UW Health
University of Wisconsin Hospital and Clinics

Division of Nuclear Medicine Procedure / Protocol

KIDNEY FLOW / FUNCTION MULTIPLE W/WO RX **CPT CODE: 78709**
UPDATED: JULY 2009

Indications:

Renovascular HT affects only 0.5% of the HT population. However, the appropriate clinical presentation can select a population with a higher prevalence (up to 30%). These presentations include:

- Accelerated or malignant HT
- Abrupt onset or sudden worsening of HT
- Continuous systolic-diastolic abdominal bruit
- HT refractory to 3-drug treatment
- Unexplained renal impairment with HT
- Renal impairment induced by ACE inhibitors
- Evidence of other vascular disease,
- Smoking history, especially in females

Patient Prep:

Patient should have NO SOLIDS, 4 hours preceding the exam.
Consume 400-500 ml (2-3 glasses) of fluids in 2 hours before the exam to ensure adequate hydration.

Refer to flow chart for timing and dosages.
Insert IV and infuse 500 ml of normal saline over the 2-hour time period.

Baseline (pt. off ACE inhibitors): Patient should be off Enalapril, Captopril, Lisinopril or Cozar for 3 days, if renal function is normal, 2 weeks if abnormal. The patient should preferably be off diuretics and K+ supplements for 3 days (these reduce sensitivity of test slightly). Other meds are OK, but calcium channel blockers now suspect for causing bilaterally abnormal renograms.

Captopril Stimulated: Standard captopril dose 50 mgm. In children the standard dose is 25 mgm. Patients should preferably be off ACE inhibitors (Captopril, Enalapril, lisinopril and Cozar for 2-3 days).

Scheduling:

Imaging time: 3 hours. Refer to flow chart.

Radiopharmaceutical & Dose:

Baseline: 5 mCi Tc-99m MAG-3. Adjusted for weight if < 45 kg or > 90 kg (refer to nomogram) furosemide 10 mg.

Captopril: 15 mCi Tc-99m MAG-3. Adjusted for weight if < 54 kg or > 90 kg (refer to nomogram) furosemide 10 mg, Captopril 50mg.

Imaging Device:

GE with LEHR collimator for MAG-3, MPS or Infinia (LEHR Picker as last choice).

Data Acquisition:

Predefined Captopril protocol GatesRenal. This produces % uptake in each kidney and renograms together with time to peak transit times and residual cortical activity at 30 minutes. It is important to include the cortical regions in the selected ROI.

Acquisition Procedure:

A. Create patient.
B. Acquisition protocol: GatesRenal
C. This protocol will set up acquisition files:
    1. Pre syringe: Acquire syringe in holder for 3 seconds, 128 x 128 matrix
    2. Preinj: Acquire one-minute pre-injection picture, 128 x 128 matrix
    3. Renaflwt: Renal Flow, 240 frames at 1 sec/frame followed by 26 frames at 1 min/frame
    4. Post syringe: Acquire syringe and stopcock in holder for 3 seconds, 128 x 128 matrix
    5. Injsite: Acquire injection site image, 15 sec image, 128 x 128 matrix

Imaging Procedure: Refer to flow chart (Appendix 1), Gates Renal (PreCap), Captopril Administration, Gates Renal (PostCaptopril). Measure the BP prior to Captopril administration then at 15-minute intervals to the end of the study. If systolic BP falls below 70% of baseline do not discharge patient. Hydration helps prevent hypotension. Hypotension is the most likely drug side effect, although 4-7% of patients develop a rash (which may be histamine induced as it can occur with first use of the drug, i.e. no prior sensitization). Inject Lasix 5 min. before start of imaging procedure.

Processing Procedure:

Process using GE **Renal Analysis** first
Enter appropriate data in the dialog box

*** For pediatric pts: Set pediatric state to "Yes" for pts under 6 yrs**

Draw ROIs for kidneys, bladder, and aorta

Select proceed
Screen-cap image that appears next

- Select Camera Based Clearance.
    - **Confirm or re-draw** injection site ROI

- Select Review icon
    - Select Renogram QC
    - Select Function QC
        - **Screen-cap** Function QC screen
        - Select **Back**

- Select Dynamic Image Review
    - **Screen-cap** Dynamic Image Review screen

- Select Renogram Review.
    - **Screen-cap** Renogram Review screen

Save and Exit protocol

Select **Renal Uptake** protocol from USER applications
Enter data in dialog box
Adjust brightness of display images
Screen-cap uptake screen
Exit

Send to PACS (see PACS section) all screen-cap files plus the file named "Appended Image" under the Renal Analysis_Results folder

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Repeat processing for 2nd Acq (GatesRenal-PostCaptopril adm) for Captopril study

Data Analysis:

Abnormal Criteria for Tc-99m-MAG-3 Captopril Stimulated Study

- Asymmetry of ERPF > 40:60.
- T-max > 6 minutes (normal 3-6 min)
- Flat or obstructive renogram curves (see grades defined below)
- Renal cortical activity (RCA) at 30 min (> 30% max)

Abnormal Results if Baseline Study Performed Following Stimulated Study

- > 10% change in relative ERPF
- > 2 minute change in time to peak of renogram
- > 15% change in RCA
- Change of 2 grades in renogram curve

If these changes occur (Captopril vs baseline) then sensitivity and specificity exceeds 90%.

