MCQ

1

.True about X-rays:

a. Differ from light in their charge
b. Are produced when Electron beam strikes the Cathode
c. Bone scan makes use of high-energy X-rays.
d. Can be emitted as well as absorbed.

2.The magnetic field strength of a 1.5 T MRI machines which are routinely used today in day to day radiology practice is how many times greater than earth's magnetic field?

a. It is equal
b. 100 times
c. 2000 times
d. 30,000 times

3.Highly ionizing radiation:

a. Deutron particles
b. Alpha particles
c. X-rays
d. Gamma radiations

4.Penetration of an X-ray beam mainly depends on:

a. mAs
b. kV
c. Ripple factor
d. All of the above

5.The radiation unit used to for effective dose is:

a. (A)Rad
b. (B)Rem
c. (C)Sievert
d. (D)Gray

6.Which of the following is the most penetrating?

a. Electron beam
b. Gamma photons
c. X-ray photons
d. Proton beam

7. Investigation of choice for dural ectasia?

a. Contrast myelography
b. Multislice CT
c. Angiography
d. MRI

8. Investigation least helpful in evaluation of a case of Prostate cancer?

a. CT chest
b. MRI pelvis
c. TRUS
d. Bone scan

9. Investigation of choice for pulmonary sequestration?

a. Digital X-ray
b. MRI Thorax
c. Color Doppler
d. DSA

10. Ionizing radiation are involved in?

a. Elastography
b. Thermography
c. Color Doppler
d. Positron emission tomography

11. Investigation of choice for evaluation of a suspected case of partial small bowel obstruction?

a. Standing X-ray abdomen
b. Barium Follow through
c. Ultrasonography
d. CT scan

12. Imaging modality that permits best degree of differentiation between Radiation necrosis and recurrence of a brain malignancy?

a. PET scan
b. SPECT Imaging
c. MR spectroscopy
d. Color Doppler study

13.Hounsfield unit value of Acute intracranial hematoma :

a. 0-20 HU
b. 20-40 HU
c. 40-60 HU
d. 100-120 HU

14.Of the following structures, which are better visualized in a CT scan in comparison to MRI:

a. Vascular malformations
b. White matter lesions
c. Interverterbral disc herniations
d. Sinonasal Diseases

15.High-resolution CT of the lung is a specialized CT technique for greater detail of lung parenchyma and it utilizes:

a. Special lung filters
b. Thick collimation
c. Bone algorithm for image reconstruction
d. Large field of view

16.Real time imaging is possible with: following except:

a. Spiral CT
b. EBCT
c. Fluoroscopy
d. USG

17.Maximum radiation exposure is by:

a. MCU
b. CT abdomen
c. Radionuclide scans
d. Bilateral nephrostogram

18.Probability of effect is function of dose in which effects of radiation?

a. Stochastic effect
b. Deterministic effect
c. Nonstochastic effect
d. Radiation call phenomenon

19.Enteroclysis is study of:

a. Esophagus
b. Liver
c. Small intestine
d. Rectum

20.All of the following show Perihilar ground-glass' haziness on chest X-ray, EXCEPT :

a. ARDS
b. Pulmonary edema
c. Pneumocystis carinii infection
d. Staphylococcal pneumonia

21.Which of the following is investigation of choice for Congenital Lobar Emphysema?

a. Bronchography
b. Helical CT
c. MRI
d. Bronchoscopy

22.“HRCT” is ideal for evaluating a suspected case of?

a. Pleural effusion
b. Bronchoalveolar cancer
c. Lung mass
d. Mediastinal adenopathy

23.Opacity with nodular & Irregular calcification is seen in
a. Pulmonary Histiocytosis
b. Sarcoidosis
c. Bronchial adenoma
d. Pulmonary hamartoma

24.Which of the following is not the correct match?
a. Rheumatoid arthritis : Diffuse pulmonary hemorrhage
b. Scleroderma progressive pulmonary fibrosis
c. SLE : shrinkage lung syndrome
d. Wegener's granulomatosis : Cavitating lung lesions

25.The extent of superior sulcus tumor is best demonstrated by :

a. Nerve conduction studies
b. HRCT
c. CECT
d. MRI

26.Earliest sign of LA enlargement on chest X-ray:

a. Elevation of left main bronchus
b. Smooth anterior indentation on esophagus
c. Double cardiac density
d. Cephalization of blood flow

27.A 50-year-old diabetic female presents with right flank pain and fever since 4-5 dys. She also has pyuria and minimal hematuria. Her urine analysis revealed several pus cells ad RBCs. X-ray KUB showed streaky radiolucencies in left renal region. CT scan abdomen reveals streaks of low attenuation foci in renal parenchyma and pevicalyseal system with perirenal fat stranding and rim of fluid collection. The likely diagnosis is:

a. (A)Pyonephrosis
b. (B)Emphysematous Pyelonephritis
c. (C)Xanthogranulomatous Pyelonephritis
d. (D)Renal abscess

28.Test used to diagnose PUJ obstruction in utero is:

a. (A)USG
b. (B)Retrograde pyelography
c. (C)Whitaker test
d. (D)MRI

29.All of the following statements about Acute Renal Colic are true, EXCEPT :

a. (A)Sonography is highly sensitive in the detection of hydronephrosis.
b. (B)Sonography can detect ureteral stones very sensitively.
c. (C)Helical NCCT is an easy and sensitive way to detect obstructing or nonobstructing ureteral calculi.
d. (D)Cystine stones are hard.

30.A well-circumscribed low attenuation mass lesion with central stellate scar and mild homogenous enhancement in a otherwise healthy middle aged female is very likely to be:

a. (A)Angiomyolipoma
b. (B)Renal Cell Carcinoma
c. (C)Oncocytoma
d. (D)Mesoblastic nephroma

31.Which of the following is the incorrect statement regarding GI Bleeding?

a. (A)The sensitivity of angiography for detecting GI Bleeding is about 10-20% less as compared to nuclear Imaging
b. (B)Angiography can image bleeding at a rate of 0.05-0.1 ml/min or less
c. (C)99mTc-RBC scan will image bleeding at rates as low as 0.05-0.1ml/min

d. (D)Angiography will detect bleeding only if extravasation is occurring during the injection of contrast.

32.Posterior indentation on esophagus on barium column is seen in:

a. Right aortic arch
b. Double aortic arch
c. Aberrant right subclavian artery
d. Scleroderma

33.False about are MRCP :

a. MRI is used with HASTE being the "Work-horse"pulse sequence used
b. Screening tool of choice for primary sclerosing cholangitis
c. Secretin MRCP is extremely useful in diagnosis of dysfunction of sphincter of Oddi
d. Dye has to be injected endoscopically

34.'Carman's meniscus' sign diagnostic of :

a. Peptic ulcer disease
b. Strawberry gallbladder
c. Carcinoma stomach
d. Patent vitellointestinal duct

35.'Double duct' sign is seen in :

a. Benign biliary stricture
b. Malignant biliary stricture
c. Periampullary carcinoma
d. Duodenal obstruction

36.Multislice CECT is most poor in delineating which of the following in cases of Ca stomach:

a. Pancreatic infiltration
b. Peri-gastric lymphnode enlargement
c. Ascites
d. Liver secondaries

37.All the following are diagnostic barium follow through features of Ileo-caecal tuberculosis, EXCEPT :

a. Pulled up contracted caecum
b. Widening of ileocaecal angle
c. 'Tooth paste' appearance of ileum
d. Strictures involving terminal ileum

38.Which is not a usual feature of Ulcerative colitis on Ba enema?

a. Fine mucosal granularity
b. Pseudopolyps
c. Lead pipe colon
d. Colovesical fistula

39.Study of choice for Intussusception:

a. Barium enema
b. Colonoscopy
c. Ultrasonography
d. CT scan

40.Cupola sign on Abdominal X-Ray is a feature of:

a. Small Intestinal obstruction
b. Meconium ileus
c. Large intestinal obstruction
d. Pneumoperitoneum

41.Caroli's disease:

a. Type 3 choledochal cyst
b. PTC is currently investigation of choice
c. Association with tuberous sclerosis known
d. Central dot sign

42.The initial investigation of choice for a Post-cholecystectomy biliary stricture is:

a. USG
b. ERCP
c. Computed Tomography
d. MRCP

43.The best investigation for diagnosis of Acute Pancreatitis:

a. USG
b. CECT
c. MRI
d. ERCP

44.Which one of the following hepatic lesions can be diagnosed with high accuracy by using nuclear imaging?

a. Hepatocellular carcinoma
b. Hepatic adenoma
c. Focal nodular hyperplasia
d. Cholangiocarcinoma

45.Reversible ischemia of the heart is detected by :

a. Angiography
b. Thallium-201 scan
c. MUGA
d. Resting Echocardiography

46.Kerly B lines are seen in:

a. Pulmonary embolism
b. Pulmonary infarct
c. Pulmonary hemosiderosis
d. Pulmonary venous hypertension

47.Investigation of choice for pericardial effusion is :

a. CT Scan
b. MRI
c. Echocardiography
d. X-Ray Chest

48.False about Cardiac MRI:

a. Sensitive most for assessing left ventricular function
b. LV non-impaction syndromes can be diagnosed.
c. Gating is not required with 1.5T MRI machines.
d. Best modality for detection of pericardial tumors.

49.Investigation of choice in aortic aneurysm:

a. USG
b. CT scan
c. MRI
d. Digital subtraction Angiography

50.MRI is Best investigation for following except?

a. Traumatic paraplegia
b. ADEM
c. Diastomatomyelia
d. Fracture of dens

51.'Wormian bones' can be seen in following EXCEPT:

a. Hypophosphatasia
b. Down's syndrome
c. Pyle's disease
d. Menke's kinky hair syndrome

52.NOT true about congenital hip dislocation?

a. It is 6 times more common in males
b. Ultrasound is investigation of choice
c. The 'hourglass' appearance of the joint capsule may prevent a successful closed reduction.
d. When the ossification center is in the lower medial quadrant, the hip is normal.

53.Most common cause of endplate destruction with reduction of Intervertebral disc space on X-ray:

a. Lymphoma
b. Tuberculosis
c. Eosinophilic granuloma
d. Metastasis

54."Iliac horns":

a. Ankylosing spondylitis
b. Juvenile Rheumatoid arthritis
c. Nail Patella syndrome
d. Osteitis condensans ilii

55.In scurvy all the following radiological signs are seen, EXCEPT:

a. Pelican spur
b. Growth arrest lines
c. Zone of demarcation near epiphysis
d. Frenkel's line

56.Which one of the following is the investigation of choice for evaluation of suspected Perthes' disease ?

a. Plain X-ray
b. Ultrasonography (US)
c. Computed Tomography (CT)
d. Magnetic Resonance Imaging (MRI)

57."Bone within bone" appearance is seen in :

a. CML
b. Osteoporosis
c. Osteopetrosis
d. Bone infarct

58."Licked candy-stick" appearance of bones is seen in :

a. Leprosy
b. Sarcoidosis
c. Hypertension
d. Madura foot

59.A 55-years–old female presented with painful swelling over the left iliac blade area. Radiograph of the pelvis showed 'an large osteolytic area of destruction with mottled areas of calcification' involving the iliac blade. Which of the following is the most likely diagnosis?

a. Metastases
b. Chondrosarcoma
c. Giant Cell Tumor
d. Osteochondroma

60.Geographic lytic lesions in skull with beveled edges seen in:

a. Multiple myeloma
b. Eosinophilic granuloma
c. Sickle cell anemia
d. Minke's Kinki Hair syndrome

61.What is the imaging study of choice in the setting of head trauma?

a. Helical CT scan without IV contrast
b. Spiral CT scan with IV contrast
c. MRI
d. Digital skull radiographs.

62.Which of the following is classic CT appearance of an acute subdural hematoma:

a. Lentiform-shaped hyperdense lesion
b. Crescent-shaped hypodense lesion
c. Crescent-shaped hyperdense lesion
d. Lentiform-shaped hypodense lesion

63.A young male develops fever, followed by headache, confusional state, focal seizures and a right hemiparesis. The MRI performed shows bilateral temporal lobe hyperintensities. The most likely diagnosis is:

a. Acute pyogenic meningitis
b. Herpes simplex encephalitis
c. Neurocysticercosis (resimose type)
d. Carcinomatous meningitis

64.Juvenile nasal angiofibroma:

a. Radiotherapy is treatment of choice

b. 'Antral sign' can be evident
c. Per-operative embolization is warranted.
d. CT Scan-contrast enhanced is the investigation of choice for juvenile nasal angiofibroma

65.Which one of the following brain tumors is highly vascular in nature?
a. Glioblastoma.
b. Meningiomas.
c. C P angle epidermoid.
d. Pituitary adenomas.

