

Medical Imaging

Medical imaging is the technique and process used to create images of the human body for clinical purposes seeking to reveal; diagnose or examine disease, including the study of normal anatomy and physiology.

As a discipline and in its widest sense, it is part of biological imaging and incorporates investigative Radiological sciences

IMAGING TECHNIQUES

- Diagnostic Radiology is the first step towards confirmative diagnosis.
- Definitive diagnosis may require additional imaging techniques like; Fluoroscopy , Endoscopy,
- Image intensifier, Ultrasonography, Computed tomography (CT),
Magnetic resonance imaging

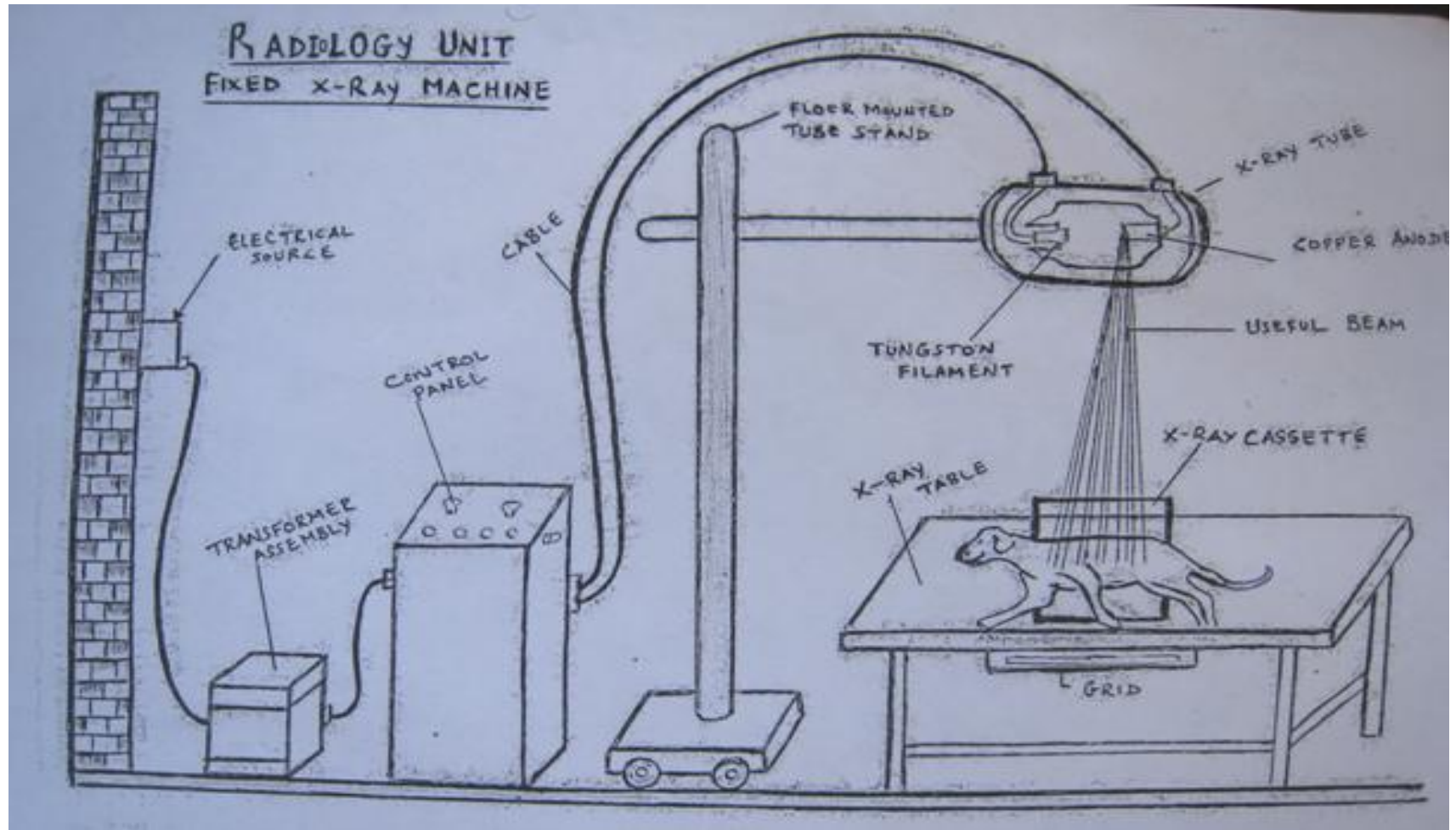
Sl.No.	Imaging Techniques	Main Indications
1.	Radiography	Investigations of radiological section.
2.	Fluoroscopy	Clinical evaluation of dynamics of the body such as peristalsis
3.	Image intensifier	Used in orthopaedic trauma surgery , Cardiac studies and Fertility studies
4.	Endoscopy	Visualize organs purposes, perform minimally invasive surgeries
5.	Ultrasonography	Scanning of fetus, urinary tract, abdominal masses, Liver, etc
6.	Computed tomography (CT)	Scanning of brain, chest, abdomen, staging malignant Tumors
7.	Magnetic resonance imaging (MRI)	Brain, spine, joint, cardiac and vascular disorders.

