Nuclear Medicine Cases
MEDIASTINAL PARATHYROID ADENOMA

- 99m-Tc-sestamibi: 20mCi
- False Positives: coexisting thyroid nodules
- Tc-99m-sestamibi has slower washout from parathyroid adenoma than thyroid tissue.
- MIBI (2-methoxy isobutyl isonitrile) accumulates in both the thyroid and parathyroid glands with a peak activity at 4-6 minutes.
Wrong Window Level

- Above images were obtained using 25.6 mCi of Tc-99m MDP at 3 hours after injection. No osseous structures were visualized with the initial images. After the energy window was correctly centered around 140 keV, the repeat images clearly show all of the osseous structures.

There are many components to a gamma camera system including the collimator, crystal, photomultiplier tubes, and the electronics. The goal of the design is to generate a "perfect" representation of the radiopharmaceutical distribution within the patient. The collimator acts to help exclude the off axis photons (scatter) from entering the crystal. The energy window (electronics) aids in discriminating "true" photons from scatter photons by excluding photons of lower energy from registering as "true" events. In this case, the energy window was set too low at the Tl-201 range of 60-80 keV, thus excluding the true 140 keV photons of Tc-99m and accepting only the scattered photons. There is no star effect over the bladder nor is there history to suggest the patient receiving I-131 or higher energy radiopharmaceutical
Papillary Thyroid Carcinoma in the setting of Graves' disease
THYROID SCINTGRAPHY

• I-123: 200 uCi po
  – Image 6 & 24 Hrs
  – T1/2 = 13.2 hrs; 159 kev

• 99mTc-pertechnetate 10 mci iv
  – Image 20 minutes after injection

• UPTAKE: 10-30%
• A solitary cold nodule, generally speaking, has between 15 to 40% chance of being malignant. The risk is greater in individuals have a remote history of exposure to low level radiation. Additionally, as thyroid nodules are more common in females, the suspicion of carcinoma is increased when such nodules are encountered in men.
ACUTE CHOLECYSTITIS
CHOLESCINTIGRAPHY

- **Tc-99m-mebrofenin**
- **Tc-99m-disofenin**
  - If bili < 2; 5.0 mCi
  - If bili 2-10 7.5
  - If bili > 10; 10

- NPO for 4 hours; if NPO > 24 hrs, give .02ug/kg in 30 ml over 30 minutes
- **MORPHINE**: .04mg/kg
- **CCK**: .02ug/kg in 30 ml over 30 minutes
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Angiographic Phase</th>
<th>Tissue Phase</th>
<th>Treatment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Phase Testicular Torsion (&lt;6 hours)</td>
<td>NI to Decreased</td>
<td>Decreased</td>
<td>Emergent surgical detorsion</td>
<td></td>
</tr>
<tr>
<td>Mid Phase Testicular Torsion</td>
<td>Increased flow to dartos</td>
<td>Decreased center with mild increased rim (halo)</td>
<td>Strongly consider surgical detorsion</td>
<td></td>
</tr>
<tr>
<td>Late Phase Testicular Torsion</td>
<td>Increased flow to dartos (marked)</td>
<td>Decreased center with increased rim</td>
<td>Elective ipsilateral orchietomy and contralateral orchiopexy</td>
<td></td>
</tr>
<tr>
<td>Spontaneous Detorsion</td>
<td>Diffuse increase or NI</td>
<td>Diffuse increase or NI</td>
<td>Elective orchiopexy</td>
<td>History of sudden relief of pain</td>
</tr>
<tr>
<td>Acute Epididymitis</td>
<td>Increased flow to epididymis</td>
<td>Increased diffuse or to epididymis</td>
<td>Antibiotic</td>
<td>Full urologic work up needed in infants and young children</td>
</tr>
<tr>
<td>Torsion of Testicular Appendages</td>
<td>Focal or diffusely increased flow</td>
<td>Focal or diffusely increased</td>
<td>Treat symptoms only</td>
<td></td>
</tr>
<tr>
<td>Scrotal trauma</td>
<td>Depends on type and length of time from trauma</td>
<td>Depends on type and length of time from trauma</td>
<td>Depends on type and length of time from trauma</td>
<td></td>
</tr>
<tr>
<td>Hydrocele</td>
<td>Depends on cause</td>
<td>Horseshoe or crescentic decreased activity around testicle</td>
<td>Depends on cause and severity</td>
<td></td>
</tr>
<tr>
<td>Abscess</td>
<td>Increased flow around photopenic center</td>
<td>Increased activity around photopenic center</td>
<td>Antibiotics</td>
<td></td>
</tr>
</tbody>
</table>
LATE TESTICULAR TORSION

- **Differential Diagnosis:**
  - Delayed torsion
  - Abscess
  - Hematoma
  - Hydrocele

- The finding of a central photopenic area surrounded by a rim of increased tracer activity has been described as the "**bull's-eye**" sign. Three entities commonly have this appearance - abscess, late torsion (formerly known as missed torsion), and hematoma. A central photopenic area without the surrounding rim of increased activity could also be due to a hydrocele.
SCROTAL SCINTIGRAPHY

