SAWA UNIVERSITY

Special Radiological Procedures Of The Head ,Breast And Respiratory System

Method Of Imaging The Brain

Sawa University — جامعـــــة ســـــــاوة الاهلية

College of health and medical techniques — كليـــــة التقنيـــات الصحيـة والطبيـة

Department of Radiology Tech. — قسم تقنيات الاشعة والسونار

. 3 Stage — المرحلـــــــــــة 3

الجانب النظري — محاضرة رقم 1

Theoretical — Lecture No. 1.

تدريسي المادة : م.م خيرات رحيم لهمود

METHOD OF IMAGING THE BRAIN

- **Human brain imaging** methods **noninvasive**, though they may include exposure to ionizing radiation or contrast agents. These methods can be equally used to noninvasively study brain structure and function.
- New technologies allow non-invasive spatial mapping, (morphology), and observations of processes within the brain during set tasks. There are a range of scanning techniques, their purpose are described below

1. X-RAY

the x-ray, early structural imaging developed in 1895. X-rays measure the density of tissues. X-rays use **photons**, a quantum of visible light that possesses energy; the photons are passed through the body and absorbed to deflected and degrees by the different photons passed on tissues. The recorded silver halide film as they passed out of the body. Dense **structures such as bone**, which block most of the photons, appear white; **structures containing** air appear black; and **muscle, fat, and fluids** appear in various shades of gray.