radiography

Diagnostic radiography is an integral part of the diagnostic and management process in a large variety of clinical problems.

RADIOLOGY UNIT

Schematic diagram showing Production Of X-ray



Requirements for Efficient Production of X -Rays

- ⌘ Powerful X-Ray machine
- ⌘ Skillful Radiographer and Radiologist
- ⌘ Meticulous preparation
- ⌘ Correct position
- ⌘ Proper restraint.

RADIOGRAPHY - Cont'd

Advancements

θ Digital Radiography

- Digital screen replaces x-ray film
- Computer manipulation of information
- Superior resorption density
- Low radiation dose

θ Computed Radiography

- IP made of photo stimulated phosphor is used

RADIOGRAPHIC IMAGE

**PRE AND POST OPERATIVE PELVIC X-
RAY SHOWING IPISILATERAL
ILIUM,PUBIS AND ISCHIUM**



RADIOGRAPHIC IMAGE

SUPRACONDYLAR FRACTURE OF THE FEMUR-INTERNAL FIXATION



2. FLUOROSCOPY

Fluoroscopy is one where the image is displayed on a television screen having been 'intensified' from an initial image, produced on a fluorescent screen. It is a dynamic radiological study.

- θ Equipments needed; Fluoroscopic screens, Table, Serial changer (spot film device) and Comprehension device
- θ Clinical application
 - o Observation in a variety of position
 - o Have some value in sheep, goats and young calves apart from small animals.

Fluoroscopy - Cont'd.....

θ Shortcomings and hazards

- Smaller details on the screen are escaped
- Greater hazard to the fluoroscopists

θ Advancements

- Digital fluoroscopy have resolution video system coupled to a computer
- Now all fluoroscopy images are viewed under con -vision
- Two or four radiographs can be taken on a single film

3. Image intensifier

Image intensifier referred to as a *C-arm* in medical settings, is an imaging device which uses X-Rays and produces a live image feed which is displayed on a TV screen.



Image intensifier

- Introduced in 1950**
- Reducing patient dose of x ray**
- Improves image quality and accuracy**
- Gives brightness and decrease hazard**
- Provide easy of visualization and interpretation**

Image intensifier - Contd.....

- **The technology has had a profound effect on orthopaedic trauma surgery but not a benign aid**
- It allows the accurate positioning of orthopaedic implants to bone, with the intraoperative images showing progress much more easily than plain radiographs.
- Image intensifier machines which are able to store and show the images taken
- Greatly reduces the radiation dose to the patient, surgeon and theatre staff.

Although the doses involved are generally low, image intensification is not a benign aid, and radiation

4. Endoscopy

- **Endoscopy** is the use of an endoscope to visualize the interior of an organ or other area, that otherwise cannot be examined without surgery.
- **Flexible Endoscopy** uses an endoscope, which is flexible and designed to bend to look and move around corners. It will have an umbilical cord to attach the scope to the light source; a handle and a flexible insertion tube to introduce into the animal.

