Clinical Protocol: RENAL Flow and Function STUDY with Tc-99m-Mercaptoacetyltriglycine (Mertiatide, MAG 3)

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

LAST REVIEWED DATE: 11/2017

POLICY BASIS FOR PROCEDURE

To establish a protocol for RENAL Flow and Function STUDY with Tc-99m-Mercaptoacetyltriglycine (Mertiatide, MAG 3)

DESCRIPTION OF STANDARD PROCEDURE

SCOPE

All Nuclear Medicine Technologists and Physicians must adhere to these guidelines when performing a renal flow and function study.

PROCEDURE

1. Indications

   A. Assess renal perfusion and function, including differential renal function.
   B. Assess urinary tract obstruction
   C. Assess renovascular hypertension
   D. Assess renal allograft perfusion, function and complications
   E. Estimate renal plasma flow (ERPF)
2. Exam time:

   A. 45-60 minutes

3. Patient Preparation:

   A. The patient should be instructed to drink plenty of fluids 24 hours before the exam.
   B. The patient should hydrate by drinking at least one large glass of water 30 minutes prior to the study.
   C. The patient should void before beginning the study.
4. Equipment and Energy Windows:

   A. Gamma Camera- large field of view.
   B. Collimator- low energy, high resolution, parallel hole.
   C. Energy window- 20% centered at 140 KeV.
   D. Processing Computer
5. Radiopharmaceutical, Dose, and Technique of Administration:

   A. Radiopharmaceutical: Tc-99m-MAG3
   B. Dose: 10 -12 mCi (370-444 MBq).
   C. Intravenous Injection
6. Patient Position and Imaging Field

A. Patient position: Supine.
B. Imaging field: Entirety of kidneys and bladder. In patients with transplants usually imaging the entire pelvis will accomplish this.

7. Acquisition Protocol:

A. Position the camera under the patient for acquisition of posterior images in patients with native kidneys. If patient has a transplanted kidney in the pelvis, position the camera above patient for acquisition of anterior images.
B. Acquire 20 sec Planar pre-syringe image 0.5 - 1mCi Tc-99m-MAG3
   Syringe to be 30cm away from camera head
   Flow: 64 x 64 matrix, Dynamic: 128X128 matrix
   Zoom: 1
C. Acquire flow images for one minute (2 seconds/frame for 30 frames) while injecting the radiopharmaceutical

D. Acquire dynamic images for 45 minutes (1minute/frame for 45 frames)

E. Have the patient void at the end of the study to significantly reduce the gonadal radiation dose.

F. Acquire a post void image after completing the study.

G. Acquire injection site image

H. Diuretic Washout:(5)
   a. If the patient has nephrostomy tubes present, clamp as close to body exit as possible if requested by ordering physician prior to beginning scan acquisition as above.
   b. At 20 minutes into the acquisition, administer 40 mg of Lasix. The amount of Lasix may be changed only if the radiologist makes the changes when protocoling the study. Lasix must be administered by technologist, physician or nurse. The study is continued for additional 25 minutes.

I. Angiotensin Converting Enzyme (ACE) Inhibitor Renography (6)
   a. The referring physician must be contacted and asked to take the patient off ACE inhibitors or other medications known to potentially cause erroneous results, such as calcium channel blockers, prior to the ACE inhibitor renal study. The length of time off varies with drug and should be matched with the biological half-life of the medicine. Consult pharmacy if you are not sure of how long to withhold medication.
   b. If the patient is taking diuretics, they may be continued.
   c. After the technologist explains the test, the patient is given 3-4 cups of water to drink.
   d. After waiting 10 minutes to relax, the blood pressure is taken.
   e. Check with the physician regarding the patient's blood pressure before continuing.

f. Orally administer 25 mg of Captopril. Monitor the patient's blood pressure every 15 minutes for 1 hour.
g. At one hour inject the Tc99m-MAG3.
h. Acquire images for 45-60 mins as stated in sections 7C and 7D.
i. If the captopril study is abnormal, perform a baseline renal scan.

8. Data Processing:
   A. All renal processing will be performed on the GE Xeleris workstation and transferred to appropriate PACS systems at the hospital.
   B. Place regions of interest over the cortex of each kidney (excluding the calyces) and lateral to or around each kidney for background subtraction.
   C. Place a region of interest over the adjacent aorta (ipsilateral iliac artery in the case of transplanted kidney).
   D. Generate 20 minute renal cortex and background curves.
   E. Subtract the background curves from the corresponding renal cortex curves (Be sure curves are normalized for area, i.e. per pixel, before subtraction).
   F. Display curves with "Time" on the X-axis and "Counts" on the Y-axis.
   G. The perfusion portion of the time-activity curve should be on an expanded scale compared to the delayed portion of the curve; this may be done either in one graph, if possible, or by using 2 separate graphs.

9. Optional Maneuvers

   A. Imaging patient in upright position.

      i. Patient is placed in the upright position seated on stool with back up against camera head.

      ii. Images are acquired in the POST projection.

      iii. The field of view includes kidneys and bladder.

      iv. The acquisition and quantification is otherwise the same as for native kidneys.

   B. To calculate GFR - calculate residue in syringe

10. Other radiopharmaceuticals may be substituted if or when Tc99m-MAG3 becomes unavailable, including Tc99m DTPA. Use the same acquisition protocols.

11. Principle Radiation Emission Data – (Tc-99m)

   A. Physical half-life: 6.01 hours
   B. Radiation: Gamma

C. Mean % per disintegration: 89.07%
D. Mean energy: 140.5 keV

Radiation Dose Estimates for Clinical Injections* of DTPA, MAG_3, or OIH—Rapid Voiding

Organ	Estimated radiation dose mSv (rem)		
	DTPA	MAG_3	OIH
Kidneys	1.4 (0.14)	1.4 (0.14)	0.16 (0.016)
Ovaries	1.3 (0.13)	0.86 (0.086)	0.068 (0.0068)
Red marrow	0.45 (0.045)	0.18 (0.018)	0.017 (0.0017)
Bone surfaces	0.68 (0.068)	0.25 (0.025)	0.013 (0.0013)
Testes	0.88 (0.088)	0.59 (0.059)	0.051 (0.0051)
Urinary bladder wall†	19 (1.9)	17 (1.7)	4.0 (0.40)
Uterus	2.4 (0.24)	1.9 (0.19)	0.15 (0.015)
Total body	0.49 (0.049)	0.24 (0.024)	0.023 (0.0023)
Effective dose equivalent	2.0 (0.20)	1.5 (0.15)	0.28 (0.028)

* 370 MBq (10 mCi) of DTPA or MAG_3 and 11.1 MBq (30 μCi) of OIH.

† Bladder voided at 30 min, then at 4 hr, then every 4 hr thereafter.

REFERENCES

1.ACR-SPR Practice Parameter for the Performance of Renal Scintigraphy (Revised 2017).

2.Stabin M, Taylor A Jr, Eshima D, Wooter W. Radiation dosimetry for technetium-99m-MAG3, technetium-99m-DTPA, and iodine-131-OIH based on human biodistribution studies. J Nucl Med. 1992 Jan;33(1):33-40

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