

# NUCLEAR MEDICINE

*DEPARTMENT OF BIO-MEDICAL IMAGING,  
UNIVERSITY MALAYA MEDICAL CENTRE.*

# HISTORY OF NUCLEAR MEDICINE

- 1) Many historians consider the discovery of artificially produced radionuclides by Frédéric Joliot-Curie and Irène Joliot-Curie in 1934 as the most significant milestone in nuclear medicine.
- 2) In February 1934, they reported the first artificial production of radioactive material in the journal Nature, after discovering radioactivity in aluminum foil that was irradiated with a polonium preparation.



FIG. 8. An illustrious mother and daughter—Marie Marie Curie and Irene. (Acme photo.)

Scanned at the American  
Institute of Physics





# THE NUCLEAR MEDICINE RADIOGRAPHER



- ◆ *The Nuclear Medicine Radiographer is a multi-skilled member of the healthcare team trained in the following aspects: the receipt, preparation, dispensing and waste disposal of radionuclides; scheduling and sequencing of nuclear medicine procedures; injecting, imaging, care and management of patients; operation and care of equipment; manipulation and presentation of data and radiation protection to patients, staff and the public.*

# RADIATION PROTECTION

- 1) After injection was given into IV, body patient emitted radiation (depends of half life radioactive)
- 2) Keep distance from these 3 people:
  - ✓ Children below 12 years old
  - ✓ Baby
  - ✓ Pregnant lady



# QUALITY CONTROL

## RADIONUCLIDE PURITY

Technologist: M. S. / ANWAR

Date: 15/11/10

### Molybdenum-99 Breakthrough Test CRC 2423 Kit

Background (empty canister) = 0 uCi (B)  
Mo-99 reading = 0 uCi (M)  
Actual Mo-99 activity = 3.5 (M-B) = 0 uCi (A)  
Technetium-99m = 827 mCi (T)

Therefore, Ratio of Mo-99 to Tc-99m  $A = \frac{0}{827} \text{ uCi/mCi} = 0$

(U.S.P. allowable limit is 1 uCi / mCi)

### Aluminium Ion Concentration Spot Test

Intensity of centre spot of sample is LESS (Less than or more than) that for centre of standard solution.

Therefore, eluate contains LESS (Less than or more than) 10ug/ml of Al<sup>3+</sup>.

Senior NMT signature: [Signature]

Remark: OK

Date: 15/11/2010

Doctor in charge: [Signature]

Remark: acceptance

Date: 15/11/2010

UNIT PERUBATAN NUKLEAR  
JABATAN PENGEMASAN BIO-PERUBATAN  
PUSAT PERUBATAN UNIVERSITI MALAYA  
59100 KUALA LUMPUR  
BX-NUM-003-E01





# HOT LAB

## The Technetium-99m Generator

- 1) Technetium-99m, which is a radioactive isotope of the man-made element technetium, is the favored choice of the medical profession because the type of radiation it emits allows the practitioner to image internal body organs without causing radiation damage.
- 2) Its half life is six hours, which is long enough for a medical examination and short enough to allow a patient to leave the hospital soon afterwards.



# WHOLE BODY BONE SCAN

- 1) **Radio-pharmaceutical**
  - ❖ MDP
  - ❖ HDP
- 2) Whole body bone scan is performed 2hrs after injection of Radio-pharmaceutical.
- 3) RAO/LAO/RPO/LPO spot images will be taken as standard procedures for patient's with CA BREAST.
- 4) Spect-CT images will be ordered if necessary.