PURPOSE OF ENDOSCOPY

- To dilate stricture (benign esophageal stricture)
- To control hemorrhage
- To remove part or all of an organ (ovariohysterectomy)
- To insert a tube (Gastrotomy feeding tube)
- To removal of foreign bodies.
- Primary use of endoscopy in veterinary medicine is to visualize and obtain tissue or cytological samples of mucosa. Rectal and gastric polyps can be removed endoscopically (polypectomy).

Endoscopy - Contd.....

The different endoscopic techniques according to the organs examined

- Gastrodudenoscopy
- Colonoscopy
- Bronchoscopy
- Cystoscopy
- Vaginoscopy

Endoscopy - Contd.....

- **Laparoscopy** is endoscopy of the peritoneal cavity and may be diagnostic or interventional. Minimally invasive surgery is increasingly becoming an accepted diagnostic and therapeutic tool in veterinary practices.
- **Arthroscopy** is the technique of endoscopy of a joint. Arthroscopes are always used through specially designed cannulas for removal of loose bodies (e.g. cartilage fragments), joint lavage for septic, traumatic management of

Endoscopy - Contd.....

Advantages

- θ Often much quicker than regular surgery
- θ Often less stressful to the patient
- θ Reduced tissue trauma, morbidity and recovery time.

Disadvantages

- ⌘ Cannot remove all types of objects
- ⌘ Careless techniques can hurt the animal
- ⌘ Requires an assortment of expensive FB retrieval forceps.

5. Ultrasonography

- Ultrasonography means imaging with ultrasound.
- Diagnostic sonography gives an image of a slice of the body by directing a narrow beam of high-energy sound waves into the body.
- The sound waves are reflected by tissue interfaces to produce echoes, which are in turn detected by the transducer and converted into a signal to produce images.
- It is an interactive process involving the Sonographer, Patient, Transducer, Sonographic instrument and Sonologist.
- Transducers convert one form of energy to another. They convert electric into




ULTRASONOGRAPHY

Ultrasound does not produce an image, as sharp and clear as CT, but it has four singular advantages.

1. It **does not employ ionizing radiation** and so no biological injury is produced.
2. It can be employed in transaxial plane or sagittally or at any chosen obliquity as required by the anatomic region being investigated.
3. It is far less expensive than CT or MRI.
4. It can even be performed portably at the bed side of very sick patients.

Ultrasonography - Cont'd...

θ Technique

Wave reaches an object  Wave is reflected back from the object 
This echo is changed into electric current 
This is amplified in a cathode ray tube.

θ Transducers convert one form of energy to another. They convert electrical energy into ultrasound energy and vice versa.

θ Transducer types

- Linear array
- Convex
- Sector

Ultrasonography -

Interpretations

- Image displayed as a white against a black ground
- Two dimensional image represents histological section of the organ

θ Advantages

- Low cost
- Non ionizing and safe
- Scanning in any plane
- Used frequently
- Portable.

