Dr. Aseel K. Hussein
4th Year Lecture
Radiology

Diagnostic imaging techniques

- **Radiological science:** The branch of medicine that deals with diagnostic images of anatomic structures made through the use of electromagnetic radiation or sound waves and that treats disease through the use of radioactive compounds.

Procedures of diagnostic imaging techniques may include:

1. X-ray

2. Ultrasound

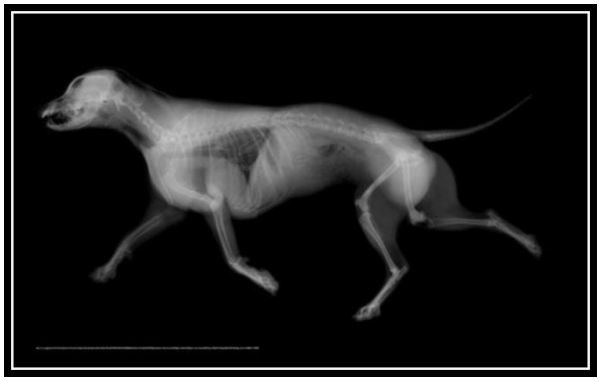
3. CT

4. MRI

The aims of the diagnostic imaging techniques are to rule out, rule in of the disease or find out new information

X-ray technique:

- **Radiograph:** It is the shadow of the objects that are within the path of x-ray beam producer which will be read on a special films or computers.



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Notes:

1. The greater the object dense is, the less radiation reach the film

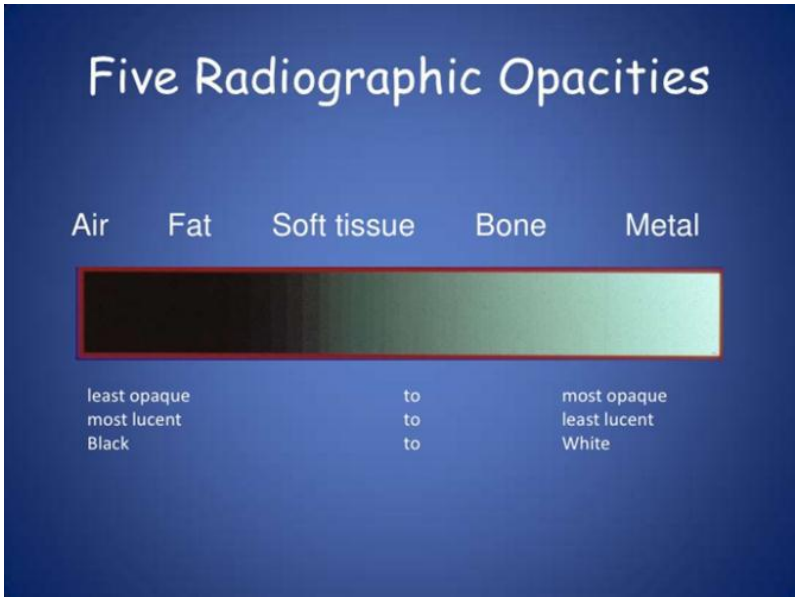
2. The denser the object is, the more the radiation will be inhibit

- **Density:** the weight per given volume of a body tissue or object in general

- **Opacity:** the measure of tissue or object to block the x-ray

Radiological opacities that can be recognized are:

1. Metal
2. Bone or mineral
3. Fluid and soft tissue
4. Fat
5. Gas (Air)



- **CONTRAST**

It means the difference. The subject densities of various tissues result in different radiographic opacities known as radiographic contrast. If a structure is surrounded by a radiopaque material, it will appear relatively radiolucent; if it is surrounded by a radiolucent material, it will appear relatively radiopaque.

Note: A low kilovoltage/high milliamperage technique produces a radiograph showing a high degree of contrast, while, a high kilovoltage/low milliamperage technique produces a radiograph of low contrast but with a wide range. The former technique is most suitable for areas of low contrast, such as the abdomen.