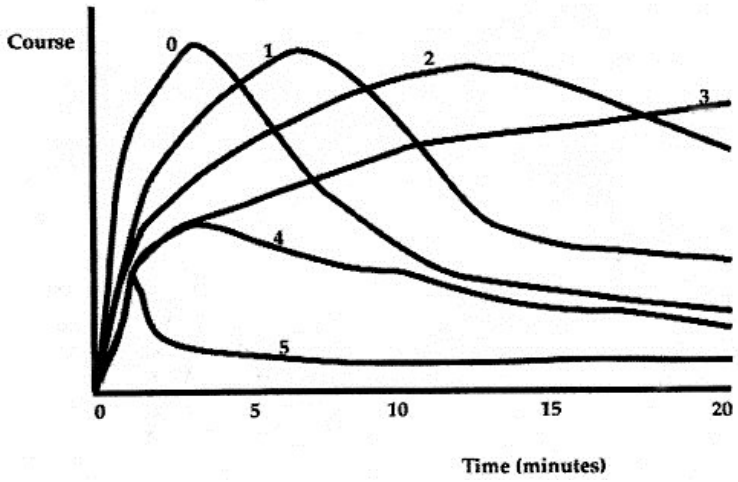


Figure 1. Patterns of renographic curves from normal to blood background type curve. 0 = normal; 1 = minor abnormalities, but with T_{max} > 5 min and a 20-min/max cortical ratio > 0.3; 2 = a marked delay in excretion rate with preserved washout phase; 3 = delayed excretion rate without washout phase (accumulation curve); 4 = renal failure pattern with measurable kidney uptake; 5 =renal failure pattern without measurable kidney uptake (blood background type curve). (Adapted from Fommei E, Ghione S, Hilson AJW, et al. Captopril radionuclide test in renovascular hypertension: a European multicentre study. *Eur J Nucl Med*. 1993;20:625–644.)

Physiology:

In renal artery stenosis (RAS) Antgiotensin II (A-II) induced vasoconstriction maintains GFR. Captopril, an ACE (angiotensin converting enzyme) inhibitor, blocks the conversion of Angiotensin I to Angiotensin II, thus the effect of A-II on the efferent arteriole is diminished, and the GFR falls. This results in decreased transit and washout of tubular tracers.

In the animal model bilateral disease is difficult to diagnose. However, in man B/L disease is common (29%) but is nearly always worse on one side so that the same scan criteria apply as for unilateral disease. The test is useful in assessing renal impairment, but more difficult to interpret.

Interpretation:

Interpretation should be provided with probability statements. The true positive rate for this test increases with the degree (percentage) of stenosis of the renal artery (e.g. < 25% stenosis –6% positive rate, > 80% stenosis – 88% positive rate). The use of diuretics may reduce the sensitivity of the test (87% vs 98%) but this was not evaluated in the same patient population. The test is equally sensitive in moderately renal impaired (creatinine >1.5 mg/l) as patients with normal renal function.

Test should be interpreted as consistent with high, intermediate, or low probability of disease.

High probability includes these criteria:

- Unilateral parenchymal retention > 90%
- Change of 2 grades in renogram (RCA) on ACE-I
- Increase by 2 minutes of time to peak on ACE-I
- Delay in renal pelvis excretion by 2 minutes on ACE-I
- RCA increases > 15% change in relative ERPF on ACE-I

Intermediate probability:

- Scan shows renal impairment unchanged by ACE-I (azotemia, HT, small poorly functioning kidney usually present)
  (salt depletion can cause bilateral symmetrical renogram changes after ACE inhibitor)

Low probability:

- Normal scans
- Grade 0 & 1 scans
- Grade 0 scans plus kidney with > 30% RCA, unchanged by ACE inhibitor.

