

Chapter 2

Practice Test # 1: Difficulty Level-Easy

Questions

1. The exposure rate of an activity of 1 millicurie (mCi) measured at 1 centimeter (cm) is called:
(A) Roentgen man equivalent (REM)
(B) The exposure rate constant (ERC)
(C) Total effective dose equivalent (TEDE)
(D) Kilobecquerel (kBq)
2. Quantitative bias that refers to the underestimation of counts density which differs from what they should be is called:
(A) Motion artifact
(B) Partial-volume effect
(C) Recovery coefficient
(D) Truncation artifact
3. Truncation artifacts in PET/CT imaging are produced by:
(A) Contrast medium
(B) Difference in size of FOV between PET and the CT
(C) Difference in scanning time between PET and the CT
(D) Beds overlapping

Answers to Test #1 begin on page 45

4. Dental fillings, hip prosthetics, or chemotherapy port are examples of PET/CT imaging artifacts described as:
 - (A) Truncation artifacts
 - (B) Motion artifacts
 - (C) Contrast medium artifacts
 - (D) Metallic implants artifacts
5. Property of PET detectors that allows them faster timing signals for coincidence detection and to work at high count rates is called:
 - (A) The stopping power
 - (B) Energy resolution
 - (C) The decay constant
 - (D) The light output
6. The picturing, description, and measurement of biological processes at the particle and cellular level is known as:
 - (A) Dynamic imaging
 - (B) Molecular imaging
 - (C) Static imaging
 - (D) Dual point imaging
7. A PET system capacity to distinguish between two points after image reconstruction is called:
 - (A) Contrast
 - (B) Resolution
 - (C) Attenuation
 - (D) Emission
8. Allergic reaction that begins within seconds/minutes of contrast media administration and rapidly progresses to cause airway constriction, skin and intestinal irritation, and altered heart rhythms is called:
 - (A) Urticaria
 - (B) Anaphylaxis
 - (C) Sepsis
 - (D) Infarction
9. The first PET radiopharmaceutical to receive the U.S. Food and Drug Administration approval in 1989 was:
 - (A) Rb-82
 - (B) F-18 Fluoride
 - (C) F-18 FDG
 - (D) N-13 ammonia

10. Choose from the following responses to interpret this ECG:

- (A) Normal sinus rhythm
- (B) Electronic ventricular pacemaker
- (C) Atrial fibrillation
- (D) Ventricular bigeminy (Fig. 2.1)

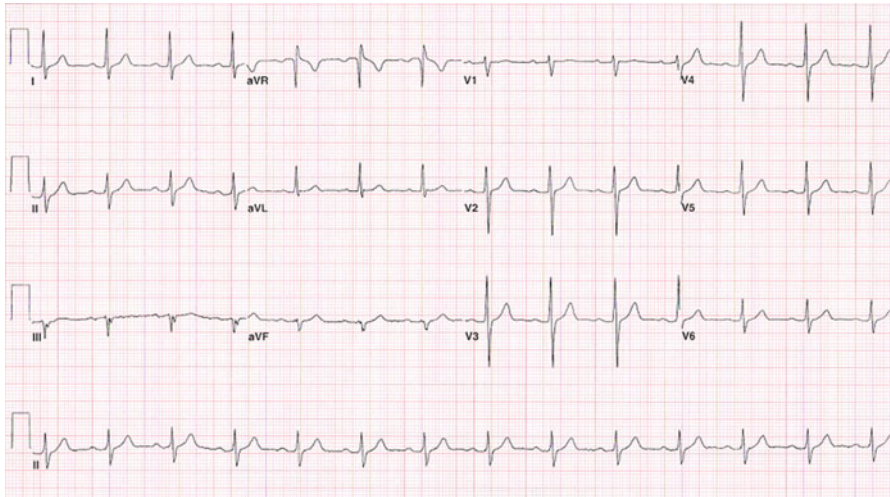


Fig. 2.1 ECG Sample Case: A 51-year-old man with atypical chest pain

11. The dose calibrator quality control procedure performed to assess the device's ability to measure accurately a range of a low to high activities is called:

- (A) Geometry
- (B) Accuracy
- (C) Linearity
- (D) Constancy

12. The following positron-emitting radionuclides are isotopes of natural elements present in most biochemical processes EXCEPT:

- (A) O-15
- (B) F-18
- (C) C-11
- (D) N-13

13. Two photons arising from the same annihilation event and detected by two detectors within the coincidence time-window are:

- (A) True coincidences
- (B) Random events
- (C) Scatter coincidences
- (D) Single events

14. Which of the following serve as the building blocks for proteins synthesis?
- (A) Amino acids
 - (B) Phospholipids
 - (C) Enzymes
 - (D) Hormones
15. Positronium (Ps) is an arrangement of:
- (A) Two positrons
 - (B) Two electrons
 - (C) An electron and a positron
 - (D) A positron and a neutrino
16. Which of the following regions is the most common site of brown fat localization?
- (A) Neck
 - (B) Mediastinum
 - (C) Paravertebral
 - (D) Perinephric
17. Which of the following scintillators commonly used in PET imaging has the highest stopping power?
- (A) LSO (lutetium oxyorthosilicate)
 - (B) BaF₂ (barium fluoride)
 - (C) BGO (bismuth germanate)
 - (D) GSO (gadolinium orthosilicate)
18. A malignant neoplasm of the skin linked with approximately 75% of skin cancer-related mortality is called:
- (A) Basal cell carcinoma
 - (B) Sarcoma
 - (C) Melanoma
 - (D) Squamous cell carcinoma
19. PET tracers have demonstrated significant potential utility and application in the following clinical areas EXCEPT:
- (A) Oncology
 - (B) Cardiology
 - (C) Pulmonology
 - (D) Neurology
20. A dose of F-18 FDG is calibrated to have 14 mCi at 12:00 P.M. How many millicuries of F-18 FDG will be remaining at 12:40 P.M.?
- (A) 2.6 mCi
 - (B) 11 mCi
 - (C) 18 mCi
 - (D) 19.6 mCi

21. The sum of the weighted equivalent doses in all the tissues and organs of the body is called:
- (A) Whole-body dose
 - (B) Effective dose
 - (C) Committed dose equivalent
 - (D) Shallow dose equivalent
22. The combined whole-body effective dose for a clinically diagnostic PET/CT is typically in the range:
- (A) <10 mSv
 - (B) 10–20 mSv
 - (C) 20–30 mSv
 - (D) >30 mSv
23. The positron has the same mass as an electron and an electric charge of:
- (A) -2
 - (B) -1
 - (C) 0
 - (D) +1
24. The initial diagnosis of melanoma is established by:
- (A) PET examination
 - (B) CT examination
 - (C) Histologic evaluation
 - (D) Dermatologist evaluation
25. In PET scanning process raw data acquired and identified as coincidence events along their LOR are stored in the raw data format called:
- (A) Histograms
 - (B) Sinograms
 - (C) Dextrograms
 - (D) Pictograms
26. Which of the following is cyclotron produced positron-emitting radionuclide?
- (A) Copper-62
 - (B) Nitrogen-13
 - (C) Gallium-68
 - (D) Rubidium-82
27. A piece of equipment that sorts out photons of different radionuclides with different photon energies and to separate scattered photons from the useful ones is called:
- (A) Photomultiplier tube
 - (B) Pulse height analyzer
 - (C) ADC converter
 - (D) Optical window

28. DNA synthesis is a measure of cellular:
- (A) Apoptosis
 - (B) Mutation
 - (C) Proliferation
 - (D) Metabolism
29. The F-18 fluoride bone uptake mechanism is similar to that of:
- (A) F-18 fluorodeoxyglucose (FDG)
 - (B) Ga-68
 - (C) Tc-99 m methylenediphosphonate (MDP)
 - (D) In-111
30. The process by which new blood vessels are formed is called:
- (A) Angiogenesis
 - (B) Embryogenesis
 - (C) Morphogenesis
 - (D) Organogenesis
31. Which of the following quality control procedures are required for proper functioning of the survey meter?
- (A) Calibration and linearity
 - (B) Geometry and constancy
 - (C) Calibration and constancy
 - (D) Linearity and geometry
32. The Circle of Willis is a circle of arteries that supply blood to:
- (A) The heart
 - (B) The lungs
 - (C) The brain
 - (D) The liver
33. The CT X-ray tube:
- (A) Detects the X-ray
 - (B) Produces the X-ray
 - (C) Shields from the X-ray
 - (D) Measures the X-ray
34. The radiodensity of distilled water at standard pressure and temperature (STP) on the Hounsfield unit (HU) scale is equal to:
- (A) -1 HU
 - (B) 0 HU
 - (C) 1 HU
 - (D) 10 HU

35. The dose calibrator quality control procedure testing a long-lived standard at each of the frequently used radionuclides settings is called:
- (A) Geometry
 - (B) Accuracy
 - (C) Linearity
 - (D) Constancy
36. Which of the following radionuclides commonly used in PET imaging has the highest energy?
- (A) Carbon-11
 - (B) Nitrogen-13
 - (C) Oxygen-15
 - (D) Fluorine-18
37. The PET scanner quality control procedure in which data are used with the transmission data in the computation of attenuation correction factors is called:
- (A) Normalization
 - (B) Calibration
 - (C) Blank scan
 - (D) Attenuation correction
38. The property of the scintillation detector described as the number of scintillations produced by each incident photon is called:
- (A) The stopping power
 - (B) Energy resolution
 - (C) The decay constant
 - (D) The light output
39. Which of the following compounds serves as a precursor for the synthesis of phospholipids?
- (A) Thymidine
 - (B) Acetate
 - (C) Choline
 - (D) Tyrosine
40. What is the percent error of the dose calibrator reading if a 4 ml reference volume (expected) of geometry test reads 2.8 mCi, and the actual reading obtained in 10 ml volume is 2.5 mCi?
- (A) 12%
 - (B) 10.7%
 - (C) -10.7%
 - (D) -12 %

41. The presented images labeled A, B, C, and D were obtained during a routine PET/CT scan. The image labeled “A” is described as:
- (A) Topogram
 - (B) Fused coronal
 - (C) Non-attenuation corrected
 - (D) Maximum-intensity projection (Fig. 2.2)