Three phase bone scan

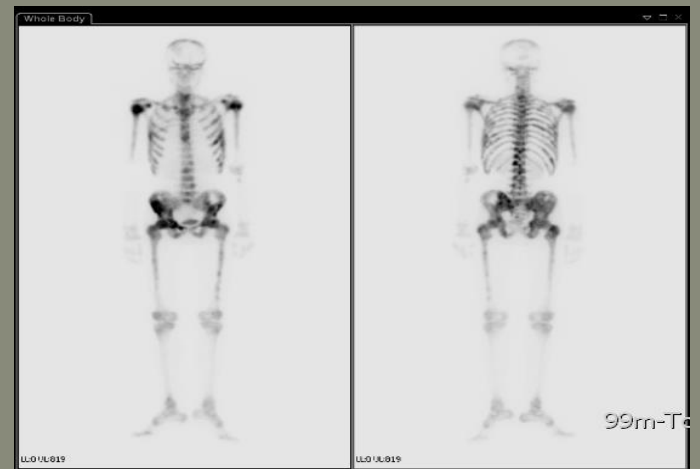
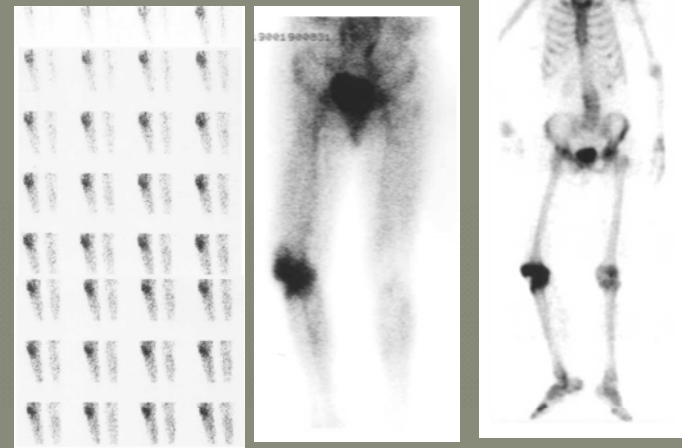


Image of Whole-body Bone Scan with presence of Metastatic Bony lesion.

# CARDIAC PERFUSION SCAN

## STRESS TEST

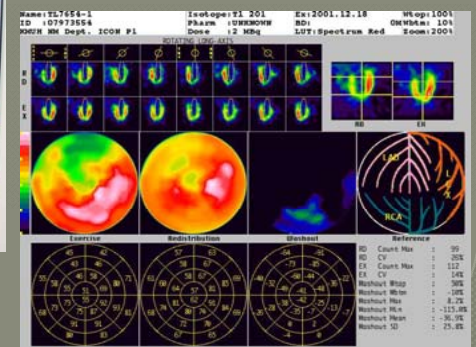
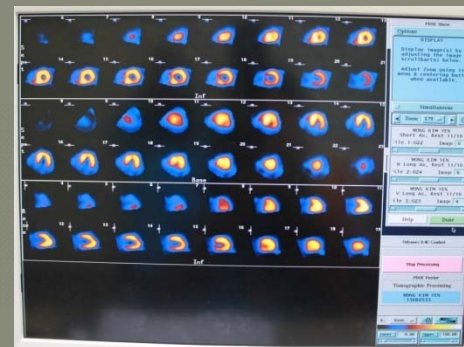
- 1) A nuclear stress test measures blood flow to your heart muscle both at rest and during stress on the heart.
- 2) It's performed similar to a routine exercise stress test, but provides images that can show areas of low blood flow through the heart and areas of damaged heart muscle.
- 3) A nuclear stress test usually involves taking two sets of images of your heart — one set during an exercise stress test while you're exercising on a treadmill or with medication that stresses your heart, and another while you're at rest.





# SINGLE PHOTON EMISSION COMPUTERIZED TOMOGRAPHY (SPECT)

- 1) The system detects single photons (energy emitted by the radioactive substance in the body) by rotating detectors around the body and recording events at each detector location.
- 2) A computer is used to create a three-dimensional image (or tomogram) of the radioactivity detected.
- 3) The images produced assist in providing the highest quality of diagnosis to the ordering physician.
- 4) A gamma camera does not emit any radiation. It may be suspended over the examination table or it may be beneath the table.



# SPECT-CT

- 1) SPECT-CT is where two different types of scans are taken and the images or pictures from each are fused or merged together. The fused scan can provide more precise information about how different parts of the body function and more clearly identify problems
- 2) The radiopharmaceutical is detected by a nuclear medicine gamma camera. The camera or cameras rotate over a 360 degree arc around the patient, allowing for reconstruction of an image in three dimensions



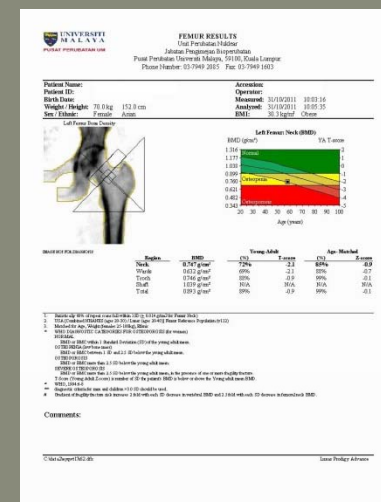
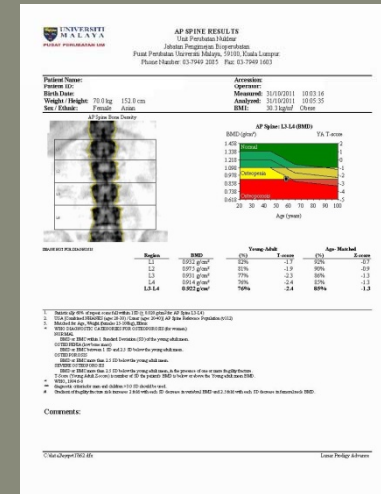


