

पुस्तिका में पृष्ठों की संख्या : 32  
Number of Pages in Booklet : 32

प्रश्न-पत्र पुस्तिका संख्या /

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Question Paper Booklet No.

पुस्तिका में प्रश्नों की संख्या : 180  
No. of Questions in Booklet : 180

**BSAPNm-02**

Paper Code : 14

SUBJECT : Nuclear Medicine

परीक्षा दिनांक :- 11/08/2020

समय : 3.00 घण्टे

Time : 3.00 Hours

परीक्षा समय :- 2:00 To 5:00

अधिकतम अंक : 180

Maximum Marks : 180

प्रश्न-पत्र पुस्तिका एवं उत्तर पत्रक के पेपर सील/पोलिथीन बैग को खोलने के बाद परीक्षार्थी प्रश्न-पत्र पुस्तिका संख्या को उत्तर पत्रक पर सावधानीपूर्वक अंकित करें। इसमें किसी भी प्रकार की त्रुटि होने पर जिम्मेदारी अभ्यर्थी की होगी।

The candidate fill the Question Paper Booklet No. on Answer Sheet carefully after opening the Paper Seal / Polythene bag. Candidate himself shall be responsible for any error.

**परीक्षार्थियों के लिए निर्देश**

1. सभी प्रश्नों के उत्तर दीजिए।
2. सभी प्रश्नों के अंक समान हैं।
3. प्रत्येक प्रश्न का केवल एक ही उत्तर दीजिए।
4. एक से अधिक उत्तर देने की दशा में प्रश्न के उत्तर को गलत माना जाएगा।
5. प्रत्येक प्रश्न के चार वैकल्पिक उत्तर दिये गये हैं, जिन्हें क्रमशः 1, 2, 3, 4 अंकित किया गया है। अभ्यर्थी को सही उत्तर निर्दिष्ट करते हुए उनमें से केवल एक गोले अथवा बबल को उत्तर पत्रक पर नीले बॉल प्वाइंट पेन से गहरा करना है।
6. OMR उत्तर पत्रक इस परीक्षा पुस्तिका के अन्दर रखा है। जब आपको परीक्षा पुस्तिका खोलने को कहा जाए, तो उत्तर-पत्र निकाल कर ध्यान से केवल नीले बॉल पॉइंट पेन से विवरण भरें।
7. प्रत्येक गलत उत्तर के लिए प्रश्न अंक का 1/3 भाग काटा जायेगा। गलत उत्तर से तात्पर्य अशुद्ध उत्तर अथवा किसी भी प्रश्न के एक से अधिक उत्तर से है। किसी भी प्रश्न से संबंधित गोले या बबल को खाली छोड़ना गलत उत्तर नहीं माना जायेगा।
8. मोबाइल फोन अथवा इलेक्ट्रॉनिक यंत्र का परीक्षा हॉल में प्रयोग पूर्णतया वर्जित है। यदि किसी अभ्यर्थी के पास ऐसी कोई वर्जित सामग्री मिलती है तो उसके विरुद्ध आयोग द्वारा नियमानुसार कार्यवाही को जायेगी।
9. कृपया अपना रोल नम्बर ओ.एम.आर. पत्रक पर सावधानीपूर्वक सही भरें। गलत अथवा अपूर्ण रोल नम्बर भरने पर 5 अंक कुल प्राप्तांकों में से काटे जा सकते हैं।

**चेतावनी :** अगर कोई अभ्यर्थी नकल करते पकड़ा जाता है या उसके पास से कोई अनधिकृत सामग्री पाई जाती है, तो उस अभ्यर्थी के विरुद्ध पुलिस में प्राथमिकी दर्ज कराते हुए विविध नियमों-प्रावधानों के तहत कार्यवाही की जाएगी। साथ ही विभाग ऐसे अभ्यर्थी को भविष्य में होने वाली विभाग की समस्त परीक्षाओं से विवर्जित कर सकता है।

**INSTRUCTIONS FOR CANDIDATES**

1. Answer all questions.
2. All questions carry equal marks.
3. Only one answer is to be given for each question.
4. If more than one answers are marked, it would be treated as wrong answer.
5. Each question has four alternative responses marked serially as 1, 2, 3, 4. You have to darken only one circle or bubble indicating the correct answer on the Answer Sheet using BLUE BALL POINT PEN.
6. The OMR Answer Sheet is inside this Test Booklet. When you are directed to open the Test Booklet, take out the Answer Sheet and fill in the particulars carefully with blue ball point pen only.
7. 1/3 part of the mark(s) of each question will be deducted for each wrong answer. A wrong answer means an incorrect answer or more than one answers for any question. Leaving all the relevant circles or bubbles of any question blank will not be considered as wrong answer.
8. Mobile Phone or any other electronic gadget in the examination hall is strictly prohibited. A candidate found with any of such objectionable material with him/her will be strictly dealt as per rules.
9. Please correctly fill your Roll Number in O.M.R. Sheet. 5 Marks can be deducted for filling wrong or incomplete Roll Number.

**Warning :** If a candidate is found copying or if any unauthorized material is found in his/her possession, F.I.R. would be lodged against him/her in the Police Station and he/she would liable to be prosecuted. Department may also debar him/her permanently from all future examinations.

इस परीक्षा पुस्तिका को तब तक न खोलें जब तक कहा न जाए।

Do not open this Test Booklet until you are asked to do so.

14 - □



1. All of the following statements are true about silicon Photodiode, except :

- (1) PM tubes are replaced with light sensitive semiconductor detectors.
- (2) Semiconductor detector in photodiode acts as a scintillators.
- (3) Typical gain for conventional Silicon photodiode is lesser than PM tubes.
- (4) It requires very low noise electronics to read out signals.

2. As the distance between parallel hole collimator and object being imaged reduces

- (1) Spatial resolution improves and count rate increases
- (2) Apparent size of object and count rate remains same
- (3) Spatial resolution and count rate remains same
- (4) Spatial resolution improves and count rate reduces

3. Starburst type of appearance is

- (1) seen with pinhole and parallel hole collimator both
- (2) due to the septal penetration of incident gamma rays
- (3) seen with low energy gamma rays
- (4) None of these

4. Which of the following radioisotope is not suitable for counting in liquid scintillation counters ?

- (1) H-3
- (2) C14
- (3) I-131
- (4) Cu-64

5. Cerenkov counting system is used for

- (1) Detecting low energy beta emitters
- (2) Detecting high energy beta emitters
- (3) Both (1) and (2)
- (4) Detection of gamma emitters

6. Which of these detectors cannot be used in Pulse height analyser ?

- (1) Proportional counters
- (2) Semiconductor detectors
- (3) GM counters
- (4) Scintillation detectors

7. Which of the following is not seen in Ideal pulse height spectrum in photon spectrometry ?

- (1) Photopeak
- (2) Backscatter peak
- (3) Compton edge
- (4) Compton region

8. Dose calibrator is based on principles of
- (1) Ionization chamber
  - (2) Geiger Muller counter
  - (3) Proportional counter
  - (4) Scintillator detectors
9. Choose incorrect statement about quenching in GM counters.
- (1) Self-quenches GM counters has quenching gas to overcome the uncontrolled avalanche.
  - (2) Organic quenching gas has limited lifetime as molecular fragments do not combine after dissociation.
  - (3) Quenching gas can readily accept electron from positive ion cloud to neutralize it.
  - (4) Quenching gas is a strong absorbed of UV rays.
10. In relation to PET QC, the difference among the daily blank sonogram, and a reference blank sonogram acquired at some point in the last setup of the scanner, is called :
- (1) Average variance
  - (2) Streak artifact
  - (3) Scatter correction
  - (4) Calibration factor
11. The number of electrons discharged from the cathode filament is controlled by the :
- (1) The tube voltage (kV)
  - (2) The temperature of the anode
  - (3) The tube current (mA)
  - (4) The distance from the target
12. The PET scanner quality control procedure in which data are used to convert the reconstructed image pixel values into activity concentration is called :
- (1) Normalization
  - (2) Calibration
  - (3) Blank scan
  - (4) Attenuation correction
13. The Full Width at Half Maximum (FWHM) of a photopeak is a measure of
- (1) PHA window setting.
  - (2) Camera sensitivity.
  - (3) Field of view.
  - (4) Detector energy resolution
14. Which type of collimator is used in thyroid uptake probe ?
- (1) Parallel hole
  - (2) Pin hole
  - (3) No collimator
  - (4) Flat field collimator