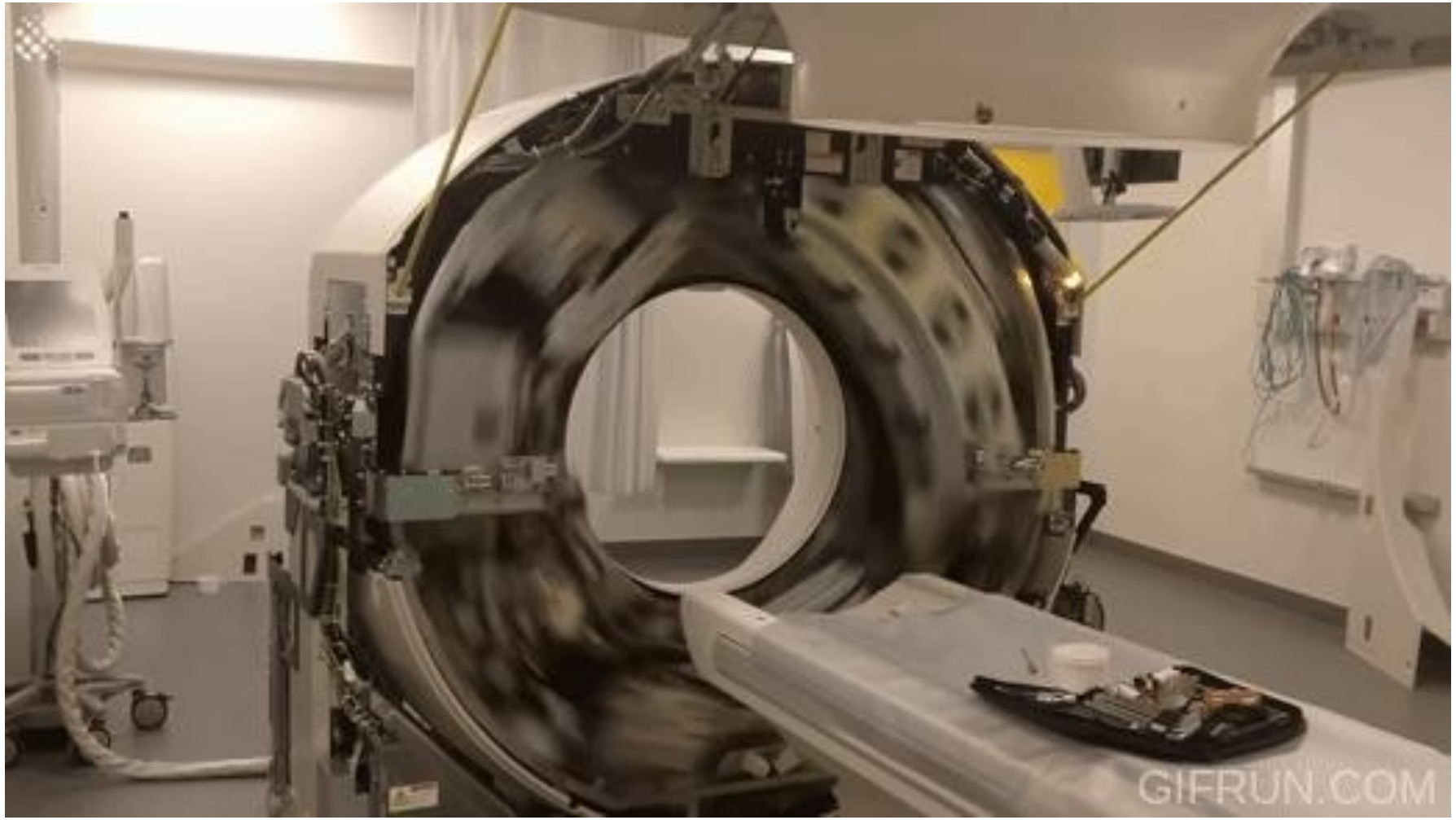
1. X-RAY

.2CT

- A **computerized tomography (CT)** scan is a series of X-ray images converted into cross-sectional images of your brain. These X-rays are combined to form cross-sectional slices or even a 3-D model of your brain. The results of a CT scan can also provide more detail than a standard X-ray.
- ***CT scans can:***
- find certain types of brain injuries (hemorrhagic strokes)
- identify cancer
- locate brain swelling or bleeding
- reveal structural brain changes from schizophrenia

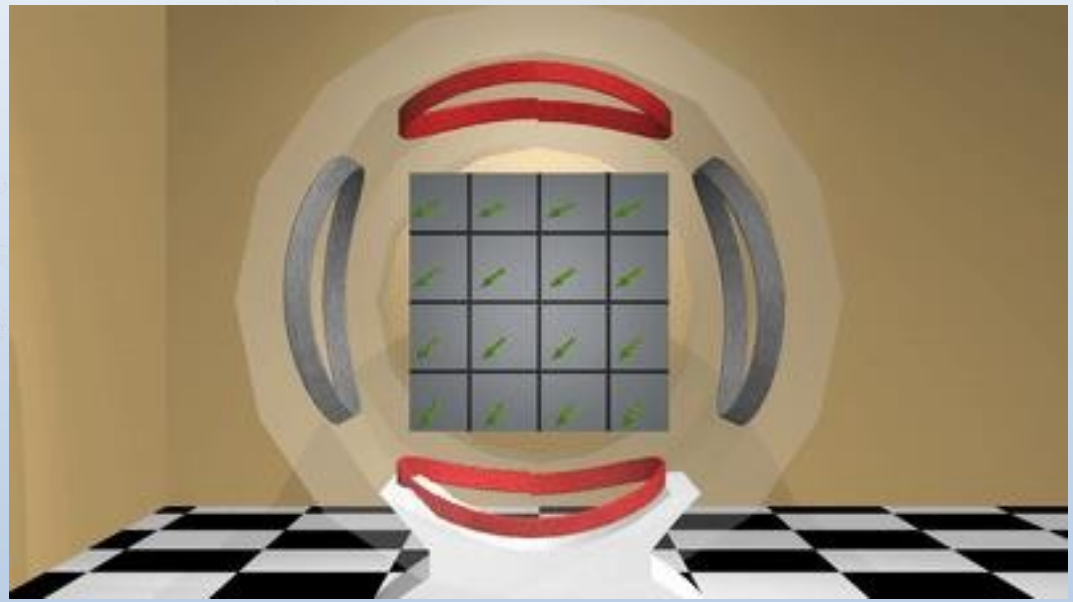
2. CT

2. CT



3.Magnetic Resonance Imaging MRI

This imaging method is a ***painless***, ***non-invasive imaging*** technology that produces 3D detailed anatomical images of our brain.
Resonance Imaging (MRI) is based on the principle of nuclear magnetic resonance (NMR) and uses radiofrequency waves the scanner uses magnetic fields that emit radio waves to manipulate the magnetic position of the hydrogen protons of the body



The rotation and energy release of the protons are detected by a powerful antenna which sends the information to a computer. The computer analyzes the information, and through complex mathematical calculations, creates a clear, cross-sectional black-and-white image of the body. These images can be converted into three- dimensional pictures of the scanned area, with the results looking something like the images below.

3.Magnetic Resonance Imaging MRI

- Clinically, MRI has become the most important diagnostic imaging modality in neuroscience. One of the many benefits of MRI in
- The central nervous system is that the radiofrequency signals readily penetrate the skull and spinal column, allowing the tissue within it to be imaged with no interference.
- Radiofrequency energy is also non-ionizing, so MRI issafer than CT scanning.
- MRI provides the best visualization of parenchymal (tissue) abnormalities in the brain and spinal cord including tumors, demyelinating lesions, infections, vascular lesions (such as stroke), developmental abnormalities, and traumatic injuries.

