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Question No : 1

DIGITAL SUBTRACTION ANGIOGRAPHY :-

Digital Substraction angiography (DSA) is a fluoroscopy technique used in interventional radiology to clearly visualize blood vessels in a bony or dense soft tissue environment.

Images are produced using Contrast medium by subtracting a "pre-contrast image" or mask from subsequent images, once the contrast medium has been introduced into

a structure
- Subtraction angiography was first described in 1935 and in English sources in 1962 as a manual technique
- Digital technology made DSA practical from the 1970s.

PROCEDURE :-

DSA and fluoroscopy:
- In traditional angiography images are acquired by exposing an area of interest with time-controlled x-rays while injecting contrast medium into the blood vessels.
- The image obtained includes the blood vessels
- The image obtained includes the blood vessels, together with all overlying and underlying structures.
- The images are useful for determining

anatomical position and variations but unhelpful for visualizing blood vessels accurately.

- In order to remove the distracting structures to see the vessels better, first a mask image is acquired.
- The mask image is simply an image of the same area before the contrast is administered.
- The radiological equipment used to capture this is usually an x-ray image intensifier, which then keeps producing images of the same area at a set rate (1 to 7.5 frames per second).
- Each subsequent image gets the original "mask" image subtracted out.
- Mathematically, the incoming image is divided by the mask image.
- The radiologist controls how much contrast media is injected and for how long.

- Smaller structures require less contrast to fill the vessel than others.
- Image produced appears with a very pale grey background, which produces a high contrast to the blood vessels, which appear a very dark grey.
- The images are all produced in real time by the computer or image processor, while the contrast is injected into the blood vessels.

Applications :-

DSA is primarily used to image blood vessels.

It is useful in the diagnosis and treatment of arterial and venous occlusions, including carotid artery stenosis, pulmonary embolisms, and acute limb ischaemia arterial stenosis, which is particularly useful for potential kidney donors in detecting

renal artery stenosis (DSA is the gold standard investigation for renal artery stenosis) cerebral aneurysms and arteriovenous malformations (AVM).

Question No: 2

Common artifacts in Digital Radiography:-

↳ Any undesirable objects or structures recorded on the radiography image cause degraded image quality.

↳ produced from:
patients such as motion, poor preparations.
Technologists such as less knowledge, less training
Machines, there are various artifacts from CR and DR radiography machines.

Noisy detector power supply artifacts :-

Appearance :-
Vertical lines, which are symmetrical around the center of the image.

Cause :
Caused by a noisy detector power supply.

Solution :-
Replace power supply.

Loose Cone Artifacts

Appearance :-
White edges.

Cause :-
Cone has fallen out of the x-ray tube port and is blocking the collimator from opening.

Solution :-
Remove the collimator and re-attach the cone to the tube port.

Bar Code Artifacts :-

Appearance :-

Barcode appear on screen.

Cause :-

Cause by a failure in a data module or the detector.

Solution :-

Perform bad pixel calibration, if calibration fail then replace detector.

Double Exposure Artifacts :-

Appearance :-

Duplication of images.

Causes :-

TWO subsequent exposure on same imaging plate.

Solution :-

Proper knowledge of using of x-ray equipment.

Poor Collimation Artifacts :-

Appearance :-
unsharp images.

Causes :-
Improper collimation.

Solution :-
Proper collimation in accordance with cassette size and body part.

Exposure through back of cassette :-

Appearance :-
Various patterns of image according to cassette design.

Causes :-
poor basic knowledge of constaction of cassettes.

Solution :-
proper education of radiographers in handling of cassettes.

Improper Exposure KV Artifacts :-

Appearance :-

Darkening or whitening of image.

Causes :-

Improper exposure setting

Solution :-

Proper exposure factors to be used based on body part and patient size.

Moire pattern Artifacts :-

Appearance :-

Different types of moire pattern.

Causes :-

Improper grid usage with low grid frequencies.

Solution :-

usage of grids with 60 lines/cm or more grid lines should run

perpendicular to plate reader's laser scan lines.

Scratches Artifacts :-

Appearance :-

Kink marks on the image.

Causes :-

Mishandling of imaging plate during cleaning process.

Solution :-

Cassettes and image plates should be handled with care.

light Bulb Artifacts :-

Appearance :-

Darkening of lower and outer portions of an image.

Causes :-

High exposure, back scattered radiation entering imaging plate from patient's bed due to increased exposure

for obese patients or due to uncollimated x ray.

Solution :-

Reduce back scatter by lowering the kV or proper collimation.

Dust Artifacts :-

Appearance :-

Focal radiopacities

Causes :-

Dust particles wedged over imaging plate

Solution :-

↳ Regular cleaning of imaging plates with proper cleaner (Ethyl Alcohol)

↳ paper towels or gauze should not be used because they leave fibers on the plate, the use of lint - free cloth is advisable.

Disparity Artifact :-

Appearance :-
Defective scanning resulting in alteration in image contrast, lower half of it was exposed to the laser beam for longer time, which resulted in higher i brighter image output.

Causes :-
~~Manuf~~ Malfunctioning of rollers in CR reader.

Solution :-
↳ periodic cleaning of roller in CR reader by the Supplier
↳ optimal image.

others artifacts are :-
↳ Deodorant Artifacts
↳ Hair Bun
↳ Clothes Ribbing
↳ Jewellery
↳ Lighter in the pocket
↳ Umbilical Ring
↳ plaster
↳ strap ↳ Finger Marks

How to Avoid Common Artifacts in DR :-

Most Radiographic artifacts can be prevented by proper storage and handling of films and by optimal darkroom technique.