15. Which of the following is not a component of gamma ray probe system ?
- (1) Collimator
  - (2) Semiconductor detectors
  - (3) Photomultiplier tubes
  - (4) Amplifiers
16. Collimation technique used in PET scanner is
- (1) Electronic collimation
  - (2) Absorptive collimation
  - (3) Ring collimators
  - (4) Parallel hole collimators
17. What is the average half-life of radionuclide which decays by positron emission with half-life of 60 minutes ?
- (1) 60 minutes
  - (2) 86.4 minutes
  - (3) 20 minutes
  - (4) 41.6 minutes
18. True about McNemar Test is
- (1) Marginal homogeneity
  - (2) Unpaired Chi-square test
  - (3) Difference in mean
  - (4) Paired T test
19. A radioactivity with half-life of 6 hours was measured by technologist in a dose calibrator within a span of 10 minutes. His readings were as follows :  
4.17mCi, 4.23mCi, 4.36mCi and 4.41mCi.  
What is this error known as ?
- (1) Technical error
  - (2) Blunder
  - (3) Random error
  - (4) Standard error
20. A patient with PCT, underwent near total thyroidectomy, 4 weeks later, his TSH was 40microIU/ml, He received 45mCi and I131-NaI Radioiodine therapy. Cumulative activity in thyroid remnant can be determined by the formula
- (1)  $1.44TeA_0$
  - (2)  $1.44TbAt$
  - (3)  $1.44TpA_0$
  - (4) None of these
21. A radionuclide decays with both gamma and beta emission. Its  $E_{\beta}^{\max}$  is 606 keV and gamma energy of 364 keV. Determine the average beta energy for this radionuclide.
- (1) 202 keV
  - (2) 303 keV
  - (3) 606 keV
  - (4) 364 keV

22. Relative Biological Effectiveness (RBE) depends upon all, except :
- (1) Linear Energy transfer
  - (2) Number of dose fractions
  - (3) Biological system or end point
  - (4) Oxygen enhanced ratio
23. Which of the following is not true regarding Oxygen Enhanced Ratio (OER) ?
- (1) It is the ratio of doses under hypoxia to aerated condition to produce same biological effect.
  - (2) Small quantity of oxygenation is required for radiosensitization.
  - (3) OER decreases as linear energy transfer increases.
  - (4) OER approaches unity for sparsely ionizing radiation.
24. A 45 years old man as referred for myocardial perfusion scintigraphy (MPS). He is worried about the radiation exposure during the procedure and wants to undergo study with minimal exposure. Which one of the following study you would advised to minimize the radiation exposure ?
- (1) Tc-99m Sestamibi rest Stress study
  - (2) Dual isotope SPECT study
  - (3) Rb-82 stress MPS
  - (4) N-13 stress MPS
25. What are the Units of Absorbed dose, Equivalent dose and exposure, respectively ?
- (1) Rad, Rem, gray
  - (2) Rem, Rad, roentgen
  - (3) Rad, Rem, coulombs/kg
  - (4) Gray, Sievert, Rem
26. Radioactive package containing Mo99-99m Technetium generator was received by Nuclear Medicine technologist. He did survey and gage details as follows :
- Which of the following description is correct for this radioactive package in terms of category, maximum exposure at surface and maximum exposure at 1 metre respectively ?
- (1) III,  $\leq 200$  mR/hr,  $< 10$  mR/hr
  - (2) III,  $\leq 50$  mR/hr,  $< 1$  mR/hr
  - (3) II,  $\leq 200$  mR/hr,  $< 10$  mR/hr
  - (4) II,  $\leq 50$  mR/hr,  $< 1$  mR/hr
27. What is the ALI value for inhalation of  $^{131}\text{I}$  ?
- (1)  $2 \times 10^7$  Bq
  - (2)  $2.0 \times 10^5$  Bq
  - (3)  $1.0 \times 10^8$  Bq
  - (4)  $1.0 \times 10^6$  Bq

28. What is the most radioresistance phase of cell cycle ?

- (1)  $G_1$
- (2)  $G_2$
- (3) S
- (4) M

29. What is the radiation weighting factor for alpha particles ?

- (1) 1
- (2) 20
- (3) 5
- (4) 10

30. For humans the  $LD_{50}(60)$  value is in the range of

- (1) 2-5 Gy
- (2) 3-5 Gy
- (3) 4-6 Gy
- (4) 5-6 Gy

31. A Nuclear Medicine resident gets effective dose report of 0.5mSv in a quarter. The derived quantity is

- (1) An estimate of cell death incurred in the quarter
- (2) Hormesis achieved in the quarter
- (3) Cumulative cancer risk
- (4) Bone marrow damage

32. What is the maximum permissible amount of Mo-99 per mCi (per 37 MBq) of Tc-99m at the time of injection ?

- (1) 0.15 kBq per MBq
- (2) 1.5 microcurie/mCi
- (3) 0.5 microcurie/mCi
- (4) 0.15 microcurie/MBq

33. 60 years old male patient underwent a Tc-99m MDP bone scan. His whole body image showed diffuse radiotracer in the region of stomach and also in thyroid gland. Nuclear Medicine Physician ordered radiopharmaceutical QC testing with thin layer paper chromatography and acetone. Which of the following observation best explains the given situation best ?

- (1) Counts near origin of source of radioactivity 9700 and at top 300
- (2) Counts near origin of source of radioactivity 9600 and at top 400
- (3) Counts near origin of source of radioactivity 8000 and at top 2000
- (4) Counts near origin of source of radioactivity 2000 and at top 8000

34. Which of the following statement is a false ?
- (1) N-13 decays 100% by positron (beta+) emission.
  - (2) At physiological pH, the major form of ammonia is  $\text{NH}_4^+$ .
  - (3) N-13 ammonia has a 70% to 80% extraction rate by myocardial cells at normal coronary flow rates
  - (4) Extraction efficiency does not drop at higher flow rates.
35. Limit for radiochemical impurity with Ge68 breakthrough in Ge68 - Ga68 generator is
- (1) < 0.001%
  - (2) < 0.01 %
  - (3) < 0.002%
  - (4) < 0.02%
36. Which of the following is true regarding "Colloid shift" ?
- (1) There is increased colloid uptake in Kuffer's cell.
  - (2) Decreased colloid uptake noted in spleen and liver.
  - (3) Seen in conditions with diffuse involvement of liver like Cirrhosis.
  - (4) None of these
37. All are true about myocardial perfusion agents, ECEPT :
- (1) All three Thallium 201, MIBI and tetrofosmin are cations.
  - (2) Mechanism of uptake of MIBI & tetrofosmin is by passive diffusion & negative transmembrane potential of mitochondria.
  - (3) Mechanism of uptake of Thallium is active transport by Na/K ATPase pump.
  - (4) Intracellularly Sestamibi and Tetrofosmin retained in the nucleus while thallium 201 appears in free form in cytosol.
38. Regarding Tc-99m ECD (Ethyl Cysteinate Dimer) false statement is
- (1) It is also known as Tc-99m bicisate.
  - (2) It is a neutral lipophilic agent that passively diffuses across the blood brain barrier.
  - (3) It has a first-pass extraction of 90%.
  - (4) Inside the cell it undergoes enzymatic de-etherification.
39. The most useful PET tracer for evaluation of epileptogenic tubers in tuberous sclerosis is
- (1) F-18 FDG
  - (2) C-11 Methionine
  - (3) C-11 Flumazenil
  - (4) C-11 Methyl-l-tryptophan