66.The procedure of choice for the evaluation of an aneurysm is:

a. Ultrasonography
b. Computed tomography
c. Magnetic resonance imaging
d. Arteriography

67.Which of the following is generally non-enhancing tumor?

a. Pituitary Adenoma
b. Low grade astrocytoma
c. Optic chiasmal glioma
d. Germinoma

68.Which one of the following tumors most commonly shows 'bracket calcification'?

a. Ependymoma
b. Medulloblastoma
c. Meningioma
d. Corpus calllosal lipoma

69.Posterior scalloping of vertebrae is seen:

a. Multiple myeloma
b. Neurofibromatosis
c. Bestrew disease
d. Aortic aneursm

70.The MR imaging in multiple sclerosis will show lesions in:

a. White matter
b. Grey matter (Deep)
c. Thalamus & Hypothalamus
d. Basal ganglia & External capsule

71.A middle-aged man presents with progressive atrophy and weakness of hands and forearms. On examination, he is found to have slight spasticity of legs, generalized hyperreflexia. T2W MRI reveals increased signal in the corticospinal tracts. The most likely diagnosis is:
a. Multiple sclerosis
b. Amyotrophic lateral sclerosis
c. Subacute combined degeneration
d. Pontine myelinolysis

72.Intradural metastases (drop metastasis) are a frequent complication of all, EXCEPT:
a. Medulloblastomas
b. Oligodendroglioma
c. Pineal germinomas
d. Ependymoblastoma

73.Best method to diagnose hydrocephalus in 1 month old child is:

a. X-ray
b. Ultrasound
c. CT scan
d. MRI

74.A patient comes with proptosis and Abducent N palsy. A dark homogenous mass on T2W MRI is seen which shows intense enhancement with contrast. Diagnosis is?

a. Cavernous hemangioma
b. Meningioma
c. Astrocytoma
d. Glioma

75.C1 C2 best seen in:

a. Lat view
b. Oblique view
c. AP view
d. Odontoid view

76.Which is not a sign of Hydatid cyst?

a. 'Cart-wheel' apperance
b. 'Mercedes Benz' sign
c. 'Cyst in cyst' sign
d. 'Floating membrane' sign

77.On MRI the differential diagnosis of spinal cord edema is:
a. Myelodysplasia
b. Myelomalacia
c. Myelochisis
d. Cord tumors

78.Characteristics of Thyroid carcinoma include all, EXCEPT:

a. Hyperechoic
b. Hypoechoic
c. Microcalcifications
d. Majority shows invasion into thyroid stroma.

79.Best imaging modality for neuroendocrinal tumors:
a. PET
b. CECT
c. Radio nucleotide scan
d. MRI with gadolinium scans

80.In a male fetus, ultrasound identifications of bilateral hydronephrosis and bladder dilatation (with oligohydramnios) is diagnostic of:
a. Polycystic kidney disease
b. Multicystic dysplastic kidney
c. Ureteropelvic junction obstruction
d. Posterior urethral valve

81.Which of the following features on second trimester ultrasound is not a marker of Down's syndrome?
a. Single umbilical artery
b. Choroid plexus cyst
c. Diaphragmatic hernia
d. Duodenal atresia

82.Best for unruptured ectopic pregnancy is:

a. Per abdominal US
b. HCG
c. Trans vaginal US
d. Amniocentesis

83.Intrauterine diagnosis of pyeliectasis can reliably be done when AP diameter of renal pelvis is more than?
a. 2 mm
b. 6 mm
c. 10 m
d. 14 mm

84."Omental caking" in CT scan high possibility that patient is having:
a. Ca colon
b. Ca pancreas
c. Ca stomach
d. Ovarian tumour

85.Investigation of choice in DCIS:

a. Mammography
b. CT
c. MRI
d. PET

86.Investigation of choice for preoperative evaluation of endometrial carcinoma:
a. Hysteroscopy
b. CEMRI
c. HRCT
d. Transvaginal ultrasound

87.Which ultrasound finding with an adnexal mass is most suspicious for malignancy?

a. 8 cm in diameter
b. Several internal excrescences
c. Cystic with two thin septations
d. Free pelvic fluid

88.A 55 year old post menopausal woman, on hormone replacement therapy (HRT), presents with heaviness in both breasts. A screening mammogram reveals a high density speculated mass with cluster of pleomorphic microcalcification and ipsilateral large axillary lymph nodes. The mass described here most likely represents:

a. Cystosarcoma phylloides
b. Lymphoma.
c. Fibroadenoma
d. Carcinoma.

89.Radiological investigation of female of reproductive age group is restricted to:

a. Menstrual Period
b. First 10 days of Menstrual Cycle
c. 10-20 days of M. C.
d. Last 10 days of M. C.

90.A highly accurate intracranial as well as extracranial delivery of high radiation doses with small radiation fields is best possible with?

a. CyberKinfe
b. CHART
c. IORT
d. 3D-CRT

91.Radionuclide agent of Choice for prostate implants:

a. Gold-198 seeds
b. I^{125} seeds
c. Palladium-103 seeds
d. Co-60

92.Which compound is not considered as a radiosensitizer?

a. Hyperbaric oxygen
b. Misonidazole
c. Amifostine
d. Idoxyuridine

93.Maximum radiation permitted for a worker for a year is:

a. 3 mSievert
b. 20 mSievert
c. 8 mSievert
d. 10 mSievert

94.Which of the following is a stochastic effect of radiation ?

a. Alopecia in the irradiated portal
b. Local desquamation in the irradiated field
c. Genetic mutation
d. All of the above

95.Radiation induced transverse myelitis occurs in:

a. 1-3 days
b. 4-6 months
c. 1-3 weeks
d. 1-2 years

96.Longest half life is seen in:

a. Radon
b. Radium
c. Uranium
d. Cobalt

97.True match:

a. Gallium: Ideal agents for bone scan
b. Rubidium-82: Myocardial perfusion imaging
c. Indium-111 is used for brain studies
d. MAG3 is used for functional images of pulmonary ventilation

98.Cobalt-60 is

a. A naturally occurring radioisotope
b. An artificially made radioisotope
c. A positron
d. None of the above

99.Following agents can be used in form of eye plaque for radiation treatment of lesions in the eye (like melanoma) except:
a. 90Sr/90Y
b. ^{106}Ru
c. ^{125}I
d. Plutonium

100.Which is not the R of radiolobiology:

a. Repair.
b. Repopulation.
c. Redistribution.
d. Resortment .

101.The following features help to differentiate mega voltage x-ray therapy from orthovoltage therapy, EXCEPT:
a. More skin damage
b. Very low lateral scatter
c. Homogenous distribution of radiation
d. Greater deposit of energy in the tumor

102.Gamma camera in Nuclear Medicine is used for:

a. Organ imaging.
b. Measuring the radioactivity.
c. Monitoring the surface contamination.
d. RIA

103.Sestamibi Scan is used in:

a. Ectopic thyroid
b. Ectopic parathyroid
c. Parathyroid adenoma
d. Extra adrenal pheochromocytoma

104.Which one of the following has maximum ionization potential?

a. Electron
b. Proton
c. Alpha particle
d. Gamma Photon

105.True about teletherapy?

a. Phosphorous-32 is used as a radioactive material in Teletherapy machines.
b. X-rays & gamma rays are the forms of radiation most commonly used to treat cancer.
c. X-rays rays are generated from decay of atomic nuclei in radioisotopes such as cobalt & radium.
d. It is rarely used form of radiotherapy.

106.In the treatment of Papillary Carcinoma of Thyroid, Radioiodine destroys the neoplastic cells predominantly by:

a. Alpha rays
b. Beta rays
c. Gamma rays
d. X-rays

107.Isotope commonly used in interstitial & mould therapy:

a. Iridium192
b. Cobalt60
c. Caesium137
d. Gold198

108. Low dose rate (LDR) brachytherapy means dose rate at the dose specification point(s)=

a. 0.1– 0.2 Gy/h
b. 0.4–2 Gy/h
c. 2–12 Gy/h
d. >12 Gy/h

109.Most IORT programmes today are based on electron beams produced by megavoltage linacs, since electrons provide which of the following advantage over X rays for the purposes of IORT?

a. The electron dose is deposited over a definite range.
b. The dose can be deposited homogeneously throughout the target volume.
c. No much difference between the tissue and bone absorption of megavoltage electron beams.
d. All of the above

110.Which of the following is a correct selection criterion for endocavitary rectal Radiotherapy?

a. Very poorly differentiated rectal Ca;
b. Immobile lesion with a diameter > 3cm;
c. The location of the lesion within 10 cm from the anal canal;
d. Presence of lymph node or distant metastases.

111.Multiple daily fractions, usually two with doses per fraction of ≤180–200 cGy, usually 100–120 cGy, separated by 4–8 hours, to total doses higher than those given with "standard" fractionation is defined as:

a. Hypofractionation RT
b. Hyperfractionation RT
c. Accelerated RT
d. Continuous hyperfractionation accelerated RT

112.According to recent trials palliation of metastatic disease can be done by:

a. 8 Gy in one fraction
b. 20Gy in 5 fractions
c. 30 Gy in single fraction
d. Above 70 Gy

113.Factors associated with increased risk of radiation injury to the central nervous system tissues include following except?

a. Medical illness (hypertension and diabetes).
b. Whole brain irradiation.
c. Use of Low LET beams.
d. Concomitant use of methotrexate.

114.Which of the following is not an indication of radiotherapy in parotid tumor?

a. Recurrent disease
b. Resectable local lesion
c. High grade lesion
d. Unfit for surgery

115.Gamma knife radiosurgery is most useful in Rx of?

a. Lung carcinoma
b. Renal tumors
c. Brain tumors
d. Cancer cervix

116.Point B in treatment of Ca cervix corresponds to:

a. Mackenrodts ligament
b. Obturator Lymph node
c. Ischial tuberosity
d. Round ligament

117.Total skin electron irradiation is most commonly employed for treatment of:

a. Leukemia
b. Hodgkin's disease
c. Mycosis fungoides
d. Neuroblastoma

118.PET-CT is investigation of choice for?

a. Rhinocerebral mucormycosis
b. Recurrent ovarian cancer
c. Progressive-multifocal leucoencephalopathy
d. Ductal Carcinoma in Situ of breast

119.'m' in Tc99m stands for?

a. Mass number
b. Multiple
c. Metastable
d. Measurable

a. Ultrasound
b. CT scan
c. MRI
d. SPECT scan

120.Investigation of choice detecting liver metastases in a case of carcinoma stomach?

1.**(D) . Can be emitted as well as absorbed**

X-rays are ionizing electromagnetic radiations, essentially produced when a stream of K shell electrons of an atom accelerated by a high voltage applied between the filament (cathode) and the target (anode), strikes the target and the electrons give up their energy producing characteristic radiations i.e., the X-rays. X-rays have dual property – they can be emitted as well as absorbed. In bone scan gamma radiations are used (*not x-rays*).
(Ref. Principles of Radiation – Therapy by Thomas Deeley, Pg. 33)

2.**(D). 30,000 times**

The strength of a magnetic field may be measured in tesla (T) or gauss. One tesla is equal to 10,000 gauss. The earth's magnetic field at the earth's surface varies between 0.3 and 0.6 gauss. Most clinical CMR scanners use a magnetic field of 1.5 T, or 15,000 gauss, i.e., approximately 30,000 times stronger than the earth's magnetic field. .

(Ref. MRI and CT by Lee & Rao, 4th Edition, Pg. 71)

3.**(B). Alpha particles**

Radiation interacts with other atoms or molecules in the cell of the target material and produces free radicals, which in turn diffuse far enough to cause damage to the critical targets, and causes the biological change – the indirect action. The radiation inside the cytoplasm causes hydrolysis of water (H_2O) to H^+ and OH^- ions. The free radical (OH ion) can penetrate the nuclear membrane and induce damage to the cellular DNA in presence of nascent oxygen by cross-linking. Alpha particles have highest ionization power.

(Ref. Farr & Allisy-Roberts – Physics for Medical Imaging, 1st Edition, Pg. 150)

4.**(B). kV**
mAs controls film density, while kVp controls image contrast and penetration of X-ray.
To increase contrast, reduce kV; to reduce contrast, increase kV.
(Ref. Farr & Allisy-Roberts – Physics for Medical Imaging, 1st Edition, Pg. 14)

5.**(C). Sievert**

Quantity	**Old unit**	**New SI unit**
Activity	Curie	Becquerel
Exposure	Roentgen	Coulomb/kg
Absorbed dose	Rad	Gray
Dose equivalent	Rem	Sievert

(Ref. Park – PSM, 20th Edition, Pg. 650-651)

6.**(B). Gamma photons**

Gamma photons have highest penetrating power.

The energy of proton & electron beams has not been defined.

For same energy- photon has greater penetrating power than proton (hydrogen nuclei –greater mass)

i.e. 18 MV photon > 18 MeV proton

18 MV photon > 18 MeV electron

Therapeutically used Proton beams have energy range of 150 MeV – 200 MeV.

(Ref. O.P.Tondon General chemistry)

7.D. MRI

8.A. CT chest

9.D. DSA

10.D. Positron emission tomography

11.D

12.A.

13.C.

14.D.

15.**(C). Bone algorithm for image reconstruction**

Three factors significantly improve the spatial resolution of CT such that it can be described as high resolution CT (HRCT)

Narrow beam collimation	**High Spatial reconstruction algorithm (Edge enchancing or sharp algorithm) Ex Bone algorithm**	**Small field of view**
i.e. it cuts thin slices of ≈ 1.5 mm as compared to ≈ 10 mm of CT scan	Makes structure visible sharper & reduces smoothing (opposite to sharp) but it makes image noise more obvious	Increase resolution

(Ref. Grainger, 4th Edition, Pg. 278, 279)

16.**(A). Spiral CT**

The EBCT scanner operates on the principle of electron beam tomography, whereby moving electrons are bent electromagnetically onto one of four tungsten target rings lying in the gantry below the patient. Each sweep of the target ring requires 50 ms, and there is an 8-ms delay to reset the electron beam. The x-rays generated from this electron bombardment of the target ring are tightly collimated and pass through the patient onto a double ring of *cadmium tungstate detectors* lying in the gantry above the patient. The resultant images are 8 mm in thickness. Since each of the four target rings produces two images, eight tomographic images can be generated in one scan sequence. The *images produced are contiguous*, except for a 4-mm gap between images from adjacent target rings.

Conventional and helical CT can produce excellent static images of cardiac anatomy and pericardium, whereas EBCT, a newer imaging modality, is capable of evaluating not only the static anatomy but also the functional anatomy of the heart.

Electron beam computed tomography (EBCT) (ultrafast CT) (cine CT) (fast CT), has taken its place as an important modality in the assessment of ischemic heart disease. The EBCT scanner can quantify myocardial function, assess wall motion abnormalities, evaluate intracardiac thrombi and ventricular aneurysms, and determine coronary artery bypass graft (CABG) patency. EBCT is also an important imaging modality in the evaluation of coronary artery calcification.