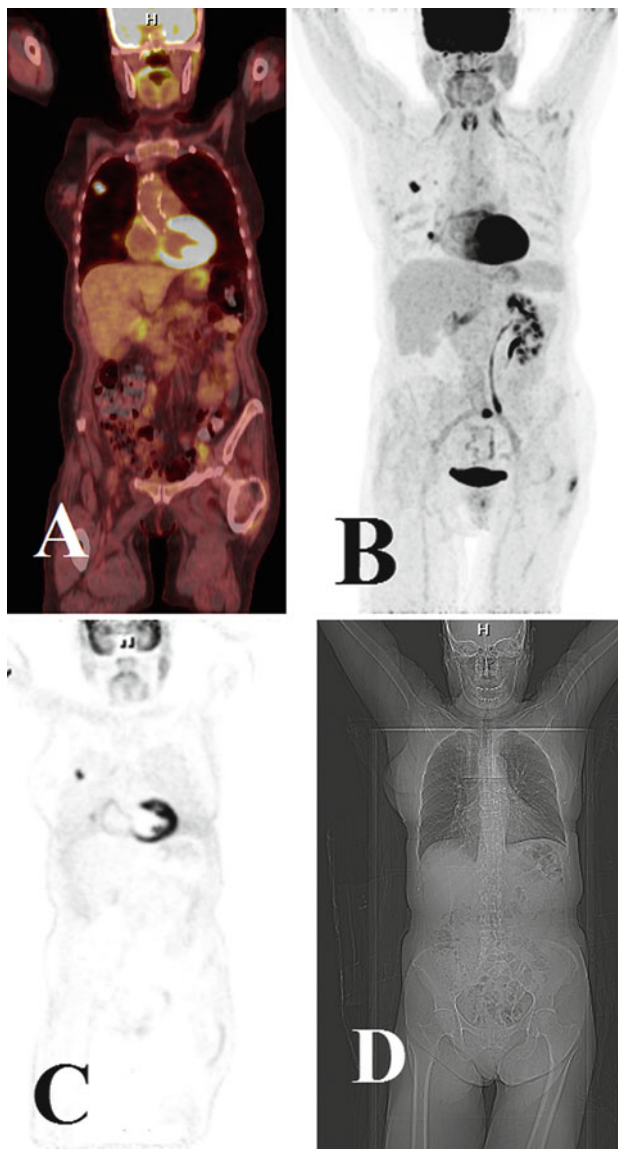


Fig. 2.2 PET/CT images

42. Which of the following is the correct order of scanning when a typical PET/CT protocol is applied?
- (A) Transmission CT, emission PET, topogram
 - (B) Transmission CT, topogram, emission PET
 - (C) Topogram, transmission CT, emission PET
 - (D) Emission PET, transmission CT, topogram
43. Presence of the non-collinearity of the annihilation photons and the finite positron range are inherent properties of positron emission tomography resulting in:
- (A) Attenuation artifacts
 - (B) Positional inaccuracy
 - (C) Scatter
 - (D) Truncation
44. Which of the following positron-emitting nuclides has the shortest half-life?
- (A) Rubidium-82
 - (B) Oxygen-15
 - (C) Nitrogen-13
 - (D) Carbon-11
45. The cathode filament of the X-ray tube:
- (A) Emits electrons
 - (B) Emits X-ray
 - (C) Attracts electrons
 - (D) Detects X-ray
46. An oncology patient referred for a positron emission tomography scan should fast prior to his/her appointment for at least:
- (A) 12 h
 - (B) 8 h
 - (C) 4 h
 - (D) 2 h
47. Daily quality control checks on the PET scanner should be performed:
- (A) After the last procedure
 - (B) During the uptake phase
 - (C) At the end of the day
 - (D) Before the patient is injected
48. Patients with malignant melanoma should be scanned with their arms:
- (A) Down
 - (B) Crossed over the chest
 - (C) Up
 - (D) Beneath the patient

49. The presence of asbestos-related plaques, benign inflammatory pleuritis, tuberculous pleuritis, and pleural effusion can result in:
- (A) False-positive uptake in FDG-PET images of patients with malignant mesothelioma
 - (B) True-positive uptake in FDG-PET images of patients with malignant mesothelioma
 - (C) FDG-PET attenuation artifacts
 - (D) FDG-PET motion artifacts
50. A 13 mCi dose of F-18 FDG is calibrated for 12:00 P.M. If the patient comes an hour early, how many millicuries will there be in the dose?
- (A) 3.6 mCi
 - (B) 9 mCi
 - (C) 19 mCi
 - (D) 46 mCi
51. The earliest disposal of the decay-in-storage waste material is permitted if it was held for a minimum 10 half-lives and has decayed to less than:
- (A) Background level
 - (B) Two times background levels
 - (C) 0.05 mR/h
 - (D) 0.5 mR/h
52. Organizing, problem solving, attention, and planning are controlled by the:
- (A) Frontal lobe of the brain
 - (B) Occipital lobe of the brain
 - (C) Parietal lobe of the brain
 - (D) Temporal lobe of the brain
53. The recommended time interval for PET imaging after biopsy is:
- (A) 1 week
 - (B) 2–4 weeks
 - (C) 2–6 months
 - (D) > 6 months
54. The example of the anatomic diagnostic modality employed in the work-up of the patient with seizures is:
- (A) Electroencephalography (EEG)
 - (B) Positron emission tomography (PET)
 - (C) Magnetic resonance imaging (MRI)
 - (D) Single-photon emission computed tomography (SPECT)

55. In the PET/CT acquisition, the CT component is performed for:
- (A) Scatter correction
 - (B) Attenuation correction
 - (C) Motion correction
 - (D) Random correction
56. A series of organized, involuntary, smooth waves of muscular contractions of the alimentary canal is called:
- (A) Diverticulosis
 - (B) Peristalsis
 - (C) Cramps
 - (D) Paralysis
57. Standardized uptake value (SUV) measurements are performed on:
- (A) Non-attenuation-corrected (NAC) images only
 - (B) Attenuation-corrected (AC) images only
 - (C) Non-attenuation-corrected (NAC) and attenuation-corrected (AC) images
 - (D) Attenuation-corrected (AC) or non-attenuation-corrected (NAC) images
58. Which of the following positron-emitting nuclides has the longest half-life?
- (A) Fluorine-18
 - (B) Oxygen-15
 - (C) Nitrogen-13
 - (D) Carbon-11
59. False-negative PET scans in lung cancer imaging occur predominantly because of:
- (A) Lesions that are too big to be evaluated by PET
 - (B) Lesions that are too superficial to be evaluated by PET
 - (C) Lesions that are too small to be evaluated by PET
 - (D) Lesions that are too deep to be evaluated by PET
60. The presented CT image Fig. 2.3 is an example of an artifact described as a:
- (A) Beam hardening artifact
 - (B) Contrast media artifact
 - (C) Motion artifact
 - (D) Streak artifact

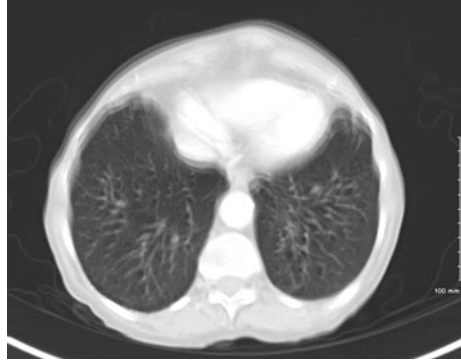


Fig. 2.3 CT axial slice

61. The principal measure of reducing radiation exposure to patients during PET/CT examination is reduce the:
- (A) Peak kilovoltage
 - (B) Product of beam current and exposure time
 - (C) Beam current
 - (D) Product of beam current and peak kilovoltage
62. A minimally invasive surgical procedure used to detect the presence or absence of occult regional nodal metastases in patients without clinically noticeable nodal disease is called:
- (A) Lymphoscintigraphy
 - (B) Sentinel node scintigraphy
 - (C) Sentinel node biopsy
 - (D) Lymph nodes mapping
63. According to minimal performance standards, the FDG uptake period that is required to minimize variability in SUV quantification should be at least:
- (A) 30 min
 - (B) 45 min
 - (C) 60 min
 - (D) 75 min
64. Lung activity observed on F-18 FDG-PET/CT imaging:
- (A) Is more prominent on attenuation-corrected images
 - (B) Increases from the posterior to the anterior segments
 - (C) Increases from the inferior to the superior segments
 - (D) Is more prominent on non-attenuation-corrected images

65. Which of the following methods, in clinical practice, is the most commonly applied to determine SUV?
- (A) Isocontour ROIs
 - (B) Manual ROIs
 - (C) SUV max
 - (D) SUV peak
66. CT and PET scans demonstrate different aspects of disease indicating regions with:
- (A) Altered metabolism (PET) and areas of structural change (CT)
 - (B) Altered metabolism (CT) and areas of structural change (PET)
 - (C) Altered metabolism (PET) and areas of structural change (PET)
 - (D) Altered metabolism (CT) and areas of structural change (CT)
67. If the pretest probability of disease is high and then a negative PET is more likely to be:
- (A) False negative
 - (B) False positive
 - (C) True negative
 - (D) True positive
68. Multiple focal cortical and subcortical defects on FDG study indicate diagnosis of:
- (A) Vascular dementia
 - (B) Alzheimer's disease
 - (C) Parkinson's disease
 - (D) Radiation necrosis
69. The process of aligning images so that corresponding features can easily be related is called:
- (A) Image smoothing
 - (B) Image filtering
 - (C) Image registration
 - (D) Image processing
70. The NRC requires that all wipe tests be recorded in disintegrations per minute (dpm). If 230 net counts per minute (cpm) were acquired with 86% well counter efficiency, what is the result of the wipe test in disintegrations per minute (dpm)?
- (A) 37 dpm
 - (B) 198 dpm
 - (C) 267 dpm
 - (D) 344 dpm

71. The concept of clinical SPECT/CT system can be described as:
- (A) A single-head scintillation camera positioned in front of a CT scanner
 - (B) A dual-head scintillation camera positioned in front of a CT scanner
 - (C) A CT scanner positioned in front of a dual-head scintillation camera
 - (D) A CT scanner positioned in front of a single-head scintillation camera
72. A normal, physiological uptake of F-18 FDG in the stomach can be described as:
- (A) Distal stomach uptake is higher than proximal stomach uptake
 - (B) Anterior stomach uptake is higher than posterior stomach uptake
 - (C) Proximal stomach uptake is higher than distal stomach uptake
 - (D) Posterior stomach uptake is higher than anterior stomach uptake
73. The recommended time interval for PET-FDG imaging after chemotherapy is:
- (A) 1 week
 - (B) > 10 days
 - (C) 2–6 months
 - (D) > 6 months
74. An area of focal FDG uptake in the lungs, without corresponding finding on CT scan, most likely represents:
- (A) Pulmonary nodule
 - (B) Radiation necrosis
 - (C) An injected blood clot
 - (D) Rib fracture
75. The display shown in Fig. 2.4 presents attenuation-corrected and reconstructed positron emission tomography (PET-FDG) viability study. The reoriented tomographic slices are:
- (A) Short-axis slices
 - (B) Vertical long-axis slices
 - (C) Oblique short-axis slices
 - (D) Horizontal long axis

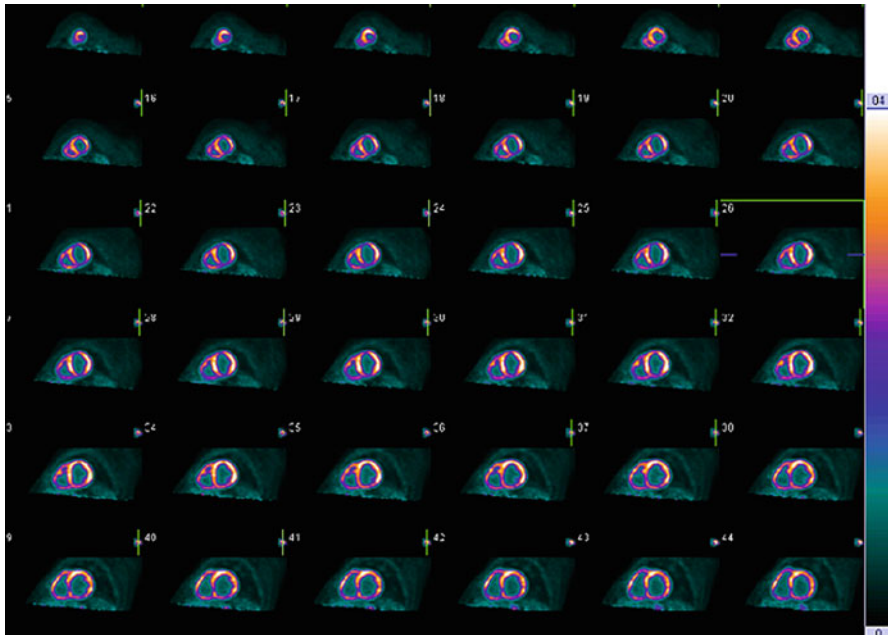


Fig. 2.4 PET/CT-FDG viability study

76. A hyperinsulinemic state affects the diagnostic quality of FDG-PET imaging and it is typically associated with:
- (A) Diffuse liver and splenic uptake
 - (B) Diffuse muscular and myocardial uptake
 - (C) Diffuse stomach and pancreatic uptake
 - (D) Diffuse brown fat and brain uptake
77. Malignant tumors of the chest wall include all of the following EXCEPT:
- (A) Lipoma
 - (B) Chondrosarcoma
 - (C) Osteosarcoma
 - (D) Ewing sarcoma
78. A group of lung diseases characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible is called:
- (A) Chronic bronchitis
 - (B) Emphysema
 - (C) Chronic obstructive pulmonary disease
 - (D) Hospital acquired pneumonias