# BONE MINERAL DENSITY (BMD)

1. Measurements are most commonly made over the lumbar spine and over the upper part of the hip. Average density is around  $1500 \text{ kg m}^{-3}$
2. Bone density (or bone mineral density) is a medical term referring to the amount of matter per cubic centimeter of bones. Bone density (or BMD) is used in clinical medicine as an indirect indicator of osteoporosis and fracture risk.

## RADIATION EXPOSURE

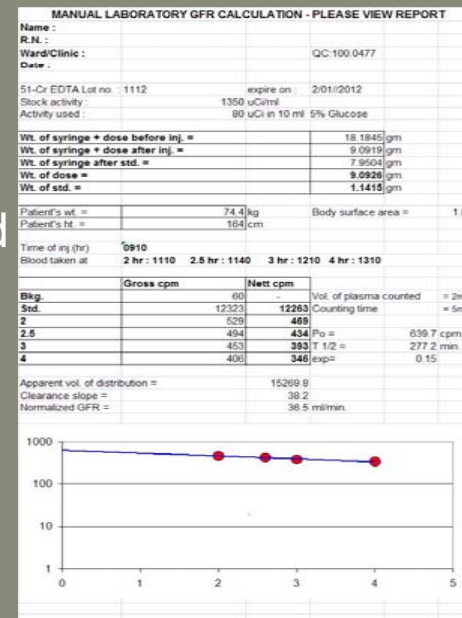
- ❖ The radiation received by the patient during the scan is less than that of an airline flight from California to New York and back



# GLOMERULUS FILTRATION RATES (GFR)

1) Glomerulus Filtration Rate (GFR) is the volume of fluid filtered from the renal (kidney) glomerular capillaries into the Bowman's capsule per unit time.<sup>[2]</sup> Central to the physiologic maintenance of GFR is the differential basal tone of the afferent and efferent arterioles (see diagram).

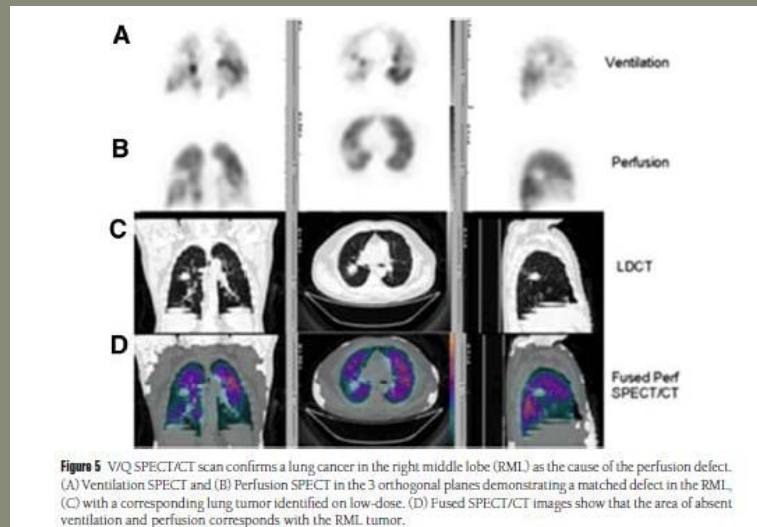
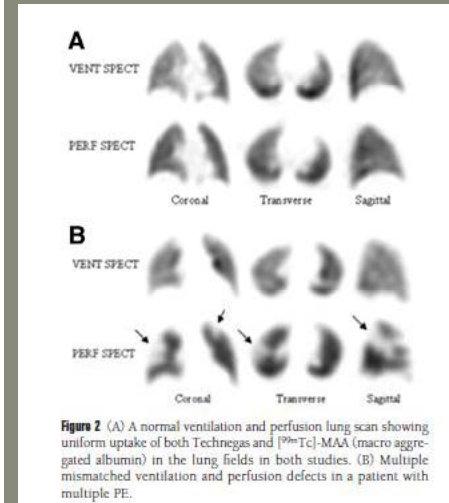
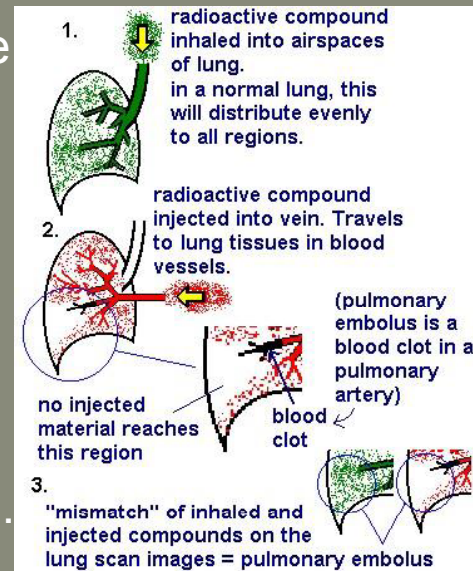
2) Glomerular filtration rate (GFR) can be calculated by measuring any chemical that has a steady level in the blood, and is freely filtered but neither reabsorbed nor secreted by the kidneys. The rate therefore measured is the quantity of the substance in the urine that originated from a calculable volume of blood.





