

Experiment Notebook Format

Experiment Notebooks will be distributed during the first weeks of the second Quarter.

Quarter 2 experiments to be completed:

Lab A: Count Rate, Time and Distance
Lab B: Determine the chemical purity of Tc^{99m} MDP and Tc^{99m} MAA
Lab C: Calculate Actual and Theoretical dead time
Lab D: Spatial Resolution

Format

Typewritten report must include:

- 1) Title Page with Name and Date(s) of Experiment
- 2) Table of Contents
- 3) Experiment Body to include:
 - Purpose
 - Description of Procedure
 - Materials/Equipment Used
 - Technique
 - Data
 - Graphs or Films (Most systems allow you to right-click on an image to save a digital copy to disk)
 - Discussion of Data
- 4) Conclusion

These experiments are designed for independent study but should always involve appropriate supervision from clinical support staff. Experiments can be completed at any institution. Labs are to be done as time permits and must not interfere with the department's responsibility to patient care. These experiments are time consuming so plan accordingly.

**Experiment Notebook
Quarter 2 – Lab D
SPECT Spatial Resolution**

References:

<http://interactive.snm.org/index.cfm?PageID=1044&RPID=969>

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Medical Design's, Inc. Spine Simulator

These experiments are to be completed under the supervision of a licensed technologist within the affiliate's nuclear medicine department. Experiments shall not interfere with clinical duties.

BACKGROUND

The Society of Nuclear Medicine developed a quality assurance program that tests the proficiency of subscribing nuclear medicine services to detect the number, location, type and significance of possible abnormalities in a simulation chest model. All VA hospitals subscribe to this service. Results are compared to a national database and published on the Society of Nuclear Medicine's Web Site.

INTRODUCTION

A 3-dimensional chest simulator developed and produced by Medical Designs, Inc (MDI) is available at each VA affiliate. In this exercise you will be asked to provide a clinical interpretation consistent with the case history and images acquired in the exercise.

MATERIALS

1. MDI/SNM 2013 Spine Phantom Simulator
2. Radioisotope (Technetium)
3. Syringes
4. SPECT camera

PROCEDURE (Your Phantom may have a slightly different filling procedure)

1. Draw 205 uCi (range = 195 – 220 uCi) in a 20cc syringe and QS (fill) with water to a total volume of 20cc. Do not use saline as the salt can damage the phantom. Record the actual activity drawn. Label as Syringe A.
2. Draw 50 uCi (range = 45 – 55 uCi) in a 20cc syringe and QS (fill) with water to a total vol of 10cc. Record the activity and label as Syringe B.
3. Mix each briefly by inverting it back and forth.
4. Place the spine simulator in the vertical position with the fill ports up.
5. Remove the large dark grey fill screw and fill with room temp water (approximately 400cc). Replace the screw cap.
6. Gently rotate the phantom to free any trapped air. Again remove the dark grey fill screw and top off with water so that the main compartment is full.
7. After topping off the main compartment with water, remove 30cc of water with a syringe from the same main port. Discard the water. DO NOT replace the gray main fill port screw cap yet.
8. SLOWLY inject the dose in syringe A into flexible fill port “A”. Detach syringe “A” from the fill port. Pull 1-2cc of air into the syringe. Reattach syringe “A” to the fill port “A” and gently inject the air into the simulator to flush activity from the tubing. Replace the cap on fill port “A”.
9. Record the residual activity in Syringe “A”.
10. SLOWLY inject the dose in syringe “B” into flexible fill port “B”. Detach syringe “B: and replace the cap on fill port “B”. DO NOT flush syringe “B” or fill port “B” with air or water.
11. Record the residual activity in Syringe “B”.
12. Replace the gray main fill port screw cap. Wipe away any leakage. Gently lift and shake the phantom from side-to-side to mix contents.
13. Place the phantom on top of blue diaper paper on the imaging table making sure the phantom’s head is oriented properly.
14. Image the phantom using your department’s bone SPECT protocol. The use of attenuation correction CT/Hawkeye is optional but recommended.
15. Save planar and axial views of the spine phantom using the standard filtering algorithm in your department. It is important to save views containing cold or hot spots so that these can be identified in your write-up. Include arrows/captions on images to support your interpretation(s)).
16. Reprocess using a different filter and save these images as well. (e.g. If a METZ filter shows a lesion that a HANN filter does not, save a copy of both for your written report and INCLUDE IMAGES in your lab write-up.
17. Reprocess images again changing the value of the ORDER and CUTOFF FREQUENCY of your filter. Save these images taking care to jot down all settings used. You will be describing filter differences in your write-up.

After imaging, store the phantom for decay. Do not drain radioactive liquid.

DATA TREATMENT

1. Provide the manufacturer and model of the camera used. Include the number of detectors, the collimator used, the computer system utilized for processing and the filters being applied (including Frequency & Order settings).
2. Provide the matrix size used, the zoom factor, the acquisition time, pixel size (in mm) and the total counts (k) or imaging time.
3. Provide the ECT mode used (continuous vs. step-and-shoot).
4. How many projections were used in the 360°?
5. What was the time per projection (in seconds)?
6. Comment on the effect each filter had on image resolution (at least two should be used). Under which circumstances might each filter work best? Which provided better edge detection and which had the best noise reduction? How do the order and cutoff settings impact resolution?
7. Provide your interpretation of the worksheet below. Please contact NMTP offices if you do not have a spine phantom at your facility.

2013 Lumbar Spine SPECT Phantom Vignette

This is a 62 year old patient with newly diagnosed prostate cancer. The Gleason score is 8. The referring physician has requested a bone scan to determine whether there is evidence of bone metastases.

Examine the planar and SPECT images and complete the following chart. Images must be included in your write-up to support the info written in below.

Region	Lesion Present (Hot/Cold/None)	Location: Central body, Facet, Lamina, Pedicle, Spinous Process, Transverse Process, Vertebral body
L1		
L2		
L3		
L4		
L5		
		Location: Central sacrum, left sacrum, right sacrum, left lateral aspect, right lateral aspect
S1		

8. Based on the lesions detected and a Gleason score of 8, what is the probability that the patient has metastatic bone disease versus some other non-malignant process?

CONCLUSION

What lessons can be learned from this experiment? Which filters (order/frequency) worked best to resolve the lesions in this scenario? When might a smoother filter be preferred over a sharper filter (and vice versa)?