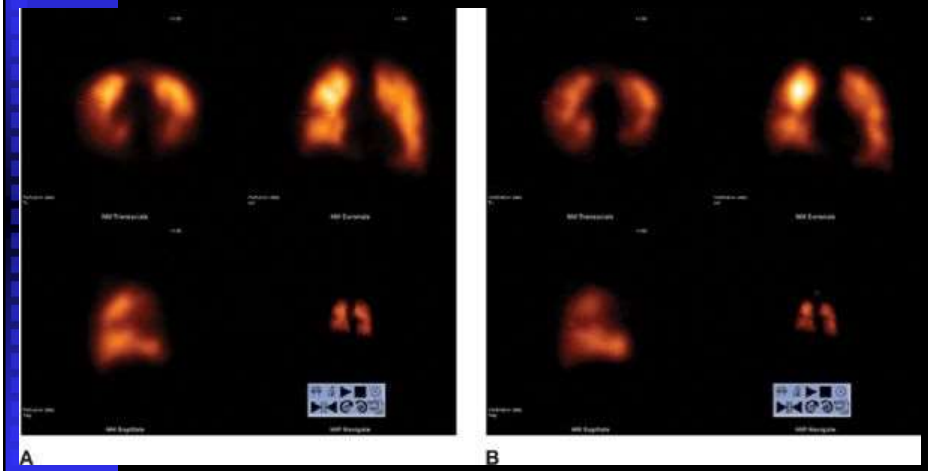
Images



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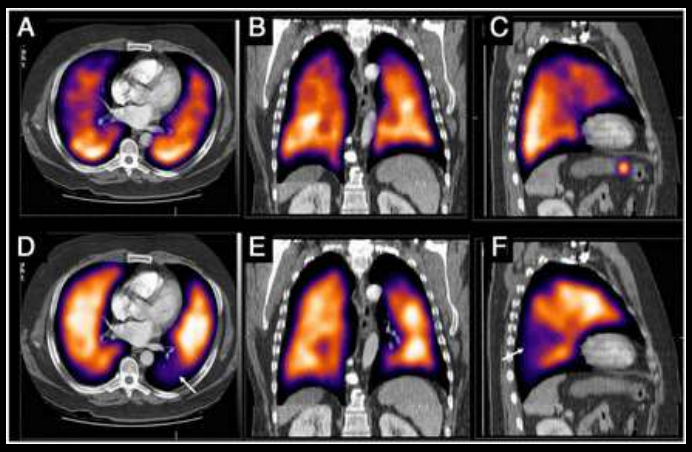
Images



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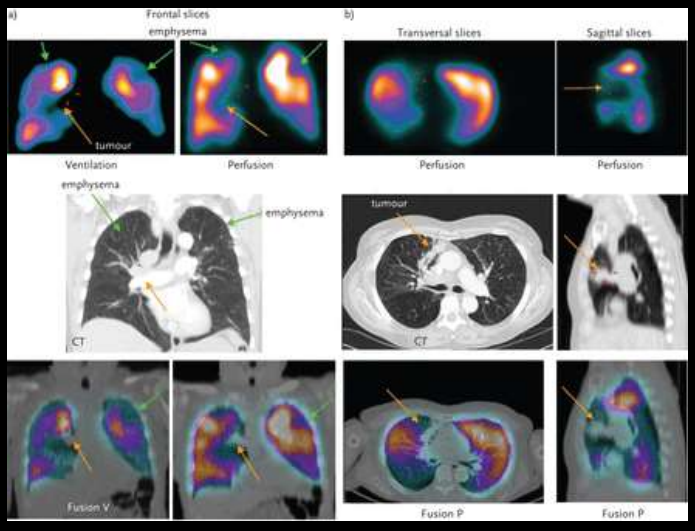
Images



https://breathe.ersjournals.com/content/9/1/48

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Final Questions

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