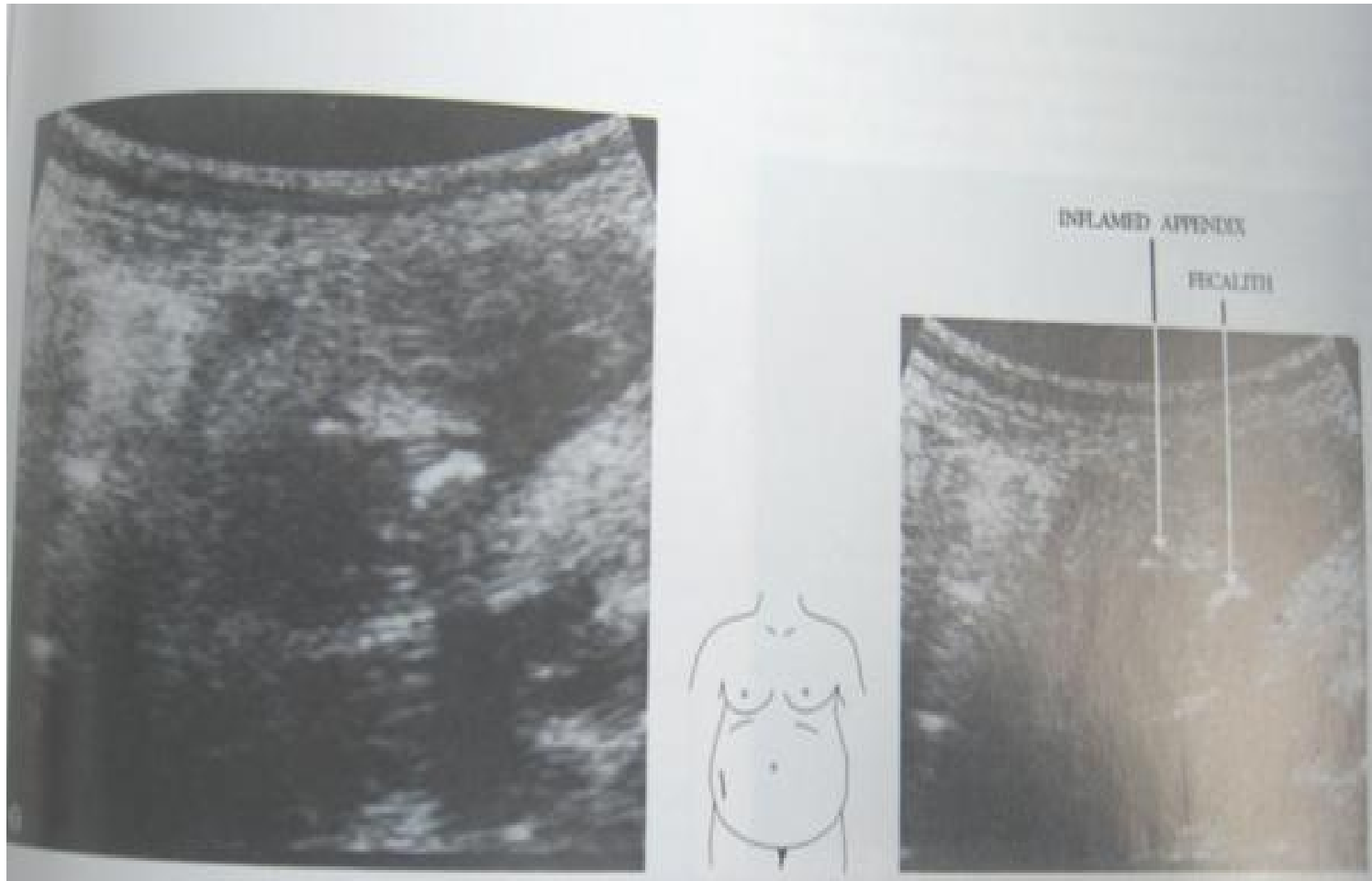
Ultrasonography - Cont'd...

- The organs usually scanned are; liver, kidney, urinary bladder, spleen, uterus, ovaries teat, and udder.
- In ruminants and equines, a rectal linear scan head is used for the diagnosis of pregnancy, ovarian and uterine disorders.
- In small animal and equine practice ultrasound is routinely used as a diagnostic aid.
- Real - time scanning produces, moving images e.g. heart movements in a fetus.
- **Sonogram** - Ultrasound scan.
- **Sonologist** - Specialist in

COLOR DOPPLER SONOGRAPHY SCANNER



ULTRASONOGRAPHIC IMAGE APPNDICITIS



6. Computed Tomography (CT scan)

Computed Tomography (CT scan) or Computed Axial Tomography (CAT Scan) is a helical tomography (latest generation), which traditionally produces a 2D image of the structures in a thin section of the body.

