

بعد البسملة

احبائي هذي مذكرة

## *Nuclear Medicine*

اعطانا المحاضرة الدكتور صالح عثمان بالنسبة لقروب ب اما قروب أ وقروب  
سي اعطائهم الدكتور دسوقي

حاولت جاهدا الحصول على سلايدات الدرس .. ولكن الدكتور رفض وقال  
الدرس كله مو مطلوب وهو كثير عليكم واعطاني هذه الاوراق وقال كافية  
وذهبت اليه وقلت له انني سوف ازيد على المذكره بعض النوات وقال  
plz ..this handout is more than enough

اخوكم

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# Nuclear Medicine

## Introduction

Nuclear Medicine is defined as that branch of medicine in which radioactive materials are used for the diagnosis and treatment of disease.

## Nuclear Structure

The nucleus is one of two major components of the atom. The nucleus contains protons and neutrons. The other is the shell of electrons that surround the nucleus.

Nuclear Medicine involves the use of radiation that originates from the nucleus of an atom unlike the x-ray which originates from the orbits of the atom (movement of electron).

## Radiopharmaceuticals:

A number of radionuclides (tracer) are used per se or after labeling with pharmaceutical part which facilitate their transport along different physiological pathways. The combination is called radiopharmaceutical (Radionuclide + pharmaceutical).

## Radionuclides:

The most useful radionuclide is technetium 99m (Tc-99m) which has the following properties:

Half-life	=	6.02 hours
Radiation	=	Gamma radiation
Energy	=	140 KeV
Supply	=	Generator of Molybdenun
	supplied	every week

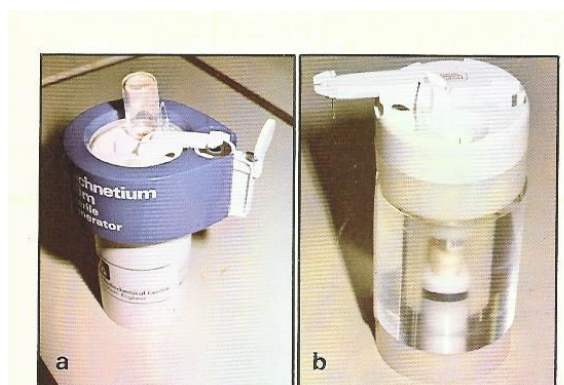


Figure 1.1 (a) A typical molybdenum-99/technetium-99 generator system in routine use, together with (b) a plastic see-through model and (c) a schematic cutaway section showing how the introduction of saline into the top of the column washes out the daughter product ( $^{99}\text{Tc}^m$ ) in the eluate.

**Other radionuclides used are summarized in the following table:**

<u>Radionuclide</u>	<u>Half-life</u>	<u>Energy</u>
Iodine I <sub>123</sub>	13.2 hrs	159 KeV
Gallium 67	78 hrs	190,290,390 KeV
Thallium 201	73 hrs	68-82 KeV
Krypton 81m	13 seconds	190 KeV
Xenon 133	5.2 days	81 KeV
Iodine I <sub>131</sub>	8 days	360 KeV

Radionuclides used in Nuclear medicine may emit gamma or beta radiation. Those emitting gamma radiation are used for diagnosis. e.g. Tc-99m while those emitting beta radiation are used for therapy. e.g. I<sub>131</sub>.

### **Administration of radiopharmaceuticals to patients:**

Most radiopharmaceuticals are administered through intravenous injection but other can be inhaled such as Xe<sub>133</sub> (for ventilation lung scan) or given orally as I<sub>131</sub> (for Grave's disease or for thyroid carcinoma).

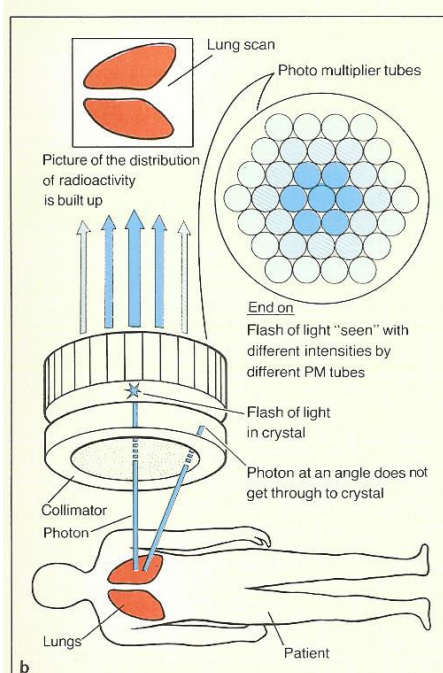
### **Equipment in a nuclear medicine department:**

Diagnostic nuclear medicine involves the detection of radiation emitted from radiopharmaceutical administered to the patients.