79. The beta-amyloid uptake can be assessed through positron emission tomography (PET) using the radiopharmaceutical:
- (A) Carbon-11-labeled Pittsburgh Compound B (C-11 PiB)
 - (B) Fluor-18 fluoromisonidazole (F-18 MISO)
 - (C) Fluor-18-3-fluorothymidine (F-18FLT)
 - (D) Carbon-11-labeled methionine (C-11 Met)
80. Calculate the effective half-life of a radiopharmaceutical using the following information:
- Physical half-life is 110 min
Biological half-life is 360 min
- (A) 470 min
 - (B) 235 min
 - (C) 84.3 min
 - (D) 3.2 min
81. Which of the following scintillators has the highest light output?
- (A) LSO (lutetium oxyorthosilicate)
 - (B) NaI (Tl) (thallium-doped sodium iodide)
 - (C) BGO (bismuth germanate)
 - (D) GSO (gadolinium orthosilicate)
82. The main organs of the digestive system include:
- (A) Teeth
 - (B) Liver
 - (C) Pancreas
 - (D) Pharynx
83. F-18 FDG-PET is considered as a superior modality, compared with CT, for evaluating posttreatment response in lymphoma patients because of:
- (A) The ability to provide anatomical information
 - (B) The ability to differentiate viable tumor from fibrosis
 - (C) Higher resolution
 - (D) Shorter imaging
84. Which of the following types of non-Hodgkin lymphomas is most common?
- (A) Burkitt's lymphoma
 - (B) Lymphoblastic lymphoma
 - (C) Diffuse large B-cell lymphoma
 - (D) Anaplastic large T-cell/null cell lymphoma

85. The major limitation of PET in the head and neck imaging is its:
- (A) Poor sensitivity
 - (B) Poor spatial resolution
 - (C) Prolonged scanning time
 - (D) Radiation exposure
86. The most common cell type found in lymphoid tissue is:
- (A) Lymphocyte
 - (B) Stem cell
 - (C) Erythrocyte
 - (D) Monocyte
87. In order to achieve precise attenuation correction data for transmission scan they should be obtained using:
- (A) Low-dose CT
 - (B) High-dose CT
 - (C) Germanium-68
 - (D) Cobalt-56
88. Hiatal hernias can cause large foci of increased F-18 FDG uptake in/at:
- (A) The hilar region
 - (B) The gastroesophageal junction
 - (C) The pyloric sphincter
 - (D) The stomach fundus
89. The lymphoma that has come back after it has been treated is called:
- (A) Aggressive
 - (B) Intermittent
 - (C) Indolent
 - (D) Recurrent
90. The diagram for the process of positron–electron annihilation is shown in Fig. 2.5. Which of the following labels identifies the annihilation photon(s)?
- (A) D
 - (B) C
 - (C) B
 - (D) A

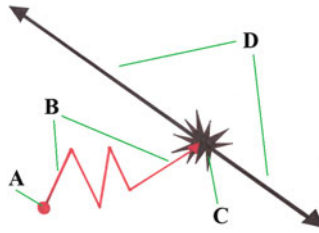


Fig. 2.5 Positron–electron annihilation diagram. *Illustration by Sabina Moniuszko*

91. The use of a low-dose CT scan in place of a conventional PET transmission scan:
 - (A) Increases the scan duration
 - (B) Reduces confidence of the scan interpretation
 - (C) Decreases throughput
 - (D) Improves accuracy of the scan interpretation
92. The one of disadvantages of nuclear medicine study over PET-FDG study in infection and inflammation imaging lies in its:
 - (A) Low resolution
 - (B) Faster time to results
 - (C) Quantitation abilities
 - (D) High sensitivity
93. Dual time point FDG-PET imaging is reflecting:
 - (A) The dynamics of lesion glucose metabolism
 - (B) The dynamics of lesion growth
 - (C) The dynamics of blood pool glucose clearance
 - (D) The dynamics of blood pool activity
94. Clinical stress perfusion studies with Rb-82 are usually limited to pharmacologic stress because of Rb-82's:
 - (A) High kinetic energy
 - (B) Short half-life
 - (C) Positron range
 - (D) High cost
95. Image-guided transthoracic needle aspiration or biopsy can be achieved with all of the following EXCEPT:
 - (A) Computed tomography (CT)
 - (B) Positron emission tomography (PET)
 - (C) Fluoroscopy
 - (D) Ultrasonography (USG)

96. Stomach reflux disease can result in increased FDG uptake in/at:
- (A) The hilar region
 - (B) The gastroesophageal junction
 - (C) The pyloric sphincter
 - (D) The stomach fundus
97. The use of PET gating for specific applications in PET/CT scanning:
- (A) Reduces motion artifacts
 - (B) Increases scanning time
 - (C) Increases spatial resolution
 - (D) Decreases sensitivity
98. The lymphatic system is not a separate system of the body, but it is considered a part of the:
- (A) Digestive system
 - (B) Hematopoietic system
 - (C) Circulatory system
 - (D) Respiratory system
99. All of the following positron emission tomography myocardial perfusion tracers are cyclotron produced EXCEPT:
- (A) Water O-15
 - (B) Rubidium Rb-82
 - (C) Acetate C-11
 - (D) Ammonia N-13
100. The presented images labeled A, B, C, and D were obtained during a routine PET/CT scan. The image labeled "B" is described as:
- (A) Topogram
 - (B) Fused coronal
 - (C) Non-attenuation corrected
 - (D) Maximum-intensity projection (Fig. 2.6)

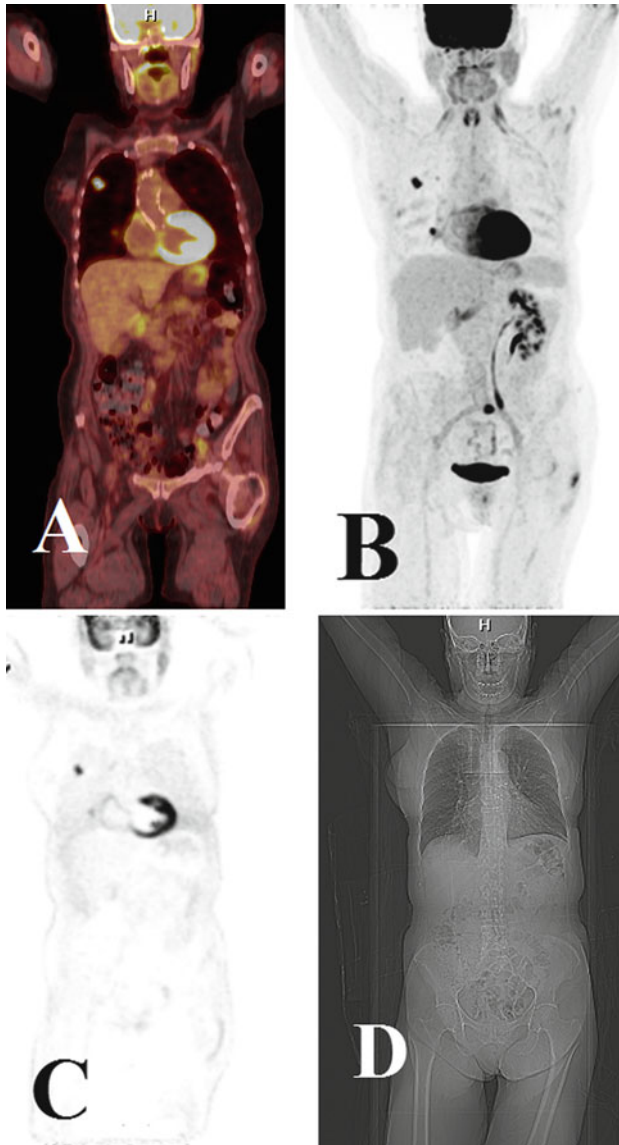


Fig. 2.6 PET/CT images

101. All of the following are examples of conventional diagnostic imaging procedures that evaluate normal anatomy via radiologic images EXCEPT:
- (A) X-ray
 - (B) Ultrasonography
 - (C) Magnetic resonance imaging
 - (D) Positron emission tomography

102. The cerebellum is located posteriorly just below the cerebrum and is responsible for the proper control of:
- (A) Body temperature
 - (B) Skeletal muscles
 - (C) Emotions
 - (D) Vision
103. A topographic image of the body used to confirm proper patient positioning is called:
- (A) The blank scan
 - (B) The scout scan
 - (C) The delayed scan
 - (D) The rescan
104. The TNM (tumor, node, metastasis) staging system that is generally used for solid tumors is not applicable to lymphoma, since:
- (A) Lymphoma spreads in a predictable pattern
 - (B) Lymphoma is a rapidly progressing disease
 - (C) Lymphoma begins in multiple sites simultaneously
 - (D) Lymphoma spreads in an unpredictable pattern
105. Rb-82 is a monovalent cationic analog of potassium and has a biologic activity similar to:
- (A) Gallium Ga-67
 - (B) Thallium Tl-201
 - (C) Technetium Tc-99 m
 - (D) Fluorine F-18
106. A pulmonary nodule (PN) is defined as a separate opacity that is entirely surrounded by lung parenchyma and has a diameter of:
- (A) 4 cm or less
 - (B) 3 cm or less
 - (C) 2 cm or less
 - (D) 1 cm or less
107. Which of the following positron emission tomography myocardial perfusion tracers is described as a model tracer for flow quantitation?
- (A) Water O-15
 - (B) Rubidium Rb-82
 - (C) Acetate C-11
 - (D) Ammonia N-13

108. All of the following diagnostic procedures can be utilized to evaluate patients with lymphoma EXCEPT:
- (A) Ga-67 scintigraphy
 - (B) Bone marrow biopsy
 - (C) Lymphangiogram
 - (D) Sentinel node localization
109. All of the following quantitative methods have been used to explore the prognostic value of FDG uptake in malignant tumors EXCEPT:
- (A) Standard uptake value max (SUV max)
 - (B) Tumor's glycolytic volume (TGV)
 - (C) Metabolic tumor volume (MTV)
 - (D) Standard uptake value min (SUV min)
110. The presented images labeled A, B, C, and D were obtained during a routine CT of the brain. The image described as D represents:
- (A) Lateral brain localizer image
 - (B) Coronal slice of the brain
 - (C) Saggital slice of the brain
 - (D) Tranverse slice of the brain (Fig. 2.7)

