**Viva Assignment CR and DR**

**Total marks: 100**

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**Instructions : Attempt all questions in MS Word or PDF file**

**Q1: What is digital subtraction angiography? Explain /20**

**ANS1:** Digital subtraction angiography (DSA) is a fluoroscopic technique used extensively in interventional radiology for visualising blood vessels. Radiopaque structures such as bones are eliminated ("subtracted") digitally from the image, thus allowing for accurate depiction of the blood vessels.

Digital subtraction angiography, whereby a pre-contrast image is acquired, then subtracted from subsequent post-contrast images, was made possible in the 1970s, thanks to real-time refreshing of the resulting images.

●Indications:

There are numerous indications for angiography and their number has been on the rise ever since interventional radiology has been shown to successfully supplant many open vascular procedures. Salient examples include:

●Endovascular aneurysms repair

●arterial balloon angioplasty

●arterial stenting

●endovascular embolisation

●thrombectomy

■Contraindications

Renal insufficiency  and hypersensitivity to iodinated contrast media are relative contraindications. Some centres use carbon dioxide as a contrast agent for these cases.

■Procedure

●Preprocedural evaluation

Patient evaluation should include, but is not limited to:

●presence of Atherosclerotic disease  (e.g. prior myocardial infarction)

●diabetes

●renal function status

●medications

●allergies and previous exposure to iodinated contrast media

prior surgical procedures, especially vascular

●reports from previously performed angiograms, if any

review of any relevant vascular imaging studies, e.g. preprocedural CT angiogram

■Positioning/room set up

The angiography suite must be equipped with a crash cart and monitoring equipment. Patient heart rate and blood oxygenation are monitored continuously, while blood pressure is measured intermittently via a self-inflating cuff.

All procedures should be performed under strict aseptic conditions, including attire, technique and preparation.

Depending on the procedure and the patient's condition, an anaesthetist may be required to administer conscious sedation or even general anaesthesia.

The patient can be positioned with their head on either end of the bed to facilitate convenience of vascular access and manoeuvring for the interventional radiologist.

■Equipment:

The fluoroscopy unit consists of a C-arm unit that can be rotated axially and sagittally around the floating-top table. The distance between the X-ray tube and the image intensifier can be adjusted, as can Collimation and several other parameters. In dedicated angiography units, there is a second set of controls for the angiographer (radiographer).

A modern angiography unit has all of the following features 2:

●collimators (including oblique) and filters for dose reduction

●pulsed fluoroscopy with a variety of frame rates for dose reduction

●ability to change and display collimator position without fluoroscopy

●road mapping and landmarking

●last image hold and frame-grab

●display of images side-by-side

●masks

●image enhancement

●different image manipulations

●cine

●measurements and quantification (e.g. of degree of arterial stenosis)

The image is at least a 1024 x 1024 pixel matrix. Most modern medical displays are flat screens; some of the detectors are flat panel.

■Technique:

●DSA technique:-

Digital subtraction angiography is used to produce images of the blood vessels without interfering shadows from overlapping tissues. This provides a clear view of the vessels and allows for a lower dose of contrast medium 4.

●The non-contrast image (mask image) of the region is taken before injecting contrast material and therefore shows only anatomy, as well as any radiopaque foreign bodies (surgical clips, stents, etc.) as would a regular x-ray image.

●Contrast images are taken in succession while contrast material is being injected. These images show the opacified vessels superimposed on the anatomy and are stored on the computer.

●The mask image is then subtracted from the contrast images pixel by pixel. The resulting subtraction images show the filled vessels only.

●Recording can continue to provide a sequence of subtracted images based on the initial mask.

●The subtraction images can be viewed in real time. Even if the patient lies still, there is bound to be some degree of misregistration of images due to movement between the acquisition of the mask image and the subsequent contrast images. The effect is prominent at high-contrast interfaces, such as bone-soft tissue, metal staples and coils, and bowel air. Pixel shifting (either manual or automatic), i.e. moving the mask retrospectively, can minimise misregistration, but focal movement such as bowel peristalsis, will not be corrected.

It should be noted that since image subtraction causes a decrease in Signal to noise ratio, the subtraction images appear noisier than the source images. The inevitable solution to this is to increase ma. There are also algorithms in place for reducing scatter.

■Procedural technique:-

For every purpose, there is at least one technique, but common to them all is the application of DSA for visualisation:

●The patient lies on the angiography table

●local anaesthesia is administered at the intended puncture site (usually lidocaine hydrochloride 1% or 2% w/v)

●In certain procedures (e.g. a child undergoing Cerebral angiography ), general anaesthesia is performed

●The Seldinger technique is used to gain access to a blood vessel

▪ ultrasound is often used for visualising the vessel in real-time for puncturing

▪ A standard access kit includes a straight 18 gauge needle and .035" guidewires, on which the diagnostic and therapeutic catheters are threaded

▪ In many cases, a micro-introducer access kit (.018" guidewire threaded through a 21 gauge initial access needle) is used for access, either for the entire procedure or to be replaced with the standard kit. Using a micro-introducer facilitates less traumatic entry and can be retrieved without massive bleeding should there be a need for re-puncturing

▪ On procedure completion, haemostasis is applied to the puncture site

■Postprocedural care:

This depends on the nature of the procedure and whether it was performed on an inpatient or outpatient basis.

Patient should be immobilised for 4-6 hours and keep on supine position. Frequent observations should be done to look for puncture site haematomas, which is the commonest complication. ■Complications:

Complications can be categorised into local and systemic complications:

Local complications (Puncture site)

●From the puncture site (commonest complication)

●thrombus formation

●local tissue damage

●arteriovenous fistula

■Systemic complications:

●thromboembolism

●air embolism

●vessel dissection

**Q2: What are common artifacts in DR? How will you avoid them. /20**

**ANS2:** X-ray artifacts can present in a variety of ways including abnormal shadows noted on a radiograph or degraded image quality, and have been produced by artificial means from hardware failure, operator error and software (post-processing) artifacts.

