



# **Nuclear Medicine Procedures and Clinical Indications**

## ***A Clinician's Quick Reference Guide***



# NEURO-NUCLEAR MEDICINE

## CEREBRAL PERFUSION SCAN

1. Diagnosis and conformation of Alzheimer's disease and other forms of dementia.
2. Diagnosis of brain death.
3. Evaluation of post-traumatic brain injury when CT/MR is non-diagnostic.
4. Localization of electrical and non-electrical seizure foci.

## RADIONUCLIDE CISTERNOGRAPHY

1. Diagnosis of normal pressure hydrocephalus.
2. Identification of cerebrospinal fluid (CSF) leaks.

# CARDIAC NUCLEAR MEDICINE

## MYOCARDIAL PERFUSION

This study can be done at rest only, with treadmill exercise stress, with pharmacologic—stress (dipyridamole, adenosine or dobutamine), or a combination of exercise with pharmacologic stress for the assessment of myocardial perfusion in a variety of clinical settings:

1. Detection of coronary artery disease (CAD) in non-acute symptomatic ischemic equivalent.
2. Detection of CAD in asymptomatic patients with high CHD risk.
3. Possible Acute Coronary Syndrome (Resting Thallium).
4. Risk assessment of known/chronic CAD.
5. Pre-operative risk assessment for non-cardiac surgery.
6. Risk assessment post ACS.
7. Assessment of viable myocardial tissues.
8. Assessment post revascularization.

## **GATED BLOOD POOL STUDY (MUGA)**

Assessment of cardiac function through quantification of left ventricular ejection fraction (LVEF), chamber size, assessment of wall motion abnormalities, diastolic filling, and sequence of chamber contraction

1. Evaluation of ischemic cardiomyopathy.
2. Prospective evaluation of EF prior to, and follow-up of, cardiotoxic drugs (i.e. Adriamycin).
3. Post-MI evaluation.
4. Assess candidates for pacemaker insertion.
5. Evaluation of causes of congestive heart failure (CHF) in patients with known or suspected CHF.
6. Quantification of left-to-right intracardiac shunt and RVEF (ordered as first pass MUGA).

# **GU NUCLEAR MEDICINE**

## **DYNAMIC RADIONUCLIDE RENAL STUDY**

1. Evaluation of renal perfusion, function and differential function.
2. Diagnosis of renovascular hypertension.
3. Detection and evaluation of renal collecting system obstruction.
4. Diagnosis of post renal transplant complications (acute tubular necrosis, renal artery stenosis, drainage obstruction...).

## **RENAL CORTICAL IMAGING (DMSA)**

1. Pyelonephritis
2. Renal scars
3. Differential function

## **GLOMERULAR FILTRATION RATE (GFR)**

1. For determination of renal glomerular filtration rate.

# GI NUCLEAR MEDICINE

## **LIVER – SPLEEN SCINTIGRAPHY**

1. Diagnosis of focal nodular hyperplasia.
2. Detection of accessory or ectopic splenic tissue or asplenia.
3. To detect residual splenic tissue in patients with previous splenectomy or splenic trauma.
4. Evaluation of diffuse hepatic disease such as cirrhosis or hepatitis.

## **GASTROESOPHAGEAL SCINTIGRAPHY**

1. Evaluate and quantify esophageal motility.
2. Detection and quantitation of gastro-esophageal reflux
3. Suspected pulmonary aspiration.

## **GASTROINTESTINAL BLEEDING STUDY**

1. Detection of active gastrointestinal and non-gastrointestinal bleeding sites. Localization provides approximate location of active bleeding site.

## **HEPATOBIILIARY STUDY**

1. Diagnosis of acute cholecystitis and hepatobiliary patency.
2. Evaluation of gallbladder function and chronic cholecystitis and biliary dyskinesia through CCK stimulation.
3. Biliary leak evaluation.
4. Evaluation of transplanted liver.
5. Detection of biliary atresia or congenital biliary disorders.

## **GASTRIC EMPTYING**

1. Diagnosis of functional gastric obstruction/dysmotility.

## **MECKEL'S SCAN**

1. Detection and localization of a Meckel's diverticulum containing functioning (bleeding) gastric mucosa.

## **C-14 BREATH TEST**

1. Detection of the presence of *H. pylori* infection.

# **PULMONARY NUCLEAR MEDICINE**

## **LUNG SCAN –V/Q**

1. Diagnosis and follow-up of pulmonary embolism.
2. Pre-op evaluation of lung function prior to thoracotomy or lobectomy (ordered as quantitative lung scan).
3. Work-up for primary pulmonary hypertension (chronic PE).
4. Assessment of congenital pulmonary abnormalities and right to left cardiac shunts.

# **ENDOCRINE NUCLEAR MEDICINE**

## **THYROID SCAN**

Determination of thyroid size, function, and position. Quantitative thyroid uptake (I-131 uptake).

1. Evaluation of hyperthyroidism (Graves Disease, functioning nodules and thyroiditis)
2. Evaluation of functional status of thyroid nodules in the setting of an abnormal TSH.
3. Detection of thyroid remnant and thyroid cancer metastases post thyroidectomy.
4. Detection of ectopic thyroid tissues such as substernal or sublingual locations of thyroid tissue.

## **WHOLEBODY IODINE IMAGING**

1. Post-therapy imaging following radioiodine ablation.
2. Follow-up detection of recurrent thyroid cancer metastases.

## **PARATHYROID SCAN**

1. Pre-operative localization of parathyroid adenomas and hyperplasia in patients with clinical and biochemical diagnosed hyperparathyroidism.

