Overview

- The Neuroectodermal/Norepinephrine Study is used primarily to image tumors that arise from the embryologic neural crest. Metaiodobenzylguanidine (MIBG) is an analog of norepinephrine and is taken up by the adrenergic nervous system of tissues that are derived from the neural crest.

Indications

- Identification and localization of tumors of neuroectodermal tissues:
  1. Benign and malignant, intraadrenal and extraadrenal pheochromocytomas.
  2. Neuroblastomas.
  3. Carcinoid tumors.
  4. Medullary thyroid tumors.
  5. Paragangliomas.
  6. Chemodectomas.

- Evaluation of myocardial norepinephrine receptors.

Examination Time

- Initially: 15 minutes (2 hours if sedation needed) for injection of the radiopharmaceutical.

- Delayed images at 20 to 24 hours with I-123 MIBG (Planar and SPECT)

Patient Preparation

- Drugs to be avoided prior to study (trade names in parenthesis):
  1. Tricyclic antidepressants and related drugs - should avoid for 6 weeks prior to the study:
     - amitriptyline & derivatives (Elavil, Endep, Etrafon, Triavil, Amitril, Emitrip, Enovil).
     - amoxapin (Asendin).
     - loxapin.
     - doxepin (Adapin, Sinequan).
     - imipramine & derivatives (Tofranil, Imavate, Janimine, Presamine, SK-Pramine, Tipramine).

  2. Anti-hypertensives - should avoid for 2 weeks prior to the study:
     - labetalol (Normodyne, Trandate).
     - calcium channel blockers.
     - reserpine (Serpasil, Sandril).

  3. Sympathetic-amines - should avoid for 2 weeks prior to the study:
     - pseudoephedrine (Haloed, Sudafed, Sudrin, others).
     - phenylpropanolamine HCL (Propagest, Sucrets Cold Decongestant, Entex, others).
     - phenylephrine HCL (Neo-Synephrine, Alconefrin, Rhinail, others).
     - ephedrine.

  4. Cocaine - should avoid at all times and for 2 weeks prior to the study.

Thyroid blockade

Thyroid blockade is important to protect the thyroid from unnecessary irradiation, an organ that is more radiosensitive in children than in adults.
Beginning on the day before tracer injections until the day after injection, children from one month to three years should receive 32 mg potassium iodide daily, from three to thirteen years 65 mg, and over this age 130 mg daily.

*New-borns* receive 16 mg potassium iodide only on the day before tracer injection. Rapid blockade by perchlorate (Irenat) is an alternative option.

**Bowel prep**

*Bowel prep* (citrate of magnesia) for night after injection is required. (Patient to acquire this at local pharmacy)

**Precautions**

1. Check if thyroid blockade has been given.
2. Check on going treatment for possible drugs interactions.
3. The tracer must be injected slowly, preferably over a period up to 5 minutes.

**Equipment & Energy Windows**

- Gamma camera: Large field of view.
- Collimator: Low energy high resolution, parallel hole.
- Energy window: I-123-MIBG: 20% window centered at 159 keV.

**Radiopharmaceutical, Dose, & Technique of Administration**

- I-123-MIBG (I-123-metaiodobenzylguanidine).
- Dose: Administered doses should be scaled down to body weight.
  - Minimum doses: I 123-MIBG = 80 MBq =2.2mCi
  - Recommended maximum doses: I123-MIBG = 400 MBq=10.8mCi
- Adult doses I-123-MIBG: I123-MIBG = 296 MBq=8 mCi
- Technique of administration: Intravenous injection over 30 seconds.

**Patient Position & Imaging Field**

- Patient position: Supine.
- Imaging field: Neck, chest, abdomen, and pelvis.
- An adapted environment, an adequate attitude toward the child, a well-trained technologist for pediatric procedures and involved parents before and during the procedure, all help in obtaining a co-operative child.
- Sedation is usually not required for a technical satisfactory examination. The most difficult age is between 1 and 3 years. *In this category, sedation is necessary*

**Acquisition Protocol**

- At (1-123 MIBG) 4 and 24 hours, acquire a whole body scan from head to mid-thigh.
- WB Length: 5cm/min Speed: 6.27 cm/min, Image Size: 256 X 256 X16
• **Static images**: 250,000 counts or 10 min counting per image are necessary (compromise between best image quality and limitation of scanning time). 256x256 matrix or 128x128 matrix with zoom.

• spot images of the entire body are the reference method.
  
  • Skull anterior, posterior
  • Skull right, left (including arms)
  • Chest anterior, posterior
  • Abdomen anterior, posterior
  • Pelvis (empty bladder) anterior, posterior (lateral if bladder is not empty)
  • Lower limbs anterior, posterior

*These views should be similar to those obtained with bone scans i.e. the toes turned inwards and the knees together. The ankles should be included.*

**SPECT of Abdomen**

• At 24 hours I-123-MIBG: SPECT images.
  1. Degrees of rotation: 360.
  2. Number of images: 64.
  3. Time per image: 20 seconds.

**Data Processing**

• AutoSpect Plus program Philips EBW.

**Optional Maneuvers**

• I-123-MIBG: SPECT images.
  1. Degrees of rotation: 360.
  2. Number of images: 64.
  3. Time per image: 20 seconds.

• Landmarking: In certain circumstances, it can be of help to use other tracers in conjunction with MIBG. In case of difficulties to differentiate between MIBG tumour uptake and retention of activity in the renal pelvis one may either use furosemide to washout the pelvic activity or use MAG3/DTPA to identify the kidney. A bladder catheter is not necessary except in particular cases. However, even in pelvic neuroblastoma, the bladder activity is rarely a problem. The child (if co-operative) should be encouraged to void prior to the imaging.

• Intraoperative localization of pheochromocytomas: May be done with a hand held probe and I-125-MIBG.

• Tumor uptake: May be estimated using a conjugate camera method.

• Myocardial uptake: May be quantitated.

**Principle Radiation Emission Data - I-123**

• Physical half-life = 13.2 hours.

<table>
<thead>
<tr>
<th>Radiation</th>
<th>Mean % per disintegration</th>
<th>Mean energy (keV)</th>
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<tbody>
<tr>
<td>Gamma-2</td>
<td>83.3</td>
<td>159.0</td>
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<tr>
<td>Ce-K, gamma-2</td>
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<td>127.2</td>
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</table>
Principle Radiation Emission Data - I-131

- Physical half-life = 8.04 days.

<table>
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<tr>
<th>Radiation</th>
<th>Mean % per disintegration</th>
<th>Mean energy (keV)</th>
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<td>Beta-4</td>
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<td>Gamma-14</td>
<td>81.2</td>
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Dosimetry - I-123-MIBG

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<th>Organ</th>
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<th>mGy/370 MBq</th>
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<tbody>
<tr>
<td>Thyroid (unblocked)</td>
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<tr>
<td>Baldder</td>
<td>2.37</td>
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<tr>
<td>Adrenals</td>
<td>1.37</td>
<td>13.7</td>
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<tr>
<td>Ovaries</td>
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<td>11.8</td>
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<tr>
<td>Spleen</td>
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<td>Total body</td>
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<tr>
<td>Liver</td>
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<td>4.4</td>
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<tr>
<td>Testes</td>
<td>0.37</td>
<td>3.7</td>
</tr>
<tr>
<td>Total body</td>
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<td>5.3</td>
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Dosimetry - I-131-MIBG

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<tbody>
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<td>Liver</td>
<td>0.44</td>
<td>4.4</td>
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References


Normal Findings
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