40. All can be considered as functional imaging strategies for presynaptic dopaminergic receptors, EXCEPT :

- (1) F-18 DOPA
- (2) C-11 Raclopride
- (3) F-18 FP CIT
- (4) Tc-99m TRODAT

41. Which of the following is a selective  $A_2A$  receptor agonist ?

- (1) Dipyridamole
- (2) Regadenoson
- (3) Papavarine
- (4) Adenosine

42. Increases chemical impurity with aluminum in Tc-99m-Sulfur colloid preparation results in increased uptake in

- (1) Thyroid
- (2) Liver
- (3) Lungs
- (4) Stomach

43. The extraction fraction of Tc-99m DTPA is

- (1) 20%
- (2) 30%
- (3) 40%
- (4) 60%

44. Splenic uptake on a Tc-99m MDP bone scan is most often seen in :

- (1) Lymphoma
- (2) Cirrhosis with portal hypertension
- (3) Sickle cell disease
- (4) Hypersplenism

45. If a kit contains 140mCi of  $^{99m}Tc$  in 23ml at 9:00 a.m., how much volume must be withdrawn to obtain a dose of 5mCi at 3:00 p.m. ?

- (1) 0.8 ml
- (2) 1.6 ml
- (3) 2.4 ml
- (4) 0.6 ml

46. Macromolecules in comparison to colloids have

- (1) Slower clearance via lymphatics
- (2) Are not used for lymphoscintigraphy
- (3) Same clearance rate as colloids
- (4) Faster clearance via lymphatics

47. Specific activity is

- (1) Radioactivity per unit mass
- (2) Radioactivity per unit volume
- (3) Radioactivity per unit time
- (4) None of these



48. Choose incorrect statement about Tc-99m – Ubiquinidin.
- (1) It is synthetic antimicrobial peptide fragment.
  - (2) It can differentiate between sterile inflammation and infection
  - (3) It can detect both gram positive and gram negative bacterial infection
  - (4) It is not useful in detection of fungal infection
49. When the half-life of daughter radionuclide is higher than parents it is
- (1) Transient equilibrium
  - (2) Secular equilibrium
  - (3) There is no equilibrium.
  - (4) None of these
50. What is the oxidation state of chemical form of  $^{99m}\text{TcO}_4^-$  eluted from a generator ?
- (1) +5
  - (2) +7
  - (3) -1
  - (4) 0
51. Radiopharmaceuticals with technetium  $^{99m}$  oxidation state 7 is
- (1) Tc-99m-macroaggregated albumin
  - (2) Tc-99m-sulphur colloid
  - (3) Tc-99m-MIBI
  - (4)  $^{99m}\text{TcO}_4^-$
52. Choose what is correct about Thallium 201.
- (1) Predominantly emits 167 keV gamma rays
  - (2) Decays by internal conversion
  - (3) Excreted predominantly through hepatobiliary system
  - (4) Half-life is 68 hours.
53. IMP is a
- (1) Renal agent
  - (2) Brain agent
  - (3) Hepatobiliary agent
  - (4) Cardiac agent
54. Which of the following drugs does not interfere with MIBG uptake ?
- (1) Beta blockers
  - (2) Antipsychotics
  - (3) Tricyclic antidepressants
  - (4) Calcium channel blockers
55. What is incorrect about Tc-99m Mebrofenin ?
- (1) It is bromotriethyl iminodiacetic acid.
  - (2) It has hepatic extraction of 98% and biological half-life of 25 minutes.
  - (3) < 1% is excreted by kidney.
  - (4) Bilirubin levels upto 20–30 mg/dl doesn't interfere with hepatic uptake.

56. Which of the following is false regarding optimal Imaging time for Infection-Seeking Radiopharmaceuticals ?

- (1) Ga-67:48 hr
- (2) In-111 leulocytes : 24 hr
- (3) Technetium-9m HMPAO leukocyte : 1-4 hr
- (4) Antigranulocyte monoclonal antibodies : 24 hr

57. What would be the correct scintigraphy description for AVN on bone marrow scan and Tc-99m MDP bone scan ?

- (1) Hypoactivity on bone marrow scan in area of hypoactivity on bone scan consistent with chronic/reparative phase AVN.
- (2) Hyperactivity on bone marrow scan in area of hyperactivity on bone scan consistent with chronic/reparative phase AVN.
- (3) Hypoactivity on bone marrow scan in area of hyperactivity on bone scan consistent with chronic/reparative phase AVN.
- (4) Hyperactivity on bone marrow scan in area of hypoactivity on bone scan consistent with chronic/reparative phase AVN.

58. In hypertrophic osteoarthropathy, all of the following statement are true, except :

- (1) There is periosteal reaction of long bones of extremities.
- (2) It involves diaphysis and metadiaphysis.
- (3) It is consequence of underlying bone metastasis.
- (4) It shows tram track appearance in long bones on Tc-99m-MDP bone scan.

59. A 35 years old male patient presented with pain in abdomen, lethargy and generalized bodyache. His abdomen ultrasound showed bilateral renal calculi. His calcium was 11.6 mg/dl, TSH-1.2  $\mu$ IU/ml and PTH was 73 ng/ml, what Nuclear Medicine procedure could be considered in this patient for further evaluation ?

- (1) Tc-99m Thyroid scan
- (2) Parathyroid scan with Tc-99m Sestamibi scan
- (3) Tc-99m DTPA renal dynamic study
- (4) Tc-99m Bone scane

60. Tc-99m MDP Bone scan has limited sensitivity for detection of skeletal metastasis from which of the following malignancy ?

- (1) Thyroid cancer
- (2) Breast cancer
- (3) Prostate cancer
- (4) Lung cancer

61. A 49 years old female patient underwent renal transplantation. On day 5 post transplantation her Tc-99m-DTPA dynamic renal study showed normal perfusion, cortical radiotracer uptake and clearance. On Day 11, she presented with raised creatinine levels and decrease in urine output. She was again referred for Tc-99m-DTPA study. It showed preserved perfusion with delayed cortical uptake and clearance. What could be the likely possibility ?

- (1) Acute rejection
- (2) ATN
- (3) Cyclosporine toxicity
- (4) Cortical necrosis

62. A 56 years old male patient presented with neck swelling. He was diagnosed as carcinoma thyroid. His preoperative evaluation with ECG showed wide QRS complex, absence of Q wave in lateral leads, dominant S wave in V1 and notched R wave in V6. His surgeon wants cardiac clearance before the surgery. Which myocardial stress study he should undergo ?

