Renal Cortical Scintigraphy

**Primary Indications:** Determining the presence of renal parenchymal scarring in children with vesicoureteral reflux; rarely, diagnosis of acute pyelonephritis.

**Rationale:** With both of the commonly used radiopharmaceuticals for renal cortical scintigraphy—Tc-99m Gluceptate (glucoheptonate; GH) and Tc-99m Succimer (dimercatosuccinic acid; DMSA)—part of the administered activity binds to the proximal tubular cells in the kidney. Most Tc-99m GH is excreted by glomerular filtration and $\approx 15\%$ of administered activity localizes in the cortex (thus allowing for the combination of conventional renal scintigraphy and cortical scintigraphy), whereas $\approx 50\%$ of administered activity with Tc-99m DMSA binds in the cortex. By 90-120 minutes after injection, the distribution of these tracers is relatively static, and images obtained subsequently reflect renal parenchymal mass. Both acute pyelonephritis and parenchymal scarring cause a focal decrease in tracer accumulation.

**Interfering Conditions:** In the presence of decreased renal function, the alternate route of excretion of Tc-99m GH is the biliary system. Biliary or bowel activity may obscure the kidneys on delayed imaging making interpretation of the study difficult, and potentially simulating urine leakage.

**Precautions:** None

**Radiopharmaceutical:** Tc-99m Succimer (Tc-99m DMSA) is the preferred agent. Tc-99m Gluceptate (Tc-99m GH) is an acceptable alternative and should be used if both renal excretory function and cortical morphology need to be evaluated with a single examination.

**Adult Dosage:** Tc-99m DMSA: 4 mCi
   Tc-99m GH: 15 mCi

**Pediatric Dosage:** Tc-99m DMSA: 55 µCi/kg with a minimum dosage of 500 µCi; maximum dose of 4 mCi.
   Tc-99m GH: 210 µCi/kg with a minimum dosage of 2 mCi; maximum dose of 15 mCi.

**Radiation Dosimetry:** Tc-99m DMSA
   Adult. Critical organ (kidneys): 2.5 rem. Effective dose: 0.24 rem.
   Tc-99m GH
   Adult. Critical organ (bladder wall): 3.11 rem. Effective dose: 0.50 rem.
   (Dosimetry is altered in the setting of impaired renal function.)

**Route of Administration:** Intravenous

**Patient Preparation:** The patient should be well hydrated for the examination. Unless otherwise specified by the physician, the patient is to be hydrated prior to starting the study with approximately 16 ounces (500 mL) of water orally (for a 70-kg adult). If this is not possible, the patient should be hydrated using intravenous fluids.
Adults should be hydrated with 500 mL of normal saline infused intravenously over 30 minutes starting 15 minutes prior to radiopharmaceutical administration. For children weighing more than 35 kg, 500 mL 5% dextrose/0.5 normal saline solution should be infused intravenously over 30 minutes starting 15 minutes prior to radiopharmaceutical administration. Smaller children should receive appropriate hydration based on body weight, using 5% dextrose/0.5 normal saline solution at a dosage of 0.5 mL/kg/min (maximum 500 mL) infused over 30 minutes starting 15 minutes prior to radiopharmaceutical administration.

**Equipment Setup:** Gamma Camera: LFOV camera for studies in adults; SFOV or zoomed LFOV camera for studies in small children.
Collimator: Both high-resolution (or LEAP, if high-resolution unavailable) and pinhole collimators are used. SPECT with high-resolution collimators is preferred over pinhole images for adults and for children ≥ 3 years old.
Energy Window: 140 keV with 20% window

**Patient Positioning:** The supine position is preferred for parallel-hole collimator imaging and pinhole-collimator imaging.

**Procedure:** Tc-99m GH is used when conventional renal scintigraphy (including diuretic renal scintigraphy) is performed in conjunction with cortical scintigraphy. The renal scintigraphy procedure should be followed for this initial component of the study.
Cortical imaging, whether using Tc-99m GH or Tc-99m DMSA, is begun 3 hours after intravenous injection of the radiopharmaceutical. Further delayed images may be helpful when there is moderately severe renal dysfunction.
Planar images, and either SPECT images for adults or larger children ≥ 3 years of age or pinhole images for small children < 3 years of age, are acquired for a complete study. Differential renal function should be determined from the anterior and posterior parallel-hole collimator images (by the geometric-mean method). SPECT imaging of posterior and posterior oblique pinhole images of each kidney are then obtained for better assessment of cortical morphology. The kidney should fill ≥ 75% of the camera field of view on each pinhole image. The pinhole aperture-to-skin distance should be the same for both of the posterior images and for both of the posterior oblique images.

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Posterior and posterior oblique pinhole-collimator images of each kidney (preferred if age is < 3 years)

150,000 counts or 5 min. for first kidney imaged. Same time for second kidney.
256 x 256 matrix, word mode

SPECT imaging (preferred if age is ≥ 3 years)

128 images over 360°
15 sec per image
16 minute per study (dual-headed acquisition)
Zoom – 2.67 128 x 128 matrix, word mode

Save Screen of labeled images

Save Screen of images selected by nuclear medicine physician

**Items Required For Complete Study:**

1. Delayed anterior and posterior parallel-hole collimator images and posterior and posterior oblique pinhole-collimator images or SPECT images (preferred for children ≥ 3 years old).

2. After transfer of the digital data, processing for determination of differential renal function using the lung quantification program will be performed by the nuclear medicine physician.