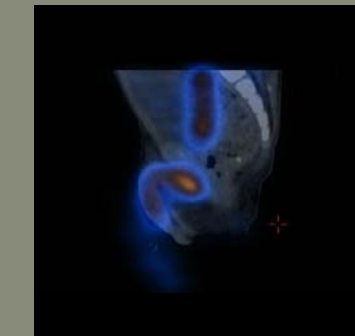
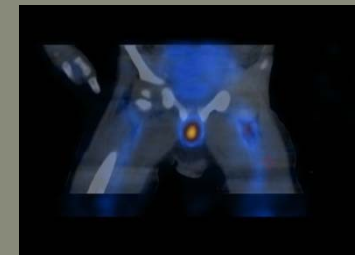
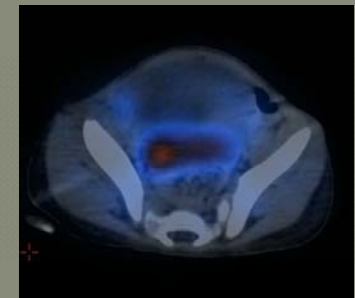
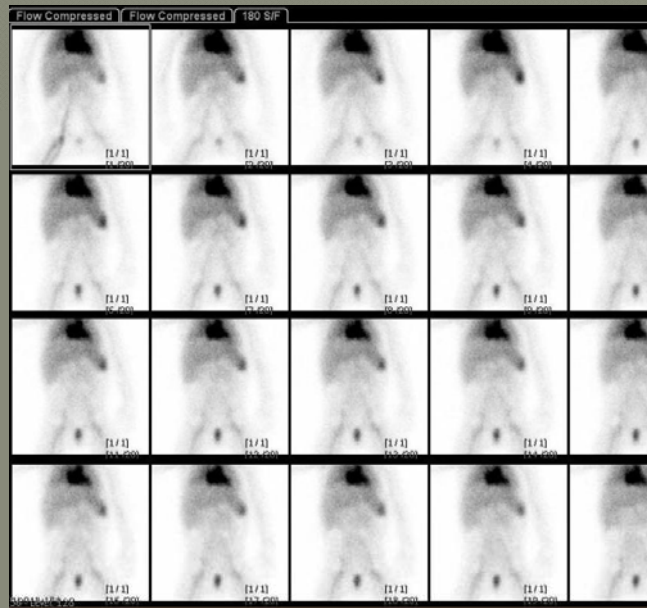
# VENTILATION-PERFUSION (V/Q) SCINTIGRAPHY

- 1) V/Q scintigraphy has been used since 1964 for the diagnosis of PE; long before the advent of CT Pulmonary.
- 2) V/Q scan became the routine clinical procedure for diagnosis of pulmonary embolism (PE) and was one of the commonest nuclear medicine procedure in the 1990's till early 2000.