- (1) Myocardial perfusion study with dobutamine stress
- (2) Myocardial perfusion study with Adenosine stress
- (3) Myocardial perfusion with exercise stress test
- (4) Patient not suitable for stress test

63. Which of the following is TRUE about the pattern of Glucose metabolism in different types of Dementia ?

- (1) Alzheimer's disease involves hypermetabolism in temporal and posterior parietal lobes.
- (2) Limbic system metabolism is preserved in Alzheimer's disease.
- (3) Lewy body dementia shows hypometabolism in occipital cortex plus temporal and parietal cerebral cortex and the posterior cingulate cortex.
- (4) The precentral gyrus and occipital lobe is typically spared in Alzheimer's disease.

64. Idiopathic Parkinson's disease initially involves

- (1) Putamen
- (2) Pre-central gyrus
- (3) Hippocampus Caudate nucleus
- (4) Amygdala

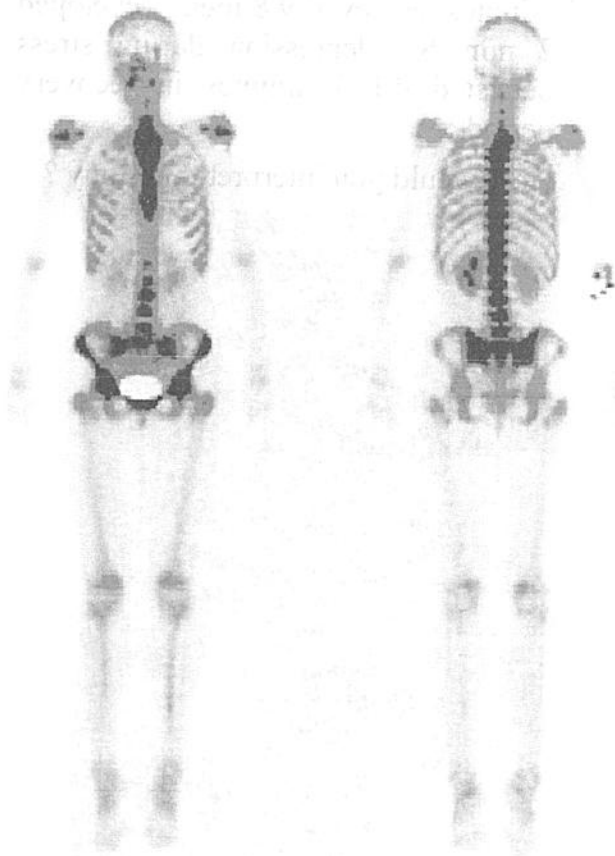
65. All of the following are TRUE about captopril renogram study, EXCEPT :

- (1) It is indicated for patients with hypertension resistant to medical therapy, abrupt or recent onset hypertension and if onset of hypertension under the age of 30 years.
- (2) In adults, Captopril 25-50 mg is administered orally 1 hr before the study.
- (3) Primary finding in renovascular hypertension MAG3 captopril study is slower uptake and delayed peak.
- (4) Decreases in GFR by  $> 10\%$  over baseline study is considered high probability for renovascular hypertension.

66. A 45 years old hypertensive man with history of 20 pack years of smoking, presents with frequent episodes of chest pain. Resting ECG during his visit to office appears normal. Treadmill shows mild ST-T changes during fourth stage at 12 mets. His cholesterol and triglycerides are elevated and is on statins. He was put on secondary preventive measures for hypertension and lifestyle modification regimen. He comes back to OPD with similar complaints. Which of the following non-invasive imaging modalities would be ideal to investigate his chest pain ?

- (1) Ammonia PET and CFR estimation
- (2) FDG PET-CT and viability assessment
- (3) Stress FDG
- (4)  $^{123}\text{I}$  BMIPP imaging and resting perfusion imaging

67. 57 years old male patient complaints of increased frequency of micturition. He also gave history of multiple dialysis for chronic renal disease. He underwent a Tc-99m MDP Bone scan. The likely possibility in this clinical scenario would be



- (1) Renal osteodystrophy
- (2) Osteomalacia
- (3) Metastatic superscan
- (4) Both (1) & (3)

68. Thyroid nodule in Marine-Lenhart syndrome is
  - (1) Non-functioning
  - (2) Responsive to TSH but not TSI
  - (3) Responsive to TSI not TSH
  - (4) Not responsive to either
69. Choose the correct statement for Dopamine transporter imaging.
  - (1) It can differentiate IPD from Parkinson plus syndromes.
  - (2) It can differentiate Parkinsons from essential tremor.
  - (3) It can differentiate between Parkinsonian plus syndromes.
  - (4) It can differentiate vascular from drug induced Parkinsons.
70. Tissue SUV in obese patients is
  - (1) Overestimated
  - (2) Underestimated
  - (3) No relation to weight
  - (4) Depends on height
71. In multigated acquisition study, Ejection fraction is given by
  - (1)  $(\text{End diastolic} - \text{End systolic volume}) / \text{End diastolic volume}$
  - (2)  $(\text{End systolic} - \text{End diastolic volume}) / \text{End diastolic volume}$
  - (3)  $(\text{End diastolic} - \text{End systolic volume}) / \text{End systolic volume}$
  - (4)  $(\text{End systolic} - \text{End diastolic volume}) / \text{End diastolic volume}$

72. Cardiac PET quantification of Myocardial Blood Flow (MBF) and Coronary Flow Reserve (CFR) may be useful for detection and evaluation of all of the following, EXCEPT :

- (1) left ventricle ejection fraction
- (2) Balanced ischemia on qualitative images
- (3) Evaluation of collateral flow
- (4) Identification of endothelial dysfunction

73. According to the PERCIST – PET Response Criteria in Solid Tumors – criteria for treatment response evaluation, the changes in SUVs should be assessed as :

- (1) Percentage change in the same lesion
- (2) Percentage change in the “hottest” lesion
- (3) Value change in the same lesion
- (4) Value change in the “hottest” lesion

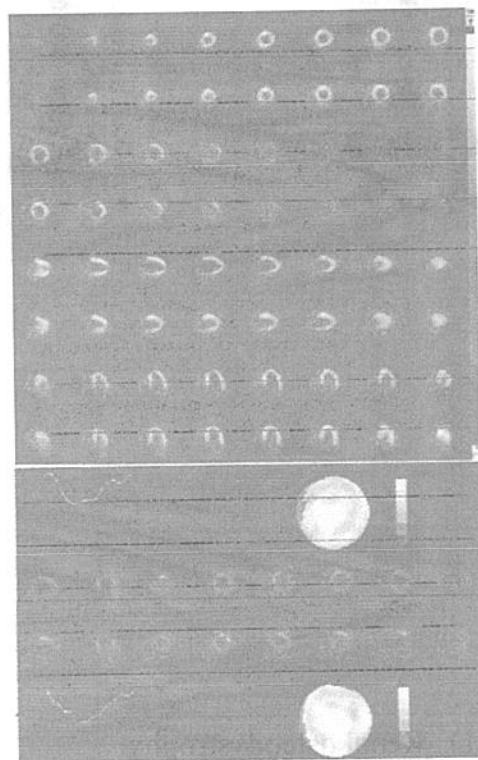
74. The tumor’s Total Glycolytic Volume (TGV) is defined as :

- (1)  $SUV \times \text{Injected activity}$
- (2)  $SUV \times \text{Tumor volume}$
- (3)  $\text{Tumor volume} \times \text{Glucose level}$
- (4)  $\text{Injected activity} \times \text{Glucose level}$

75. A 55 years old diabetic and hypertensive male patient, presented with chest pain and shortness of breath NYHA grade-I since 2 months. He gives history of smoking 2 packs per day for last 5 years. He walks daily for 1 km. His is baseline ECG was normal. Coronary angiography showed normal LMCA with 60% long segment block in LAD, 70% stenosis in LCx and 60% in proximal RCA. His stress MPS study was as follows :

Stress parameters : He walked for 8 minutes, achieved 9.8 mets, developed 2 mm ST depression during stress persisted till 3 minutes in recovery period.