## **MIBG SCAN**

1. Identification and localization of benign and malignant of neuroendocrine tumors including: pheochromocytomas, neuroblastomas, carcinoid tumors, and medullary thyroid tumors.
2. Evaluation of myocardial norepinephrine receptors.

## **SOMATOSTATIN RECEPTOR IMAGING (OCREOTIDE)**

1. Detection, follow-up and monitoring neuroendocrine tumors that contain somatostatin receptors such as carcinoids, islet cell tumors, small cell lung tumors, and medullary thyroid carcinoma.

# **RADIONUCLIDE DETECTION OF INFECTION**

## **GALLIUM SCAN**

1. Detection of vertebral osteomyelitis / discitis
2. Detection, localization, and follow-up of chronic infection and FUOs.
3. Staging and monitoring of therapy response in lymphoproliferative neoplasms (HD, NHL) where FDG PET not available.
4. Evaluation of the activity status of interstitial and chronic lung disease such as sarcoid.
5. Evaluation of infection in immunocompromised patients.

## **LABELED WBC STUDY**

1. Acute osteomyelitis (particularly useful in diabetics).
2. Prosthesis infection, graft infections.
3. Evaluation of inflammatory bowel disease.
4. Detection of abscess or acute (<4-6 weeks) infection.
5. Fever of unknown origin.

# **SKELETAL NUCLEAR MEDICINE**

## **BONE SCAN**

1. Screening and followup for bone metastases in patients with known or suspected cancer.
2. Infection (Osteomyelitis vs. cellulitis).
3. Evaluation of suspected fracture, including stress fractures.
4. To help determine age and metabolic activity in areas of aseptic necrosis and trauma.
5. Evaluation of prosthesis for loosening or infection.
6. Evaluation of non-specific bone pain.
7. Evaluation of non-specific, abnormal x-ray appearance of bone.
8. Metabolic bone disease
9. Confirm the diagnosis of complex regional pain syndrome.
10. Polyarthritis
11. Bone viability, i.e. frostbite and bone graft.

## **BONE MARROW SCAN**

1. To define marrow distribution.
2. Diagnosis of osteomyelitis in conjunction with labelled white blood cell imaging.

## **BONE MINERAL DENSITY**

1. Diagnosis of osteoporosis.
2. Assessment of response to therapy for osteoporosis.
3. Assessment of fracture risk in osteoporotic/osteopenic patients.

# **LYMPHATIC NUCLEAR MEDICINE**

## **LYMPHANGIOGRAM**

1. Evaluation of primary and secondary lymphedema.

## **SENTINEL NODE IMAGING**

1. Identification and localization of draining lymph node basin and sentinel nodes in breast cancer and melanoma.



# POSITRON EMISSION TOMOGRAPHY (PET)

-1) **Positron Emission Tomography (PET) scanning is now a publicly insured health service available to cancer patients who have one of the seven clinical indications listed below:**

- **Solitary Pulmonary Nodule (SPN):** for which a diagnosis could not be established by a needle biopsy due to unsuccessful attempted needle biopsy; the SPN is inaccessible to needle biopsy; or the existence of a contra-indication to the use of needle biopsy.
- **Thyroid cancer:** where recurrent or persistent disease is suspected on the basis of an elevated and/or rising thyroglobulin but standard imaging studies are negative or equivocal.
- **Germ cell tumours:** where recurrent disease is suspected on the basis of elevated tumour marker(s) – (beta human chorionic gonadotrophin (HCG) and/or alpha fetoprotein) and standard imaging tests are negative, or a mass persists after primary treatment for seminoma when curative surgical resection is being considered.
- **Colorectal cancer:** where recurrent disease is suspected on the basis of an elevated and/or rising carcinoembryonic antigen (CEA) level(s) during follow-up after surgical resection but standard imaging tests are negative or equivocal.
- **Lymphoma:** for the evaluation of residual mass(es) following chemotherapy in a patient with Hodgkin's or non-Hodgkin's lymphoma when further potentially curative therapy (such as radiation or stem cell transplantation) is being considered; or for the assessment of response in early stage Hodgkin's lymphoma following two (2) or three (3) cycles of chemotherapy when the chemotherapy is being considered as the definitive single modality therapy.
- **Non-small cell lung cancer (NSCLC)**
  - o For which curative surgical resection is being considered based on negative standard imaging tests; or;
  - o For clinical stage III NSCLC which is being considered for potentially curative combined modality therapy with radical radiotherapy and chemotherapy.
- **Limited disease small cell lung cancer:** for evaluation and staging where combined modality therapy with chemotherapy and radiotherapy is being considered.

- 2) The following disease indications are available through the Ontario PET Registry program:
- **Esophageal Cancer**
    - o PET scanning in the pre-operative assessment of patients with esophageal cancer.
  - **Pancreatic Cancer**
    - o PET scanning in the pre-operative assessment of patients with pancreatic cancer.
  - **Melanoma**
    - o Staging of potentially resectable high risk Melanoma and the Assessment of solitary Melanoma metastasis at recurrence.
  - **Testicular cancer**
    - o Assessment of treatment response in Testicular cancer.
- 3) Additional indications may also be approved for imaging through the Ontario Special Access program.

## **THERAPEUTIC PROCEDURES**

### **I-131 THERAPY FOR THYROID CANCER**

1. Ablation of thyroid remnants post total thyroidectomy.
2. Treatment of residual functioning thyroid cancer.

### **I-131 THERAPY FOR PRIMARY HYPERTHYROIDISM**

1. Treatment of primary hyperthyroidism (Graves's disease).
2. Treatment of hyperthyroidism secondary to autonomous functioning nodule(s).

### **SR-89 THERAPY FOR PAINFUL BONE METASTASES**

1. Symptomatic palliation of bony metastases from prostate, breast or lung cancer.