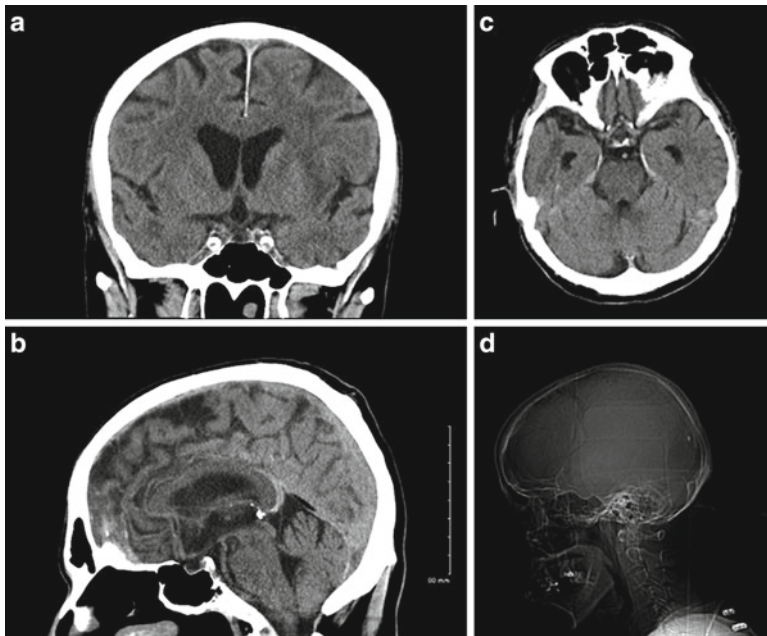


Fig. 2.7 Brain CT scans

111. Which of the following components of the PET/CT protocol delivers the highest radiation dose to the patient?
- (A) Topogram
 - (B) Low-dose CT
 - (C) Diagnostic CT
 - (D) Dose of 370 MBq of F-18FDG
112. Computed tomography (CT) assessment of pulmonary nodules includes all of the following EXCEPT:
- (A) Lobar and segmental localization
 - (B) Growth rate evaluation
 - (C) Metabolic lesion characteristics
 - (D) Size and/or volume measurement
113. Which of the following substrates, under normal conditions, are the major sources of myocardial energy?
- (A) Ketone bodies and amino acids
 - (B) Lactate and pyruvate
 - (C) Free fatty acids and glucose
 - (D) Insulin and proteins
114. All of the following organs belong to the lymphatic system EXCEPT:
- (A) Thymus
 - (B) Thyroid
 - (C) Tonsils
 - (D) Spleen
115. Colorectal cancer imaging, when PET utilizes F-18FDG as a tracer, is covered by Medicare in all of the following settings EXCEPT:
- (A) Screening
 - (B) Diagnosis
 - (C) Staging
 - (D) Restaging
116. The principal division of the lungs is called:
- (A) Segment
 - (B) Lobe
 - (C) Acinus
 - (D) Lobule

117. Which of the following PET cardiac tracers is a FDA-approved indicator of myocardial viability?
- (A) Water O-15
 - (B) Rubidium Rb-82
 - (C) Ammonia N-13
 - (D) F-18 fluorodeoxyglucose
118. The pattern of F-18 FDG uptake in the bowel most likely associated with a neoplastic process can be described as:
- (A) Segmental
 - (B) Diffuse
 - (C) Focal
 - (D) Absent
119. The fundamental limit of restricted spatial resolution of PET scanners is due to:
- (A) The distance positrons travel before they annihilate with an electron
 - (B) The non-collinearity of the pair of annihilation photons
 - (C) The scanner geometry
 - (D) The crystals light output
120. A heterogeneous group of hematologic malignancies arising from lymphocytes is called:
- (A) Anemia
 - (B) Leukemia
 - (C) Lymphoma
 - (D) Thrombocytopenia
121. A breast-feeding patient referred for PET imaging should:
- (A) Discontinue breast-feeding 12 h before injection of radiotracer
 - (B) Discontinue breast-feeding 6 h before injection of radiotracer
 - (C) Discontinue breast-feeding for at least 6 h after injection of radiotracer
 - (D) Discontinue breast-feeding for at least 12 h after injection of radiotracer
122. Differentiated thyroid cancer (DTC) is divided into:
- (A) Papillary and follicular
 - (B) Medullary and insular
 - (C) Anaplastic and papillary
 - (D) Medullary and follicular
123. Dose extravasation at the antecubital injection site can cause:
- (A) Ipsilateral inguinal node uptake
 - (B) Contralateral axillary node uptake
 - (C) Ipsilateral axillary node uptake
 - (D) Contralateral inguinal node uptake

124. The portion of the large intestine that runs across the abdomen from the hepatic flexure to the splenic flexure is called the:
- (A) Sigmoid colon
 - (B) Transverse colon
 - (C) Ascending colon
 - (D) Descending colon
125. A much higher sensitivity of positron emission tomography (PET) imaging over single-photon emission computed tomography (SPECT) results in all of the following EXCEPT:
- (A) Improved noise-to-signal ratios
 - (B) Improved temporal resolution
 - (C) Shorter scanning time
 - (D) Improved image quality
126. The most common primary symptom of dementia is/are:
- (A) Personality changes
 - (B) Diminished thinking ability
 - (C) Changes in memory
 - (D) Depression
127. Noninvasive, accepted methods for improving the diagnostic accuracy of FDG-PET include all of the following EXCEPT:
- (A) Furosemide administration in kidney tumor
 - (B) Stomach distention in gastric carcinoma
 - (C) Beta blockers in suspected brown adipose tissue uptake
 - (D) Valium administration in dementia imaging
128. According to the Centers for the Medicare & Medicaid Services (CMS), an inconclusive test is a test(s) whose results are NOT:
- (A) Equivocal
 - (B) Reproducible
 - (C) Technically uninterpretable
 - (D) Discordant with a patient's other clinical data
129. Stunned or hibernating myocardium is:
- (A) Nonviable
 - (B) Dysfunctional but viable
 - (C) Dysfunctional and nonviable
 - (D) Functional
130. In the image in Fig. 2.8, what structure is depicted by line "b"?
- (A) Right ventricle
 - (B) Liver
 - (C) Left ventricle
 - (D) Aorta

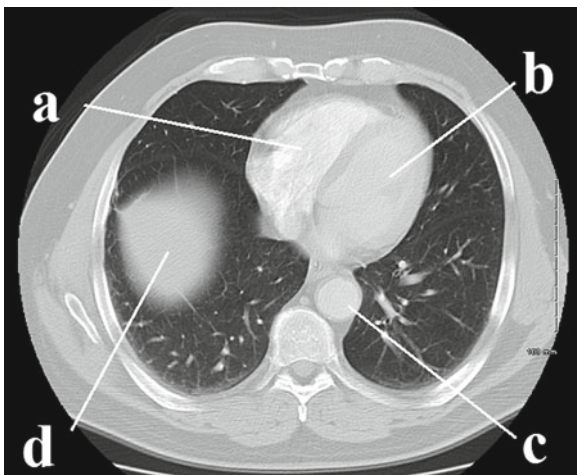


Fig. 2.8 Chest CT scan

131. After completion of the F-18 FDG study, the patient's fluid intake:
- (A) Should be stopped
 - (B) Should be continued
 - (C) Is not relevant
 - (D) Is contraindicated
132. The duodenum, jejunum, and ileum make up:
- (A) The small intestine
 - (B) The stomach
 - (C) The large intestine
 - (D) The rectum
133. A PET quantifier, calculated as the tracer activity concentration within a volume of interest, divided by the injected dose per unit body weight is called:
- (A) Fractional uptake value
 - (B) Standardized upload value
 - (C) Standardized uptake value
 - (D) Fractional upload value
134. For optimal patient care and interpretation of FDG-PET images, the following information from the patient referred for PET scanning should be obtained EXCEPT:
- (A) Breast-feeding info
 - (B) Recent surgery info
 - (C) Use of medication info
 - (D) Housing info

135. In the image in Fig. 2.9, which of the following arrows is pointing to the gallbladder?
- (A) d
 - (B) c
 - (C) b
 - (D) a

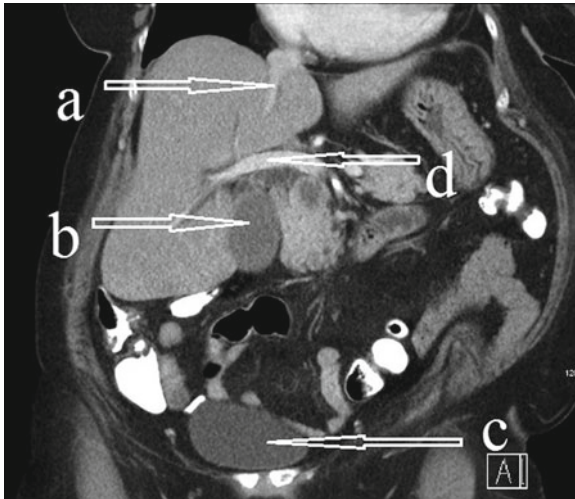


Fig. 2.9 Abdomen CT scan

136. The patient should remain relaxed and avoid talking, chewing, or hyperventilating during the uptake phase after F-18 FDG injection in order to:
- (A) Minimize physiologic lung uptake
 - (B) Minimize physiologic muscular uptake
 - (C) Maximize physiologic muscular uptake
 - (D) Maximize physiologic liver uptake
137. A condition of an abnormally low number of neutrophils is called:
- (A) Neutrophilia
 - (B) Leukocytosis
 - (C) Neutropenia
 - (D) Leucopenia
138. The temporal lobe is located on either side of the brain around the level of the ears and controls:
- (A) Auditory information
 - (B) Visual information
 - (C) Smell sensation
 - (D) Tactile sensation

139. PET-FDG provides beneficial information in all of the following areas of lymphoma evaluation EXCEPT:
- (A) Diagnosis
 - (B) Response to therapy
 - (C) Recurrence detection
 - (D) Staging
140. It is permitted by a facility to combine two unit doses of F-18 FDG, as long as they originated from the same lot number. There are two 14 mCi/2 ml contingency doses possessing the same lot number of F-18 FDG calibrated for 13:00 h. If a patient needs to be injected at 14:00 h for a PET/CT scan with a 14 mCi of dose, how much volume must be drawn from one unit dose to make another unit dose of 14 mCi?
- (A) 0.3 ml
 - (B) 0.6 ml
 - (C) 0.9 ml
 - (D) 1.2 ml
141. The main source of potential radiation hazard to a breast-feeding infant of the postpartum woman undergoing PET scanning is from:
- (A) Ingested milk
 - (B) Proximity to the breast
 - (C) Background radiation
 - (D) Scanning device
142. All of the following are well-established indications for PET functional imaging in patients with suspected recurrent colorectal carcinoma EXCEPT:
- (A) Falling CEA levels in the absence of a known source
 - (B) Staging recurrent colorectal carcinoma
 - (C) Preoperative staging
 - (D) Equivocal lesion on conventional imaging
143. Which of the following kinds of treatment/therapy has the promoting effect on the spleen and bone marrow?
- (A) Antibiotic treatment
 - (B) Bone pain therapy with ^{153}Sm -lexidronam
 - (C) Granulocyte colony-stimulating factor (G-CSF) therapy
 - (D) Brachytherapy for prostate carcinoma
144. Anxiolytic medication given before a PET scanning:
- (A) Induces hyperglycemia
 - (B) Relaxes patient
 - (C) Prevents hyperinsulinemia
 - (D) Forces diuresis

145. Administration of highly concentrated intravenous agent and/or high-density barium-based oral agents during routine CT scanning will yield:
- (A) Overestimated standardized uptake value (SUV)
 - (B) Unchanged standardized uptake value (SUV)
 - (C) Underestimated standardized uptake value (SUV)
 - (D) Standardized uptake value (SUV) equal to 1
146. The pattern of F-18 FDG in the normal palatine and lingual tonsils is described as:
- (A) Absent
 - (B) Asymmetrical and increased
 - (C) Symmetrical and increased
 - (D) Asymmetrical
147. In quantitative PET imaging, e.g., SUV calculation, the following scanner related parameters need to be corrected EXCEPT:
- (A) Correction for random coincidences
 - (B) Correction for scatter coincidences
 - (C) Correction for effects of attenuation
 - (D) Correction for table speed
148. The section of the image assessed for count content reflecting either the flow of radionuclide or concentration of radionuclide in that area is called:
- (A) Polar map
 - (B) Region of interest
 - (C) Background region
 - (D) Activity curve
149. Positrons are subatomic particles that have all of the characteristics of electrons EXCEPT:
- (A) Mass
 - (B) Magnitude of charge
 - (C) Size
 - (D) Polarity of charge
150. The diagram for the process of positron–electron annihilation is shown in Fig. 2.10. Which of the following labels identifies the positron–electron annihilation event?
- (A) D
 - (B) C
 - (C) B
 - (D) A