Question No : 3

Disadvantages of DR :-

Any exposure to radiation, No matter how small, has the potential to cause harmful biologic changes.

- ↳ Can cause permanent damage to living cells & tissues.
- ↳ Genetic Mutation
- ↳ Can cause cancer.

Critical organs :-

- ↳ Skin
- ↳ Thyroid Gland
- ↳ Lens of the Eye
- ↳ Bone Marrow

other Disadvantages :-

- ↳ One of the main disadvantages of digital radiography is the high start-up cost but generally this is accepted due to the long term benefits of having the system and recouping costs over time.

↳ whilst underexposure will give us a grainy appearance, overexposure is automatically corrected by imaging software so there is a tendency to overexposure to ensure a good quality image.

↳ with computed radiography systems, image need to be processed almost immediately as any delay will results in loss of image information due to trapped electrons returning to a lower energy state. This tends to be a problem in field radiography where images are required away from the practice.

Question No: 4

Comparison between the image quality of Screen film radiography & DR:-

→ CONVENTIONAL :-

The difference in appearance of Conventional and digital radiographs can be striking. However, when good quality, well-maintained Conventional systems and digital radiography are compared, there is little difference in the actual diagnostic quality of the resulting images. In fact, good conventional systems have slightly higher spatial resolution. In reality, operator error (such as over or under-exposure) and poor equipment maintenance commonly result in poor radiographic quality of Conventional radiographs.

Another relative disadvantage of conventional film is that contrast and latitude are inversely related, which means that a high contrast image is automatically associated with a low grey scale.
Image contrast and latitude also depend on many factor, including the type of film, processing and the exposure factors, where high KV settings result in a relatively low-contrast image and low KV settings in higher contrast.
Conventional films have a relatively narrow dynamic range.
Exposure factors have to be carefully adjusted to the region of interest and its thickness to avoid over or underexposure.

DIGITAL :-

Digital radiography biggest advantages is that it is less

dependent on exposure settings and maintenance. This is mainly due to their dynamic range which allows a larger range of exposure factor. The amount of radiographs that have to be retaken due to poor exposure selection can be ~~automatically~~ decreased. However, severe over or underexposure cannot be corrected and those result in artefact formation.

Although spatial resolution can be inferior to conventional films digital radiography's is more independent relationship between contrast and latitude, resulting in higher contrast resolution.

KV and mAs settings have less influence on contrast and latitude, and inconsistent or poor film development does not occur due to electronic processing.

CONCLUSION :-

Digital radiography can be a valuable and affordable imaging technique that can offer some advantages over conventional radiography. Provided the operator is aware of its limitations.

To use digital radiography to its best potential, it is important for clinicians to be familiar with the imaging system, principles of image processing, and commonly occuring artefacts.

Superior :-

Digital radiography is superior than conventional radiography because in conventional radiography repetation may be done or exposure (radiation dose will be high). on the other hand in digital radiography no repeatition and less exposure therefore digital radiography is superior.

Question No: 5

Difference between Image Receptors used in conventional radiography and digital Radiography :-

Digital Image Receptor :-

Digital image receptors is the device that intercepts the x-ray beam after it has passed through patient's body, produces an image in digital form, that is a matrix of pixels each with a numerical value. It replaces that cassette containing intensifying screens and films that is used in conventional film screen radiography.

Digital image receptor is in the form of a matrix of individual pixel elements, which work based on certain technologies like solid state technology

and photostimulable phosphor (PSP) plate technology. When a pixel area is exposed by x-ray beam (after passing through) patients body. x-ray photons are absorbed and energy produces an electrical signal. Three types of solid state sensors are in use - charge couple device (CCD), complementary metal oxide semiconductor (CMOS) and thin film transistor (TFT).

PSP consists of a phosphor coated on top of a plate in which latent image is formed after x-ray exposure. latent image is converted to a digital image by a scanning device through stimulation by laser light.

↳ Image formation is temporary stored within the phosphor.

↳ Image plates are used to differentiate from film and solid state detectors.

Digital Radiography Image Receptor :-

↳

charged electronic device

↓

CCD

↓

flat panel

↓

PSP

↓

CMOS

Conventional Radiology :-

Just like the other modilities of radiography it has also a x-ray source which emitt x-ray, and a receptor which recieves capture the x-ray which exist the patient.

Image Receptor of Conventional Radiography :-

It Consist of the following parts.

1) Radiographic film
2) Intensifying Screen

These two are used as an image receptors in the Convehtional radiography, but there are Some procedures or Cases in which there is no use of intensifying Screen and the film is exposed to the radiation.

Radiographic film :-

It require tight quality Control.

It has following parts.

1) Base
2) Emulsion
3) Adhesive layer
4) Gelatin layer

Base :-

Also known by foundation of radiographic film. It is made of up polyester. provides rigid structure to the film, it is flexible.

Emulsion :-

The emulsion is known by the heart of the radiographic film. It is the material with which the light or x-ray photons strikes and the formation of latent image occur on emulsion.

Adhesive layers :-

The adhesive layer is present between the emulsion and base of the film and act as a glue between the emulsion and base.

Gelatin layer :-

The gelatin is a protective layer on the emulsion, and protects the emulsion from scratches, contamination etc.

Intensifying Screen :-

The intensifying screens are thin sheet or layers of fluorsent material, they are kept in the x-ray cassette with the radiographics film it produce large number of photon when the light strikes with it.

Layers :-

1) Base
2) Reflecting layer
3) Phosphor :→ Conversion of x-ray photon to visible light occurs.