How would you interpret this study ?



- (1) Stress induced ischemia in LAD territory
- (2) Normal perfusion at stress and rest
- (3) LBBB related artifacts
- (4) Balanced ischemia

76. Dementia with Lewy Bodies (DLB) has pattern of FDG uptake similar to that present in patients with Alzheimer's Disease (AD) but in addition it also involves :
- (1) The frontal lobe
  - (2) The occipital lobe
  - (3) The cerebellum
  - (4) The basal ganglia
77. All of the following passes through NAI symporter except ?
- (1)  $\text{KMnO}_4$
  - (2)  $\text{NaTcO}_4$
  - (3)  $\text{KClO}_4$
  - (4)  $\text{KMnO}_3$
78. First step in the ischemic cascade is
- (1) Flow heterogeneity
  - (2) Metabolic shift
  - (3) Diastolic dysfunction
  - (4) Wall motion abnormality
79. Diastolic dysfunction is evaluated in all, except :
- (1) MUGA
  - (2) gated SPECT MPS
  - (3) First pass duty
  - (4) Gates stress FDG MPS

80. All are true ischemic memory zone, except :
- (1) Normal perfusion
  - (2) Hot spot on FDG
  - (3) Cold spot on BMIPP
  - (4) Hot spot on BMIPP
81. What is the accurate description for ATN in renal transplant evaluation with Tc-99m EC renography ?
- (1) Poor perfusion, slow but good uptake, slow progressive excretion
  - (2) Poor perfusion, poor uptake, slow progressive excretion
  - (3) Good perfusion, slow but good uptake, little or no excretion
  - (4) Good perfusion, good uptake, little or no excretion
82. GI bleeding study using Tc-99m labeled RBC
- (1) Less sensitive than CT angiography
  - (2) Can detect intermittent GI bleed
  - (3) Minimum bleeding rate is 1 ml/minute for detection of Tc-99m labeled RBC scintigraphy
  - (4) Tc-99m labeled RBC scintigraphy can locate exact bleeding site

83. What is true about Meckel's diverticulum ?

- (1) Most Meckel's diverticula become symptomatic during adolescence.
- (2) Gastric mucosa is found in approximately 50% Meckel's diverticulum.
- (3) More than 90% bleeding Meckel's diverticula shows ectopic gastric mucosa.
- (4) Patient preparation with potassium perchlorate is required before  $^{99m}\text{Tc}$ -pertechnetate study.

84. All of the following malignant tumors has less sensitivity on F-18-FDG PET-CT, EXCEPT :

- (1) Primary cutaneous T cell lymphoma
- (2) NSCLC Bronchioloalveolar carcinoma
- (3) Low grade carcinoma prostate
- (4) Neuroendocrine carcinoma

85. A 60 years old male patient was found to have spiculated solid pulmonary nodule of size 9 mm in right lung upper lobe on contrast enhanced CT scan. He gives history of smoking for 10 years. His father died due to carcinoma lung. He is apprehensive about this nodules. According to Fleischner Society guidelines, what should be further plan of management in this patient ?

- (1) No intervention required
- (2) F-18-FDG PET-CT
- (3) CT scan thorax after 6 months
- (4) CT scan thorax and MRI brain

86. 28 years old female patient diagnosed as DLBCL. She had involvement of mediastinal and cervical lymph nodes on baseline F-18 FDG PET-CT. She received 3 cycles of chemotherapy. Her interim F-18-FDG PET-CT showed intense FDG avid cervical and mediastinal lymph nodes (uptake 2-3 times greater than liver uptake). However, corresponding CT images showed 50% reduction in SPD. There was no new lesions compared to baseline F-18-FDG PET-CT. According to Lugano criteria, these PET-CT findings could be summarised as

- (1) Partial response to treatment
- (2) Stable disease
- (3) Progressive disease
- (4) Minimal response to treatment

87. False negative results with C-14 urea breath test can be seen with all, except :

- (1) Antibiotics
- (2) Bismuth
- (3) Proton pump inhibitors
- (4) Fasting

88. Positive results with C-14 urea breathe test for H-pylori infection can be interpreted as

- (1)  $> 50$  DPM at 10 minutes
- (2)  $> 100$  DPM at 10 minutes
- (3)  $> 150$  DPM at 10 minutes
- (4)  $> 200$  DPM at 10 minutes



89. Choose best method for estimation of measured GFR.

- (1) Iodine-125 – Iothalamate
- (2) Cr-51-EDTA renal clearance
- (3) Cr-51-EDTA plasma clearance
- (4) DTPA renal clearance

90. 35 years male patient was diagnosed with megaloblastic anaemia. Which In-vitro Nuclear Medicine test could be useful in diagnosis of this clinical condition ?

- (1) Co-57 labelled Vitamin B<sub>12</sub>
- (2) Co-58 labelled Vitamin B<sub>12</sub> plus Intrinsic factor
- (3) Chromium-51-RBC survival study
- (4) Both (1) and (2)

91. Radiosotope used for estimation of plasma volume is

- (1) Chromium-51
- (2) Iodine-125
- (3) Cobalt-57
- (4) Cobalt-58

92. Radioimmune assay was discovered by

- (1) Chals & Wastone
- (2) Berson & Yalow
- (3) Vector & Logan
- (4) Watson & Crick

93. Purpose of radioimmune assay is all, except :

- (1) Detection of target protein
- (2) Quantification of drug levels in blood
- (3) Detection of malignant cells
- (4) Quantification of hormone levels

94. Platelet survival study can be done following radioisotope/s :

- (1) Chromium-51 sodium chromate
- (2) Indium-111 oxine
- (3) Both (1) & (2)
- (4) Iodine-125

95. What is the normal  $\tau_{1/2}$  of Cr-51 labelled red blood cells ?

- (1) 28 days
- (2) 40 days
- (3) 9 days
- (4) 14 days

96. Chromium-51 is used for assessment of

- (1) RBC survival study
- (2) Plasma volume estimation
- (3) Detection of H-pylori infection
- (4) Both (1) & (2)

97. What is the biological basis for peptide receptor radionuclide therapy in Neuroendocrine tumors ?

- (1) SSRT 2-mediated internalization and intracellular retention of the radiopeptide
- (2) SSRT 3-mediated internalization and intracellular retention of the radiopeptide
- (3) Binding with SSRT 2 without internalization and intracellular retention of the radiopeptide
- (4) Binding with SSRT 3 without internalization and intracellular retention of the radiopeptide

98. Binding of certain antibody to an antigen involves

- (1) Concentration and localization
- (2) Enhanced affinity and low avidity
- (3) Enhanced avidity and low affinity
- (4) Enhanced affinity and avidity

99. Ideal properties for therapeutic radionuclide are all, EXCEPT :

- (1) high absorbed dose rate
- (2) low non-penetrating equilibrium does constant
- (3) high target to non-target ratio
- (4) high specific activity

100. False statement about bone pain palliation therapy with radionuclide is

- (1) Patient should have life expectancy of at-least 3 months.
- (2) Preferable to delay bone pain palliation therapy for 2-3 months post large field radiotherapy.
- (3) Bisphosphonates can be used concomitantly.
- (4) Pain relief start early with Sr89 chloride compared to Sm-153-EDTMP.