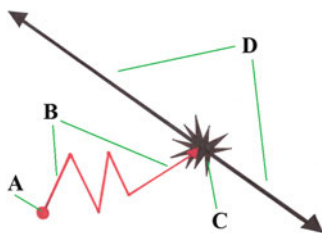


Fig. 2.10 Positron–electron annihilation diagram. *Illustration by Sabina Moniuszko*

151. Wipe testing to detect removable contamination in each area of use must be performed:
 - (A) Daily
 - (B) Weekly
 - (C) Biweekly
 - (D) Monthly
152. The parameters as perfusion, permeability, and transit time offer an insight into the functional status of the:
 - (A) Respiratory system
 - (B) Gastrointestinal system
 - (C) Vascular system
 - (D) Reproductive system
153. An event assigned to a line of response (LOR) joining the two relevant detectors is called:
 - (A) An annihilation event
 - (B) A random event
 - (C) A coincidence event
 - (D) A Scatter event
154. A hormone vital to regulating carbohydrate and fat metabolism in the body by causing cells in the liver, muscle, and fat tissue to take up glucose from the blood is called:
 - (A) Inulin
 - (B) Parathormone
 - (C) Insulin
 - (D) Estrogen
155. Which of the following routes of F-18 FDG administration is acceptable if intravenous access is not available?
 - (A) Subcutaneous
 - (B) Intramuscular
 - (C) Oral
 - (D) Rectal

156. The medication given to relieve myocardial ischemia that works by causing both venous and arterial dilation is called:
- (A) Propranolol
 - (B) Aminophylline
 - (C) Nitroglycerine
 - (D) Digoxin
157. All of the following interventions can be used to reduce urinary tract F-18 FDG activity EXCEPT:
- (A) Furosemide administration
 - (B) Foley catheter placement
 - (C) Patient hydration
 - (D) Valium administration
158. The infiltrated dose can result in all of the following EXCEPT:
- (A) Masked myocardial ischemia
 - (B) Lowered counting statistics
 - (C) Altered distribution of the radiopharmaceutical
 - (D) Decreased biological half-life of the radiopharmaceutical
159. Advantages of positron emission tomography myocardial perfusion imaging versus single-photon emission computed tomography include all of the following EXCEPT:
- (A) Shorter acquisition time
 - (B) Higher extraction fraction of tracers
 - (C) More equivocal reports
 - (D) Higher spatial, temporal, and contrast resolution
160. Convert 14 mCi to megabecquerels (MBq).
- (A) 518 MBq
 - (B) 378 MBq
 - (C) 0.518 MBq
 - (D) 0.378 MBq
161. The radiation sensitivity of a tissue is inversely proportional to the:
- (A) Degree of cell differentiation
 - (B) Distance from the source of radiation
 - (C) Time of radiation exposure
 - (D) Rate of cell proliferation

162. All of the following conditions can lead to false-positive results in PET/CT scanning EXCEPT:
- (A) Mastitis
 - (B) Tuberculosis
 - (C) Necrosis
 - (D) Sarcoidosis
163. After F-18FDG administration, a 20- to 30-mL saline flush is recommended in order to:
- (A) Prevent the dose infiltration
 - (B) Reduce the dose venous retention
 - (C) Hydrate the patient
 - (D) Reduce radiation exposure
164. The Y-axis of the data plotted on PET sinogram represents:
- (A) The angle of orientation of the LOR
 - (B) The shift of the LOR from the center of gantry
 - (C) The window of coincidence of the LOR
 - (D) Displacement of the LOR from center of FOV
165. Diffuse, symmetric uptake of F-18 FDG observed in the thyroid gland:
- (A) Indicates hypothyroidism
 - (B) Indicates malignancy
 - (C) Is a normal variant
 - (D) Is always abnormal
166. The type of study defined as flow either per unit volume or per unit mass of tissue is called:
- (A) Perfusion study
 - (B) Bolus study
 - (C) Wash-in study
 - (D) Wash-out study
167. When septa separate each crystal ring and coincidences are only recorded between detectors within the same ring and/or in closely neighboring rings the data are acquired:
- (A) In hybrid mode
 - (B) In 2D mode
 - (C) In 3 D mode
 - (D) In 4D mode

168. Spatial information is converted to frequency information by the mathematical process known as:
- (A) Fourier transform
 - (B) Convolution
 - (C) Filtering
 - (D) Fourier rebinning
169. A graph that records the electrical activity of the heart is called:
- (A) The echocardiogram
 - (B) The encephalogram
 - (C) The electrocardiogram
 - (D) The elastogram
170. The presented images labeled A, B, C, and D were obtained during a routine PET/CT scan. The image labeled “C” is described as:
- (A) Topogram
 - (B) Fused coronal
 - (C) Non-attenuation corrected
 - (D) Maximum-intensity projection (Fig. 2.11)

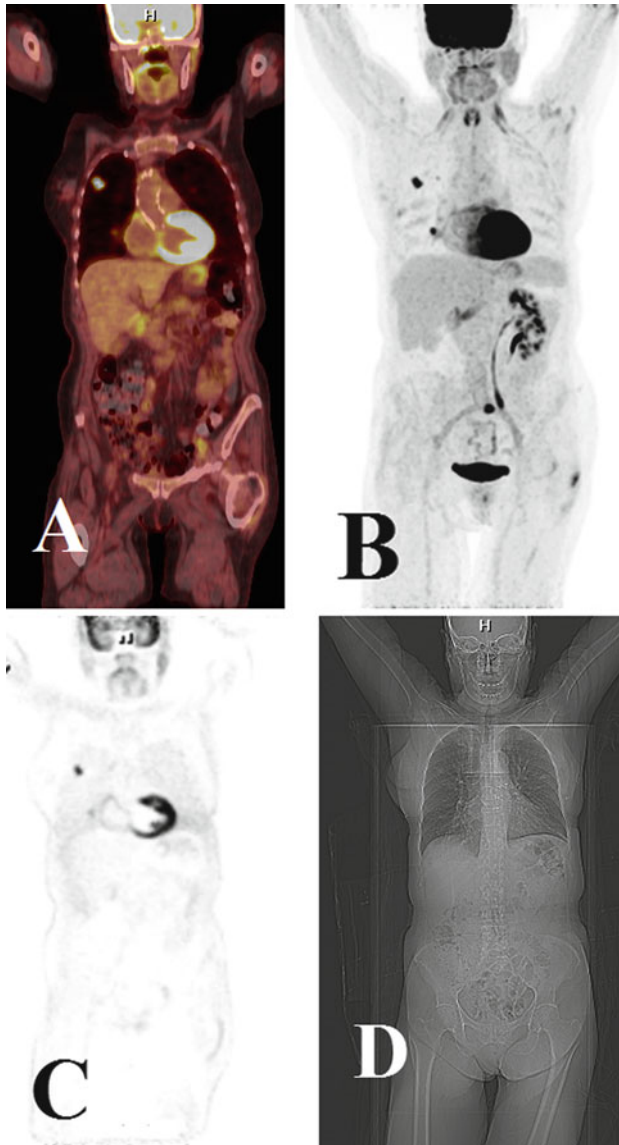


Fig. 2.11 PET/CT images

171. The whole-body dosimeter should be issued to personnel who might exceed minimum whole-body doses of:
- (A) 100 mrem/year (1 mSv/year)
 - (B) 200 mrem/year (2 mSv/year)
 - (C) 300 mrem/year (3 mSv/year)
 - (D) 500 mrem/year (5 mSv/year)

172. Advantages of FDG-PET over conventional scintigraphy in the demonstration of infectious and inflammatory processes include all of the following EXCEPT:
- (A) Rapid reporting
 - (B) High radiation burden
 - (C) Superior resolution
 - (D) Higher lesion-to-background ratios at early time points
173. An organ, attaining its largest size at the time of puberty, gradually shrinks and almost disappears. This organ, which serves as the site of T-cell differentiation, is called:
- (A) Thyroid
 - (B) Thrombus
 - (C) Thymus
 - (D) Thalamus
174. The pharmacological effect of dipyridamole and adenosine, used as pharmacological stress agents in patients who cannot exercise, depends on:
- (A) Vasoconstriction
 - (B) Tachycardia
 - (C) Vasodilation
 - (D) Hypertension
175. When monitoring response to treatment with PET-FDG imaging is essential to obtain:
- (A) Baseline PET-FDG scan
 - (B) Interim PET-FDG scan
 - (C) PET-FDG scan on the last day of therapy
 - (D) PET-FDG scan two days after therapy
176. A low blood glucose level, accompanied by the signs and symptoms of increased activity of the autonomic nervous system and depressed activity of the central nervous system, is called:
- (A) Hypoxemia
 - (B) Hypothermia
 - (C) Hypoglycemia
 - (D) Hypoinsulinemia
177. Which of the following patient/lesion characteristics suggests lung malignancy?
- (A) Lesion has a smooth margin on CT
 - (B) Patient is nonsmoker
 - (C) Lesion is 3 mm in size
 - (D) Patient has hemoptysis

178. The 2010 Guidelines for Cardiopulmonary resuscitation (CPR) and Emergency Cardiovascular Care (ECC) of American Heart Association (AHA) recommend in adults a compression rate of at LEAST:
- (A) 120/min
 - (B) 100/min
 - (C) 80/min
 - (D) 60/min
179. Medicare coverage specific for FDG-PET non-small cell lung cancer (NSLC) imaging includes all of the following EXCEPT:
- (A) Screening
 - (B) Diagnosis
 - (C) Staging
 - (D) Restaging
180. A 15-year-old child needs to have a PET/CT scan prior to chemotherapy. The child's weight is 142 pounds and an adult dose for a PET/CT scan in this facility is 13 mCi. Using Clark's formula, calculate the pediatric F-18 FDG dose.
- (A) 6.5 mCi
 - (B) 7.3 mCi
 - (C) 8.0 mCi
 - (D) 12.3 mCi
181. The computed tomography X-ray tube:
- (A) Shields the patient from X-ray
 - (B) Moves the patient table
 - (C) Rotates the scanner detectors
 - (D) Produces the beam of X-ray
182. In the process of interpretation and analysis of PET/CT images, a normal study with further investigations or clinical follow-up excluding focal inflammation or malignancy is called:
- (A) False positive
 - (B) False negative
 - (C) True negative
 - (D) True positive
183. The relative variations in count densities between adjacent areas in the image of an object are called:
- (A) Contrast
 - (B) Background
 - (C) Noise
 - (D) Shadow

184. FDG uptake by cancer cells tends to decline as:
- (A) Blood glucose and insulin levels decrease
 - (B) Blood glucose level decreases and insulin levels increase
 - (C) Blood glucose and insulin levels increase
 - (D) Blood glucose increases and insulin levels decreases
185. Which of the following positron emission tomography myocardial perfusion tracers has the highest kinetic energy?
- (A) Water O-15
 - (B) Rubidium Rb-82
 - (C) FDG F-18
 - (D) Ammonia N-13
186. The pattern of FDG uptake/glucose metabolism in patients with multi-infarct dementia is characterized by the presence of:
- (A) Frontal hypometabolism
 - (B) Scattered foci of hypometabolism
 - (C) Occipital hypometabolism
 - (D) Parietotemporal hypometabolism
187. All of the following are the U.S. Food and Drug Administration (FDA)-approved cardiac PET tracers EXCEPT:
- (A) Water O-15
 - (B) Rubidium Rb-82
 - (C) Ammonia N-13
 - (D) F-18 fluorodeoxyglucose
188. Fatigue, anemia, altered bowel function, and weight loss are frequently presenting symptoms of the:
- (A) Lung cancer
 - (B) Brain cancer
 - (C) Prostate cancer
 - (D) Colorectal cancer
189. The sensitivity and specificity of PET-FDG for detecting and characterizing malignant lung nodules greater than 1 cm are correspondingly:
- (A) 96% and 57%
 - (B) 96% and 77%
 - (C) 56% and 57%
 - (D) 56% and 77%
190. What is seen in this ECG?
- (A) Normal sinus rhythm
 - (B) Electronic ventricular pacemaker