(Ref. Grainger's Diagnostic Radiology, 4th Edition, Pg. 108)

17. **(B). CT abdomen**

Examination	Effective total dose (mSv)
Chest radiograph	0.06
Skull radiograph	0.2
Pelvis radiograph	0.65
Lumbar spine radiograph	1.3
Upper GI series (Barium)	2.45
Abdomen radiograph	0.55
Barium enema	2.8 to 4
IVP/IVU	1.6
Extremities	0.01
Enteroclysis	1.5
CT chest	8
CT abdomen	10
CT head	3.5
RNI	4.8

(Ref. Bailey and Love, 25th Edition, Pg. 130)

18. **(A). Stochastic effect**

Deterministic/non-stochastic effects are the effects not subjected to the laws of chance or probability. There is a threshold dose below, which the effect does not occur. Dose significantly above the threshold will inevitably produce the effect, and its severity increases with radiation dose, e.g. somatic effects and radiation accidents.

Non-deterministic/stochastic are the effects obey the laws of chance or probability. The risk of an effect occurring is increased as exposure to radiation increases, but the effect is not inevitable. Also the severity of effects is not related to dose received. There is no threshold dose below, which the effect does not occur, e.g. induction of cancer and genetic effects i.e. Chromosomal mutations and Leukemias and tumors.

(Ref. Harrison's Principles of Medicine, 17th Edition, Vol. 1, Pg. 2610)

19. **(C). Small intestine**

In enteroclysis, often, barium is infused through a nasogastric tube placed in duodenum or jejunum.

(Ref. Sutton, 6th Edition, Pg. 864)

20. **(D). Staphylococcal pneumonia**

Causes of perihilar ground-glass haziness include:

- (A) ARDS
- (B) Pulmonary edema
- (C) Pneumocystis carinii infection

(Ref. Grainger's Diagnostic Radiology, 4th Edition, Pg. 312)

21. **(D). Helical CT**

Congenital lobar emphysema

- Progressive over inflation of one or multiple lobes, usually of the upper lobes or right middle lobe.
- Left upper lobe is most commonly affected (43%).
- The word emphysema is misnomer as there is no alveolar wall destruction
- The etiology is unknown in many cases but is related to obstruction of the bronchus by a ball valve mechanism
- Present with respiratory distress (90%) with progressive cyanosis within 6 months of life.
- Associated congenital anomalies (cardiovascular) are seen in 50% cases
- Treatment is by lung resection

(Ref. Grainger Diagnostic Radiology, 4th Edition, Pg. 459,652)

22. **(B)** Bronchoalveolar cancer

1. Pleural effusion is seen by plain X-ray chest AP view and in lateral decubitus view. If these are still doubts, we can go in for USG
2. Interstitial lung disease is ideally evaluated with High Resolution CT.
3. Lung mass also can be evaluated by CT.
4. Mediastinal adenopathy is visible in plain X-ray chest, PA view as well as in CT.

RADIOLOGY

HRCT is superior to the plain chest X-ray for early detection and confirmation of suspected ILD. Also, HRCT allows better assessment of the extent and distribution of disease, and it is especially useful in the investigation of patients with a normal chest radiograph. Coexisting disease is often best recognized on HRCT scanning, e.g., mediastinal adenopathy, carcinoma, or emphysema. In the appropriate clinical setting HRCT may be sufficiently characteristic to preclude the need for lung biopsy in IPF, sarcoidosis, hypersensitivity pneumonitis, asbestosis, lymphangitic carcinoma, and PLCH. When a lung biopsy is required, HRCT scanning is useful for determining the most appropriate area from which biopsy samples should be taken.

The other tests used for interstitial lung diseases would include

Radionuclide scanning: Gallium-67lung scanning is of limited value in evaluating the inflammatory component diethylenetriamene pentacetate (DTPA) is an index of pulmonary epithelial permeability that results from inflammation. This test may provide a means of assessing the activity of ILD. Normal 99mTC-DTPA clearance in IPF predicts stable disease, while rapid clearance identifies patients at risk for deterioration.

Pulmonary function testing: Spirometry and lung volumes measurement of lung function is important in assessing the extent of pulmonary involvement in patients with ILD. Most forms of ILD produce a restrictive defect with reduced total lung capacity (TLC), functional residual capacity, and residual volume. Forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) are reduced, but these changes are related to the decreased TLC. The FEV1/FVC ratio is usually normal or increased. Reductions in lung volumes increase as lung stiffness worsens with disease progression. A few disorders (uncommon in sarcoidosis and hypersensitivity pneumonitis, while common in tuberous sclerosis and LAM) produce interstitial opacities on chest X-ray and obstructive airflow limitation on lung function testing.

Diffusing capacity: A reduction in the diffusing capacity of the lung for carbon monoxide DLCO is a common but nonspecific finding in most ILDs. This decrease is due, in part, to effacement of the alveolar capillary units but more importantly, to mismatching of ventilation and perfusion (V/Q). Lung regions with reduced compliance due to either fibrosis or cellular infiltration ma be poorly ventilated but may still maintain adequate blood flow and V/Q in these regions act like true venous admixture. The severity of the reduction in DLCO does not correlated with disease stage.

Arterial blood gas: The resting arterial blood gas may be normal or reveal hypoxemia (secondary to a mismatching of ventilation to perfusion) and respiratory alkalosis. A normal arterial O_2 tension (or saturation by oximetry) at rest does not rule out significant hypoxemia during exercise of sleep. CO_2 retention is rare and is usually a manifestation of end-stage disease.

Cardiopulmonary exercise testing: Because hypoxemia at rest is not always present and because severe exercise – induced hypoxemia may go undetected, it is useful to perform exercise testing with measurement of arterial blood gases to detect abnormalities of gas exchange. Arterial oxygen desaturation, a failure to decrease dead space appropriately with exercise [i.e., a high VD/VT ratio], ad an excessive increase in respiratory rate with a lower than-expected recruitment of tidal volume provide useful information about physiologic abnormalities and extent of disease. Serial assessment of resting and exercise gas exchange in an excellent method for following disease activity and responsiveness to treatment, especially in patients with IPF.

Fibre optic bronchoscopy and bronchoalveolar lavage (BAL)

In selected disease (e.g., sarcoidosis, hypersensitivity pneumonitis, DAHs, cancer pulmonary alveolar proteinosis), cellular analysis of BAL fluid may be useful in narrowing the differential diagnostic possibilities among various types of ILD. The role for BAL in defining the stage of disease and assessment of disease progression or response to therapy remains poorly understood, and the usefulness of BAL in the clinical assessment and management remains to be established.

(Ref. Textbook of Radiology and Imaging, David Sutton, 7th Edition, Pg. 187)

23. **(D). All of the above**

All these conditions are associated with eggshell calcification

Honey combing is seen in:

- Histiocytosis X
- Tuberous sclerosis
- Sarcoidosis
- Pneumoconiosis
- Cryptogenic Fibrosing alveolitis
- Scleroderma
- Rheumatoid arthritis
- Lipoid pneumonia
- Extrinsic allergic alveolar
- Lymphangiomatosis
- Amyloidosis

Crazy pavement appearance is seen in alveolar proteinosis

(Ref. Harrison, 15th Edition, Pg. 1470; Oxford Textbook of Medicine 17.10)

24. **(A). Rheumatoid arthritis : Diffuse pulmonary hemorrhage**

Rheumatoid arthritis	:	Lung nodules
Scleroderma	:	Progressive pulmonary fibrosis
SLE	:	'*Shrinking lung*' syndrome
Wegener's granulomatosis	:	Cavitating lung lesions
Sarcoidosis	:	Bilateral symmetrical hilar adenopathy Parenchymal, interstitial & pleural changes
Good Pastures syndrome	:	Diffuse pulmonary hemorrhage

Sjogren's syndrome	:	Interstitial fibrosis similar to cryptogenic fibrosing alveolitis mainly affecting lower zones and lymphocytic interstitial pneumonitis

(Ref. Harrison's, 17th Edition, Vol. 2, Pg. 2078, 2088)

25.**(D). MRI**

Pancoast tumor includes bronchogenic carcinoma, usually squamous cell type, affecting left lung apex, eroding ribs (1st and 2nd) involving brachial plexus and sympathetic chain (Horner's syndrome). MRI is optimal modality to demonstrate the extent of superior sulcus tumor.

(Ref. Grainger Diagnostic Radiology, 4th Edition, Pg. 321, 463, 475)

26.**(A) Elevation of left main bronchus.**

Elevation of left main bronchus is the earliest chest x-ray sign of LA enlargement on chest xray . On barium swallow study the esophageal indentation is earliest evident.

(Ref. David Sutton, 6th Edition, Vol. 1, Pg. 345)

27.**(B) Emphysematous Pyelonephritis**

Emphysematous Pyelonephritis

- It is chronic suppurative granulomatous infection in diabetics.
- It can be type1 or type2.
- The infecting organism is usually E. coli.
- There is female preponderance.
- On x-ray there may be air lucencies seen.
- CT findings include loss of CM differentiation with calculi and low attenuation air foci in the renal parenchyma with/without in PCS and perinephric space and perirenal fat stranding.
- If untreated it can be life threatening.

(Ref. Grainger's Diagnostic Radiology, 4th Edition, Pg. 1551, 1764)

28.**(A). USG**

Ultrasound scanning is the least invasive means of detecting hydronephrosis and has been used to diagnose pelviureteric junction obstruction in utero.

Excretion urography is helpful if there is still significant function in the obstructed kidney. The extrarenal pelvis is dilated and the minor calyces lose their normal cupping and become 'clubbed'. In very advanced cases, the thin rim of poorly functioning renal parenchyma may give a faint nephrogram around the dilated calyces — a 'soap-bubble' appearance. If the level of obstruction is in doubt it can help to take follow up films up to 24 hours after the contrast has been injected.

The radio-opaque medium slowly diffuses to fill the obstructed system down to the block.

Isotope renography is the most helpful test to establish that dilatation of the renal collecting system is due to obstruction.

(Ref. Bailey and Love, 25th Edition, Pg. 1294)

29.**(B). Sonography can detect ureteral stones very sensitively and is therefore commonly used in the evaluation of renal colic**

Spiral CT without intravenous contrast is an easy and sensitive way to detect obstructing or nonobstructing ureteral calculi. If the calculus is larger than 5 mm, lithotripsy is usually necessary to fragment the stone to allow its passage. With stones less than 5 mm, hydration with pain management is usually adequate. The passage can be monitored with plain films.

Sonography is highly sensitive in the detection of hydronephrosis. It cannot detect ureteral stones, however, and is therefore not commonly used in the diagnosis or management of renal colic.

In patients with renal colic in whom CT does not detect a ureteral stone, other causes of pain can be evaluated with CT, thereby simplifying the diagnostic work-up.

(Ref. CEDT, 5th Edition, Pg. 761)

30.**(C).** Von Hippel Lindau syndrome

A well-circumscribed low attenuation mass lesion with central stellate scar and mild homogenous enhancement in a otherwise healthy middle aged female is very likely to be Oncocytoma.

(Ref. Grainger's Diagnostic Radiology, 4th Edition, Pg. 1529)

Topic 2 – Gastrointestinal System, CVS, Musculoskeletal System

31.**(B). Angiography can image bleeding at a rate of 0.05-0.1 ml/min or less**

Detection of gastrointestinal bleeding depends on:

Angiography:

- Angiography will detect bleeding only if extravasation is occurring during the injection of contrast.
- Angiography detects bleeding at the rate of 0.5 mL/min
- Angiography is 63% sensitive for upper GI bleed and 39% for lower GI bleed while radionuclide methods are very sensitive in detecting blood loss from GIT, but less accurate than angiography in localizing the site of bleeding.
- Advantages:

- Precise localization of bleeding site in areas inaccessible to endoscopy
- Even in significant active bleeding, good angiography is almost certain in identifying the culprit site
- Transcatheter embolization can be simultaneously applied, especially to much wider range of lesions than endoscopy can.

Radionuclides scan:

- RBC nuclear scan (Tc-99m Sulfur colloid) detects bleeding at the rate of 0.05 - 0.1 mL/min with almost higher specificity, however are usually used as a complimentary to arteriography.
- Tc 99m-labeled RBCs are not useful in occult bleeding and detect acute /intermittent bleeding of 0.35ml or more per minute.

(Ref. Grainger Diagnostic Radiology, 4th Edition, Pg. 1171; RRM Dahnert, 5th Edition, Pg. 1111)

32. (C). Aberrant right subclavian artery

- **Aberrant right subclavian artery passes posterior to esophagus from left to right and cause indentation on esophagus.**

(Ref. Sutton, 7th Edition, Pg. 552-554)

33. **(A). MRI is used with HASTE being the "Work-horse"pulse sequence used**

- MRCP (Magnetic resonance cholangiopancreatography) is a radiological technique that produces images of the pancreatobiliary tree that are similar in appearances to those obtained by invasive radiographic methods, such as endoscopic retrograde cholangio-pancreatography (ERCP), MRCP do not require administration of contrast agents.