- Tc-99m-pertechnetate 10 mci
INSUFFICIENCY FRACTURES

• Differential Diagnosis:
  – Insufficiency fracture
  – Osseous metastasis

• Although multiple areas of abnormal bone activity in an elderly patient are most likely to indicate multifocal bony metastases, the distribution of the foci in this case would be unusual for metastases. The foci are not in the metaphyses or diaphyses as one would expect, but rather are in weight-bearing areas. These findings suggest the presence of multiple insufficiency fractures
COLLOID SHIFT

• 99m-Tc-sulfur colloid: 6mCi iv
  -99m-Tc- Sulfur colloid: 4-6 mCi

-Marrow & Spleen > liver
Meckles Diverticulum

• 99m-Tc-pertechnetenate 5-10mCi
• 30% have ectopic gastric mucosa
• 98% of those with bleeding have gastric mucosa
Pagets Disease
• PERFUSION:
  – Tc-99m-MAA 4.0 mCi (400,000 particles)
  – Reduce # of particles to 60,000 : pregnant, pulmonary htn

• VENTILATION:
  – GAS : XENON-133 : 20 mCi
  – ARESOL : 99m-Tc-DTPA 25 mCi (5-10% is delivered to the lung)
Bronchial obstruction
Newborn with hypothyroidism
Thyroid Dyshormonogenesis

- DYSHORMONOGENESIS
- inability of the thyroid to synthesize thyroid hormone
- iodine and pertechnetate uptake and uptake mechanisms are normal
- it is the absence of normal levels of thyroid hormone that suggests the diagnosis of dyshormonogenesis
- diagnosis can go undetected on Tc-99 imaging as it is trapped but not organified by the thyroid – the thyroid appears normal on these images
- with I-131 and I-123, thyroid uptake is not seen since radiotracer washes out of the gland due to failure of synthesis of thyroid hormone
- this can result in elevated levels of TSH and goiter formation
- reasons for abnormal thyroid hormone levels in a newborn
  - agenesis
  - ectopic thyroid
  - dyshormonogenesis – gland present but does not
- the question to answer is where is the thyroid and is it working
- give Tc-99m pertechnitate PO
Hepatic Metastasis

- Soft tissue uptake is seen throughout an enlarged liver. There is no evidence of metastatic disease to bone.

- DDX: hepatic necrosis; excess colloid; amyloidosis; Mets
CNS lymphoma

• TI-201
  – Used to differentiate CNS lymphoma from infection in AIDS
RENAL SCAR

• **Differential Diagnosis:**
  – Renal cortical scarring
  – Acute pyelonephritis

• Tc-99m DMSA is a cortical binding agent. Such agents are effective for morphologic imaging because of their prolonged and stable retention within the kidneys following background and urinary clearance.

• In the acute setting of pyelonephritis there may be multiple peripheral cortical defects. These defects may return to normal on follow-up studies (generally 3-6 months later) in the absence of significant cortical scarring or persistent infection. When the kidneys have cortical scarring, the cortical defects will be permanent.
• **Findings:**

• The posterior images were obtained 3 hours after the injection of the tracer. Both kidneys are normal in size and location. However, there is a cortical defect in the upper pole of the right kidney that corresponded to the abnormality on the immediate and static views.
• TUBULAR AGENT
  – 99m-Tc-MAG 3 8 mCi

• GLOMERULAR AGENT
  – 99m-Tc-DTPA 15 mCi

• CORTICAL BINDING AGENT
  – 99m-Tc-DMSA 5 mCi
mycobacterial infection

• While PCP, lymphoma, and bacterial and non-bacterial infections are gallium-avid, Kaposi’s sarcoma is not.

• **Differential Diagnosis** The differential diagnosis for the adenopathy seen in the chest and abdomen in this patient with AIDS includes lymphoma, tuberculosis, and other mycobacterial infections (e.g., MAI).
• Ga-67:
  – 5 mCi: infection
  – 10mCi: tumor
Alzheimer's

- 99m-Tc-HMPAO; 20mCi
- Decreased activity in parietal/temporal lobes
UPJ OBSTRUCTION

• Differential Diagnosis:
  – Ureteropelvic junction obstruction
  – nonobstructive hydronephrosis in a poorly hydrated patient

A t1/2 of washout of the urinary collecting system greater than 20 minutes is consistent with obstruction. A washout period of 10 to 20 minutes is considered indeterminate.
Small Bowel Carcinoid

• **Findings:** The Octreotide scintigraphy shows normal activity in the spleen, liver, kidneys and bladder. There are also three regions of abnormal uptake seen within the mid abdominal region, which remain unchanged on 24 hour delayed images.
*Indium-111 Octreoscan 6 mci iv
*somatostatin analog
*normal distribution: thyroid, liver, gb, spleen, kidneys
*kidneys retain activity on delayed images
*neuroendocrine tumors (carcinoid, gastrinoma, insulinoma, pituitary adenomas, pheos, medullary thyroid, lung
*cns tumors
*other: lymphoma, breast, lung, renal cell cancer
SUPERSCAN

• Increased bone uptake with decreased renal uptake
Ischemic Cardiomyopathy

- Anterior/septal/apical: reversible
- Septal: nonreversible
- Lateral: reversible
- Inferior: nonreversible
- Dilated LV worse during stress with hypokinesis and dyskinesis