# 99m-Tc RBC GIT. BLEED SCINTIGRAPHY

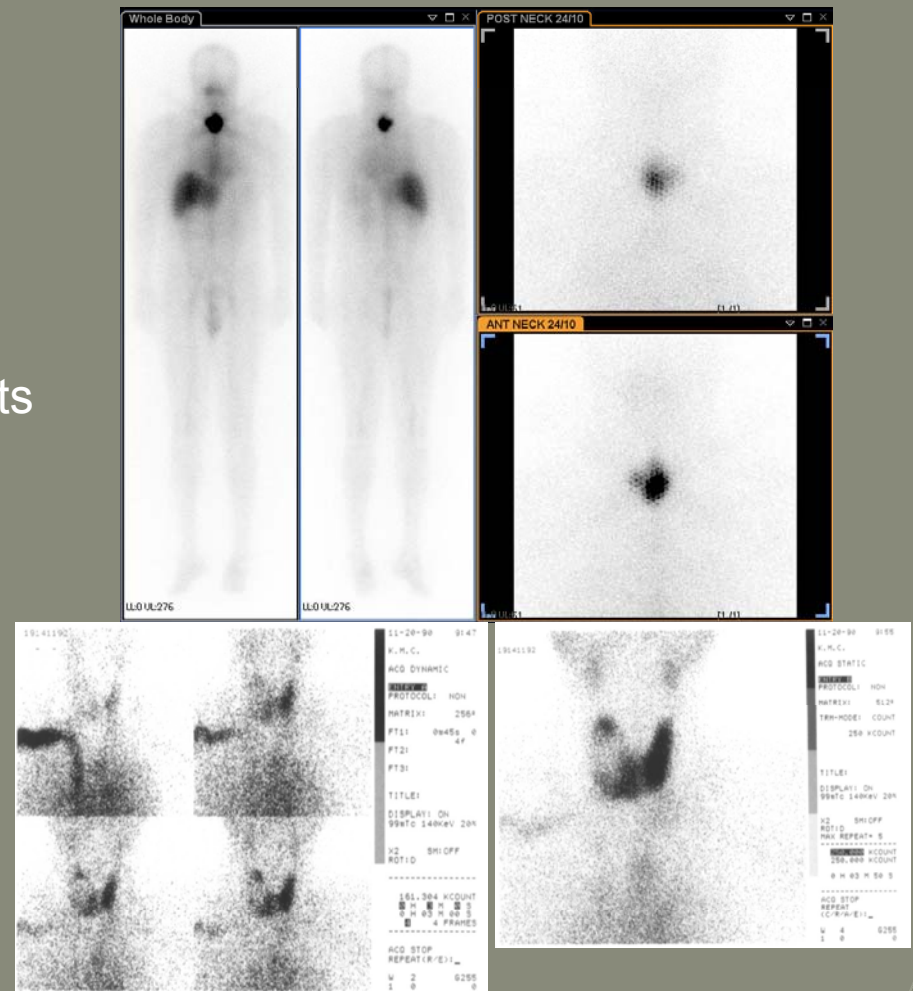
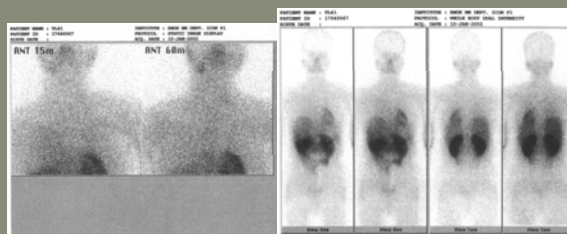
- 1) 99mTechnetium-labelled red blood cell scintigraphy (99mTc RBC scintigraphy) was used as the second-line investigation to localise bleeding.
- 2) Scintigraphy was available on a 24 h basis
- 3) 99mTc RBC scintigraphy was less useful in patients who were not bleeding actively or who were being investigated for chronic anaemia.





# I-131 WB SCAN

- 1) It is used in nuclear medicine therapeutically and can also be seen with diagnostic scanners if it has been used therapeutically.
- 2) Use of the  $^{131}\text{I}$  as iodide salt exploits the mechanism of absorption of iodine by the normal cells of the thyroid gland.
- 3) Examples of its use in radiation therapy are those where tissue destruction is desired after iodine uptake by the tissue.



# RENAL IMAGING

- 1)  $^{99m}\text{Tc}$ -DMSA scan is a radionuclide scan that uses dimercaptosuccinic acid in assessing the renal function,
- 2) It is now the most reliable test for the diagnosis of Acute pyelonephritis.
- 3) The major clinical indications for this investigation are the detection and/or evaluation of a renal scar, the small or absent kidney, an occult duplex system, certain renal masses, systemic hypertension or suspected vasculitis.

PATIENT NAME : DMSA51  
PATIENT ID : 13286818  
BIRTH DATE :  
INSTITUTE : KMH NM DEPT. ICON P1  
PROTOCOL : STATIC IMAGE DISPLAY  
ACQ. DATE : 09-NOV-2001