Diagnostic advantages	**Diagnostic contraindication**	**Contraindication**	**Complications**	**Comment**	**Limitations**
i) Magnetic resonance cholangiopancreatography :					
Useful modality for visualizing pancreatic and biliary ducts	Cannot offer therapeutic intervention		Claustrophobia		None
	Intervention		Certain metals (iron)		
Has excellent sensitivity for bile duct dilatation biliary					

stricture and intraductal abnormalities. Can identify pancreatic duct dilatation or stricture, pancreatic duct stenosis, and pancreas divisum					

ii. **Endoscopic Retrograde Cholangiopancreatogram :**

Simultaneous Gastroduodenal pancreatography	**Pregnancy obstruction**	**Pancreatic**	**Cholangiogram of**
Best visualization of distal biliary tract Bile or pancreatic cytology Endoscopic sphincterotomy and stone removal Biliary manometry treatment possibility	? Roux en Y biliary enteric anastomosis Perforation (rare) Prior biliary surgery Endoscopic Sphincterotomy - α	? Acute Severe cardio infected pancreatic pseudocyst pulmonary	Cholangitis, sepsis choice in : pancreatitis Absence of dilated ducts? pancreatic ampullary disease or grastroduodenal disease

(Ref. Harrison, 16th Edition, Pg. 1889)

34. **(C). Carcinoma stomach**

Ulcerating carcinoma of the stomach with mass is the most frequent type encountered in North America and Western Europe. These carcinomas have been described as irregular, saucer-shaped lesions with ulcerated centers. Such a configuration may produce the meniscus or Carman sign, which indicates a large irregular ulcer with a mass. This is a long-present lesion. The size of the tumor is not in itself an indication of benignity or malignancy. The most important criteria for malignancy are irregularity of the ulcer, failure to project from the lumen of the stomach, and nodularity of the surrounding mass. Occasionally a benign ulcer surrounded by a large ulcer mound may simulate an ulcerating carcinoma.

(Ref. Grainger diagnostic Radiology, 4th Edition, Pg. 1043, 1057)

35. **(C). Periampullary carcinoma**

Ampullary carcinoma

Malignant epithelial neoplasm arising from ampulla of Vater

Patients present with jaundice, abdominal pain and weight loss with typical history of passing silvery stools

Classic imaging appearance:

Lobulated soft tissue mass arising from ampulla of Vater

"Double duct sign" with obstruction of PD.

(Ref. Bailey & Love, 25th Edition, Pg. 1148-1152)

36. **(A).** Pancreatic infiltration

On barium meal, the loop of duodenum is widened also k/a Pad Sign in cases of carcinoma head of pancreas.

(Ref. Das manual on Clinical Surgery, 5th Edition, Pg. 368)

37. **(C). ''Tooth paste' appearance of ileum**

Intestinal TB:
The main types of intestinal TB are ulcerative form (most frequent), hypertrophic form and mixed form.
Location: Ileocaecal region > ascending colon > jejunum > appendix > duodenum > stomach > sigmoid > rectum > esophagus.
i.Ileocaecal area:

- Stierlin sign → rapid emptying of narrowed terminal ileum into shortened rigid obliterated caecum on barium examination.
- Thickened Ileocaecal valve

- Fleischner's sign (inverted umbrella defect)→ wide gaping patulous ileocaecal immediately adjacent terminal ileum
- Deep fissures + large shallow linear/stellate ulcers with characteristic elevated margins.
- Symmetric annular 'napkin ring' stenosis
- Widened IC angle (Normal is 90^{o}) → it becomes obtuse

ii. Colon:
- Segmental colonic involvement
- Diffuse ulcerating colitis + pseudopolyps
- Amputated/ Coned/ Contracted caecum

iii. Gastroduodenal:
- Simultaneous involvement of pylorus + duodenum → 'Linitus plastica' appearance.
- Linitus plastic may also be a feature of gastric lymphoma and Scirrhous carcinoma, eosinophilic gastritis

(Ref. Grainger's Diagnostic Radiology, 4th Edition, Pg. 1087, 1134)

38. **(D). Colovesical fistula**

Ulcerative colitis
- Inflammatory bowel disease
- Rectum is always involved
- Bloody diarrhea is the most common presentation

Double Contrast Barium Enema (DCBE) is the radiological examination of choice to show disease extent and severity

Instant enema→ In UC the large bowel is inflammed and contains no fecal matter, and hence enema study can be done without bowel preparation.

Acute changes:
1. *Earliest radiological change* on DCBE is blurring of mucosal lining and a fine mucosal granularity (enface) due to edema.
2. Colorectal narrowing and incomplete filling due to spasm and irritability
3. Scalloping of the edges of colon, especially the sigmoid colon
4. Mucosal stippling due to crypt abscesses (continuous; not transmural)
5. 'Collar button' ulcers
6. Toxic megacolon
7. Pseudopolyps

Chronic changes:

1. Shortening and narrowing of colon
2. 'Lead pipe' colon
3. Loss of haustrations
4. Backwash ileitis
5. Thickened rectal valve
6. Widening of Presacral space (normally 1.5 cm at S_4 vertebral level)

7. Benign stricture
8. Carcinoma of colon/rectum

(Ref. Sutton's Radiology, 7th Edition, Pg. 647, 648)

39. **(C). USG**

Barium enemas although have added advantage of chances of reduction of **Intussusception,** but there occurs ionizing radiation dose exposure.

Ultrasonography can promptly diagnose **Intussusception,** without risk of radiation hazard and if required under image guidance hydrostatic saline reduction can be attempted.

(Ref. Harrison's Principles of Internal Medicine, 17th Edition, Vol – II, Pg. 1904)

40. **(D). Pneumoperitoneum**

Pneumoperitoneum is characterized by free gas under the domes of diaphragm.

Signs of Pneumoperitonium on supine film are:

- Football sign (air dome)
- **Rigler'sdouble wall sign** (visualization of both sides of bowel wall)
- Saddlebag/mustache Cupola sign (air trapped below the central tendon of diaphragm)
- Doge's cap sign (triangular collection of gas in Morrison's pouch)
- Lucent liver sign
- Inverted 'V' sign (medial and lateral umbilical ligament visualization)
- Visualization of falciform ligament
- Urachus sign
- Right upper quadrant gas (perihepatic, subhepatic, Morrison's pouch)
- Gas in scrotum (in children)
- Tell-tale triangle sign (air seen between bowel loops) on lateral horizontal beam film

(Ref. Grainger's Diagnostic Radiology, 4th Edition, Pg. 991)

41. **(A). Carolis disease**

Caroli's disease is a rare, congenital cystic dilatation involving intrahepatic bile ducts. The term Caroli's syndrome is used if the above anomaly is associated with congenital hepatic fibrosis. These entities belong to the group of hepatic fibropolycystic diseases, which are usually associated with renal polycystic disease. We report a case of Caroli's syndrome presenting as portal hypertension with medullary sponge kidneys. The classical "**central dot sign**" described on CT is well **demonstrated easily on ultrasound**. Awareness of this finding is highlighted

Caroli's disease is characterized by congenital, segmental, nonobstructive, saccular dilatation of intrahepatic bile ducts without other hepatic abnormalities. It was presumed to be autosomal recessive in character. Two forms of the disease have been described. The rare, so called pure form described by Jacqui Caroli is characterized by

segmental saccular communicating intrahepatic bile duct dilatation, frequently present with stone formation, recurrent cholangitis and hepatic abscess. The liver involvement can be diffuse, lobar or segmental. It usually presents in childhood and about 75% of affected patients are boys. Cholangiocarcinoma can develop in 7% of patients. Caroli's syndrome is another form that is more common and is associated with congenital hepatic fibrosis. The dilatation of intrahepatic biliary ducts in usually less prominent. Both the conditions result from malformation of the embryonic ductal plate at different levels of the biliary tree http://www.ijri.org/article.asp?issn=0971-3026;year=2000;volume=10;issue=3;spage=173;epage=174;aulast=Moorthy - ref3#ref3. These patients present with features of portal hypertension. This ductal plate malformation of the interlobar bile ducts results in malformed and abnormally shaped branch bile ducts, around the portal tracts. Some of the bile ducts contain bile. There is no inflammation or regeneration of nodules. Choledochal cysts may be associated. Portal hypertension is caused by hypoplasia or fibrous compression of portal vein radicles in the fibrous bands surrounding the nodules. These dilated sacculi or cystic spaces appear as anechoic areas on ultrasound and are hypodense on CT. The fibrovascular bundles containing portal vein radicals and a branch of the hepatic artery bridging the saccule appears as a central dot or a linear structure on CT, enhancing with contrast. This "central dot sign" described on CT can be easily seen on ultrasound as demonstrated in our case. Awareness of this finding on ultrasound can result in proper diagnosis and can avoid invasive tests for confirmation. The dilated cysts communicate with bile ducts. On color flow Doppler imaging, flow can be demonstrated within the linear strands. Cholangiography shows diverticulum-like sacculi of intrahepatic bile ducts of varying sizes, shapes and distribution. Calculi are common. The common bile duct is normal. Hepatic scintigraphy with 99 mTc diethyl IDA shows the typical "beaded" appearance of dilated intrahepatic bile ducts. In Caroli's syndrome both CT and ultrasound show focal mild dilatation of intrahepatic bile ducts (2-3 mm). The liver shows changes of portal hypertension (shrunken liver, splenomegaly, splenic and esophageal varices and ascitis). Intrahepatic biliary calculi are absent. Cholangiography shows typical findings of focal segmental dilatation. The MRCP findings in Caroli's disease are similar to ERCP [8].
Caroli's disease may be associated with choledochal cysts, medullary sponge kidney, infantile and adult polycystic kidney disease and cystic renal dysplasia. Cholangiocarcinoma may be a complication. Cirrhosis of liver mimics this condition and can be differentiated by biopsy where there will be hepatocellular dysfunction. Caroli's disease is sometimes included in the classification of choledochal cyst, which is not appropriate since choledochal cysts occur in extra hepatic bile ducts and there is no renal involvement.

(Ref. http://www.ijri.org/article.asp?iss, Pg.0971-3026; year=2000; Volume=10; Issue=3; Pg. 173; Pg. 174; aulast=Moorthy)

42. **(A). USG abdomen**

Benign strictures of the biliary tree have a variety of causes including traumatic, chronic pancreatitis, gallstones, infection, and other rare causes. Surgical injury is by far the most common and accounts for 95% of cases.

At cholangiography, benign strictures are typically focal, smooth areas of narrowing with proximal biliary dilatation.

CT and ultrasonography typically show only the duct dilatation with a gradual tapering of the duct diameter, without a surrounding mass present.

Postcholecystectomy strictures usually occur in the mid common duct near the junction with the cystic duct, although if instrumentation of the duct is performed, strictures can occur more distally as well. Distal strictures at the sphincter of Oddi may be difficult to diagnose at cholangiography, since the duct normally terminates in this region. An elongated or rigid ampullary segment and failure of the CBD to drain contrast material at 45-minute delay filming is highly suggestive of stricture.

ERCP has become **primary method** of direct cholangiography and additionally it offers the ability to examine upper GIT, the papilla of Vater and the pancreatic duct.

It has developed considerable therapeutic potential and guided biopsies are possible. Post cholecystectomy biliary stricture is important to identify and if ultrasound or other studies suggest that obstruction is low, ERCP is investigation of choice.

(Ref. Sutton's Radiology 6th Edition, Pg. 963, 971, 972);

43. **(B). CECT**

CECT is investigation of choice for Acute pancreatitis.

CT also is useful to predict the severity of the case.

Scoring system for severity of Acute Pancreatitis by CT is called CT severity Index/CTSI and is as follows:

CT features	**Score**
I. Grade	
Normal gland	0
Focal / diffuse enlargement	1
Peripancreatic inflammatory changes	2
Single Peripancreatic fluid collection	3
2 or more fluid collections or abscess	4

II. Necrosis	
None	0
< 33%	2
33-50%	4
> 50%	6

Total CTSI (0-10) = Balthazar grade (0-4) + CT scoring (0-6)

Score	**Morbidity**	**Mortality**
0-3	8%	3%
4-6	35%	6%
7-10	92%	17%

(Ref. Bailey & Love, 25th Edition, Pg. 1140-1141)

44. **(C). Focal nodular hyperplasia**

Liver parenchyma is primarily made up of two type of cells :

1. Hepatocytes → Perform excretory & synthetic function
2. Kupffer cells → They have Reticuloendothelial function.

Both these cells can be investigated with Tc labeled cells. Two types of Radionucleotide imaging procedure are used in liver.

A. Hepatocytes based imaging (IDA imaging)
IDA compounds are taken up by functioning hepatocytes, excreted unchanged in bile & not resorbed from the gut.

It will allow imaging of liver parenchyma, trace the flow of bile, in the ducts, gall bladder & bowel.

Its uses are

a) Assessment of liver function
b) Biliary obstruction

c) In liver trauma to see bile leaks
d) Choledochal cyst
e) Demonstration of G. B. Function

B. Colloid Scintigraphy
They demonstrate the functioning tissue by targeting the reticuloendothelial cells of liver.

Interpretation is :

Non functioning area → Mass lesion which do not contain functioning RE cells

Hot spots → Mass lesions which contain functioning RE cells (Kupffer cells)

Focal Nodular hyperplasia →

Only liver tumour which consistently contains functioning RE cells & shows uptake of labelled colloids.

FNH also contains functioning hepatocytes and takes up IDA compound.

Histology typically shows presence of bile ductules within FNH but ducts do not communicate with biliary tree so there is no excretory pathway.

This explains why FNH lesions characteristically show prolonged retention of IDA on delayed images.

Hepatic Adenoma

This Benign tumour contains little functioning RE cells so colloid scan will show non functioning area.

IDA scan will show normal Hepatocytes

Hepatic carcinoma

Contain little or no functioning liver tissue. Both the colloid and IDA uptake is very low.