Tomography is imaging by sections or sectioning, through the use of any kind of penetrating wave

Computed Tomography (CT)

- θ CT was introduced by British physicist Godfrey Hounsfield in 1972
- θ Principle: Instead of beam exposing on x ray, film photo multiplier tube is employed.
- θ **Technique**
 - X ray from anode which rotates around the patient
 - The x ray beam is picked up by a circle of electronic detectors.
 - Signal analyzed by computer and image is created.

Computed Tomography (C.T. Scan)

In computed tomography (CT) the x-ray tube revolves around the patient. The emergent beam is picked by electric detectors. This information is conveyed to a computer. Pictorial arrangement made “Slices” are obtained at predetermined intervals.

Computed Tomography

Cont'd...

① Interpretation

- Picture is in a gray scale
- Radio opaque tissue appear white
- Computer prints out each section in the absorption coefficient
- CT image consists of matrix of picture (voxel)

The differences between plain Radiographs and CT

- In plain radiographs superimposition shadow grams are produced and the images of all superimposed structures appear on the film.
- The computed tomography gives focused radiographic information about one cross-sectional slice of the patient only, without any confusing superimposed images.

The CT should be considered as a sophisticated study, for special problems.

Contrast media may be used during CT scanning to enhance the difference in density of various structures.

CT SCAN - GANTRY DESIGN



CT SCAN

CENTRAL PROCESSING UNIT(CPU),DISC
DRIVE AND MAGNETIC TAPE



7. Magnetic Resonance

- ⌘ **Imaging (MRI)**
MRI is a diagnostic procedure that uses a combination of large magnets, radio frequencies and computer to produce image.
- ⌘ MRI has multi planar capacity and no radiation burden.
- ⌘ In 1973, an imaging method using NMR data and computer calculations of tomography was developed. It provided the first magnetic resonance image (MRI).
- ⌘ **Principle**
 - ⌘ Production of image by utilizing the magnetic property of certain

Magnetic Resonance Imaging

- Magnetic resonance imaging (MRI), like ultrasound **does not use ionizing radiation** as diagnostic radiography and CT do.
- The rapid development of MRI makes it essential to have some idea of its uses in clinical medicine as well as the exquisite visualization of anatomic structures in the living patients.

Looking through an MRI Scanner



MRI – Cont'd.....

Techniques

- ⌘ Patient in the scanner surrounded by a large magnet
- ⌘ Patient is subjected to a high magnetic field
- ⌘ Positive charged photon come into alignment
- ⌘ Contrast between tissue emerges
- ⌘ Computer analyze this energy into digital signal
- ⌘ It converts to gray scale image

MRI - Cont'd.....

θ Medical applications

- It has musculo - skeletal application
- Evaluation of internal drainagement of knee joints
- Technique of choice for brain and spinal cord
- T1 weighed image for looking anatomical structures
- T2 weighted image for molecular nature and pathology of tissue.

θ Interpretation

- Tissues with high hydrogen are clearly visible and vice versa.

A Sagittal MRI of Knee



8. Nuclear Scintigraphy (NS)

- NS is an external measurement of distribution of an administered radio nuclides in the patient.
- The energy source is inside the patient

Principle

- NS is the medical use of radioisotopes particularly for all

Nuclear Scintigraphy -

Cont'd.....

θ Technique

- Injection of pharmaceuticals labeled with isotopes
- Localization of isotopes occurs in the tissues
- Emission of gamma rays from an area of interest
- The gamma rays are detected by camera.

θ The data interpretation depends on;

- The distribution radio nuclides

Nuclear Scintigraphy -

Cont'd.....

① Main problems of NS

- ⊗ Organs other than those being examined are also involved
- ⊗ Cost of equipment is high
- ⊗ Requires isolation of the patient
- ⊗ Requires other clinical information.

Nuclear Scintigraphy - Cont'd.....

The nuclear medicine gives, less precise anatomic information, but much more important physiological information, which will help to understand metabolic process, both normal and abnormal.