101. Which of the following is contraindication for bone pain palliation therapy with radionuclide ?

- (1) Hemoglobin 100 g/L
- (2) Platelets counts  $< 90 \times 10^9/L$
- (3) WBC counts  $5 \times 10^9/L$
- (4) Metastatic bone marrow involvement

102. What is true about relation of LET, OER and RBE ?

- (1) OER decreases with increase in LET.
- (2) RBE decreases with increases in LET.
- (3) Both OER and RBE increases with LET.
- (4) Both OER and RBE decreases with LET.

103. Amifostine is a

- (1) Radio protector
- (2) Radiation sensitizer
- (3) Radiation modifier
- (4) No effect on radiation effects.

104. \_\_\_\_\_ is added to reduce the volatile nature of  $\text{Na}^{131}\text{I}$

- (1) Sodium bicarbonate
- (2) Sodium triphosphate
- (3) Sodium polyphosphate
- (4) Sodium thiosulphate

105. What is the estimated cancer risk per Sievert for radiation worker after acute radiation exposure ?

- (1) 10%
- (2) 8%
- (3) 5%
- (4) 4%

106. A medical physicist working in the department of Nuclear Medicine observed that his TLD badge readings for the given monitoring period is 8 mSv. He is apprehensive about his readings. What is the most appropriate action required in this situation ?

- (1) Report RSO and AERB about the overexposure.
- (2) Report RSO and AERB about the overexposure and perform chromosome aberration test.
- (3) Report the incidence to AERB and refrain him from working in radiation working area.
- (4) No active intervention required. Monitor exposure readings for rest of the year. Ask him to practice ALARA principle strictly.

107. What is the radiation unit used to represent deterministic effect for radiation ?

- (1) Gray
- (2) Sievert
- (3) Barendsen
- (4) Roentgen

108. Which dose response model is used to determine stochastic effects by regulatory body ?

- (1) Linear no threshold
- (2) Linear quadratic dose response
- (3) Linear threshold model
- (4) Both (1) & (2)

109. The radiation exposure rate at a distance of 12 inches from a radioactive source is 12.5 mR/h. How many feet away should the technologist stand to reduce the exposure level to 3.0 mR/h ?

- (1) 2 ft.
- (2) 4.2 ft.
- (3) 24.5 ft.
- (4) 60 ft.

110. In Nuclear Medicine a physician wants to plan an isolation ward with facility for 2 patients. According to area available maximum single isolation room of size of  $3 \times 5$  sq. metres is possible. For a maximum dose of 250 mCi I-131, what should be the minimum thickness of concrete wall for this isolation room according to AERB guidelines ?

- (1) 20 cm
- (2) 9 cm
- (3) 14 cm
- (4) 30 cm

111. According to AERB guidelines, what should be the capacity of delay tank for effective collection and storage of effluent waste in high dose radioisotope therapy isolation ward with facility for 2 patients ?

- (1) Dual delay tank system with capacity of 3000 litres each
- (2) Dual delay tank system with capacity of 6000 litres each
- (3) Single delay tank system with capacity of 6000 litres
- (4) Dual delay tank system with total capacity of 6000 litres.

112. According to AERB, what should be the I-131 concentration in the effluent waste at the time of discharge into public sewerage system ?

- (1)  $< 0.6 \mu\text{C/L}$
- (2)  $< 0.06 \mu\text{C/L}$
- (3)  $< 0.7 \mu\text{C/L}$
- (4)  $< 0.07 \mu\text{C/L}$

113. During administration of  $\text{Sm-153 EDTMP}$  for metastatic carcinoma prostate patient, physician noticed extravasation. What should be the immediate action ?

- (1) No intervention required continue remaining infusion.
- (2) Terminate the procedure and reschedule the patient.
- (3) Stop the administration and try to withdraw radiopharmaceutical as much as possible.
- (4) Inject another radiopharmaceutical dose.

114. According to AERB guidelines, what is the maximum exposure limit for the radiation worker in the given monitoring period ?

- (1) 10 mSv
- (2) 20 mSv
- (3) 30 mSv
- (4) 8 mSv

115. Radiation safety officer after wipe test from fume hood finds a reading of  $32 \text{ Bq/cm}^2$ . What is correct statement regarding above situation ?

- (1) ALARA principles are not followed in the laboratory practices properly.
- (2) Report the incidence to regulatory body immediately.
- (3) Reading is well within the prescribed limits of contamination for given area.
- (4) Seal the area for 24 hours.

116. Determine the transmission factor of an attenuating material that reduced the count rate from 1600kct to 400kct ?

- (1) 0.55
- (2) 0.45
- (3) 0.25
- (4) 0.35

117. Selumetinib is a

- (1) MEK inhibitor
- (2) DNA methylase inhibitor
- (3) PPAR-gamma Agonists
- (4) Demethylation and histone-Deacetylase inhibitor

118. Which of the following bone pain palliation agent showed improvement in overall survival ?

- (1) Ra-223
- (2) Sm-153
- (3) Sr-89
- (4) Leu-177 EDTMP

119. Ra-223 has a half-life of

- (1) 10.4 days
- (2) 11.4 days
- (3) 12.4 days
- (4) 13.4 days

120. Which of the following radionuclides can be used in radioactive patches for skin therapies ?

- (1) P-32
- (2) Y-90
- (3) Re-188
- (4) Leu-177

121. Incorrect statement about Nephrotoxicity with Leu-177/Y-90 PRRT therapy for NET.

- (1) It is due to glomerular filtration, reabsorption and retention of small sized radiopeptides in proximal tubules.
- (2) It is more common with Leu-177 than Yttrium 90 therapy.
- (3) Positively charged molecules L-lysine and/or L-arginine competitively inhibit the proximal tubular reabsorption of the radiopeptide.
- (4) 4% succinylated gelatine infusion helps in inhibiting proximal tubular resorption of radiopeptides.



122. Which of the following is not a theragnostic radionuclide ?
- (1) Copper 67
  - (2) Scandium 87
  - (3) Samarium 153
  - (4) Zirconium 89
123. Which is not the indication for radiosynoviorthesis ?
- (1) Rheumatoid Arthritis (RA)
  - (2) Seronegative spondyloarthropathy
  - (3) Haemophilic arthritis
  - (4) Osteoarthritis
124. Which method/s are useful for dosimetry after Yttrium-90 therapy of neuroendocrine tumors ?
- (1) Bremsstrahlung imaging
  - (2) Imaging with Yttrium 86
  - (3) Both (1) & (2)
  - (4) Gamma ray imaging
125. What are the advantages of radiosynoviorthesis for haemophilic arthritis ?
- (1) Reduces the requirement of clotting factor replacement
  - (2) It can be done in severely unstable joints.
  - (3) Prevents joint deformity
  - (4) Less Factor VIII or IX requirement
126. I-131 tositumomab (Bexxar) is radiommune therapy directed against the
- (1) CD20 antigen
  - (2) CD37 antigen
  - (3) CD19 antigen
  - (4) CD22 antigen
127. Cu-64 produced in cyclotron by following reaction :
- (1)  $(n, p)$
  - (2)  $(2n, p)$
  - (3)  $(3n, p)$
  - (4)  $(2d, n)$
128. A 60 years old male patient with castrate resistant prostate cancer underwent Ga68 PSMA PET CT scan, which showed multiple PSMA avid metastases to liver, retroperitoneal & pelvic lymph nodes and skeletal sites. PSA levels > 600ng/ml. What should be the best possible treatment option for this patient ?
- (1) Radium-233 therapy
  - (2) Lutetium-177 PSMA therapy
  - (3) Lutetium-177 EDTA therapy
  - (4) None of these

129. 35 years old male patient was diagnosed with rheumatoid arthritis of metacarpophalangeal joint. Which is the ideal radionuclide for radiosynoviorthesis ?