- (C) Atrial fibrillation
- (D) Ventricular bigeminy (Fig. 2.12)

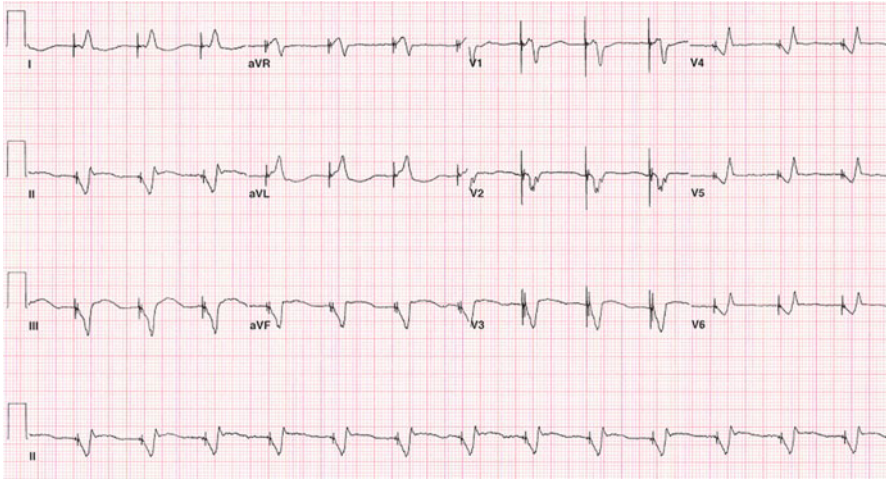


Fig. 2.12 ECG Sample Case: A 65-year-old man with dyspnea

191. If an approximate dose received from a PET scan is 25 millisieverts (mSv), what is the dose received in Roentgen equivalent man (rems)?
- (A) 2.5 rems
 - (B) 250 rems
 - (C) 2,500 rems
 - (D) 25,000 rems
192. Common causes of needle-stick injuries include all of the following EXCEPT:
- (A) Recapping needles
 - (B) Disposing sharps
 - (C) Using Luer-activated devices
 - (D) Accessing IV tubing with needles
193. Pulmonary mass is defined as having any pulmonary, pleural, or mediastinal lesion seen on chest radiographs and having a diameter:
- (A) >1 cm
 - (B) >2 cm
 - (C) >3 cm
 - (D) >4 cm

194. The following data are necessary for calculating standardized uptake value (SUV) EXCEPT:
- (A) Patient height
 - (B) Patient weight
 - (C) Injected dose
 - (D) Patient age
195. A package of F-18 FDG is producing an exposure rate of 2 mR/h at a distance of 3.3 ft. How many meters away should one stand to secure a background level of 0.03 mR/h? (1 m = 3.3 ft)
- (A) 7.6 ft.
 - (B) 8.2 m
 - (C) 26.94 m
 - (D) 76 ft.
196. A substance used to enhance the visibility of a structure or fluid in the body for medical imaging is called:
- (A) Contrast media
 - (B) Radiotracer
 - (C) Filter
 - (D) Buffer agent
197. A PET scanner parameter defined as the coincident count rate in a measurement that does not include scattered or random coincidences is called:
- (A) Noise equivalent count rate (NECR)
 - (B) Contrast
 - (C) Signal-to-noise ratio (SNR)
 - (D) Sensitivity
198. A group of age-related symptoms involving progressive impairment of brain function resulting in diminished thinking ability, loss of memory, and personality changes is called:
- (A) Parkinson's disease
 - (B) Dementia
 - (C) Schizophrenia
 - (D) Huntington's disease
199. The following types of therapy can be employed in the treatment of patients with lymphomas EXCEPT:
- (A) Chemotherapy
 - (B) Radiotherapy
 - (C) Radioimmunotherapy
 - (D) Magnotherapy

200. The exposure rate from a radioactive source is 100 millirem per hour (mR/h) at 3 m. What is the new exposure rate if the distance from the radiation source is increased to 6 m?
- (A) 75 mR/h
 - (B) 55 mR/h
 - (C) 25 mR/h
 - (D) 15 mR/h

Answers

1. B—The exposure rate constant (ERC)

For positron emitters, the exposure rate constant (ERC) is about 6 R/h per millicurie at 1 cm. The exposure rate of a 10 mCi dose of F-18 is approximately six times greater than that of a 10 mCi dose of Tc-99m at a distance of approximately 8 inches.

(PET Radiation Safety. Duke [2011](#)))

2. B—Partial-volume effect

PVE is caused by the finite spatial resolution of the imaging system which reveals how far the signal “spills out” around its actual location. The signal spreading falsely increases the object size and volume. Image sampling, where voxels in ROI include the signal from underlying tissues, also contributes to the phenomenon known as partial-volume effect.

(Soret et al. [2007](#))

3. B—Difference in size of FOV between PET and the CT

Discrepancy between fields of view (FOVs) in a PET/CT scanner—70 cm causes a truncation artifact when imaging extends beyond the CT FOV-50 cm; as a result no attenuation correction values for the truncated anatomy are being applied.

(Sureshbabu and Mawlawi [2005](#))

4. D—Metallic implants artifacts

Metallic implants create streaking artifacts on CT images because of their high photon absorption. Higher Hounsfield numbers consequently produce high PET attenuation coefficients and an overestimation of PET findings.

(Sureshbabu and Mawlawi [2005](#))

5. C—The decay constant

The decay constant decides how long the scintillation flashes in the crystal; a short decay time reduces detector dead time and as a result higher annihilation rates can be accepted.

(Saha [2005](#))

6. B—Molecular imaging

Radionuclide originated molecular imaging techniques such as positron emission tomography

(PET) and single-photon emission computed tomography (SPECT) capture functional or phenotypic changes associated with pathology and unfold the molecular abnormalities responsible to form basis of many diseases.

(Vallabhajosula [2007](#))

7. B–Resolution

A PET system resolution, according to NEMA guidelines, is assessed by imaging a point source in the air and reconstructing the images with no smoothing or transformation of images. The resolution of the system is affected by the annihilation ambiguities, the detector ring diameter and the size of the scintillation crystal.

(Nuclear Medicine/PET GE [2011](#))

8. B–Anaphylaxis

Like the majority of other allergic reactions, anaphylaxis is caused by the release of histamine and other chemicals from mast cells (type of white blood cell found in vast numbers in the airways, digestive system, and skin).

(Robbins and Cotran [2010](#))

9. A–Rb-82

Sr 82- Rb 82 generator (Cardiogen-82; Bracco Diagnostics, Inc, Princeton, NJ) for myocardial perfusion imaging studies.

(Vallabhajosula et al. [2011](#))

10. A–Normal sinus rhythm

Normal sinus rhythm is the reference physiologic rhythm of the heart. By convention, normal sinus rhythm is usually defined as sinus rhythm with a heart rate between 60 and 100 beats/min.

(Goldberger [2006](#))

11. C–Linearity

Linearity is performed at installation and quarterly. The DC must function linearly between the lowest and highest activities used in the NM department.

(Early and Sodee [1995](#))

12. B–F-18

The PET radiopharmaceuticals O-15, C-11, and N-13 are biochemically indistinguishable from their natural counterparts. On the other hand, the half-lives of these three PET radionuclides are not perfect for routine clinical use.

(Vallabhajosula et al. [2011](#))

13. A–True coincidences

A true coincidence (event) is registered each time contained by the coincidence time-window when neither photon is undergoing any form of interaction prior to discovery. Singles are coincidence events which are lost due to, e.g., dead time, tissue attenuation.

(Nuclear Medicine/PET GE [2011](#))

14. A–Amino acids

The tumor growth and development are described by an increase in the rate of protein synthesis. Because amino acids (AAs) are the building blocks for protein synthesis, transport of AAs into cells is one of the most important and essential steps in protein synthesis.

(Vallabhajosula et al. [2011](#))

15. C–An electron and a positron

Being unstable, the two particles annihilate each other converting all its mass into energy and in that way emitting two photons of 511 keV each (which is resting energy of the electron or positron) in opposite direction.

(Shukla and Kumar [2006](#))

16. A–Neck

Brown adipose tissue is especially abundant in newborns and in hibernating mammals. Studies using PET scanning of adult humans have shown that brown fat is related not to white fat, but to skeletal muscle and it is still present in adults (females>males, children>adults) in the upper chest and neck (neck (2.3%)>paravertebral (1.4%)>mediastinum (0.9%)>perinephric (0.8%), overall up to 4%).

(Cannon and Nedegaard [2004](#))

17. C–BGO (bismuth germinate)

The stopping power of the scintillators governs the mean distance the photon travels before it stops, and depends on the density and effective Z of the detector material.

(Lin and Alavi [2009](#))

18. C–Melanoma

Although melanoma mainly is found in the skin, it can also arise in mucosal surfaces (anus, vaginal surfaces), ocular locations, or meningeal surfaces.

(Karakousis 2011)

19. C–Pulmonology

Because of the complication associated with cancer biology, the PET radiopharmaceutical use in oncology accounts for most applications. The recent advancement in tracers' development in neurology and cardiology, a PET/CT application in these areas, might even top the current PET/CT utility in oncology.

(Vallabhajosula et al. [2011](#))

20. B 11 mCi

(Formula 16A)

21. B–Effective dose

It is given by the expression: $E = \text{SUM}(\text{WT} \times \text{CDE})$

where:

E =the effective whole-body dose, WT =the tissue weighting factor, CDE =committed dose equivalent.

(Lombardi 1999)

22. C–20–30 mSv

The combined whole-body effective dose can be reduced to 5–15 mSv if a low-dose CT is used.

(Patton et al. 2009)

23. D– + 1

The positron or antielectron is the antiparticle or the antimatter counterpart of the electron.

(Early and Sodee 1995)

24. C–Histologic evaluation

The diagnosis of a melanoma is made by pathologic analysis of the excisional biopsied specimen.

(Karakousis and Czerniecki 2011)

25. B–Sinograms

PET data are acquired directly into sinograms in a manner similar to matrix mode in planar imaging and all necessary corrections are often applied at the time of sinograms formation.

(Wahl 2009)

26. B–Nitrogen-13

Cu-62 (parent radionuclide Zinc-62), Ga-68 (parent Germanium-68), and Rb-82 (parent Strontium-82) are generator produced radionuclides.

(Wahl 2009)

27. B–Pulse height analyzer

The signal from the photomultiplier tube goes into a PHA in order to do this energy distinction. Only signals of a certain size (height) will pass the analyzer and become registered. This pulse height is preset by defining a voltage window (ΔE) between a lower level (LL) and an upper level (UL). In the PET systems the window of PHA is centered on 511 keV with LL of 350 keV and UL of 650 keV.