FMRI

Functional magnetic resonance imaging (fMRI) can detect changes in blood flow and oxygen levels that result from your brain's activity. It uses the magnetic field of the scanner to affect the magnetic nuclei of hydrogen atoms, so they can be measured and converted into images.

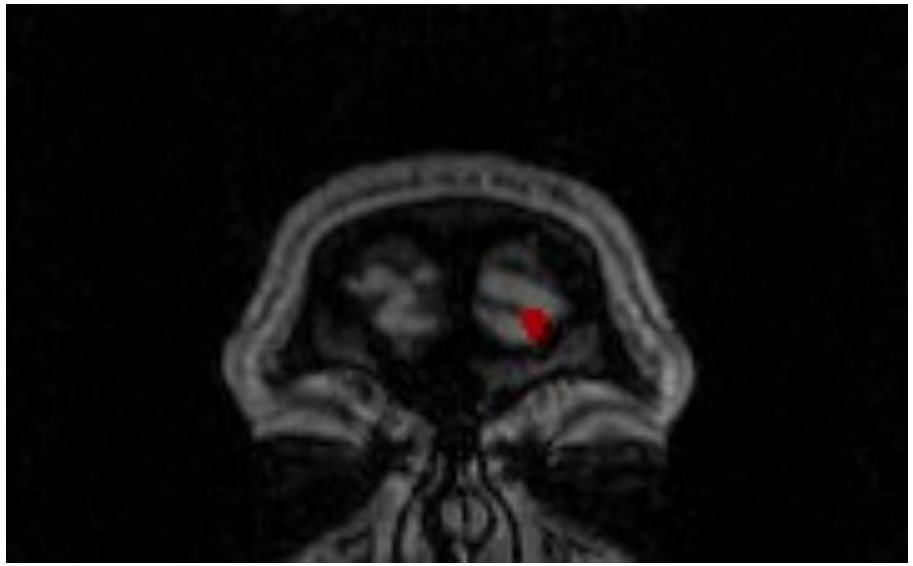
MRIs display anatomic structure and fMRIs measure metabolic function.

fMRIs have many uses, such as:

