SUBJECT: RENAL MAG-3 ONLY STUDY

TUBULAR SECRETION
(Tc-99m MAG3)

Overview

Tc-99m MAG3 is a technetium-labeled compound with many of the functional properties of I-131 Hippurite. After IV injection, it is highly protein-bound and excreted primarily by tubular secretion, with no retention in normal kidney parenchyma. Renogram curves for MAG3 are essentially the same as for iodohippurate, with the advantage of superior image quality and decreased radiation exposure to the patient.

Tc-99m MAG3 studies image the radiopharmaceutical as it passes through the vascular system, renal tubular cells, tubular lumens, and the renal collection system. This series of images allows the sequential evaluation of renal perfusion, renal clearance by tubular secretion, renal parenchymal transit time, and passage of urine through the renal collection system. In addition, the study provides high contrast images for the evaluation of renal anatomy.

Indications

1. Evaluate and assess renal perfusion and function.
2. Evaluate renal failure.
3. Evaluate renal trauma.
4. Evaluate renal hypertension.
5. Evaluate renal transplant.

Contraindications

Radiographic contrast agents may interfere with kidney function. If contrast studies have been performed, the real scan should be deferred for 24 hours. If the patient has undergone renal angiography or angioplasty, the study should be deferred for 3 days, if clinically feasible.

Examination Time

Vascular Flow and Function with Lasix: 45-60 minutes.

Patient Preparation

- Drink 32 ounces of water starting 2 hours before the appointment, or hydrate according the sedation guidelines for pediatric sedation cases.
- Good hydration is required for all renal studies (urine flow rate of more than 1 mL/min).
- If patient has inadequate hydration, have them drink 300 to 500 mL of water or juice and then begin in 30 to 45 minutes.
- The patient should void before beginning the study, or have a urinary catheter placed.
- Note: If the patient has an indwelling urinary catheter, check with the nuclear physician about whether it should be clamped for the duration of the study.
Renal Studies

PEDIATRICS:
If sedation is ordered:
- NPO solids for 6 hours.
- Clear liquids only up to 2 hours before procedure.
- NPO TOTALY 2 hours before procedure.
- I.V. fluids to deliver 15 mls/kg over 30 minutes beginning at least 15 minutes before injection.
- I.V. fluids to continue at rate of 200 ml/kg/24 hr as maintenance for remainder of study.
- Place urinary bladder catheter prior to isotope injection.

Equipment & Energy Window
Gamma camera: Large field of view
Collimator: VXGP, LEHR
Energy window: 20% window centered at 140 keV.

Radiopharmaceutical, Dose, & Technique of Administration
Radiopharmaceutical: Tc-99m MAG3.
Dose: 3 mCi Tc-99m MAG3
Adjust dose according to the pediatric dose chart
Technique of Administration: Bolus delivery

Patient Position & Imaging Field
Patient position: Supine. Place camera facing the lower back with kidneys in the top third of the field of view (FOV).
- Transplant: Supine with camera anterior to patient’s abdomen with kidney in the middle of FOV. (Look at surgical site for placement under the camera, or if unsure, have the patient place hand over kidney.
- Positioning: Find the xyphoid with your hand and place a radioactive source over the xyphoid. On the acquisition screen you want the source to show up about ½ to 1 inch below the top of the screen. You can also see where elbows are on the screen. They should be about 1/3 the way down the screen. Run the source down the sides of the patient to make sure that they are all the way in the field of view.
- Double check that camera is as close to patient as possible.

ACQUISITION PROTOCOLS
A. VASCULAR FUNCTION ONLY

Place IV site, obtain history, weight/height, and get medication list.
1. Acquire - MAG3 pre-syringe – static image - 128X128 matrix – 60 seconds
   MAG3 FLOW 1 – Dynamic - 128X128 matrix – 1 sec/frame – 60 frames
   MAG3 FLOW 2 - Dynamic - 128X128 matrix - 5 sec/frame -360 frame
   MAG3 post-syringe - static image – 128X128 matrix – 60 seconds.

To acquire the needed bolus MAG3 flow studies-
   a. First, check the IV site to make sure that it is patent.
   b. Start camera
   c. Push as hard as possible on the syringe to get the dose in quickly
Renal Studies

d. Follow immediately with a bolus of the saline. (10 mL of normal saline.)