- **FACTORS AFFECTING IMAGE QUALITY**

• *Motion:* movement of the subject or the film will cause blurring (Foggy appearance).

• *Film properties:* fast film results in a less sharp image.

• *Object/film distance:* the nearer an object is to the film, the sharper its outline will be.

• *Grids:* grids improve film quality when thicker parts are under examination.

• *Processing:* processing faults affect image quality; underdevelopment results in a pale image and overdevelopment results in a dark, flat image.

• *Artifacts:* adventitious marks on a film, such as scratches, dirt marks, or marks from dirty or damaged cassettes; may interfere with interpretation.

• *Distortion:* distortion of an image can be caused by improper positioning of the patient or the radiation source. Standard positioning is a prerequisite of good film quality.

- **Border Effacement (Silhouette Sign):**

Border effacement is when two objects of the same radiopacity are in contact and their individual margins cannot be distinguished from one another. Conversely, an object of a different radiopacity, such as air or fat, interposed between them will provide contrast, and individual margins can then be identified. This latter effect has sometimes been called a *negative silhouette.* It is seen commonly in thoracicradiographs.

RADIOLOGIC CHANGES

As well as demonstrating the varying opacities of bodies under examination, the x-ray beam also delineates their outlines or shapes. The edges of a bone permit determination of its size and shape, and the varying opacities of the cortex and medulla will be visible. A radiograph, then, is an image consisting of the outlines of structures and their varying opacities. It therefore can be said that as far as abnormalities are concerned, **five** observations of significance can be made from the study of a radiograph. One can detect changes in:

• Size
• Shape
• Number
• Position
• Opacity

- **STANDARD VIEWS**

For changes in outline, position, and opacity to be appreciated, it is essential that the radiologist be familiar with the radiologic appearance of

normal structures that is, radiologic anatomy. If one is unfamiliar with the normal appearance, one cannot appreciate aberrations from it. Because almost any structure can be rotated through 360 degrees, it would be virtually impossible to become familiar with all the possible projections that could be produced from any given organ. Consequently, standard views of each part of the body are used. These usually consist of two views made at right angles to one another so that a three dimensional impression is gained of the structure under study.

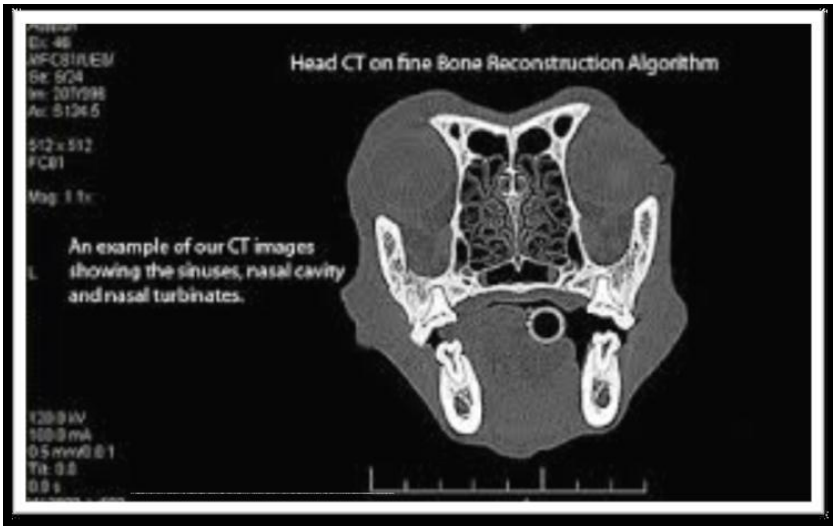
Ultrasonography

High-frequency sound waves to visualize soft tissue structures in the body at a real time. No ionizing radiation is involved, but the quality of the images obtained using ultrasound is highly dependent on the skill of the person (ultrasonographer) performing the exam and the patient's body size.

CT scan (Computed tomography)

CT imaging uses X-rays in conjunction with computing algorithms to image the body. In CT, an X-ray tube opposite an X-ray detector (or detectors) in a ring-shaped apparatus rotate around a patient, producing a

computer-generated cross-sectional image (tomogram). CT is acquired in the axial plane, with coronal and sagittal images produced by computer reconstruction. CT exposes the patient to more ionizing radiation than a radiograph.