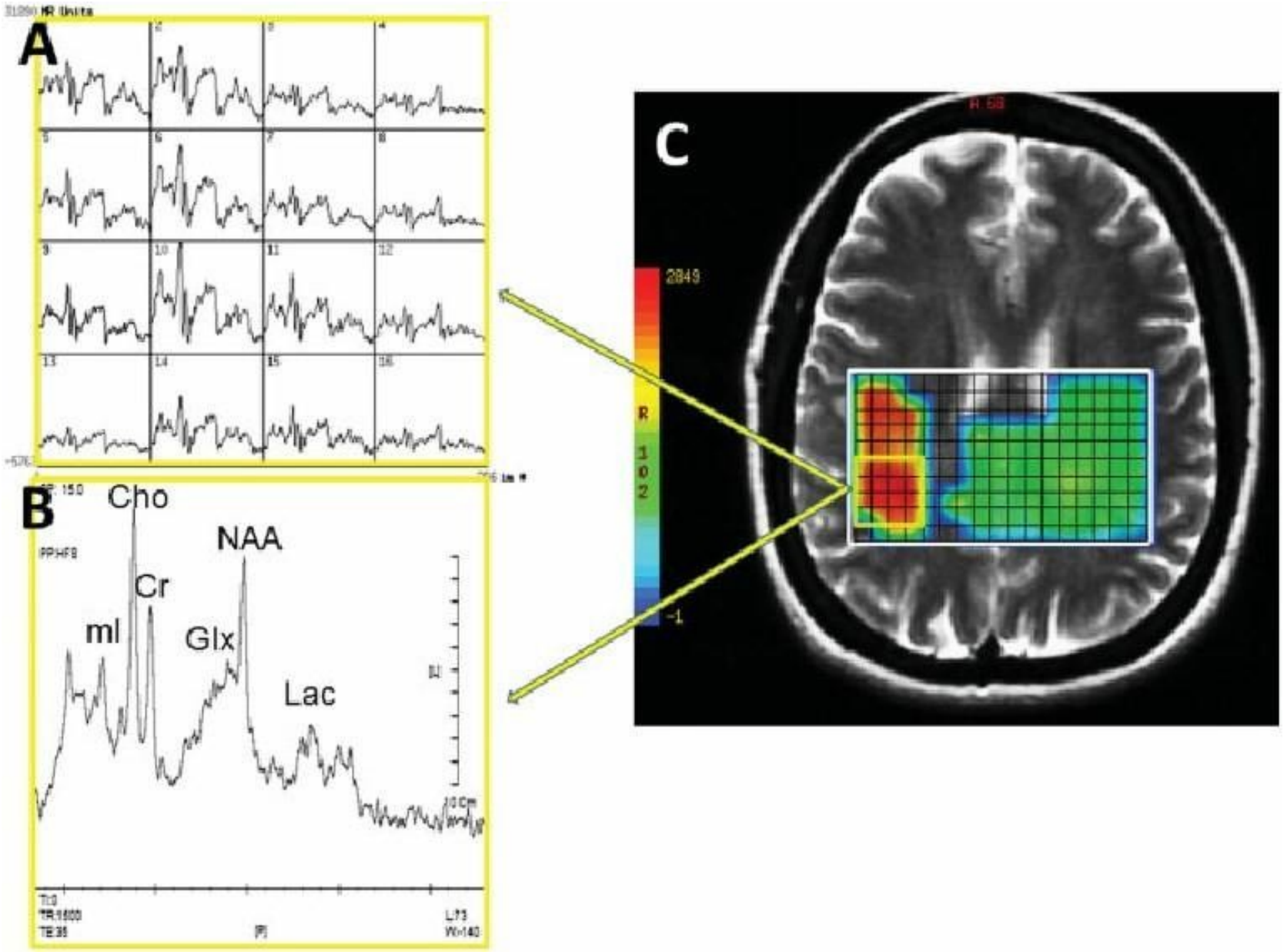
assessing brain activity

finding brain abnormalities

creating pre-surgical brain maps



FMRI



4.PET

A positron emission tomography (PET) scan uses a radioactive tracer that attaches to the glucose in your bloodstream. Since your brain uses glucose as its primary fuel source, the tracer accumulates in areas of higher brain activity.

A PET scan is able to see these tracers and observe how they move and accumulate in your brain. This allows doctors to see trouble spots where glucose isn't moving correctly.

PET scans can evaluate:

seizures
Alzheimer'

5.EEG

An electroencephalography (EEG) test measures your brain waves. Before the scan, clinicians will attach small electrodes to your scalp that are attached to wires. These electrodes detect electrical activity in your brain and send it to a computer where it creates a graph-like image. Each type of frequency appears on its own line and gives your doctor information about your brain activity.

EEG can detect issues such as:

anxiety

head injuries

epilepsy

5.EEG

6.MEG

Magnetoencephalography (MEG) measures the magnetic field from neuron electrical activity. This type of scan can locate and identify malfunctioning neurons in your brain. Doctors use MEG to evaluate both spontaneous brain activity, as well as neuronal responses triggered by stimuli. ***MEG allows doctors to assess areas such as:***