The main equipment used for this purpose is the *Gamma Camera*

which produces an image corresponding to the distribution of the radioactive substance in the body. A computer will display the images with numerical assessment (Quantitation) is frequently employed to generate complementary information.

Radiopharmaceuticals preparation is carried out under aseptic conditions. An instrument called "*Dose calibrator*" is used to measure the dose before administration to the patient.



Radiation safety is important in all aspects of Nuclear Medicine and the department is equipped with several contamination monitors and dose-rate meters.

### **Units used in Nuclear Medicine:**

Any one working or requesting a nuclear medicine test should be aware of certain units used to describe doses.

#### **I. Units of activity:**

Millicurie : old unit

Megabecquerel : new units replacing old unit

#### **II. Units of absorbed dose:**

Millirem (mrem) : old unit

Millisievert (msv) : new unit

## **Diagnostic Aspects of Nuclear Medicine**

### **I. Respiratory System: V/Q Lung Scan**

Tc-99m macro aggregated albumin (MAA) used for perfusion lung scan. Xe-133 or Kr81m used for ventilation lung scan.

Perfusion-Ventilation mismatch is indicative of pulmonary embolism.

### **II. Cardiovascular System :**

- a. Myocardial perfusion scan: performed using thallium 201 or Technetium 99m Sestamibi or tetrofosmin: Reversible versus nonreversible ischemia.
- b. Multigated cardiac study (MUGA) performed using Tc-99m labeled red blood cells measure EF% and wall motion.
- c. Radionuclide venography : performed using Tc-99m MAA to detect DVT.

### **III. Genitourinary System :**

#### **a. Dynamic study (Renogram):**

- ✓ Tc-99m DTPA to assess glomerular filtration and patency of collecting system.
- ✓ Tc-99m MAG3 to assess tubular function and excretion
- ✓ Lasix can be administered during the renogram to differentiate dilated nonobstructed from dilated obstructed system.

#### **b. Cortical scan using Tc-99m DMSA to assess renal cortex integrity (Scars).**

#### **c. Testicular scan using Tc-99m pertechnetate for diagnosis of testicular torsion and inflammation.**

### **IV. Gastrointestinal System :**

#### **a) Meckel's diverticulum scan using Tc-99m pertechnetate.**

#### **b) Milk scan using Tc-99m DTPA**

#### **c) Hepatobiliary (HIDA) scan using Tc99m HIDA (Cholecystitis).**

#### **d) Liver spleen scan using Tc99m colloid.**

#### **e) Liver haemangioma study using Tc-99m red blood cells**

### **V. Endocrine System:**

#### **a. Thyroid scan: using Tc-99m pertechnetate or I<sub>123</sub>.**

#### **b. Parathyroid scan: using Tl-Tc-99m subtraction or Tc99m Sestamibi Scan.**

#### **c. Adrenal medulla scan : I123 MIBG for diagnosis of neuroendocrine tumors such as pheochromocytoma.**

### **VI. Bone Scan: using Tc99m MDP.**

#### **a. Three phase bone scan, when infection is suspected.**

#### **b. One phase delayed scan to diagnose metabolic bone disease, bone metastases and bone trauma.**

#### **c. Bone mineral density (DEXA) using two x-ray beams to measure bone density.**

## **VII. Central nervous system**

- a. SPECT brain scan : using Tc-99m HMPAO.

## **VIII. Localization of Infection and tumors:**

- a. Gallium 67 Citrate: used for diagnosis of infection and tumors  
e.g. Lymphomas, Osteomyelitis.
- b. Indium III labeled white blood cells or Tc-99m HMPAO  
leucocytes or Gallium 67 citrate for diagnosis of infection.

## **Therapeutic aspects of nuclear medicine:**

Certain radionuclides emitting beta radiation are used for therapy of different disease. The most widely used one is  $I_{131}$  for treatment of hyperthyroidism and thyroid cancer.