MRI (Magnetic resonance imaging)

Strong magnetic fields to align spinning atomic nuclei (usually hydrogen protons) within body tissues, then disturbs the axis of rotation of these nuclei and observes the radio frequency signal generated as the nuclei return to their baseline status. MRI scans give the best soft tissue contrast of all the imaging modalities. One disadvantage is that the patient has to hold still for long periods of time in a noisy, cramped space while the imaging is performed.

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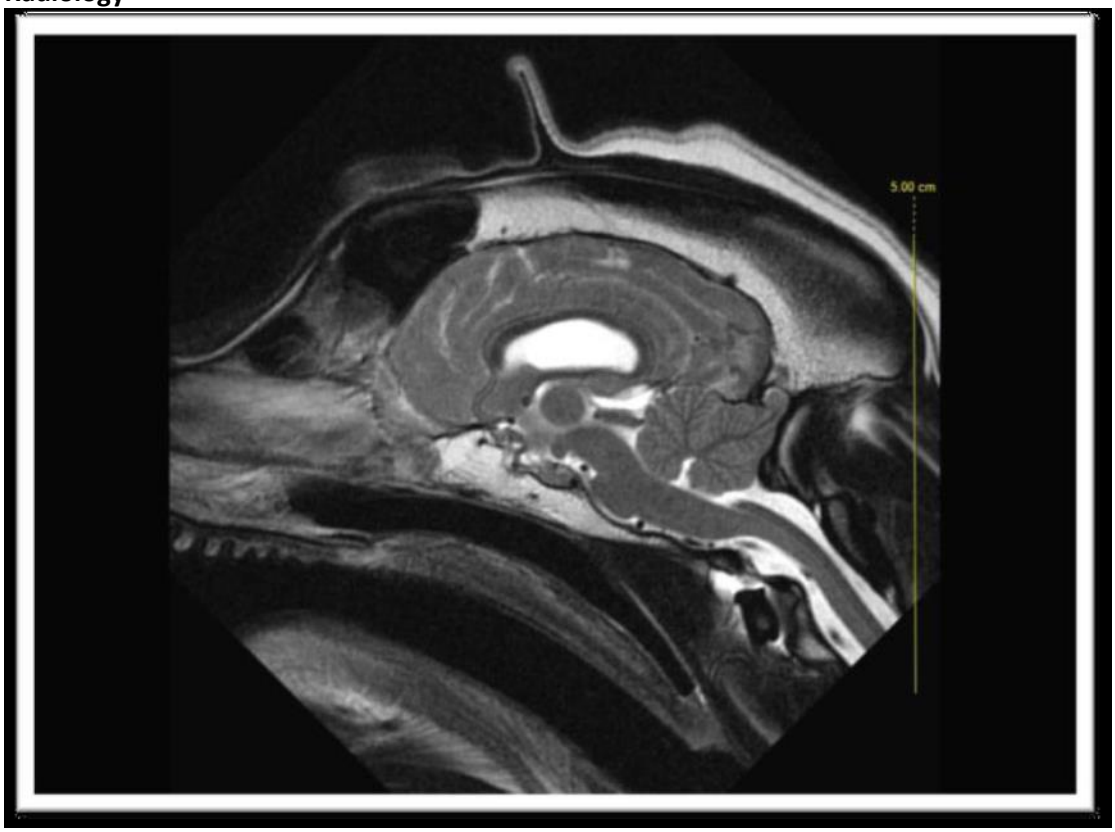

Contrast agents

Contrast medium (contrast agent): is a substance used to enhance the contrast of structures or fluids within the body in medical imaging.

Types of contrast media:

1. Positive contrast medium: substance with high density like (Barium sulphate, iodine compounds-ionic & nonionic, gadolinium)
2. Negative contrast medium: substance with low density like (air, CO2 and O2)