(Saha 2005)

28. C–Proliferation

Cell proliferation, increased mitotic rate, and lack of differentiation are considered as the focal reasons accountable for accelerated malignant growth. (Vallabhajosula et al. [2011](#))

29. C–Tc-99 m methylenediphosphonate (MDP)

Fluoride ions diffuse through capillaries into the bone extracellular fluid and chemisorb onto the bone surface by exchanging with hydroxyl (OH) groups in hydroxyapatite crystal of bone to form fluoroapatite. The uptake of Tc-99 m MDP and F-18 fluoride in malignant bone lesions reflects the increased regional blood flow and bone turnover. (Blake et al. [2001](#))

30. A–Angiogenesis

Angiogenesis is required in various physiological as well as pathological processes, including physical development, wound repair, reproduction, response to ischemia, solid tumor growth, and metastatic tumor spread. (Wahl [2009](#))

31. C–Calibration and constancy

Calibration or accuracy is performed before the first use of the instrument, annually, and after repair. Constancy QC of the survey meter is performed daily with a long half-life reference source. (Christian et al. [2004](#))

32. C–The brain

The Circle of Willis is formed by the merging of the anterior, middle, and posterior cerebral arteries and the anterior and posterior communicating arteries (connect the left and right sides of an artery). (Christian et al. [2004](#))

33. B–Produces the X-ray

X-ray photons are produced by bombarding the target in the vacuum tube with a stream of fast-moving electrons; X-rays are produced when the electrons are suddenly decelerated upon collision with the metal target. (“Bremsstrahlung” or “braking radiation”) (Wahl [2009](#))

34. B– 0 HU

The radiodensity of distilled water at standard pressure and temperature (STP) is defined as zero Hounsfield units (HU), while the radiodensity of air at STP is defined as –1,000 HU. (Prokop and Galanski [2003](#))

35. D—Constancy

Daily readings of the standard, e.g., Cs-137 should fall within the tolerance limits $\pm 10\%$ for NRC regulated states.

(Christian et al. 2004)

36. C—Oxygen-15

Oxygen-15: half-life of 2 min, mean energy 735 8.2 keV, and positron range in water of 8.2 mm.

(Wahl 2009)

37. C—Blank scan

The blank scan is acquired daily using transmission rod sources and can be used to monitor system (crystals, blocks, and modules) stability. It represents the sensitivity response to the transmission source without attenuating material or patient in the gantry (blank).

(Christian et al. 2004)

38. D—The light output

The scintillation process means the conversion of high-energy photons into visible light via interaction with a scintillating material. A scintillation detector or scintillation counter is obtained when a scintillator is coupled to an electronic light sensor such as a photomultiplier tube (PM). Among the properties listed above, the light output is the most important, as it affects both the efficiency and the resolution of the detector.

(Early and Sodee 1995)

39. C—Choline

All cells use choline for the biosynthesis of phospholipids, which are fundamental components of all cellular walls.

(Roivainen et al. 2000)

40. B—10.7%

The given volume is additional information and must be disregarded, since the percent error formula does not utilize it.

(Formula 8A)

41. B—Fused coronal

(Wahl 2009)

42. C—Topogram, transmission CT, emission PET

In general, PET/CT is performed using a protocol comprising a topogram followed by a low-dose CT for attenuation correction (CT-AC) and anatomical correlation and by PET scan.

(Wahl 2009)

43. B—Positional inaccuracy

Other characteristics of PET offset this disadvantage. “Native” or “built in” positional inaccuracy is not present in, e.g., conventional single-photon emission techniques (SPECT).

(Wahl 2009)

44. A—Rubidium-82

Rubidium Rb-82 decays by positron emission and associated gamma emission with a physical half-life of 75 s and necessitates on-site generator use. CardioGen-82 is a closed system used to produce rubidium Rb-82 chloride injection for intravenous administration.

(Wahl 2009)

45. A—Emits electrons

The electrons are discharged from the cathode only when the filament is heated to the right temperature. Temperature is controlled by the tube current (mA).

(Wahl 2009)

46. C—4 h

A delay time of 90 min postinjection is recommended for lesions where FDG uptake is relatively low, e.g., in breast cancer, and for suspected liver lesions in patients with colorectal cancer.

(Lin and Alavi 2009)

47. D—Before the patient is injected

It is important that QC be performed for PET and for CT machines by established protocols in accordance with predetermined daily, weekly, and quarterly schedules.

(Christian et al. 2004)

48. A—Down

Patients with melanoma need the whole body captured.

(Lin and Alavi 2009)

49. A—False-positive uptake in FDG-PET images of patients with malignant mesothelioma

Most benign pleural processes have an SUV < 2.2, although epithelioid tumors might not be FDG avid, and consequently, may be a source of false-negative results.

(Lin and Alavi 2009)

50. C—19 mCi

$$13\text{mCi} = I_0 \times e^{-(0.693)(60\text{min}/110\text{min})} = 19\text{mCi (Formula 16B)}$$

51. B—Two times background levels

Before disposing of the waste, all radiation symbols and signs should be removed or defaced.

(Christian et al. [2004](#))

52. A—Frontal lobe of the brain

The frontal lobe is the anterior portion of the brain. It is responsible for “higher cognitive functions” including emotions, creativity, and behavior (abstract thinking, creative thought, intellect, initiative, judgment). The frontal lobe is also involved in motor skills.

(Christian et al. [2004](#))

53. A—1 week

To avoid false-positive/false-negative results in PET imaging, the time interval of 2–6 months is recommended for postradiation therapy scans.

(Lin and Alavi [2009](#))

54. C—Magnetic resonance imaging (MRI)

Magnetic resonance imaging (MRI) remains the imaging modality of choice when structural or anatomic abnormalities are suspected.

(Placantonakis and Schwartz [2009](#))

55. B—Attenuation correction

Attenuation correction and anatomical correlation enhance PET/CT specificity compared with PET alone.

(Lin and Alavi [2009](#))

56. B—Peristalsis

Once broken up, the food bolus is forced into the pharynx and beyond to the esophagus and stomach through peristalsis and gravity.

(Frohlich [2001](#))

57. B—Attenuation-corrected (AC) images only

AC must be completed before SUV is calculated—if not, the amounts would depend upon the extent of attenuation.

(Lin and Alavi [2009](#))

58. A—Fluorine-18

Fluorine-18 has a physical half-life of 110 min and carbon-11, nitrogen-13, or oxygen-15 with physical half-lives of 20, 10, and 2 min, respectively. Mnemonic: ONC -2,10,20.

(Wahl [2009](#))

59. C—lesions that are too small to be evaluated by PET

Also, bronchioloalveolar carcinoma, differentiated adenocarcinoma, carcinoid, and mucoepidermoid carcinoma seem to have poor FDG avidity, and can be a source of false negatives.

(Lin and Alavi 2009)

60. C—Motion artifact

Motion can be voluntary, e.g., patient movement or involuntary, e.g., respiration. The most efficient way to reduce motion artifacts is to reduce the scanning time. Methods to reduce patient motion artifacts also include patient immobilization, ECG-gated CT, and some correction algorithms.

(Lin and Alavi 2009)

61. B—Product of beam current and exposure time

Modifying kVp will also reduce radiation exposure, but to a lesser extent.

(Patton et al. 2009)

62. C—sentinel node biopsy

Best identification of the sentinel node (SN) is currently achieved by using preoperative SN localization lymphoscintigraphy and dual-modality intraoperative detection, using the γ probe and a blue dye.

(Karakousis and Czerniecki 2011)

63. C—60 min

At least 60 min time interval allows sufficient uptake in the tumor and contrast with the background. According to the minimal performance standards, the use of longer uptake time intervals is allowed.

(Boellaard 2011)

64. D—Is more prominent on non-attenuation-corrected images

Normal FDG uptake in the lungs is faint and homogeneous on AC images.

(Lin and Alavi 2009)

65. C—SUV max

Although SUV max is easily measured, it is highly dependent on the statistical quality of the images, and the size of the maximal pixel.

(Wahl 2009)

66. A—Altered metabolism (PET) and areas of structural change (CT)

Both the CT and PET CT fusion images are used to localize PET uptake abnormalities.

(Lin and Alavi 2009)

67. A–False negative

A positive PET scan in this circumstance is more likely to be true positive. Pretest probability is the probability that a person suffers from a disease before the test is executed.

(Lin and Alavi 2009)

68. A–Vascular dementia

Lower metabolism differentiating vascular dementia from Alzheimer's disease (AD) is mainly observed in the deep gray nuclei, cerebellum, primary cortices, middle temporal gyrus, and anterior cingulate gyrus.

(Lin and Alavi 2009)

69. C–Image registration

Registration aligns images by applying transformations to one of the images so that it matches the other; image registration aids in many critical tasks such as diagnosis, performing image guided surgery, planning radiotherapy, and/or surgery etc.

Hajnal et al. 2001

70. C–267 dpm

The background counts are subtracted from the given gross counts to obtain the net counts. If the net counts are given, there is no need for background counts subtractions.

(Formula 11)

71. B–A dual-head scintillation camera positioned in front of a CT scanner

Equipment manufacturers are using dual-head scintillation cameras positioned in front of a CT scanner and sharing a common imaging table.

(Patton et al. 2009)

72. C–Proximal stomach uptake is higher than distal stomach uptake

Moderate diffuse stomach uptake is also considered as a normal, physiologic variation.

(Lin and Alavi 2009)

73. B–>10 days

This time allows avoidance of the chemotherapeutic effect, and of transient fluctuations in F-18 -FDG uptake due to stunning or flare of tumor uptake.

(Wahl 2009)

74. C—An injected blood clot

The injury to the venous endothelium during injection causes formation of blood clots at the site of injury, which consecutively detach from the vein, settle in the pulmonary vasculature, and are noted as hot spots in the lung.

(Lin and Alavi 2009)

75. A—Short-axis slices

The short-axis tomograms is displayed with the apical slices always shown first, then progressing serially toward the cardiac base. The orientation is as if the viewer were observing the heart from the cardiac apex, with the left ventricle to the viewer's right and the right ventricle to the viewer's left.

ACC/AHA/SNM 1992

76. B—Diffuse muscular and myocardial uptake

A hyperinsulinemic state is caused by increased serum insulin levels from either exogenous administration or endogenous secretion of insulin associated with insufficient fasting.

(Lin and Alavi 2009)

77. A—Lipoma

On FDG-PET imaging, malignant tumors generally appear as hypermetabolic lesions with uptake correlating well with the tumor histologic grade. A lipoma, the most common form of soft tissue tumor, is a benign tumor composed of adipose tissue.

(Hickeson and Abikhzer 2011)

78. C—Chronic obstructive pulmonary disease

“Chronic bronchitis” and “emphysema” are included within the chronic obstructive pulmonary disease (COPD) diagnosis.

(Kumar and Abbas 2010)

79. A—Carbon-11-labeled Pittsburgh Compound B (C-11 PiB)

The beta-amyloid protein, by forming a major part of the amyloid plaque, is implicated in Alzheimer's development and increased C-11 PiB uptake is observed in patients with AD.

(Wahl 2009)

80. C—84.3 min

(Formula 14)

81. B–NaI (Tl)

The property of the scintillation detector described as the number of scintillations produced by each incident photon is called the light output. Sodium iodide doped with thallium-NaI (Tl) scintillator has the highest light output, it is hygroscopic, has low stopping power-low linear attenuation coefficient for 511 keV, long decay time, and is no longer used in PET imaging.

(Lin and Alavi 2009)

82. D–Pharynx

The main organs of the digestive system also comprise: mouth, esophagus, stomach, and small and large intestines.

(Christian and Bernier 2004)

83. B–The ability to differentiate viable tumor from fibrosis

Up to 64% of patients with Hodgkin Lymphoma (HL) will present with a residual mass on CT following treatment, but only 18% will actually relapse.

(Iagaru et al. 2008)

84. C–Diffuse large B-cell lymphoma

Diffuse large B cell can occur at any age, and it is slightly more common in men than women, making up approximately 40% of all cases. Diffuse large B-Cell lymphoma is considered a high-grade lymphoma and therefore requires prompt treatment.

(Jhanwar and Straus 2006)

85. B–Poor spatial resolution

PET/CT scanners use the high spatial resolution of CT and as a result PET/CT is superior to either PET or CT alone for the evaluation of head malignancy.

(Wahl 2009)

86. A–Lymphocyte

The two most common lymphocytes are the B cell and the T cell that protect the body against germs by producing antibodies (B cells) against fungi, viruses, and bacteria (T cells).