- (1) Yttrium 90
- (2) Erbium 169
- (3) Rhenium 188
- (4) Rhenium 186

130. A 56 years old female patient presented with neck swelling since 2 yrs. FNAC suggestive of papillary carcinoma thyroid. She underwent total thyroidectomy and neck dissection. Final histopathology showed 4.3 cm tumor confined to right lobe of thyroid with 4/6 N1 group of lymph nodes showing metastatic deposits. I-131 whole body scan did not show any distant metastasis. What will be the staging according to AJCC 8 ?

- (1) Stage I
- (2) Stage II
- (3) Stage III
- (4) Stage IV

131. According to AJCC 8; the cut off age for staging well differentiated Thyroid cancer is

- (1) 35 years
- (2) 45 years
- (3) 55 years
- (4) 60 years

132. NETTER I trials is related to which of the following ?

- (1) Metastatic Prostate carcinoma
- (2) Midgut NET
- (3) Undifferentiated Thyroid cancer
- (4) Bone pain palliation

133. According to latest ATA guidelines, minimum dose required for thyroid remnant ablation post total thyroidectomy in a patient with thyroid carcinoma is –

- (1) 40 mCi
- (2) 30 mCi
- (3) 20 mCi
- (4) 50 mCi

134. Redifferentiation therapy for thyroid cancer includes all of the following, EXCEPT :

- (1) Retinoic acid
- (2) Radiotherapy
- (3) Satins
- (4) Sorafenib

135. False statement regarding Sm-153 EDTMP is

- (1) Maximum beta particles energy is 0.8 MeV.
- (2) Skeletal uptake is upto 48% of administered radioactivity.
- (3) Pain relief starts earlier compared to Sr89 chloride.
- (4) Emits gamma rays of 113 keV.

136. Terbium-161 :

- (1) Alpha emitter
- (2) Emits both beta and gamma radiation
- (3) Emits low-energy conversion and Auger electrons
- (4) Both (2) & (3)

137. All the following radiopharmaceuticals can be used for evaluation of metastatic medullary carcinoma, except :

- (1) I-131 MIBG
- (2) I-131 antiFFP antibody
- (3) F-18 FDG
- (4) In-111 octreotide

138. Choose false statement regarding side effects of bone pain palliation therapy with different radionuclide.

- (1) Flare phenomenon is commonly observed within 72 hours of treatment in 10% patients.
- (2) Myelosuppression is seen earlier with Sm-153EDTMP compared to Sr-89 Chloride and P-32.
- (3) Myelosuppression is usually temporary and recovers within 3 months.
- (4) Flushing sensation is common with Sm-153 EDTMP.

139. Most common gene mutation associated with Hobnail variant of papillary carcinoma thyroid is

- (1) BRAF<sup>V600E</sup>
- (2) RET
- (3) RAS
- (4) APC

140. Thyroid carcinoma commonly associated with a germline mutation in the Adenomatous Polyposis Coli (APC) gene is

- (1) Hobnail variant of papillary carcinoma thyroid
- (2) Invasive Follicular carcinoma thyroid
- (3) Cribriform-morular variant of papillary carcinoma thyroid
- (4) None of these



141. The encapsulated follicular variant of papillary carcinoma thyroid frequently have
- (1) RAS mutations
  - (2) BRAF<sup>V600E</sup>
  - (3) PAX8/PPARc
  - (4) RET
142. Papillary carcinoma thyroid in children more commonly associated with following mutation :
- (1) RET/PTC
  - (2) RAS
  - (3) BRAF<sup>V600E</sup>
  - (4) Both (1) and (2)
143. Burch and Wartofsky diagnostic criteria is used for diagnosis of
- (1) Myxedema coma
  - (2) Thyroid storm
  - (3) Graves' ophthalmopathy
  - (4) Carcinoid syndrome
144. Which of the following is not used for assessment of Graves' ophthalmopathy ?
- (1) EUGOGO
  - (2) NOSPECS
  - (3) VISA
  - (4) Burch and Wartofsky
145. Which is not included in Clinical activity scoring criteria for Graves' Ophthalmopathy ?
- (1) Decrease of acuity equivalent to 1 Snellen line
  - (2) Inflammation of caruncle
  - (3) Spontaneous orbital pain
  - (4) Epiphora
146. Which of the following alpha emitters is also nano generator ?
- (1) Actinium 225
  - (2) Radium 223
  - (3) Astatine 211
  - (4) Thorium 227
147. ALSYMPCA trial with Ra223 in castrate resistance prostate cancer showed
- (1) Prolong survival and skeletal related events
  - (2) Prolong time to increase in PSA levels only
  - (3) Prolong time to skeletal related events only
  - (4) No impact on survival.

148. 53 years male patient presented with a swelling in anterior neck. USG showed 4 cm nodule in right lobe of thyroid. FNAC showed papillary carcinoma of thyroid. He underwent right lobectomy followed by completion thyroidectomy, central compartment clearance and right neck dissection. Final histopathology showed PCT with metastasis to level VI and VII group of lymph nodes. I-131 whole body scan showed mild uptake only in thyroid remnant with no distance metastasis. What would be the disease stage ?

- (1) Stage I
- (2) Stage II
- (3) Stage III
- (4) Stage IV

149. All are true about Neuroendocrine Tumors (NET), EXCEPT :

- (1) There is overexpression of SSTR receptor 2, 3, 5 by neuroendocrine tumor.
- (2) Low grade tumor shows more Ga-68-DOTANOC avidity than high grade tumors.
- (3) F-18-FDG PET-CT can be helpful in evaluation of grade I tumor.
- (4) Leutitium-177 labelled Peptide Receptor Radionuclide Therapy (PRRT) is a promising treatment option in neuroendocrine tumors.

150. Grade II Neuroendocrine tumors show increase radiotracer uptake on

- (1) Ga-68-DOTA NOC PET-CT
- (2) F-18-FDG PET-CT
- (3) F-18-FDG PET CT is not useful grade II NET.
- (4) Both (1) and (2)

151. Choose false statements regarding Thyroglobulin in monitoring patients with carcinoma thyroid.

- (1) Serum Thyroglobulin levels after 3-4 weeks of thyroidectomy helps in identifying high risk patients.
- (2) Serum Thyroglobulin levels serves as marker for assessing response to Radioiodine therapy.
- (3) Stimulated Serum Thyroglobulin levels along with I-131 whole body radioiodine scan at 6 months post radioiodine therapy can be used as predictor or recurrence free survival.
- (4) Low Serum Thyroglobulin levels obviates the need of I-131 whole body radioiodine scan.

152. Patient performance scale used for cancer patient status assessment

- (1) ECOG has grades from 0 to 5.
- (2) Karnofsky performance status index is between 0-10.
- (3) In ECOG performance scale Lower grade suggests good performance.
- (4) Karnofsky index 100 indicates poor patient status.

153. According to latest WHO classification, high grade Neuroendocrine tumors are defined as

- (1) Ki 67 index > 20%
- (2) Mitotic rate 2-20
- (3) Ki 67 index 3-20 %
- (4) Both (2) & (3)

154. All of the following agents are used for intra-arterial radionuclide therapy for HCC, except :

- (1) I-131 Lipiodol
- (2) Rhenium-188 Lipiodol
- (3) Scandium-47
- (4) Holmium-166 microspheres

155. True about Yttrium-90 radioembolization therapy is all, except :

- (1) It is a form of intravascular brachytherapy, delivering implantable radioactive microspheres into the arteries that feed liver tumors.
- (2) Hepatopulmonary shunt that would deliver 30Gy to lungs with a single infusion is absolute contraindication to yttrium-90 radiobolization therapy.
- (3) Compromised pulmonary function and an inadequate liver reserve is relative contraindication for radioembolization therapy with Yttrium-90.
- (4) Patients with history of prior irradiation to liver is relative contraindication for radioembolization therapy with Yttrium-90.