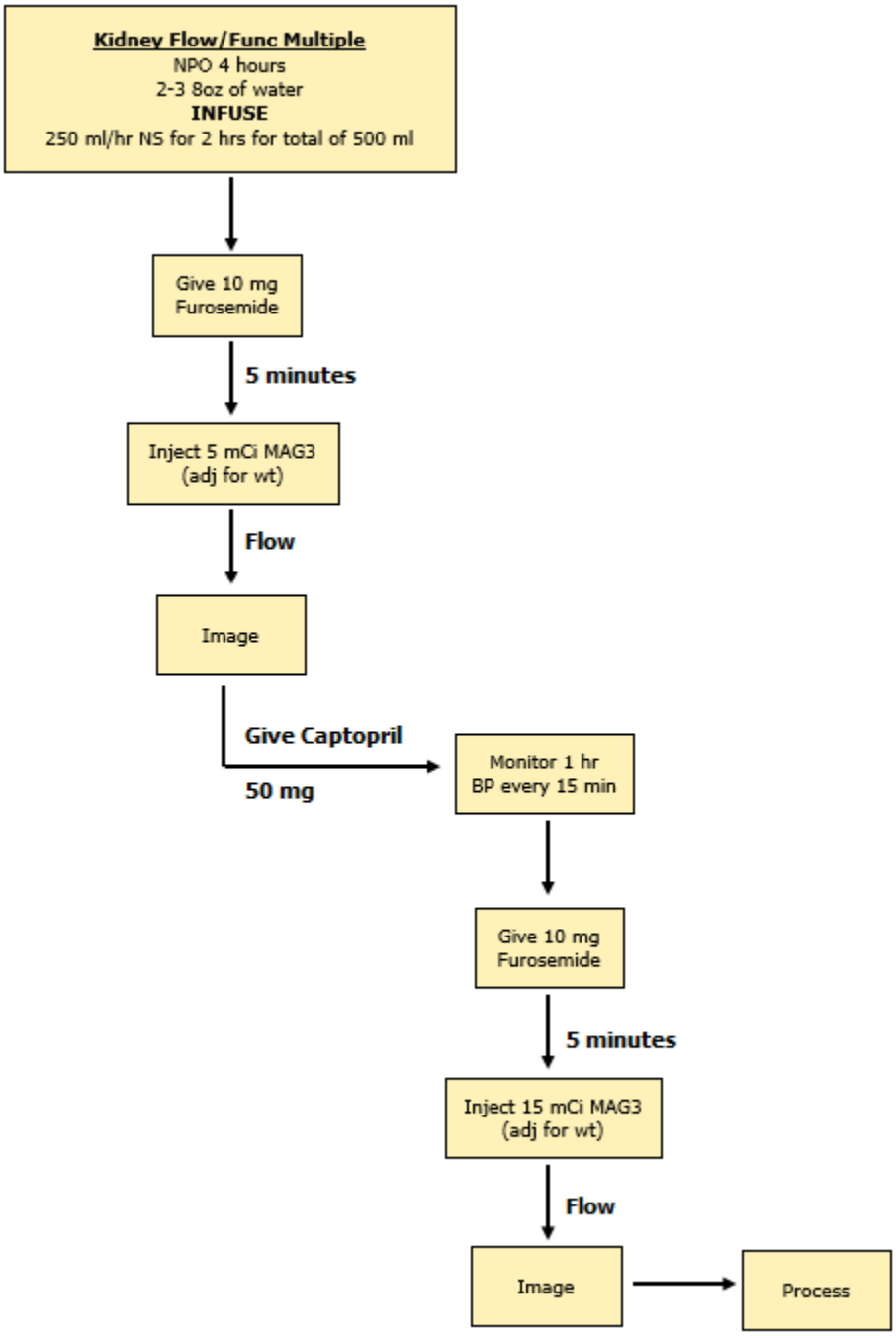
PACS: Send to PACS, all screen-cap files plus the file named "Appended Image" under the Renal Analysis_Results folder.

Comments: A Nuclear Medicine staff or resident physician should be consulted to determine if additional views are indicated.

Reviewed By: S. Perlman, D. Fuerbringer, S. Knishka

Scott B. Perlman, MD, MS Chief, Nuclear Medicine	Derek Fuerbringer, CNMT Manager, Nuclear Medicine	Scott Knishka, RPh, BCNP Radiopharmacist

Appendix 1:


Kidney Flow/Func Multiple
NPO 4 hours
2-3 8oz of water
INFUSE
250 ml/hr NS for 2 hrs for total of 500 ml
Give 10 mg Furosemide
5 minutes
Inject 5 mCi MAG3 (adj for wt)
Flow
Image
Give Captopril
50 mg
Monitor 1 hr BP every 15 min
Give 10 mg Furosemide
5 minutes
Inject 15 mCi MAG3 (adj for wt)
Flow
Image
Process