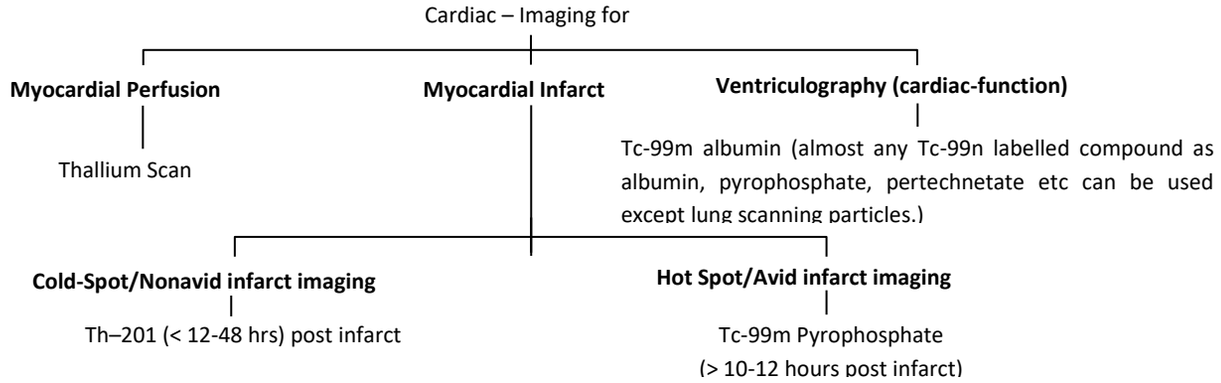
(Ref. Sabiston, 16th Edition, Pg. 1015-1016; Bailey & Love, 24th Edition, Pg. 1068)

45. **(B). Thallium-201 scan**

- For myocardial perfusion imaging agent of choice is Thallium-201-chloride.
- Interpretation of stress thallium image

Immediate Image	Delayed Image	Diagnosis

Normal	Normal	Normal
Defect	Fill-in	Reversible/Excretional Ischemia
Defect	Defect persist	Myocardial-scar
Defect	Partial fill-in	Scar + Persistent Ischemia



(Ref. Braunwald Heart Disease, 6th Edition, Pg. 279; Wofgang, 5th Edition, Pg. 1102;

Harrison, 15th Edition, Pg. 1276)

46. **(D) Pulmonary venous hypertension**

There is dialation of upper lobe pulmonary veins and constriction (l/t oligemia) of lower lobe veins causing inverted moustache sign, in mitral stenosis.

In mitral stenosis there is increase in PCW pressure which cause radiological changes.

PCWP (mm hg)	Finding
5 -12	Normal
12-17	Cephalization of pulmonary vessels (only in chronic conditions)
17-20	Kerley lines, subpleural effusion
> 25	Alveolar flooding edema

Radiographic changes of mitral valve disease (mainly rheumatic)

1. Left atrial enlargement seen as straightening of left border to bulge immediately below left bronchus.
2. Upper lobe blood diversion seen as distension of upper lobe veins and constriction of lower lobe veins.
3. Interstitial Edema seen as Kerley's septal costophrenic B lines and central A lines.
4. Alveolar edema seen as perihilar confluent shadows.
5. Pulmonary hemosiderosis seen as fine punctuate densities through out lung (miliary shadow) usually after years and in MS
6. Pulmonary ossified nodules seen as discrete calcified densities at the lung base, is d/t PAH in long standing MS.
7. Pulmonary arterial hypertension seen as enlargement of main pulmonary artery and central pulmonary vessels with peripheral vessels pruning.

(Ref. Grainger, 4th Edition, Pg. 833/ 877; Harrison)

47. **(C). Echocardiography**

Pericardial Effusion		
X-Ray	Investigation of choice	Best investigation
Water bottle / Pear shaped heart	Echocardiography	CT / MRI Used when echo is equivocal or if epicardial fat is present

(Ref. Branwald – heart disease, 6th Edition, Pg. 1839)

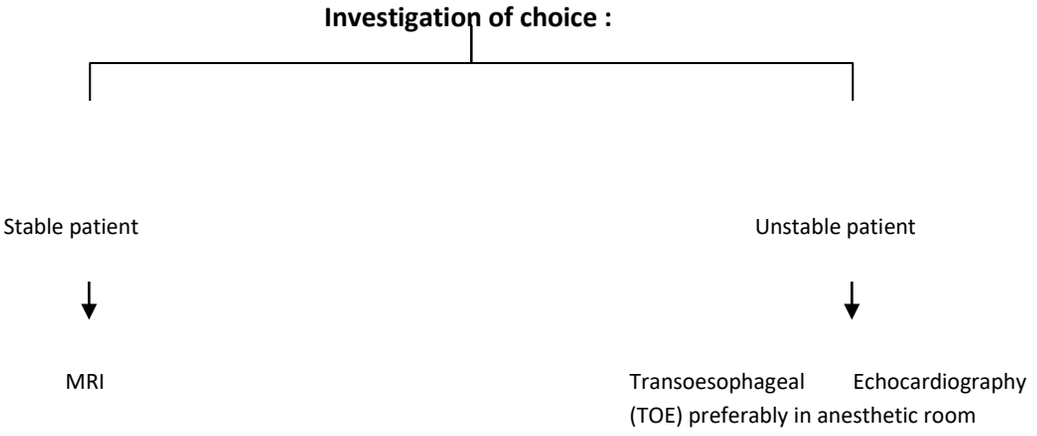
48. **(C). Gating is not required with 1.5T MRI machines.**

Echocardiography often displays the tumor as a mass adjacent to the heart, but CT or MRI can only show the exact localization of the tumor and its relationship to the pericardium. In patients with suspected pericardial or paracardiac tumors, MRI has advantages over CT because it is a multiplanar modality. Coronal or sagittal images may more clearly demonstrate the relationship of tumor, pericardium, and other cardiac structures.

(Ref. Radiology by David Sutton, 7th Edition, Pg. 349)

49. **(C). MRI**

- Most patients are in 50-70 years age group presents with very sudden onset pain often accompanied by tearing sensation. It is usually felt in the precordium and substernal region but may be in back between scapula. These patients are usually misdiagnosed as having cardiac ischemia, which increases risk of complications.
- Dialation and dissection in Marphan Syndrome are probably caused by a failure to resist shearing stress in media. In Ehlers-Danlos collagen molecule abnormalities predispose to dilation and saccular aneurysms but not to dissection these patients have normal resistance to shearing stress.
- Stanford classifies it into two types as Type A (involving ascending aorta) – which is more common and carry high probability to complications and mortality; and Type B (not involving ascending aorta).



- Aortography is the gold standard

(Ref. Grainger, 4th Edition, Pg. 956-58)

50. **(B). Fracture of dens**

- MRI is the investigation of choice for imaging traumatic spine and parenchymal disesase.
- CT is second best investigation.

(Ref. Maheshwari, 3rd Edition, Pg. 154)

51. **(C). Pyle's disease**

Wormian bones can be seen in:

- Normal infants (up to 6 months of age)
- Down's syndrome
- Cleidocranial dysostosis
- Hypothyroidism
- Hypophosphatasia
- Healing phase of Rickets
- Osteogenesis imperfecta
- Otopalatodigital syndrome
- Kinky hair syndrome
- Progeria
- Pachydermoperiostitis
- Pyknodysostosis

(Ref. Grainger Diagnostic Radiology, 4th Edition, Pg. 1949)

52. **(D).** It is 6 times more common in males.

<u>Developmental dysplasia of the hip (DDH)</u>

- The hip is a ball and socket joint with the ball (called the femoral head) coming from the top part of the femur (thigh bone) and the socket (called the acetabulum) coming from the pelvis.
- The cause is unknown, but genetic factors may play a role.
- Problems resulting from very mild developmental dysplasia of the hip may not become apparent until the person is in their 30's or 40's.
- One or both hips may be involved.
- Risk factors include being the first child, being female, a breech delivery, and a family history of the disorder.
- A hip radiograph is helpful in older infants and children. But, ultrasound of the hip remains the most important imaging study and will demonstrate hip deformity.
- When the ossification center is in the upper outer quadrant, the hip is dislocated.

(Ref. Sutton, 6th Edition, Pg. 1105)

53. **(B).** Tuberculosis

Causes of vertebral destruction without loss of OR maintained of IVD space :
- Lymphoma
- Metastases
- Trauma
- Osteoporotic fractures

(Ref. Radiology Review Manual, 5th Edition, Pg. 182)

54. **(A). Ankylosing spondylitis**

"Iliac horns" are feature of Nail Patella syndrome.

Diagnostic radiological features of Ankylosing spondylitis are:
- Bilateral symmetrical Sacroilitis (earliest and most specific feature)
- Bamboo-spine (knobby spine, poker back or universal syndesmophytosis) is a characteristic feature of it.
- Syndesmophytes are gracile ossifications of the outer fibers of annulus fibrosis.
- Enthesitis (earliest pathological change)
- Uncommon involvement of small joints of hand and feet.

(Ref. Sutton's Textbook of Radiology, 6th Edition, Pg. , 1220)

55. **(B).Growth arrest lines**

Characteristic radiological signs in scurvy :
1. The **epiphysis** is small & sharply **marginated** by **sclerotic rim** (Wimberger sign)
2. The zone of provisional calcification at the growing metaphysis is dense, giving a white line **(Frankel's line)**
3. Beneath this is a lucent zone due to lack of mineralization of osteoid (Trumerfeld zone)

4. As this area is weakened, it is prone to fractures which manifest themselves at the cortical margin, giving rise to **(Pelkan's) spurs**.
5. Periosteal elevation due to subperiosteal hemorrhages and subsequent new bone formation particularly following treatment.

(Ref. Textbook of Radiology & Imaging, Sutton, 7th Edition, Pg. 1356)

56. **(D). Magnetic Resonance Imaging (MRI)**

Perthe's disease is a type of aseptic necrosis of bone that occurs in the femoral head. It has numerous causes like trauma, hemolytic anaemia, diabetes, etc.
MRI is best imaging modality for showing early change of Perthe's disease such as bone marrow oedema & surrounding soft tissue changes. These are signs that are evident before any bone change like reduced bone density.
CT will show early bone changes like devascularisation but is not able to shows marrow changes. X ray changes take much longer.

(Ref. Sutton 6th edition. Pg.68-70)

57. **(C). Osteopetrosis**

In osteopetrosis there is reduced osteoclastic bone resorption resulting in diffuse symmetrical skeleton sclerosis. Also k/a marble bone disease d/t its stone like quality of bones; however the bones are abnormally brittle and fracture like a piece of chalk. It can present radiologically as

- Sclerosis of all bones more prominent at base of skull
- Sclerosis of vertebral end plate l/t characteristic sandwich or broad stripped (rugby jersey spine).
- Bone in bone appearance d/t sclerotic foci with in the bone.

(Ref. Robbin's Pathological basis of disease, 7th Edition, Pg. 1281)

58. **(A). Leprosy**

Abnormalities in the forefoot may reflect infection alone, neuropathy alone, or a combination of neuropathy, infection, and small-vessel disease. Although abnormalities in the midfoot and hindfoot are most likely to represent neuropathy, osteomyelitis of the calcaneus may arise secondary to an underlying infected plantar ulcer. Hypertrophic or atrophic neuroarthropathy may occur in the forefoot. In the atrophic type, osteolysis of the distal ends of the metatarsals combined with broadening of the bases of the proximal phalanges produce "pencil and cup" deformities that simulate those of leprosy; *"sucked candy-stick" or "sharpened pencil" deformities of the metatarsal heads* may occur. Alternatively, the metatarsal heads may become flattened or fragmented. Dorsiflexion and shortening of the toes combined with plantar subluxation of the metatarsal heads predispose to neurotrophic ulceration of the soft tissues beneath the metatarsal heads and over the proximal interphalangeal joints. Unperceived chronic trauma may lead to periosteal reaction along the shaft of a bone in the absence of infection and may evolve into sclerosis of the entire shaft. Infection may accompany the neuropathic changes and accelerate joint destruction. Neuroarthropathy is a contraindication to joint

replacement because of the associated tendency to instability resulting from unrecognized trauma combined with subluxation.

(Ref. Sutton's Radiology, 6th Edition, Pg. 61, 62)

59. **(B). Chondrosarcoma**

The given clinical, radiological, and histological features are classical of chondrosarcoma.

Cartilagenous benign tumors:

- Enchondroma
- Chondroblastoma
- Chondromyxoid fibroma

Cartilagenous malignant tumor:

- Chondrosarcoma

(Ref. Apley's System of Orthopedics, 5th Edition, Pg. 171)

Topic 3 – Head, Neck & Spine, Endocrine System Obstetrics & Gynecological Radiology, Breast Imaging & Interventional Radiology

60. **(B). Eosinophilic granuloma**

Histiocytosis commonly involves the skull, particularly in Letterer- Siwe and Hand Schuller Christian disease where the typical 'geographical skull' defects may be seen. Eosinophilic granuloma may present as an isolated lesion.

(Ref. Harrison, 17th Edition, Pg. 374)

61. **(A). Helical CT scan without IV contrast**

In head trauma the imaging study of choice is CT scan.
Usually is contrast study is not needed for head injury per se.
Skull radiographs have extremely limited value as compared to CT except in evaluation of skull fractures that to depressed skull fracture/fracture base of skull.
Indications for CT include:

- **Loss of consciousness**
- **Altered mental status**
- **Focal neurologic signs**
- **Clinically suspected basilar fracture**

- **Depressed skull fracture**
- **Penetrating wound (e.g. bullet)**
- **Suspected acute SAH/EDH/SDH/ Parenchymal Hematoma.**

(Ref. RRM by Dahnert, 5th Edition, Pg. 285)

62. **(C). Crescent-shaped hyperdense lesion**

An acute subdural hematoma, i.e, within 48 hours of injury, appears on non –contrast CT scan as a **hyperdense (white), crescentic (concavoconvex) mass** along the inner table of the skull, most commonly over the frontoparietal regions or middle cranial fossa and associated with ipsilateral brain swelling. Subdural collection are generally of higher attenuation than the brain for about two weeks, and after three to four weeks are of lower attenuation, eventually approaching that of CSF.

Extradural hematomas appear as high – density, biconvex (lentiform) areas immediately subjacent to the vault.

Subacute subdural hematomas often become lens-shaped and can be confused with an epidural hematoma.