156. 52 years female diabetic, hypertensive patient, presented with nodule anterior neck since 4 years. She also complains of increases heart rate, weight loss, profuse sweating. She also gives history of fever, rashes and sore throat after taking T. Carbimazole for 2 years. Her Tc-99m, Scan shows diffusely increased raditracer uptake in enlarged thyroid gland. What should be the next treatment of choice for this patient ?



- (1) Propylthiouracil (PTU)
- (2) Continue carbimazole
- (3) I-131 treatment
- (4) PTU followed by surgery

157. False statement about Iodine-124 is

- (1) It is a positron emitting radionuclide.
- (2) It is a reactor produced radionuclide.
- (3) It has very high positron energies.
- (4) It has very high X-ray energies.

158. Ga-68 Exendine is a radiopharmaceutical for imaging patient with

- (1) Carcinoma prostate
- (2) Neuroblastoma
- (3) Glucagonoma
- (4) Insulinoma

159. F-18 Florbetapir is imaging agent for

- (1) Intracellular deposition of Tau protein
- (2) A $\beta$  amyloid
- (3) Post synaptic dopamine receptor
- (4) Both for Tau protein and A $\beta$  amyloid

160. Which is incorrect about Ga-68 DOTA-FAPI PET-CT ?

- (1) It is fibroblast activation protein inhibitor.
- (2) There is overexpression of FAP in cancer associated fibroblast.
- (3) There is less radiotracer uptake in liver, brain and oral mucosa compared to FDG.
- (4) Effective dose is more compared to F18-FDG PET-CT.

161. Choose the incorrect statement regarding F-18 FLT.

- (1) It monitors DNA synthesis as a reflection of cell proliferation.
- (2) Actively transported through cell like thymidine and phosphorylated by TK1.
- (3) Further metabolized into difluorothymidine, trifluorothymidine and then get incorporate into DNA.
- (4) It shows intense uptake in bone marrow, moderate uptake in liver and no uptake in brain.

162. ISCHEMIA trial concludes :

- (1) There was no difference in cardiovascular events and death between revascularization and optimum medical treatment.
- (2) Cardiovascular events and death rates were lower in patients treated with coronary revascularization than in patients treated with optimum medical treatment.
- (3) Study included patients with chronic stable angina and acute coronary syndrome.
- (4) Optimum medical treatment shows less cardiovascular events and death.

163. All are TRUE about functional imaging in patients with dementia, EXCEPT :

- (1) Glucose hypometabolism is a characteristic features of neurodegeneration and hence F-18 - FDG PET CT can be useful in this condition.
- (2) F-18 - Florbetapir is used for imaging intracellular protein deposition inside neurofibrillary tangles.
- (3) Amyloid-beta deposition is a relatively early event on the path to Alzheimer's disease and can be imaged by C-11-PIB compounds.
- (4) F-18-THK 5117 is the imaging agent used for intracellular Tau deposition.

164. PET-CT "PROMISE" criteria is for

- (1) Prostate cancer
- (2) Pancreatic Neuroendocrine tumor
- (3) Differentiated Thyroid cancer
- (4) Neuroendocrine tumor

165. False about PSMA RAD PET-CT reporting system is

- (1) Category 2 : "likely benign" with equivocal uptake at sites atypical; for prostate cancer involvement.
- (2) Category 3 : "equivocal" with lesion suggestive of malignancy on anatomic imaging but no uptake at sites typical for prostate cancer involvement.
- (3) Category 4 : "prostate cancer highly likely" with intense uptake at typical sites of prostate cancer involvement but lacking definitive findings on conventional imaging and biopsy is mandatory.
- (4) Category 5 : "prostate cancer almost certainly present" with intense uptake at typical sites of prostate cancer involvement and with/without corresponding findings on conventional imaging. Unlikely that biopsy confirmation will be needed.

166. Both Copper-67 and Scandium-47 are comparable in all aspects, except :

- (1) Half life
- (2) Beta energy
- (3) Imageable photon energy
- (4) Specific activity & Radiochemistry

167. When a neutron deficient nucleus emits a positron ?
- (1) Atomic mass number decreased by 1.
  - (2) Atomic mass number increased by 1.
  - (3) Atomic number increases by 1.
  - (4) Atomic mass number is unchanged.

168. Bragg's peak occurs in
- (1) Interaction of alpha particles
  - (2) Interaction of neutron
  - (3) Interaction of gamma rays
  - (4) Both (1) & (2)

169. What is not true about photoelectric effects ?
- (1) It is the interaction of gamma rays with tightly bound inner shell electrons.
  - (2) Gamma ray is completely absorbed and electron is ejected.
  - (3) It is more probable with high density material.
  - (4) It is directly proportional to the gamma ray energy.

170. Which of the following scintillator has the maximum light output ?
- (1) LSO
  - (2) NaI (Tl)
  - (3) BGO
  - (4) GSO

171. Gamma rays were discovered by

- (1) Joliot Curie
- (2) Lawrence
- (3) Villard
- (4) Roentgen

172. Which of the following statement is false ?

- (1) Crystal hydration in a camera can be checked by shifting the photopeak.
- (2) Electrons can't be accelerated in cyclotron because it achieves relativistic mass very shortly.
- (3) The medical exposure to Indian population is 0.14 mSv/year.
- (4) The efficiency of a parallel hole collimator decreases with the increase in distance.

173. Incorrect statement about Semiconductor detectors is

- (1) It can be used for energy selective radiation counting.
- (2) Si(Li) and Ge(Li) need liquid nitrogen to reduced thermal induced background current.
- (3) Lithium impurity can cause electron trap and reduces amount of electrical signals.
- (4) CZT can be operated at room temperature.

174. Most effective absorbing material for neutron beam is

- (1) Lead
- (2) Tungsten
- (3) Mercury
- (4) Polyethylene

175. Interaction of low energy photon and atom as whole is known as

- (1) Compton scatter
- (2) Cerenkov effect
- (3) Pair production
- (4) Rayleigh scattering

176. Which of the following detectors that have been used in PET imaging is intrinsically radioactive?

- (1) LSO (Lutetium oxyorthosilicate)
- (2) BaF<sub>2</sub> (Barium fluoride)
- (3) BGO (Bismuth germanate)
- (4) GSO (Gadolinium orthosilicate)

177. Which radiation detector can perform energy sensitive counting?

- (1) Ionization chamber
- (2) Proportional counter
- (3) Geiger Muller counter
- (4) All gas field detectors

178. All are correct for the differences between electron emitted in internal conversion and  $\beta$ -decay, except:

- (1) In beta decay electron originates from nucleus.
- (2) In Internal conversion decay electron originates from nucleus.
- (3) Internal conversion emits electron with discrete energy.
- (4)  $\beta$ -particle has spectrum of energy.

179. Choose incorrect statement regarding Bremsstrahlung photon.

- (1) It is interaction of sufficiently high energy charged particle and nucleus.
- (2) Energy of Bremsstrahlung photon can be from zero up to the energy of incident particle.
- (3) It increases with increasing the atomic number of absorbing material.
- (4) Percentage radiation losses is given by formula:

$$ZE\beta_{\max}/2000 \times 100$$

180. What is the most common interaction of gamma rays with water?

- (1) Bremsstrahlung
- (2) Photoelectric effect
- (3) Compton effect
- (4) Pair production

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