epilepsy

sources motor

areas

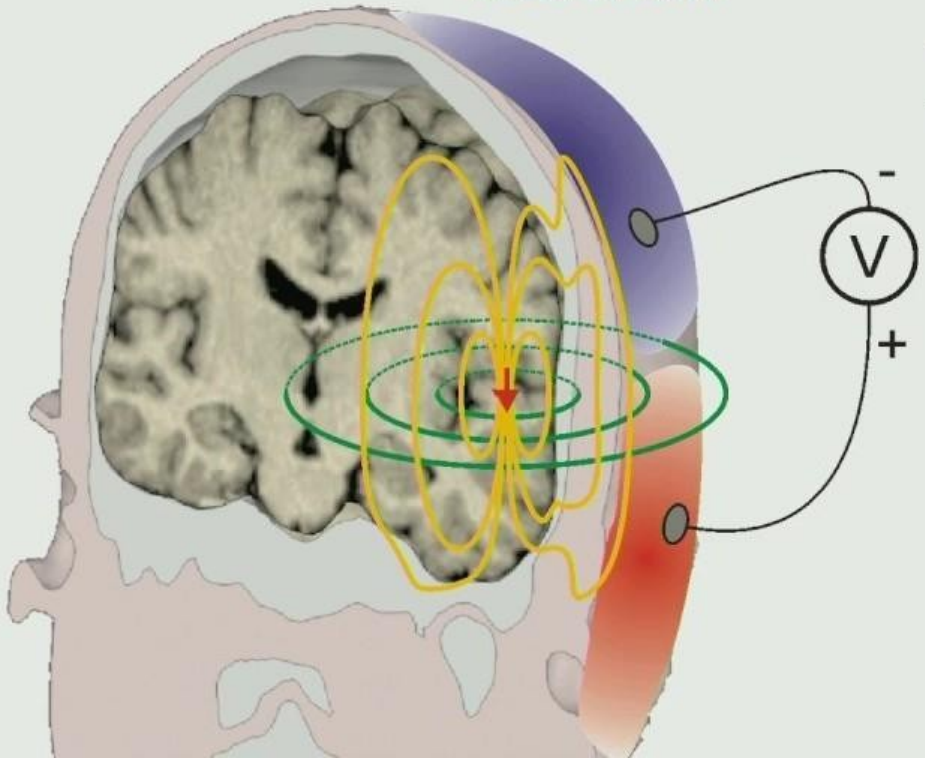
sensory areas

6.MEG

What is MEG?

Currents in active neurons...

... give rise to small electric voltages and weak magnetic fields on the surface of the head



EEG = measuring the voltages on the scalp

Parkkonen,

7. NIRS

Near-infrared spectroscopy (NIRS) monitors your brain's oxygen saturation. It uses infrared light to detect variations in hemoglobin oxygen levels in your blood. Since oxygen is critical for your brain to function properly, NIRS can assist doctors in any clinical setting where brain oxygen levels may fluctuate.

NIRS is used to monitor:

brain oxygen levels during cardiac surgery

brain function and oxygenation levels in preterm infants in a neonatal intensive care unit (NICU) setting

8. NIRS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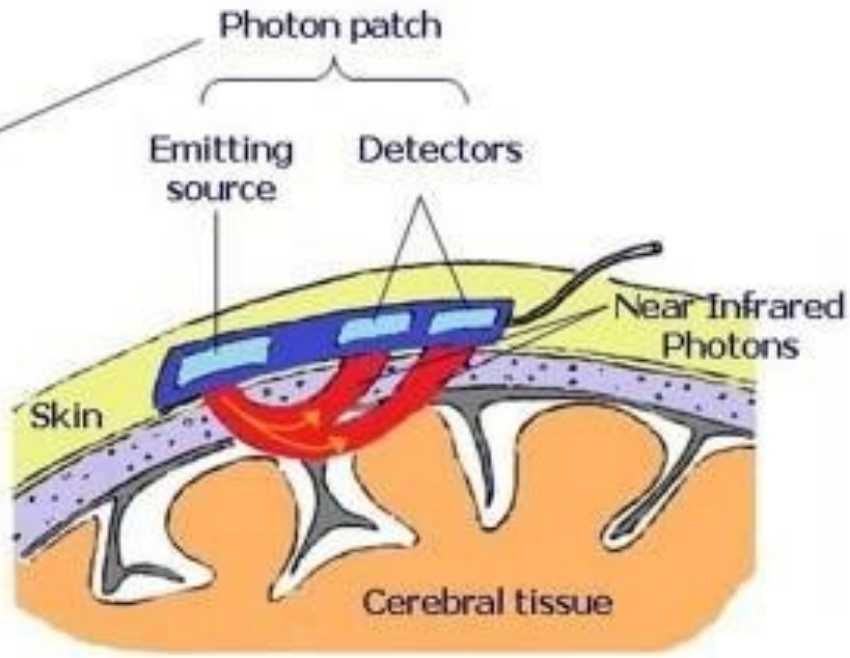
Photon patch
Emitting source
Detectors
Near Infrared Photons
Skin
Cerebral tissue

QUIZ

Q1/What is the basic principle of X-ray imaging, and how do different structures like bone and air appear on the film?
Q2/What is a Computed Tomography (CT) scan, and how does it differ from a standard X-ray? Name two clinical applications of a CT scan.
Q3/What is the underlying principle that Magnetic Resonance Imaging (MRI) uses to produce brain images, and what is its safety advantage compared to a CT scan?
Q4/What is the key difference between what an MRI and a functional MRI (fMRI) measure? Name one use of fMRI.
Q5/How does a Positron Emission Tomography (PET) scan work, and what is the role of the "radioactive tracer"?
Q6/What does an Electroencephalography (EEG) test measure, and what is one issue it can detect?
Q7/What measurement does Near-infrared spectroscopy (NIRS) provide? And in what clinical context is this technique used?

Any questions?