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Pro Bs (Radiology)

Dep AHS

Q 1 Describe the parts of a digital fluoroscopy Image system and explain function

Ans 1: Parts of Digital fluoroscopy System :-

① Monitor
② Vedio camra
③ optical coupling
④ Imag intensifier
⑤ Grid
⑥ Patient
⑦ Table
⑧ Filteration
⑨ Collimator
⑩ x-ray Tube
⑪ x-ray Generator

Image Receptor x-ray image Intensified (xRII):-

The x-ray image intensifier is an electronic device that converts the x-ray beam intensity pattern (also the remnant beam) into a visible image suitable for capture by a video camera and display on a video display monitor. The key components of an xRII are an input phosphor layer a photocathode, electron optics and an out put phosphor.

System Configurations:-

Fluoroscopic System are manufacture in a variety of configuration to optimize usebility for that clinical task(s) for which key are intended 'Conventional' radiography / fluoroscopy systems consists of a patient table

that often tilts all the way to vertical position permitting fluoroscopy while the patient stand upright these have system the X-ray tube positioned under the table top with the image receptor above the and are most often used for gastrointestinal imaging (upper and lower GI barium enhanced studies

Image Display:-

Fluoroscopy requires high-quality video display that allow users to appreciate fine details and subtle contrast differences in the anatomy of interest. Medical image display technology has been fortunate to "ride on the coattails" of the television industry over the last several years.

Image Receptor- flat panel Detector (FPD):- in recent

We have seen the introduction of fluoroscopic systems in which the xBII and video camera components are replaced by a "flat panel detector" (FPD) assembly when flat panel x-ray detector first appeared in radiography they offered the advantage of a "digital camera" compared with existing technologies

Collimation:

Shutters that limit the geometric extent of x-ray field are present in all x-ray equipment. In fluoroscopy the collimation may be circular or rectangular in shape, matching the shape of image receptor.

Beam filtration:

It is common for fluoroscopic imaging system to be equipped with

imaging system to be equipped with imaging beam hardening filter between the x-ray tube exit port and the collimator. Added alumi and/or copper filtration can reduce skin dose at the patients entrance surface, while a low kvp produces a spectral shape that is well matched to the barium or iodine k-edge for high contrast in the anatomy of interest.

X-ray Source :-

The high-voltage generator and x-ray tube used in most fluoroscopy systems is similar is design and construction to tube used for general radiophic application for special purpose rooms such as those used for cardiovascular imaging extra heat capacity is needed to allow angiographic 'runs'

image acquired in rapid Succession to visualize opacified vessels. These runs are often interspersed with fluoroscopic imaging in a diagnotic or interventional.

image Intensifier:-

capture x-ray from the x-ray tube and converts it to an image that is displayed on the monitors

x-ray tube:-

Emits x-ray that penetrates the patient to produce are image that captured by the image intensifier

Q2. Explain the four prime exposure factors:

Ans, Four prime exposure factors:

(i) Kilovolt peak (kvp)

(ii) current (MA)

(iii) Exposure time (S)

(iv) Source-to-image receptor distance (SID)

(1) Kilovolt peak (kvp):

kvp control screen-film radiographic contrast.

Beam penetrability

The kvp has more effect than any other factor on image receptor exposure.

kvp increass, less differential absorption occurs Therefore, high kvp results in reduced image contrast.

(2) Milliamperes &
The mA selected determines the number of x-rays produced and therefore the radiation quantity. As more electrons flow through the x-ray tube, more x-ray are produced.

With a constant exposure time, mA controls the x-ray quantity and therefore the patient radiation dose.

x-ray quality remains fixed with a change in mA.

A change in mA dose not change the kinetic energy of electrons flowing from cathode to anode.
It simply changes the number of electrons.

(3) Exposure Time :-
Radiographic exposure time usually are kept as short as possible.

The pupose is not to minimize patient radiation dose but rather to minimize motion blur that can occur because of patient motion.

Short exposure time reduce motion blur.

(4) Distance :-

Distance has no effect on radiation quality.

Distance (SID) affects OD.

Q3 Identify four Image-quality factors and explain how they influence the characteristics of a radiograph?

Ans, Image quality factors :-
Image quality factors refers to characteristics of the radiographic image these include OD, contrast, image detail, and distortion.

Image quality factors are considered the language of radiography.

Optical Density :-
optical density is the degree of blackening of the finished radiograph.

In medical imaging, many problems involve an image being "too dark" or "too light".

Contrast :-

The function of contrast in the image is to make anatomy more visible.

Contrast is the difference in OD b/w adjacent anatomical structures, or the variation in OD on a radiograph.

Contrast, therefore, is perhaps the most important factor in radiographic quality.

kvp is the major factor used in controlling radiographic contrast.