(Ref. Textbook of Radiology & Imaging, Sutton, 7th Edition, Vol.2, Pg. 790)

63. **(B). Herpes simplex encephalitis**

Herpes simplex encephalitis predominantly involves the **temporal** and **frontal** lobes and presents with fever, headache, behavioral changes, **confusion**, **focal neurological findings** and abnormal CSF findings. There are, however, no pathognomonic clinical findings and the definitive diagnosis depends upon the identification of HSV within the CSF by means of PCR or within the brain tissue by means of brain biopsy. **MRI**, which is highly sensitive to white matter changes, is the investigation of choice and reveals the lesions as **high signal (hyperintense)** on T_2 weighted images. Hemorrhage may occur as increased signal on T_1 weighted images & usually implies extensive necrosis. MRI also shows periventricular signal change not apparent on CT.

MRI in neurocysticercosis shows small rounded, cyst like structures due to the individual bladders. Small calcified foci representing the residual scolex are not identified on MRI.

Acute pyogenic meningitis does not generally produce changes in the CT or MRI, though evidence of ischemia or empyema may be seen.

Carcinomatous meningitis, on MRI, demonstrates meningeal enhancement, usually at the basal cisterns. The ventricular lining is frequently involved.

(Ref. Harrison, 17th Edition, Pg. 1088, 2625, 2630-2633, 1097-1100)

64. **(D).** Radiotherapy is treatment of choice

Angiofibroma is very vascular tumor of **teen age boys.CT scan** is the inv. of choice to see the extent of invasion.

Juvenile Nasopharyngeal Angiofibroma/ Nasopharyngeal fibroma

|

CT Scan with contrast enhancement **MRI**

• **Inv. of choice** • Anterior bowing of posterior wall of maxillary sinus (antral sign) is pathognomic	• When soft tissue extension is present intracranially / infratemporal fossa or into the orbit.

(Ref. P. L. Dhingra, 3rd Edition, Pg. 300)

65. (B). Meningiomas

A number of neoplastic lesions in the head and neck area are hypervascular, most commonly meningiomas and hemangioblastomas intracranially and paragangliomas and juvenile nasopharyngeal angiofibromas extra cranially.

(Ref. Radiology Review Manual, 5th Edition, Pg. 299)

66. **(D). Arteriography**

Arteriography is considered the gold standard in evaluation of **arteriovenous fistula, aneurysm and aortic dissection.**

- Aneurysm is a sac filled with blood in direct communication with the interior of an artery. A true aneurysm is due to local dilatation of the artery where as a false aneurysm is a sac with walls formed of condensed connective tissue which communicates with the lumen of the artery through its apparatus in its wall. Aneurysm may be classified into congenital, infective, degenerative, dissecting, post stenotic, post inflammatory (arteritic; necrotic), traumatic and cirsoid.
- Arteriography is the gold standard for all types of aneurysms; but in dissecting aneurysm (aortic dissection) the investigation of choice is MRI in stable patients and TOE (trans oesophageal echocardiography) in unstable patients.
- For detecting aortic dissection MRI had a **sensitivity** of 98.3%, TOE 97.7%, CT 93.8% and TTE 60% (MRI>TOE>CT>TTE). MRI had **specificity** of 97.8%, CT of 87%, TTE 83% and TOE 77% (MRI>CT>TTE>TOE). MRI and CT were more sensitive than TTE in **detecting thrombus formation** but not superior to TOE (TOE>MRI>CT>TTE). CT was not effective in detecting the entrance site or regurgitation but MRI and TOE accurately identified both.
- **Aortography (Arteriography)** is considered the **gold standard** in evaluation of aortic dissection. The diagnosis can be made by recognizing an initial flap or a double lumen, findings which are pathognomic. The indirect findings are – compression of true lumen, thickening of aortic valve, branch vessel abnormalities, aortic insufficiency or an ulcer like projection beyond the aortic intima wall.

(Ref. Wolfgang Dan hert, 5th Edition, Pg. 604-605;

Grainger and Allison's 4th Edition, Pg. 841-843, 956-958, 2379)

67. **(B).** low grade astrocytoma

Usually low grade astrocytomas do not show contrast uptake.

(Ref. Sutton, 7th Edition, Pg. 1752)

68. **(**D) Corpus callosal lipoma

Corpus callosal lipoma shows bracket clacification.

Meningiomas show the highest incidence & the density of calcification among brain tumours. It also typically causes hyperostosis of overlying skull vault. Ependymomas & medulloblastomas also calcify but to lesser extent. Plain CT scan is the most sensitive investigation for tumour calcification.

(Ref. www.emedicine.com/RADIO/topic439.htm; Harrison, 17th Edition, Pg. 2605, 2606)

69. **(B).** Neurofibromatosis

Neurofibromatosis, Ankylosing spondylitis, ependymoma & achondroplasia cause posterior scalloping.

Causes of anterior scalloping of vertebrae :

a) Aortic aneurysm

b) Lymphadenopathy

c) Multiple myeloma

d) Tuberculosis

(Ref. Textbook of Radiology & Imaging – David Sutton, 7th Edition)

70. **(A). White matter**

Disease related changes are detected by MRI in more than 90% of patients who otherwise meet diagnostic criteria for definite multiple sclerosis. On inversion-recovery of T_1-weighted imaging sequences, the brain may appear normal or show darkened (hypodense) punctuate foci in the white matter.

Characteristic changes of MS are best appreciated with spin-echo (T_2 weighted) and proton density sequences, in which abnormal hyperintense areas stand out brightly from the surrounding brain substance.

Some foci that are hyperintense on T_2 weighted image may appear to extend outward from the ventricular surface, corresponding to a pattern of perivenous demyelination that is pathologically observed in MS (Dawson's fingers) Lesions are also commonly found within the brain stem, cerebellum and spinal cord.

Multiple sclerosis (MS) is characterized by a triad of inflammation, demyelination, and gliosis (scaring). For diagnosis of **(MS)** involvement must reflect predominantly disease of white matter long tracts, usually including (a) pyramidal pathway (b) cerebellar pathway (c) medial longitudinal fasciculus (d) optic nerve (e) posterior columns :

– Lesions in the anterior corpus callosum are helpful diagnostically because this site is usually spared in cerebrovascular disease.

(Ref. Harrison, 17th Edition, Vol. II, Pg. 2074, 2611)

71. **(B). Amyotrophic lateral sclerosis**

Amyotrophic lateral sclerosis

It is characterized by progressive muscle weakness, limb and truncal atrophy and bulbar signs and symptoms. Mean age at diagnosis at 57 years. Disease progression is relentless; half the patients are dead within 3 years and 90% have died by 6 years following symptom onset.

Non-tau inclusions and degeneration in spinal motor neurons and pyramidal tracts (Corticospinal tracts) usually produce no specific sign on MRI except for occasional signal changes on T2WI. T2WI disclose high signal areas along the large myelinated pyramidal tract fibers in the posterior limb of the internal capsule and cerebral peduncles in about 25% cases.

(Ref. Annie Osborn Diagnostic Neuroradiology, Pg. 778)

72. **(B). Oligodendroglioma**

Intradural metastases (drop metastasis) are a frequent complication of intracranial medulloblastoma, ependymomoblastoma, and pineal germinomas and are less commonly associated with high-grade astrocytomas, mature ependymomas, malignant choroid plexus papillomas, and angioblastic meningiomas.

Patients with intracranial medulloblastoma, ependymomoblastoma, and pineal germinomas are routinely surveyed by gadolinium- enhanced spinal MRI for evidence of CSF dissemination and drop metastases, and CSF cytology remains the definitive analysis for drop metastases.

(Ref. Sutton, 6th Edition, Pg. 1602, 1474, 1611, 1600-2)

73. **(B). Ultrasound**

Hydrocephalus

Obstetric ultrasound study is one of the best methods for antenatal diagnosis of hydrocephalus as it is noninvasive and hazard-free not only to fetus but also to mother.

However, assessment prior to GA of 20 weeks may be difficult, as ventricles constitute a large portion of cranial vault.

Signs suggestive of fetal hydrocephalus on obstetric USG study are:

- Atrial size > 10 mm
- Dangling "choroid plexus" sign
- Banana sign
- Lemon sign
- BPD > 95th percentile
- ± Polyhydramnios

(Ref. Sutton Radiology, 6th Edition, Pg. 1586)

74. **(A). Cavernous hemangioma**

Extraaxial cavernous hemangiomas: Rare and very rarely arise in the cavernous sinus. Although this malformation is categorized as a vascular malformation and has well-defined histologic characteristics, it sometimes presents tumor like behavior, including mass effects, enclosure of neurovascular structures, and proliferation during pregnancy.

The lesions are found predominately among women.

The onset of symptoms is usually insidious, and symptoms are caused by the large size of the lesions.

Patients usually present with headaches and dysfunction of the cranial nerves passing through the cavernous sinus, manifesting particularly as ptosis and diplopia. MRI reveals well-defined masses that are **Hypointense** or **isointense** on t1-weighted images and **markedly hyper intense on t2-weighted** images, which indicates the relationship between the lesion and the intracavernous ICA.

The marked hyper-intensity on t2-weighted images and homogenous enhancement seem to distinguish these lesions from other types. **Meningiomas often similar signal intensity** to gray matter **on both t1- and t2-weighted images**.

Schwannomas tend to give **lower signal intensity than gray matter on t1-weighted** images and **almost uniformly give higher** signal intensity **on t2-weighted** images.

Both Schwannomas and meningiomas show **prominent contrast enhancement**, which tends to be a **slightly heterogeneous pattern**.

(Ref. Characteristic MR Imaging Findings of Cavernous Hemangiomas in the Cavernous Sinus. American Journal of Neuroradiology 24:1148-1151)

75. **(D). Odontoid view**

Jafferson's Fracture

- It is most common type of atlas fracture. It is cause by axial compression force (with or with out extension force), resulting from a fall on the head from a height or mass falling on head. This mechanism of injury results in a burst fracture of ring of atlas (C1) vertebrae, that occurs secondary to the occipital condyles being driven into the interior portions of the ring of atlas and driving the lateral masses outwards.

- Lateral displacement of C1 lateral mass lateral the outer cortex of the C2 lateral mass raises concerns for the structural integrity of the transverse Atlantal ligament (TAL). The stability of atlas depends on TAL.
- Due to outward movement of lateral masses, there is no encroachment on the neural canal and, usually, no neurological damage.
- Classical Jafferson's fracture (as described by Jafferson in 1920) was four part fracture of ring of atlas (2 part # of anterior ring & 2 part # of posterior ring). However more common are two part or three part fractures.

- It is typically diagnosed on plain radiographs
  - Open mouth (odontoid) view may show asymmetry of the lateral masses of C1 on C2 with overhang.
  - A bilateral overhang > 6.9 mm suggests disruption of transverse ligament and potential late instability.
  - On lateral radiograph presumptive evidence of transverse ligament disruption is >4mm atlanto-dents interval.
- Coronal CT reformation provides the best method of evaluating important atlas fracture characteristics.

(Ref. Apley's System of Orthopaedics & Fractures, 8th Edition, Pg. 650-51;Current Diagnosis & Treatment in Orthopaedics, 3rd Edition, Pg. 271-72)

76. **(B).** 'Mercedes Benz' sign

'Mercedes Benz' sign is seen in gallstones (tri-radiate).

77. **(B). Myelomalacia**

Both cord edema and myelomalacia appear as On T1 – III defined hypointense area On T2 – Hyperintense area

	Cord Edema	Myelomalacia / Cord atrophy
Etiology	Reflects focal accumulation of intracellular & interstitial fluid in response to injury	In end stage of cord trauma and result of trauma, ischemia and release of vasoactive substances & cellular enzyme
MRI T1WI T2WI	• III defined hypointense area • Focus of hyperintensity	• Poorly marginated hypointense area • Hyperintense cord parenchyma

(Ref. MRI of Brain & Spine by Scott W. Atlas, 3rd Edition, Pg. 1802, 1810)

78. **(A). Hyperechoic**

Virtually all thyroids Ca are poorly echogenic and majority will show invasion into thyroid stroma and thyroid capsule whereas thyroid adenoma are hypoechoic compared to normal thyroid tissue.

(Ref. Text book of Radiology, D. Sutton, 6th Edition, Pg. 1293-1294)

79. **(C). Radio nucleotide scan**

Neuroendocrinal tumors (NET) are derived from diffuse neuroendocrine system of gastrointestinal (GD) tract, which is composed of amine and acid producing cells with different hormonal profiles depending on the site of origin.

Net refers to two types of tumors

Name	Biologically active peptide secreted
I. Carcinoid Tumor	**Serotonin**, possibly tachykinin, ,pilin, Prostaglandin
II. Pancreatic Endocrinal Tumor (PET)	
– Zollinger-Ellison Syndrome	**Gastrin**
– Insulinoma	Insulin

– Glucagonoma	Glucagons
– Somatostatinoma	Somatostatin
– GRF-oma	**Growth Hormone Releasing Hormone**
– Acth-oma	ACTH
– VIP oma (Verner Morrison Syndrome / WDHA, Pancreatic cholera)	Vasoactive intestinal peptide (VIP)
– PET causing Carcinoid syndrome	Serotonin, Tachykinin
– PET causing hypercalcemia	PTHrP

Because of its greater sensitivity than conventional imaging (CT, MRI, USG) and its ability localize tumor throughout the body at one times. **SRS (Somatostatin receptor Scintigraphy) now the imaging modality of choice for localizing both primary and metastatic NET tumors. (Except for Insulinoma).**

- **Best modality of localizing Insulinoma is endoscopic u/s**
- Somatostatin receptors are of 5 types, radiolabeled octreotide binds with highest affinity to SS_2 receptor.
- SRS is not a diagnostic investigation. Diagnosis is confirmed by detecting peptides or amines (or their metabolites) secreted by the tumors in urine or serum.