There are common and distinct artifacts for Film, Computed (CR) and Digital radiography (DR).

■Common causes:

* improper handling of the films
* errors while processing the films
* patient movement while taking the image

■Common artifacts (all forms of radiography)

* motion artifact
* due to patient movement resulting in a distorted image
* image compositing (or twin/double exposure)
* superimposition of two structures from different locations due to double exposure of same film/plate
* Grid cut-off
* radiopaque objects on/external to the patient (e.g. jewellery (e.g. necklaces, piercings), clothing (e.g. buttons), hair (e.g. pony tail, hair braids etc.).
* debris in the housing

debris in the housing caused by the collimator tube can cause small trapezoidal regions, indicative of lead shavings

■Film radiography artifacts:

* finger marks

improper handling with hands

* clear film

malfunction of the machine or placing the film in the fixer before developer solution

* static electricity

black “lightning” marks resulting from films forcibly unwrapped or excessive flexing of the film

* crescent-shaped black lines

due to fingernail pressure on the film

* crescent-shaped white lines

due to cracked intensifying screen

* black film

complete exposure to light.

* clear spots

air bubbles sticking to film during processing

fixer splashed on film prior to developing

dirt on the intensifying screen

■Computed/digital radiography artifacts:

* detector image lag or ghosting

latent image from previous exposure present on current exposure

* incorrect detector orientation i.e. upside-down cassette

●backscatter

electronics are visible on the exposed image

increased radiation exposure required for portable DR (digital radiography) examinations

* stitching artifacts
* Over exposure
* Dead pixel artifacts
* signal dropout 4

large areas of signal loss, due to detector drop

* speckled radiopaque spots 4

due to detector drop

* detector calibration limitation 4

faint radioopaque striping (often vertical) in the background of an image, yet not evident on the anatomy

this artifact should be carefully examined, if it does not interfere with the anatomy, it is not a detector failure/grid cut off, rather a limitation of the detector calibration.

often seen as lower exposure

* failure of detector offset correction 4

similar to ghosting, however, the digital detector not being calibrated when promoted is the cause

* electronic shutter failure 4

the digital image often will have obscurely shaped, tight collimation that defies logic

often a computer error often fixed with recollimation post exam (this should be explored before reexamination)

* values of interest misread 4

image appears washed out, and underexposed

this is often due to a largely collimated area of smaller anatomy i.e. a patella protection

tighter digital collimation in conjunction with reprocessing will correctly assign the correct values of interest

* mid gray clipping 4

loss of contrast in areas of different pixel density yet not change in density can be seen i.e. the metal on a knee replacement

due to poor contrast enhancement

* grid-line suppression failure 4​​

faint grid lines present on an image, with no grid cut off.

**Q3: What are disadvantages of DR? /20**

**ANS3: ■Disadvantages of DR:**

1. It is expensive initially.  
The cost of DR machines is high as an initial investment. But when we include the reduction of resources used in traditional machines, it could be a better deal.

2. It may require constant replacement of equipment.  
Since technology is continuously evolving, it won’t be surprising if the current digital radiography machines in the market today will become obsolete a few years from now. This means we need to invest in a new set of equipment every few years to keep up with the latest software or hardware.

3. It requires new knowledge and skills.  
There is a need to learn how to set up and operate the new machinery and computer programs. We will have to train ourselves as radiology team, and repeat the process again when we get newer models or upgraded software.

4. It may cause technicians to lose their jobs.  
If older radiology technicians cannot keep up with the new technology and learn how to operate the advanced DR machines, they could lose their value in the medical industry and end up unemployed.

**Q4: Compare the image quality of screen film radiography and DR, which one is superior ? /20**

**ANS4:** Film radiography takes time to process. Each image can then only be assessed after it comes out of the processor and put on a light-¬box, but digital radiography can be viewed immediately. This instant access allows technicians to see if the patient is positioned correctly or if the exposure is balanced.

Digital radiography is a key development in diagnostic imaging that can help improve patient care, support better patient outcomes, expand consultation capabilities, and enhance client interaction. It has become the gold standard in the veterinary industry for over 15 years. It started as a very costly investment when first launched, but as it has become more mainstream, the modality has become more affordable.

●Image Quality :  
Getting a clear read from traditional film radiography isn’t always easy, whether it’s due to errors from patient movement, positioning, or exposure issues. Zooming and changing the appearance of the image is also impossible with film. If a veterinary practice has trouble consistently obtaining high¬ quality radiographic images using film, making the switch to digital radiography is a clear solution that pays for itself. DR is also much more forgiving than film due to the image processing algorithms. Practices can expect images with a balanced presentation of bone structures and overlapping soft tissue along with a realistic representation of the anatomy.

**Q5: What are the differences between image receptors used in conventional radiography and digital radiography?**

**ANS5:** The image receptor may be the conventional film-screen or, most likely, a photosensitive phosphor plate as in computed radiography (CR) or a charged electronic device as in digital radiography, also known as direct digital radiography, (DR). The image receptor in CR is a photostimulable phosphor plate. The latent image is created when x-rays pass through the body part and strike the phosphor, some giving off light; however, some are held within the phosphor particles, creating a latent image. The image receptor in DR is a charged electronic device. The x-ray photons strike a scintillator or a photoconductor. The latent image is in the form of an electrical signal. In any case the image is latent; it is not visible to the human eye and needs to undergo processing to make it visible.