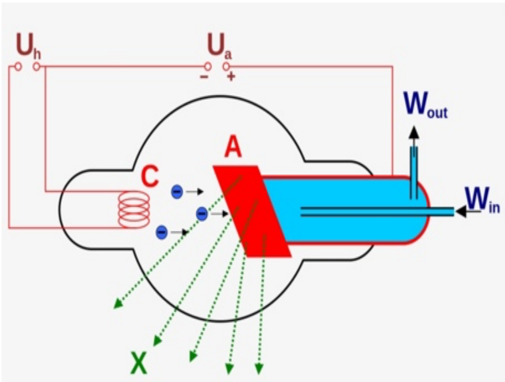
Lec2_ Medical imaging-part1

X-ray imaging

X-ray imaging is a technique based on sending X-rays from the source through the patient and detected either by the film or the ionization chamber of the opposite side of the body, as shown in Figure (1-2).



In X-ray radiography, the resulting image is a simple two-dimensional projection of tissue between the X-ray source and the film. X-ray planar radiography is used for a number of different purposes: Abdominal radiography to study the liver, bladder, abdomen and pelvis. chest radiographs for lung diseases and rib fractures; and X-ray fluoroscopy (in which images are obtained continuously over several minutes) of different areas of the genitourinary and digestive system. And radiography can be used to image all parts of the body. One of its important applications is the mammography device. However, in the case of imaging overlapping layers of soft tissue or complex bone, this cannot be done using the usual X-ray imaging methods. The contrast in the image between different tissues arises from the differential attenuation of X-rays in the body. For example, X-ray attenuation is particularly effective in bone, but is less effective in soft tissues X-ray radiography of overlapping layers of soft tissue or bone is somewhat complicated by conventional X-ray imaging methods.

Structures are often difficult to interpret, even for a skilled radiologist. In these cases, a computerized tomography (CT) scan is used. The X-ray source is tightly paralleled to interrogate the "thin slice" through the patient. The source and detectors rotate together around the patient. A series of one-dimensional projections are produced at a number of different angles as this data is reconstructed to give a two-dimensional image. Very high spatial and also provides reasonable contrast between soft tissues In addition to anatomical imaging, computed tomography is the imaging method that can produce angiographic images of the highest resolution, that is, images that show blood flow in the vessels.

Computed tomography made it possible to obtain complete three-dimensional images of a single patient. The main drawback of both X-ray imaging and computed tomography is the fact that this technique uses more ionizing radiation. Because ionizing radiation can cause tissue damage, the total radiation dose that a patient can be exposed to in one year must be reduced.

Several factors most commonly used to measure the "quality" of the resulting X-ray image are spatial resolution, and contrast-to-noise ratio. The ideal image has a high value for each of these factors, but there are often preferences among these factors.

Clinical applications of X-ray imaging

A number of clinical applications of x-ray imaging have already been described. Plain film radiography is used to determine the presence and severity of fractures or cracks in the bone structure of the brain, chest, pelvis, arms, legs, hands, and feet. Dual-energy scanning is used to diagnose lung disease and to find other masses within the chest wall. Angiography, using contrast agents injected with iodine, is performed to study poor blood flow, particularly in the brain and heart, but also in peripheral blood vessels and arteries. Urinary tract diseases can be diagnosed using barium sulfate as a contrast agent. But one of the most important applications of x-ray imaging is mammography and x-ray computed tomography technology.

Mammogram technology

It uses mammography technology to accurately detect breast x-rays to detect microcalcifications, which may be much smaller than 1 mm in diameter. Doctors often use a mammogram to look for early signs of breast cancer. Regular mammograms are the best tests that doctors should catch early, sometimes up to three years before they are felt. The most important question is what do white spots on mammograms mean?

White spots appear on mammograms due to the presence of calcifications. Calcifications are small calcium deposits within breast tissue that look like small white spots on a mammogram. It may or may not be caused by cancer. Any area that does not resemble normal tissue is a potential cause for concern. The radiologist will look for areas of high-density white tissue and note their size, shape, and edges. A lump or tumor will appear as a focused white area on a mammogram. The entire mammogram process takes about 30 minutes. Each of your breasts will be compressed for only 20 to 30 seconds.

You could have dense breasts and still have a negative mammogram result. A negative result means that nothing abnormal was detected.

There were no abnormalities, calcifications, or lumps, and the breasts looked the same.

There is a good chance that it is not cancerous, since most breast tumors are benign. Breast tissue can be lumpy or dense, which is normal. It's a good idea to have monthly breast exams to get a sense of your breast tissue and what's normal for you. Two pictures are taken of each breast - one from the side and one from the top.

There are two main types of mammography: film screen mammography and digital mammography, also called digital mammography.