(Ref. Harrison, 15th Edition, Pg. 594-602 17th edition Pg.616)

80. (D). Posterior urethral valve

Urethral obstruction, most often occurring in males and due to posterior urethral valves, has the following sonographic findings: bilateral hydronephrosis and hydroureter, a large thick-walled bladder, and a dilated posterior urethra. Associated oligohydramnios occurs when urethral obstruction is severe.

(Ref. Sutton Radiology 7th Edition, Pg. 1017, 1061)

81. (A). Single umbilical artery

The umbilical cord normally contains three vessels: two arteries and a vein, which are protected by Wharton's jelly. It is important to document the number of vessels in the cord. *Single umbilical artery* occurs in up to 1% of cases. Ten to twenty percent of these cases have malformations including:

1. **T**risomies 13 and 18,
2. **A**nomalies of the urinary tract, central nervous system and heart,
3. **O**mphalocele,
4. **S**irenomelia, and

5. **V**ATER association.

(Ref. Ultrasonography in OBGY by Callen, 4th Edition, Pg. 44)

82. **(C). Trans vaginal US**

Best method of diagnosing unruptured ectopic pregnancy is combination of transvaginal sonography & quantitative B-HCG values

Dx of Ectopic pregnancy

Transvaginal USG (most accurate

- Absence of intrauterine pregnancy with positive pregnancy test
- Fluid in pouch of Douglas
- Adnexal mass clearly separated from ovary
- Rarely cardiac motion in mass

B-HCG

- Lowest level of BHCG at which gestational sac is visible on –
- B-HCG > 2000 IU/L, with empty uterine cavity on TVS
- Failure to double the value of B HCG by 48 hours with empty uterus.
- Lower level of B-HCG compared to gestational age

(Ref. Dutta obs., 5th Edition, Pg. 197-199, 6th Edition, Pg. 185-186)

83. **(B). 6 mm.**

The sonographic feature of pyelictasis is dilated renal pelvis with Ap diameter >/= 6mm.

(Ref. Sutton Radiology, 7th Edition, Pg. 1050)

84. (D). Ovarian tumour

The thickened omentum produced by "caking" appears as a large soft tissue mass with poorly defined edges. Fat planes are obscured.

Following diagnostic signs characterize the lesions of mesentery/omentum according to their appearance:

1) Rounded masses - NHL (most common), leukemia and ovarian tumor (rare)
2) Ill-defined masses - NHL, Carcinoma ovary (most common), Colon, pancreas, stomach (rarely)
3) Cake-like masses - Ovarian tumors, NHL and leukemia
4) Stellate pattern - All types of metastatic disease except lymphomas and leukemias.

75% ovarian neoplasms are benign, 21% are malignant, 4% are borderline malignant.

(Ref. CT and MR Imaging of Whole Body by Haaga, Pg. 1653)

85. **(C). MRI**

Ductal carcinoma-in-situ (DCIS) and lobular carcinoma-in-situ (LCIS) are confined to the ducts and acini, respectively. There are four subtypes of DCIS: comedocarcinoma, micropapillary carcinoma, cribriform carcinoma and solid carcinoma. Among these subtypes, comedocarcinoma is the most aggressive. DCIS now accounts for 20–40% of all cancers detected by screening mammography.

MRI must be able to demonstrate and characterize mammographically detected lesions (including DCIS) and, ideally, reveal mammographically occult lesions. This requires MRI to have high-resolution capabilities.

(Ref. Grainger Radiology, 4th Edition, 2269-2273)

86. **(B). CEMRI**

CEMRI (Contrast Enhanced Magnetic Resonance Imaging) is most useful investigation for the preoperative evaluation of cervical carcinoma. The normal cervix appears as two distinct zones, an inner high signal intensity zone (endocervical canal) and an outer low signal intensity zone (fibrous stroma). It may occasionally have three zones similar to those of the uterus. On axial images, the lower cervix normally is a complete, low-intensity ring. If disrupted, this may serve as an important landmark for the identification of parametrial tumor extension. MRI is quite accurate in detecting tumor involvement of the vagina, parametrium, pelvic sidewall, bladder, or rectum. However, MRI may underestimate the extent of very superficial disease and cannot detect carcinoma in situ reliably. It has similar constraints in the detection of lymph node enlargement as CT, namely, that it cannot depict microscopic tumor involvement of normal-sized nodes or differentiate benign nodal enlargement from malignant lymph node enlargement.

(Ref. Shaw's Textbook of Gynaecology, 13th Edition, Pg. 387)

87. **(B). Several internal excrescences**

USG is the initial imaging modality of choice in the evaluation of pelvic masses. It is accurate for the determination of the presence, size, location, and character of pelvic masses but is relatively nonspecific of tumor type.

The sonographic appearance of cystadenocarcinoma is cystic, with areas of solid tissue on the inner cyst wall and papillary excrescences protruding from the septa. Spokewheel-like septations suggest mucinous

cystadenocarcinoma. The appearance of other malignant ovarian neoplasms may be completely solid, primarily solid with irregular cystic areas, or thick-walled with necrotic centers.

(Ref. Radiology Review Manual 5th Edition, Pg. 1001)

88. **(D). Carcinoma**

Pleomorphic microcalcification in a spiculate mass is hallmarks of Breast Ca. Females on HRT are at a high risk for breast Ca.

Cystosarcoma phylloides occurs in younger women, generally occurs bilaterally has typically finger like projections on imaging.

Fibroadenoma shows dense calcification is wider more than taller, and has smooth margins.

(Ref. Chapman, 4th Edition, Pg. 365)

89. **(B). First 10 days of Menstrual Cycle**

- Ten day Rule: Radiological investigation in a reproductive age gp. Female should be carried out with in 10 days of last Menstrual Period i.e. Ist 10 days of M. C. (i.e. within in 10 days of onset of menstruation).
- This was stated in the belief that there was then least likelihood of conception talking place (but if it did the embryo would be most sensitive to radiation) it is now believed that fetus is relatively insensitive to radiation in early stages of pregnancy any adverse effect leads to spontaneous abortion.
- The fetus is most sensitive to radiation at 8-15 weeks gestation for increased incidence of Down's syndrome and slight reduction in IQ.

(Ref. Grainger, 4th Edition, Pg. 233)

Topic 4 – Nuclear Medicine & Radiotherapy

90. **(A). CyberKnife**

CyberKnife

The CyberKnife was developed in the mid 1990s by Accuray as an innovative tool for intracranial stereotactic radiosurgery (see Section 15.2.5.3). It delivers the dose with a miniature (104 MHz) linac mounted on an industrial robotic arm, a combination that offers excellent spatial accuracy in dose delivery and allows, in comparison with isocentric linacs and tomotherapy units, a great deal of flexibility in directing the beam towards the target.

Owing to its on-line target imaging and automatic adjustment of the radiation beam direction to compensate for target motion, the CyberKnife provides a frameless alternative to conventional radiosurgical procedures. The rigid invasive stereotactic frame, the essential component of standard radio- surgical treatments used for target localization, treatment set-up and patient immobilization during treatment, is not required for treatment with the CyberKnife.

The location of the lesion is predetermined through a family of axial CT images that serves as a base for the determination of a set of digitally recon- structed radiograph (DRR) images. A set of paired orthogonal X ray imagers determines the location of the lesion in the room coordinate system and communicates these coordinates to the robotic arm, which adjusts the pointing of the linac beam to maintain alignment with the target.

The CyberKnife radiosurgery system provides an innovative approach to image guided dose delivery that is based on an on-line orthogonal pair of digital X ray imagers, a patient CT data set fused with MR and/or PET images and a miniature linac mounted on an industrial robotic arm. This new approach to highly accurate intracranial as well as extracranial delivery of high radiation doses with small radiation fields opens the field of radiosurgery to very exciting new research directions, both in basic radiation physics and clinical cancer research.

Besides the obvious advantage of dispensing with the need for a stereo- tactic frame without compromising the treatment's spatial accuracy, the CyberKnife also offers several other advantages over conventional radio-surgery, such as:

● Veritable image guided dose delivery.

● Possibility for fractionated treatment of intracranial malignant tumours.

● Possibility for treatment of extracranial spinal lesions, relying on the skeleton to provide a reference frame.

● Possibility for radiosurgical treatment of other organs such as the lung and prostate using surgically implanted fiducial markers as a reference frame.

● Capability for on-line tracking of target motion, which results either from patient motion during treatment or from organ motion within the patient during treatment.

(Ref. Radiation Onco physics By E. B. Podgorsak pg. 543)

91. **(B). I^{125}**

Choice of radionuclide for prostate implants:

The use of permanent radioactive seed implants for the treatment of early prostate cancer has gained renewed interest with the introduction of 125I and 103Pd seeds, which emit low energy (~30 keV) photons.

Gold-198 seeds, which emit medium energy photons (~400 keV), were used in the past, but the unnecessary radiation exposure hazard prevented the use of this radionuclide from gaining wide acceptance.

Palladium-103, which has a shorter half-life (17 days) than 125I (60 days), delivers a higher initial dose rate and hence has been found useful in treating fast growing high grade tumours.

(Ref. Radiation Onco physics By E. B. Podgorsak pg. 465)

92. **(C). Amifostine**

Many thiol [SH] groups of compounds like *amifostine* are used to protect normal cells from the harmful side effects of radiation. The agent amifostine is used commonly in clinical practice to protect from toxicities of chemoradiotherapy.

(Ref. Harrison, 17th Edition, Pg. 671)

93. **(B). 20 mSievert**

Recommended Dose Limit :

Effective dose : Occupation worker – 20 mSv per year

Average over defined periods of 5 years.

The effective dose should not exceed 50 mSv this in any single year.

In India, AERB permits not > 30 mSv per/year.

(Ref. Introduction to Radiation Biology, P. Uma Sevio, A. Nagarathan, Pg. 215, 216)

94. **(C). Genetic mutation**

Indeterministic/stochastic effects of radiation :

Independent of the total dose of radiation. It is an all are none phenomenon.

e.g. Genetic mutations.

Deterministic/Non stochastic effects of radiation. Depend on the total dose of radiation given.

e.g. Alopecia in the irradiated portal.

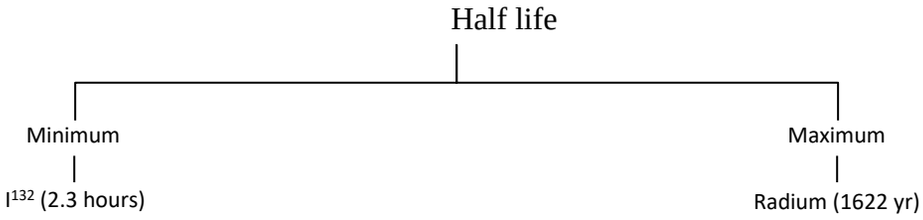
(Ref. Introduction to Radiation Biology – Uma Nagarathnam, 1st Edition, Pg. 26)

95. **(D). 1-2 years**

Transverse myelitis after radiation treatment is a spinal cord reaction similar to cerebral necrosis. The syndrome consists of progressive and irreversible leg weakness and loss of bladder function and sensation referable to a single spinal cord level. Flaccid paralysis eventually occurs. Symptoms can occur as early as 6 months after radiation treatment, but the usual time of onset is 12 to 24 months. Studies have shown that at 45 Gy, the incidence of radiation myelitis is < 0.2 %.

(Ref. http: // www. ijri.org/articles/archives/2002-12-1/major-papers-21.htm)

96. **(B). Radium**



(Ref. Harrison, 17th Edition, Pg. 1109; CMDT 2005, Pg. 199)

97. **(A). Gallium: Ideal agents for bone scan**

Diagnostically used radionuclides:

- **Technetium-99m (6 h):** Used in to image the skeleton and heart muscle in particular, but also for brain, thyroid, lungs (perfusion and ventilation), liver, spleen, kidney (structure and filtration rate), gall bladder, bone marrow, salivary and lacrimal glands, heart blood pool, infection, etc.
- **Selenium-75 (120 d):** Used as seleno-methionine to study the production of digestive enzymes.
- **Xenon-133 (5 d):** Used for pulmonary (lung) ventilation studies.
- **Gallium-67 (78 h):** Used for tumor imaging and localization of inflammatory lesions (infections).
- **Indium-111 (2.8 d):** Used for specialist studies, e.g. brain studies, infection and colon transit studies.
- **Iodine-123 (13 h):** Increasingly used for diagnosis of thyroid function, it is a gamma emitter without the beta radiation of I-131.
- **Krypton-81m (13 sec) from Rubidium-81 (4.6 h):** Kr-81m gas can yield functional images of pulmonary ventilation, e.g. in asthmatic patients, and for the early diagnosis of lung diseases and function.
- **Rubidium-82 (65 h):** Convenient PET agent in myocardial perfusion imaging.
- **Thallium-201 (73 h):** Used for diagnosis of coronary artery disease other heart conditions such as heart muscle death and for location of low-grade lymphomas.

(Ref. Harrison, 16th Edition, Pg. 232, 84, 1324, 120, 1518, 1411; 17th Edition, Pg. 517,682t, 805, 1994-1995)

98. **(B). An artificially made radioisotope**

Co-60 is an isotope of Co-59 produced artificially by bombarding its nucleus by neutrons. The target material (Co-59) is bombarded by neutrons in a nuclear reactor. The target atoms capture these neutrons and in turn emit photons (gamma-rays) or particles or both, to transform itself into the required radionuclides. This method is called "activation" since radioactivity is induced into the target material.

$$^{59}_{27}Co + ^{1}_{0}n \rightarrow ^{60}_{27}Co + \gamma$$

Both Co-59 and Co-60 have the same atomic number, the same properties and cannot be separated chemically.