Detail :-

Detail describes the sharpness of appearance of small structures on the radiograph. With adequate detail, even the smallest parts of the anatomy are visible, and the radiologist can more readily detect tissue abnormalities.

Sharpness of image detail refers to the structural line or borders of tissue in the images.

sharpness of image detail is best measured by spatial resolution.

Distortion :-
The misrepresentation of objects size and shape on the radiograph. Because of the position of the x-ray tube, the anatomyical part, and the image receptor the final image may misrepresent the object.

Distortion is reduced by positioning the anatomical part of interest in a plane parallel to that of the image receptor.

Characteristics of a radiograph.

(i) Focal spot size :-
Region of the anode target in which electrons interact to produce x-ray.

(ii) Filtration :-
Removal of low-energy x-ray from the useful beam with aluminum or another metal. It results in increased beam quality and reduced patient dose.

(iii) High-voltage Generation :-
The radiologic technologist cannot select the type of high-voltage generation to be used for a given examination. That choice is fixed by the type of x-ray imaging system that is used. Still it is important to understand how the various high-voltage generation

Q5. Enumerate the advantages to using a flat panel image receptor.

Ans. Flat Panel image receptor
The futher improvement of DF imaging is developing the flat panel image receptor (FPIR)

Such an image receptor is composed of cesium iodide (CsI) /amorphous silicon (a-Si) pixels.

The FPIR is much smaller and lighter and is manipulated more easily then an image intenesifier.

Flat-panel detector are more sensitive and faster than film

Their sensitive allows a lowes lower dose of radiation for a given picture quality than film.

* Distortion free images
* Constant image quality over the entire image.
* Improved contrast resolution over the entire image
* Rectangular image area coupled to similar image monitor.
* High DQE at all dose levels.
* Unaffected by external magnetic fielde.

(B) Describle the properties and use of a charge-coupled device.

Charge-Coupled device:-
A major change from Conventional Fluoroscopy to DF is the use of an charge coupled device. (CCD) instead of a TV camera tube.

The sensitive component of a CCD a layer of crystalline silicon.

The CCD is mounted on the output phosphor of the image intensifier tube and is coupled through fiber optics.

The CCD has greater sensitivity to light a lower level of electronic noise than a television camera tube.

The response of the CCD to light is very stable. Warm up of the CCD is not required.

DF with CCD results in wider dynamic range and better contrast resolution than conventional fluoroscopy.

Manner in which a CCD can be coupled to the image intensifier tube.

* Properties of C.C.D :-
High spatial resolution
High signal-to-noise ratio
High detective quantum efficiency
No warm-up required
No log or blooming
No spatial distortion
No maintenance
unlimited life
unaffected by magnetic fields
Liner response
Lower patient dose.

Q4 Describe the componats of an image intensifier?

Ans Image intensifier ⁂
The image intensifier tube is a complex electonic device that receives the image forming x-ray beam and converts it into a visible light image of high intensity.

The tube components are contained within a glass or metal envelope that provides structural support but more importantly maintains a vacuum.

When installed, the tube is is mounted inside a metal container to protect it from rough handling and breakage

x-ray that exit the patient and are incident on the image intensifier tube are transmitted through the glass envelope and interact with the input phosphor which is cesium iodidide (CsI).

When an x-ray interacts with the input phosphor, its energy is converted into visible light.

The CsI crystals are grown as tiny needles and are tightly packed in a layer of approximately 300 um. Each crystal is approximately 5 um in diameter.

The next active element of the image-intensifier tube is the photocathode, which is bonded directly to

the input phosphor with a thin transparent adhesive layer.

The photocathode is a thin metal layer usually composed of cesium and antimony-compounds that respond to stimulation of input phosphor light by the emission of electrons.

This process is known as photoemission.

The number of electrons emitted by the photocathode is directly proportional to the intensity of light that reches it.

The image intensifier tube is approximately 50 cm long.

A potential difference of about 25000v is maintained across the the tube b/w photocathode and anode so that electrons produced by photoemission will be accelerted to the anode.

The anode is a circular plate with a hole in the middle through which eletrons pass to the output phosphor.

which is just the other side of the anode and is usually made of Zinc cadmium sulfide

The output phosphor is the site where electron interact and produce light

For the image pattern to be accurate, the electron path from the photocathode to the output phosphor must be precise

The engineering aspects of maintaing proper electron travel are called eletron optics

The interaction of these high energy electron with the output phosphor produce a considerable amount of light.
Each photoelectron that arrives at the output phosphor produce 50 to 75 as many light photons as were necessary to create it.
Ratio of the number of light photons at the output phosphor to the number of x-rays at the input phosphor is the flux gain
The ability of the image intensifier to increase the illuminance level of the image is called its brightness.