B. VASCULAR FUNCTION WITH LASIX

❖ Contraindications:
   1. Check for possible allergy to furosemide (Lasix)
   2. Radiographic contrast agents may interfere with kidney function. If contrast studies have been performed, the renal scan should be deferred for 24 hours. If the patient has undergone renal angiography or angioplasty, the study should be deferred for 3 days.

Place IV site, obtain history, weigh/height and get medication list.

| ADULTS – 1MG/KG (MAX DOSEIS 40 MG) |
| PEDIATRIC – 1 MG/KG |
| INJECT AT 20MIN POST START OF EXAM |

MAG3 FLOW 2 - Dynamic - 128X128 matrix - 5 sec/frame -360frames
Starting around frame 100 (or when urine is visualized in the ureters), slowly inject lasix over 1 to 2 minutes. Record the frame that you start injecting it on for later use.

MAG3 post-syringe - static image – 128X128 matrix – 60 seconds

❖ Note: Normal halftime clearance is approximately 10 minutes: abnormal is over 20 minutes; and between 10 and 20 minutes is often considered indeterminate.

C. CAPTOPRIL ENHANCED VASCULAR FUNCTION

(Angiotensin Converting Enzyme (ACE) Inhibitor Renal Study)

Contraindications

• Allergy to furosemide (lasix).

• Radiographic contrast agents may interfere with kidney function. If contrast studies have been performed, the renal scan should be deferred for 24 hours. If the patient has undergone renal angiography or angioplasty, the study should be deferred for 3 days, if clinically feasible.
Renal Studies

- Chronic administration of ACE inhibitors and diuretics may decrease the sensitivity of the test.
- Stop ACE inhibitors for 48 hours prior and no diuretics on the day of exam.
  a. Stop lisinopril and enalaprilat for at least 1 week.
  b. Patient must refrain from food for at least 4 hours prior to the exam.
  c. Patient must be well hydrated prior to the exam (1 quart of water starting 2 hours before the exam.

Administration of Captopril

- Record the patient's weight and height.
- Place IV (in AC if possible).
- Captopril: 50 mg orally (tablet to be ground with mortar and pestle, and suspended in water): (Since food in the gastrointestinal tract delays absorption, the patient should fast for 4 hours)
- Have the patient lay down on bed.
- Record the patient’s blood pressure prior to taking Captopril and then every 15 minutes for 60 minutes after Captopril is given to monitor effect of Captopril.

5 minutes before last BP is to be taken set up camera to acquire the pre MAG-3 syringe counts.

IMAGING

- MAG-3 pre-syringe – static image - 128X128 matrix – 60 seconds
  
  After the hour is up from the administration of Captopril take a last BP.

- Positioning: Find the xyphoid with your hand and place a radioactive source over the xyphoid. On the acquisition screen you want the source to show up about 1/2 to 1 inch below the top of the screen. You can also see where elbows are on the screen. They should be about 1/3 the way down the screen. Run the source down the sides of the patient to make sure that they are all the way in the field of view.

- Acquire - LASIX GIVEN IMMEDIATELY POST MAG-3 INJECTION.
  MAG3 FLOW 1 – Dynamic - 128X128 matrix – 1 sec/frame – 60 frames
  MAG3 FLOW 2 - Dynamic - 128X128 matrix - 5 sec/frame -360 frames
  MAG3 post-syringe - static image – 128X128 matrix – 60 seconds.

  To acquire the needed bolus MAG3 flow studies-
  e. First, check the IV site to make sure that it is patent.
  f. Start camera
  g. Push as hard as possible on the syringe to get the dose in quickly
  h. Follow immediately with a bolus of the saline. (10 mL of normal saline.)
Renal Studies

- If patients BP drops too low from the Captopril have patient lie down and start giving them a saline drip with 250 mL bag of normal saline. Inform nuclear physician of patient's status. Continue to monitor BP until it returns to normal.
- Captopril studies need to be started right at the 1-hour post Captopril dosing mark.
- If the ACE inhibitor renal study is abnormal, a baseline Tc-99m MAG3 renal study should be performed later when the patient has been off ACE inhibitors for at least 2 days.

Data Processing

Process according to the protocol for the EBW.

Principle Radiation Emission Data - Tc-99m (36)

- Physical half-life = 6.01 hours.

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<th>Radiation</th>
<th>Mean % per disintegration</th>
<th>Mean energy (keV)</th>
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<td>Gamma-2</td>
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Dosimetry - Tc-99m-MAG3 (9)

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<th>Organ</th>
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References

Renal Studies


Normal Finding

Renal Studies