Other artificially produced radioisotopes →

$\text{Phosphorus} - 32, {}^{3}_{1}\text{H}, {}^{4}_{2}\text{He}$

${}^{137}_{55}\text{Cs}, {}^{96}_{37}\text{Rb}, \text{etc.}$

Positron is an elementary particle which has a unit positive charge and which exists in nature only when it is in motion. A slow moving or stationary positron quickly annihilates with an electron to give two photons.

(Ref. Fundamental Physics of Radiology, 3rd Edition, Pg. 561)

99. **(D). Plutonium**

Eye plaques

Intraocular melanoma is the most common eye tumour. An eye plaque, loaded with 125I seeds, is applied externally to the scleral (outer) surface over the tumour base. The number of seeds to be used is related to the size of the plaque, and ranges from 7 to 24 for plaque diameters of 12–20 mm. The typical activity used is 0.5–5 mCi per seed so as to achieve treatment dose rates of 0.5- 1.25 Gy/h, with a prescription dose of 100 Gy delivered in 5–12 consecutive days.

The prescription point is defined as the tumour apex if the apical height exceeds 5 mm, and 5 mm depth from the interior sclera if the apex is less than 5 mm high. Tumour localization is usually performed using fundoscopy, fundus photography and ultrasound A and B scans. CT and magnetic resonance imaging (MRI) may also be used. Post-implant, plaque placement verification is carried out with ultrasound imaging.

A less common approach to the treatment of lesions in the eye is based on b emitting sources: 90Sr/90Y (maximum electron energy: 2.27 MeV; penetration into tissue: 12 mm) and more recently 106Ru (maximum electron energy: 3.4 MeV; penetration into tissue: 20 mm).

(Ref. Radiation onco physics By E. B. Podgorsak pg. 466)

100. **(D). Resortment**

The basis of fractionation is rooted in five primary biological factors called the five Rs of radiotherapy:

- Radiosensitivity. Mammalian cells have different radiosensitivities.
- Repair. Mammalian cells can repair radiation damage. This is a complex process that involves repair of sublethal damage by a variety of repair enzymes and pathways.
- Repopulation. Cells repopulate while receiving fractionated doses of radiation.
- Redistribution. Redistribution in proliferating cell populations throughout the cell cycle phases increases the cell kill from a fractionated treatment relative to a single session treatment.
- Reoxygenation. Reoxygenation of hypoxic cells occurs during a fractionated course of treatment, making them more radiosensitive to subsequent doses of radiation.

(Ref. CMDT, Pg. 2006-1595)

101. **(A). More skin damage**

Megavoltage x-ray therapy (> 1 mev) has following advantages over orthovoltage therapy (150 to 400 kv):

- Skin-sparing effect.
- Very low lateral scatter.
- Homogeneous distribution of the radiation energy.
- Greater deposit of the energy in the tumor, or in the target volume.

Orthovoltage therapy causes **highest skin damage.**

(Ref. Introduction to Radiotherapy by Rafla, Pg. 8)

102. **(B). Measuring the radioactivity**

A gamma camera, measures radioactivity of the substance that is taken up by specific organ or tissue of interest, by detecting gamma rays.

- Working of gamma camera
  - Nuclear medicine studies require the oral or intravenous introduction of very low level radioactive material (called radio pharmaceuticals, radionuclide or radiotraces) into the body; which is taken up by a particular organ or tissue.
  - The decay of radiotracer then leads to emission of γ(gamma) rays, which are measured by gamma camera with the help of its crystal detector (or scintillation crystal)

(Ref. Oxford textbook of surgery, 6th Edition, Pg. 6.7, 33.2)

103. **(C). Parathyroid adenoma**

- Tc99-sestamibi scan is for parathyroid adenoma detection
- Tc99-MIBI (methoxyisobutyl isonitrile) scan is also used for parathyroid

(Ref. Grainger and Allison's, 4th Edition, Pg. 1374, 1380, 1390)

104. **(C). Alpha particle**
IONIZING RADIATIONS

Ionizing radiation is radiation that can produce charged particles (ions) in materials that it strikes.
Types of ionizing radiation are:

- Alpha radiation (Helium ions): consist of nucleus of helium atoms positively charged with "+2", low penetrating ability, stopped by thin sheet of paper or skin. Of all the ionizing radiations alpha particles are most ionizing ones.
- Beta radiation: consist of electrons, negatively charged with "-1", more penetrating than alpha particles, and can pass through 1-2 cm of water or tissue or a few mm of aluminum.
- Gamma radiation: are electromagnetic radiation emitted from nucleus in excited state (radioactive material), are highly penetrating, can pass through the human body, and cannot be absorbed completely.
- X-rays: are electromagnetic radiation emitted when fast moving charged particles (like electrons) are stopped, have penetrating power less than gamma rays but more than alpha and beta rays, can pass through human body, and cannot be absorbed completely.

(Ref. Harrison, 17th Edition, Pg. 1358)

105. **(B). X-rays & gamma rays are the forms of radiation most commonly used to treat cancer.**

- Cobalt 60 is used as a radioactive material in Teletherapy machines.
- X-rays & Gamma rays are the forms of radiation most commonly used to treat cancer.
- Gamma rays are generated from decay of atomic nuclei in radioisotopes such as cobalt & radium.
- Tele is most often used form of radiotherapy today.
- Cobalt 60 is the most commonly used isotope, another important isotope being cesium – 137 (g rays)

(Ref. Principles and Practice of Radiation Oncology, 3rd Edition, Pg. 252)

106. **(B). Beta rays**

I-131 decays by beta particle emission and a principle gamma ray energy. Its beta emission makes it therapeutically useful. Non-malignant condition like thyrotoxicosis and well-differentiated thyroid tumors and their metastases are treated by I-131.

(Ref. Walter and Miller's Textbook of Radiotherapy, Pg. 272)

107. **(A). Iridium192**

When the radionuclide is placed on the surface of the skin, (mould or plaque) is called plesiocurietherapy. Ir 192 is most commonly used agent for mould therapy.

(Ref. Harrison, 16th Edition, Pg. 1296 (t), 17th Edition, Pg. 517)

108. **(B).** 0.4–2 Gy/h.

BRACHYTHERAPY TREATMENTS CLASSIFIED WITH RESPECT TO DOSE RATEa

Dose rate	**Numerical value of the dose rate at the dose specification point(s)**
Low dose rate (LDR)	0.4–2 Gy/h
Medium dose rate (MDR)	2–12 Gy/h
High dose rate (HDR)	>12 Gy/h

I^{125}, Cobalt-60 Iridium 192 all are used in brachytherapy.

Iodine-125 is used as permanent seeds in prostate cancer.

Cobalt-60 can be used for intracavitary, and Cobalt plaques are used in ophthalmic tumors.

Iridium-192 is the most common source used in interstitial brachytherapy and ICA.

I-131 is used for thyroid imaging & ablation.

(Ref. Harrison, 17th Edition, Pg. 1360, 1362)

109. **(D). All of the above**

Most IORT programmes today are based on electron beams produced by megavoltage linacs, since electrons provide several advantages over X rays for the purposes of IORT:

—The electron dose is deposited over a definite range, thus sparing tissue downstream from the target;

—Depending on the target thickness and electron energy, the dose can be deposited homogeneously throughout the target volume;

— In contrast to low energy X rays, there is not much difference between the tissue and bone absorption of megavoltage electron beams..

(Ref. Introduction to Radiation Biology, Uma Devi, Satish Rao, Pg. 126-127)

110. **(C). The location of the lesion within 10 cm from the anal canal;**

Selection criteria for endocavitary rectal irradiation are as follows:

● A biopsy proven, well or moderately well differentiated rectal adeno- carcinoma;

● A mobile lesion with a maximum diameter of 3 cm;

● The location of the lesion within 10 cm from the anal canal;

● No evidence of lymph node or distant metastases.

Postoperative chemotherapy has established role in colon.

(Ref. Schwartz, 7th Edition, Pg. 336; Bailey & Love, 25th Edition, Pg. 1179-1184)

111. **(B). Hyperfractionation RT**

- Hyperfractionation RT:
  1. It means, Multiple daily fractions, usually two with doses per fraction of ≤180–200 cGy, usually 100–120 cGy, separated by 4–8 hours, to total doses higher than those given with "standard" fractionation.
  2. Suitable for haedand neck and Lung tumors.

Accelerated fractionation reduces the overall treatment time, minimizing tumour cell repopulation during the course of treatment.

CHART (continuous hyperfractionated accelerated radiation therapy) is an experimental programme used with three fractions per day for 12 continuous days.

112. **(A). 8 Gy in one fraction**

Palliation of metastatic disease is a substantial component of radiation oncology, and a vital aspect of cancer patient care in general; severe pain and debilitation resulting from untreated metastases not only have a significant impact on the patients' quality of life, but on health care and economics as well. Standard treatment was 30 Gy in 10 fractions. However, there are recent trails, which have found 8 Gy in one fraction to be as effective, & this is standard today.

(Ref. Walter and Miller's Textbook of Radiotherapy, 5th Edition, Pg. 466)

113. (C) Use of Low LET beams.

Factors associated with radiation tolerance of the normal central nervous system tissues:

Factor*	Factors for increased risk of injury	:Tolerance increased by
Total dose	Higher total dose	Decreasing total dose , hyperfractionation, radiosensitizers.
Dose per fraction	Dose per fraction >180–200 cGy	Decreasing dose/fraction to ≤ 180–200 cGy
Volume	Increased volume, e.g.,: whole-organ radiation	Decreasing volume, e.g., partial-organ radiation
Host factors	Medical illness, e.g., hypertension, diabetes	Unknown, possibly radioprotectors
Beam quality	High LET radiation beams, e.g., neutrons	Low LET beams, e.g., photons
Adjunctive therapy	Concomitant use of CNS toxic drugs, e.g., methotrexate	Avoid concomitant use of CNS toxic

(Ref. Harrison's Medicine, 17th Edition, Pg. 560, 2607-2609, 2603)

114. **(B). Resectable local lesion**

Indications of RT in Parotid tumor:
(a) **Recurrent disease (benign or otherwise)**
(b) Residual disease left at surgery
(c) High grade lesion
(d) Those that refuse surgery
(e) Unfit for surgery
(f) Unresectable local lesion

If deep lobe is involved **total parotidectomy** is done which requires facial nerve sacrifice. Reconstruction of facial nerve trunk by a cable or sural nerve graft decreases the incidence of facial palsy post operatively.
Radiotherapy is indicated for histological malignant recurrence.

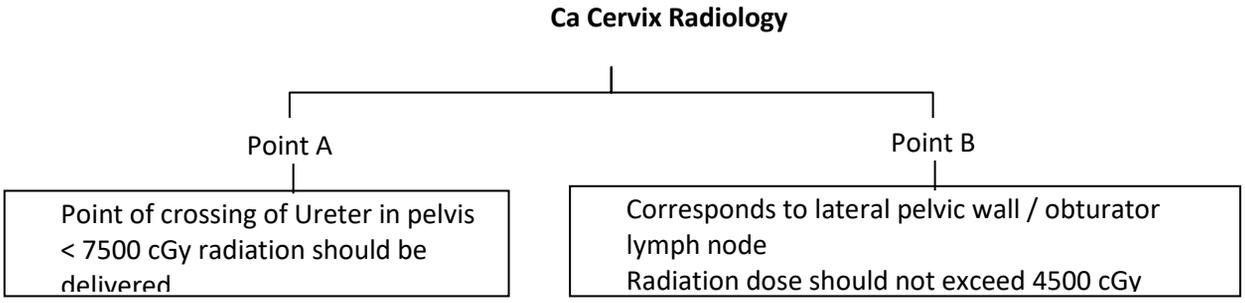
(Ref. Deretta, 6th Edition, Pg. 891)

115. **(C).** Brain tumors
gamma knife Radiotherapy
It refers to sterotactic radiosurgery.
Useful in:

- Metastasis
- Meningiomas
- AVMs
- Acoustic neuromas

(Ref. Harrison's Principles of Medicine, 17th Edition, Pg. 557-561, 558t, www.blackwellsurgery.com)

116. **(B). Obturator Lymph node**



(Ref. Shaws, 13th Edition, Pg. 410)

117. (C). Mycosis fungoides.

Total Skin Electron Irradiation is a special radiotherapeutic technique that aims to irradiate the patient's whole skin with the prescribed radiation dose while sparing all other organs from any appreciable radiation dose. Since skin is a superficial organ, the choice of electron beams for the treatment of generalized skin malignancies (most commonly mycosis fungoides) is obvious, even though superficial X rays also could be, and actually were in the past, used for this purpose.

Mantle and inverted Y RT is technique of extended field irradiation for disease above and below the diaphragm respectively. The term 'Mantle technique' derives from the similarity of the treatment fields to a cloak. External beam radiation therapy, which comes from a machine outside the body, is usually used for Hodgkin's disease. Mantle radiation, which is given to the neck, chest, and lymph nodes under the arms, may also be used. Mantle

radiation and radiation to the spleen and lymph nodes in the upper abdomen and pelvis is called total nodal irradiation. RT may be administered with or without chemotherapy.

(Ref. Walter and Miller's Radiotherapy, 5th Edition, Pg. 566)

118. **(B). Recurrent ovarian cancer.**

PET-CT is investigation of choice for recurrent ovarian cancer.

The main advantages of PET/CT machines are as follows:

- Earlier diagnosis of disease;
- Accurate staging and tumour localization;
- More precise treatment;
- Monitoring of response to treatment and early detection of recurrences;
- Reduction of biopsy sampling errors;
- Reduction of the number of invasive procedures required during follow-up.

(Ref. Radiation onco physics By E. B. Podgorsak pg. 547)

119. **(C) Metastable**

'm' in Tc99m stands for Metastable form of Tc99.

Tc99 is reacted with aluminium resins to get Tc99m, which is a metastable form with half life of just 6 hours.

120. Ans, C.