Any woman who needs a breast exam should consider a 3D mammogram. Women with dense breast tissue in particular may benefit because it provides a clearer image. The use of 3D mammograms makes it easier for doctors to detect breast cancer early. It also helps us in getting more cancers.

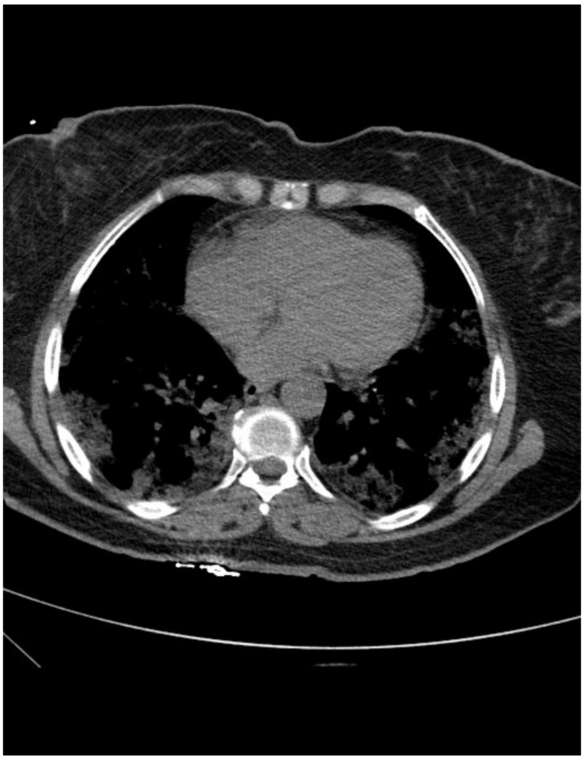
Very dense tissue, such as bone, appears white on an X-ray. The fat appears dark gray on an X-ray. Breast cancer and some benign breast conditions are denser than fat and appear lighter than gray or white on a mammogram. At the stage of infection with the Corona virus, many researchers began to monitor the developments in the breast area simultaneous with this virus using mammogram.

Abnormal mammographic findings occur when mammograms reveal an irregular area of the breast that may be malignant. This can come in the form of small white spots called calcifications, lumps or tumors called lumps, and other suspicious areas. Figure (2-2), depicting the imaging use of the mammogram .

Computer Tomography imaging

working principle

Codferry Hounsfield invented the X-ray computed tomography (CT) technique in 1972 and in 1979, computed tomography (CT) succeeded in obtaining two-dimensional X-ray images of thin 'slices' across the body. Multiple images can be obtained from adjacent slices in a format for 3D volume reconstruction. CT images show reasonable contrast between soft tissues such as the kidneys, liver, and muscles because the X-rays transmitted through each organ are no longer superimposed on each other at the detector, as is the case in planar X-ray radiography. The basic principle behind the scanner is that the 2D internal structure of an object can be reconstructed from a series of slices. The reconstructed image is displayed as a 2D matrix, with each pixel corresponding to a tissue CT number at that spatial location. Several components of the CT system such as the X-ray source, collimator, and anti-dispersion mesh are very similar to the previously described devices for level X-ray radiography Figure (3) shows the scanner device and the resulting image from it.



CT X-ray machine development challenges

Computerized tomography (CT) is one of the important tools in imaging what is happening inside the body without surgery, and basically this technique depends on directing x-rays on the body from all angles to obtain the image slice and then processing it by the computer. Therefore, it is possible to scan any part of the body in the form of a series of slides. Computerized tomography (CT) is a complex type of medical imaging device that relies on X-rays to produce three-dimensional cross-sectional images of the body by combining a series of X-ray images taken from different angles around the body and using computer processing to create cross-sectional images (slices).) to the bones, blood vessels, and soft tissues inside the body. CT scan images provide more accurate and detailed information than regular X-rays. Computerized tomography (CT) scans can be used to image almost all parts of the body and are used to diagnose disease or injury, as well as to plan medical, surgical or radiological treatment. Computed tomography has a higher ability to scan solid tissues than MRI. Since the emergence of epidemics such as the Corona epidemic, CT scans have taken a remarkable step in the diagnosis of lung damage. It gives a picture of the impact of the Corona epidemic on the lung and the level of development. However, frequent use of this type of imaging tool has its risks due to the dose of radiation that the patient's body receives in each imaging session. If a patient performs CT scans more than once within a short period of time, this leads to the accumulation of affected cells with each dose of radiation in his body, which increases the possibility of developing cancer. In addition to the possibility of transmitting the virus infection from a Corona patient to the next person in the imaging room.

Over the past 30 years, single-chip CT scanners have been developed from systems with a single source and a single detector, which take several minutes to acquire an image, to a single source, and multi-detector instruments, which can acquire an image in twos or threes. Multi-chip systems have also been developed and described. And the update continues to this day, depending on the research in the field of engineering and medicine.