(Kumar 2010)

87. C–Germanium-68

Attenuation correction factors measured by CT are only scaled up for 511 keV and PET-CT enables only segmental attenuation correction. Typical transmission scans with a rotating rod add about 3–6 min to the single-bed imaging time. This is acceptable for cardiac imaging, but a significant drawback for multi-bed position oncology scans.

(Wahl 2009)

88. B—The gastroesophageal junction

Increased FDG uptake at the gastroesophageal junction can result in a false-positive study imitating a distal esophageal neoplasm or node.

(Lin and Alavi 2009)

89. D—Recurrent

A recurrent lymphoma does not have to return to the same site of the body or be the exact same subtype in order to be considered a recurrent lymphoma. Indolent Non-Hodgkin's lymphoma (NHL), represents a group of incurable slow growing lymphomas, e.g., follicular lymphoma, a small lymphocytic lymphoma that is highly responsive to initial therapy, but relapses with less responsive disease.

(Andreoli et al. 2001)

90. A—D

Electron–positron annihilation occurs when an electron (e^-) and a positron (e^+ , the electron's antiparticle) collide. The result of the collision is the annihilation of the electron and positron, and the creation of two gamma ray photons.

(Wahl 2009)

91. D—Improves accuracy of the scan interpretation

The coregistered, high-resolution anatomy accurately aligned with PET data localizes functional abnormalities and clarifies equivocal situations.

(Patton et al. 2009)

92. A—Low resolution

Increased FDG activity in infection and inflammation depends on its uptake in activated granulocytes and macrophages with increased rates of glucose metabolism.

(Wahl 2009)

93. A—The dynamics of lesion glucose metabolism

Result of the percentage change in SUV of a lesion from early to delayed imaging is reflecting the dynamics of lesion glucose metabolism. The auxiliary value of the dual time point FDG-PET is problematic, mainly because of the substantial overlap of benign and malignant nodule FDG-PET characteristics.

(Barger and Nandalar 2012)

94. B—Short half-life

Exercise stress is somewhat difficult with Rb-82 due to its short half-life, breathing motion from immediate postexercise imaging, and close patient contact that may significantly increase the radiation exposure to the staff.

(Zaret and Beller 2005)

95. B–Positron emission tomography (PET)

Pneumothorax and hemorrhage are the most common complications of transthoracic needle biopsy.

(Houseni et al. [2011](#))

96. B–The gastroesophageal junction

In patients without a specific history of esophagogastric disease, a gastroesophageal maximum SUV of less than 4 is usually not associated with gastroesophageal neoplasia.

(Lin and Alavi [2009](#))

97. A–Reduces motion artifacts

Gated acquisitions improved quantification over nongated acquisitions by 8% and 10% for 2D and 3D modes accordingly.

(Vines et al. [2007](#))

98. C–Circulatory system

The lymphatic system is comprised of a network of conduits called lymphatic vessels that transport excess fluids away from interstitial spaces in body tissue and return the fluids to the bloodstream.

(Kumar and Abbas 2010)

99. B–Rubidium Rb-82

Rb-82 is produced from a strontium-82 (Sr-82)/Rb-82 generator, which can be eluted every 10 min. The half-life ($T_{1/2}$) of Sr-82 is 25.5 days, which results in a generator life of 4–8 weeks.

(Zaret and Beller [2005](#))

100. D–Maximum-intensity projection

Maximum-Intensity Projection (MIP) is a simple image-order rendering technique. MIP involves visualizing the regions/structures with the highest intensity values.

(Lin and Alavi [2009](#))

101. D–Positron emission tomography

PET images describe function, in that they represent metabolic or biochemical processes (physiology), while the other imaging modalities, such as CT and MRI, visualize structure and shape (anatomy).

(Christian et al. [2004](#))

102. B—Skeletal muscles

The cerebellum coordinates voluntary movements such as posture, balance, coordination, and speech, resulting in smooth, balanced muscular activity. (Christian et al. [2004](#))

103. B—The scout scan

A scout scan can be obtained with a transmission scan using a Ge-68 source on a dedicated PET unit, with a low-dose CT on PET/CT scanners, or with an emission image after injection of a small activity in labs using Rb-82. (Di Carli and Lipton [2007](#))

104. A—Lymphoma spreads in a predictable pattern

The staging system used for lymphomas is an anatomical classification, which is created upon the model that lymphoma spreads in a foreseeable pattern of neighboring disease. Lymphoma starts at a single lymph node and then advances to neighboring lymph nodes via the lymphatic system, before disseminating to distant sites and organs. (Kumar and Abbas 2010)

105. B—Thallium Tl-201

During one capillary pass, Rb-82 is incompletely extracted by the myocardial cells via the Na⁺/K⁺ adenosine triphosphatase pump, and extraction is inversely and nonlinearly proportional to perfusion. Furthermore, extraction and retention, at a given perfusion level, may be affected by drugs, severe acidosis, hypoxia, and ischemia. (Zaret and Beller [2005](#))

106. B—3 cm or less

By definition PN is not associated with the hilum or mediastinum and is not linked to atelectasis, pleural effusion, or lymphadenopathy. (Houseni et al. [2011](#))

107. A—Water O-15

Water O-15 uptake is linearly correlated to flow and a single compartment model is used for flow quantitation. Al-Mallah et al. [2010](#)

108. D—Sentinel node localization

The route of the initial lymph drainage and extent of tumor spread can be determined by locating the sentinel lymph node—the first node that filters lymph fluid draining from the melanoma or breast carcinoma. (Wahl [2009](#))

109. D—Standard uptake value min (SUV min)

Metabolic bulk-based parameters, metabolic tumor volume (MTV), tumor's glycolytic volume (TGV), and total lesion glycolysis (TLG=MTV x SUV mean), seem to be better indicators of primary tumor aggressiveness and, as a result, more sensitive than the single-pixel-derived SUV max.

(Gerbaudo et al. [2011](#))

110. A—Lateral brain localizer image

A localizer ("scout" or "scanogram" or "topogram" depending on vendor) is usually a specific image that is not really a cross-section but a projection image.

(Brant et al. [2007](#))

111. C—Diagnostic CT

An average effective dose from diagnostic CT is 2–3 times higher than that from F-18 FDG.

(Brix et al. [2005](#))

112. C—Metabolic lesion characteristics

CT is in general used to further differentiate nodules that are detected on other imaging tests such as chest radiography.

(Prokop and Galanski [2003](#))

113. C—Free fatty acids and glucose

The heart metabolizes a comprehensive variety of substrates such as free fatty acids, glucose, lactate, pyruvate, ketone bodies, and amino acids, but under normal conditions, free fatty acids and glucose are the most important sources of energy.

(Bengel et al. [2009](#))

114. B—Thyroid

The bone marrow, lymph nodes, lymph vessels, and the appendix are also parts of the lymphatic system. The spleen is the only lymphatic organ responsible for filtering blood.

(Kumar and Abbas 2010)

115. A—Screening

Determining location of tumors if rising CEA level suggests recurrence was the earliest indication approved for Medicare reimbursement. Whole-body PET scans for assessment of recurrence of colorectal cancer cannot be ordered more frequently than once every 12 months, unless medical necessity documentation supports a separate reevaluation settings of a rising CEA within this period.

(CMS [2011](#))

116. B–Lobe

The right lung is divided into three lobes, superior, middle, and inferior, by two interlobular fissures and the left lung is divided into two lobes, an upper and a lower, by an interlobular fissure.

(Hansell et al. [2008](#))

117. D–F-18 fluorodeoxyglucose

Medicare covers FDG-PET for the determination of myocardial viability as a primary or initial diagnostic study prior to revascularization, or following an inconclusive SPECT.

(NCD 2012)

118. C–Focal

The focal uptake associated with GI pathology is observed in ~70% of cases. The incidence of false-positive results, e.g., normal, focal uptake in the ascending colon, is lower with PET/CT imaging.

(Lin and Alavi [2009](#))

119. B–The non-collinearity of the pair of annihilation photons

PET scanners have insufficient spatial resolution, due to instrumentation and physical factors when compared with other imaging modalities, such as CT and MR. The key limiting factor is attributable to the distance that positrons, once released from the parent nucleus, must travel before they lose energy and annihilate with an electron in tissue.

(Zaidi and Thompson [2009](#))

120. C–Lymphoma

The malignant lymphocytes accumulate in lymph nodes, causing enlargement and appearance of solid masses. The lymphocytes can also infiltrate extranodal tissues eg. bone marrow and various organs (gastrointestinal tract, lung, skin, central nervous system).

(Kumar and Abbas [2010](#))

121. D–discontinue breast-feeding for at least 12 h after injection of radiotracer

The short physical half-life of ^{18}F and the low excretion of FDG into breast milk support the use of PET as the preferred oncologic imaging procedure in nursing mothers if imaging cannot otherwise be avoided. Some authors concluded that cessation of breast-feeding is unnecessary after PET studies but close contact should be avoided.

(SNM [2011](#))

122. A–Papillary and follicular

DTC is divided into papillary cancer (classic type and encapsulated, follicular variant, and aggressive variants such as sclerosing, columnar, or tall cell variants) and follicular cancer (classic, Hurthle, and clear cell types).
(Kumar and Abbas 2010)

123. C–Ipsilateral axillary node uptake

Node uptake at the draining lymph node is due to particle formation and subsequent phagocytosis.
(Lin and Alavi 2009)

124. B–Transverse colon

The ascending colon is located on the right side of abdomen up to the hepatic flexure and the descending colon is located on the left side of the abdomen from the splenic flexure to the iliac crest.
(Moore et al. 2010)

125. A–Improved noise-to-signal ratios

Increases in sensitivity enhance signal-to-noise ratios (SNRs) in the data, which also corresponds to advances in image SNR.
(Rahmim and Zaidi 2008)

126. C–change in memory

The word dementia comes from the Latin *de* meaning “apart” and *mens* from the genitive *mentis* meaning “mind”.
(Symptoms of Dementia 2011)

127. D–Valium administration in dementia imaging

Sedatives, antipsychotic medications, drugs such as amphetamines, and narcotics modify cerebral metabolism and it should not be used in the brain metabolism imaging.
(Wahl 2009)

128. B–Reproducible

The above definition is applied when the PET scan, whether at rest alone or rest with stress, is used following a SPECT that was found to be inconclusive.
(CMS 2011)

129. B–Dysfunctional but viable

Stunned or hibernating myocardium has the capacity to return to normal or display substantial improvement in contractile function with revascularization.
(Takalkar et al. 2011)

130. C—left ventricle

Cardiac imaging with CT and MR imaging always relies on technical developments because high temporal and spatial resolution is necessary for the satisfactory evaluation of heart vascular systems.

(Madden 2007)

131. B—Should be continued

After completion of the study, the patient should be instructed to continue with fluid intake and voiding to minimize radiation exposure.

(Hamblen and Lowe 2003)

132. A—The small intestine

The small intestine is suspended from the body wall by an extension of the peritoneum called the mesentery. It is the major site of chemical digestion and absorption of nutrients by the body.

(Moore et al. 2010)

133. C—Standardized uptake value

Standardized uptake value (SUV)—sometimes known as the dose uptake ratio (DUR), or dose absorption ratio (DAR)—is a method for normalizing whole-body PET images relative to volume of distribution in the patient and injected dose.

(Hallett 2004)

134. D—Housing info

Information on recent chemotherapy and/or radiation therapy, presence of inflammatory conditions, and other relevant features (e.g., claustrophobia, difficulty with lying flat) is also necessary for optimal patient care and interpretation of FDG-PET images.

(Wahl 2009)

135. C—b

The gallbladder is a small pouch that sits just under the liver. In adults, the gallbladder measures approximately 8 cm (3.1 in) in length and 4 cm (1.6 in) in diameter when fully distended. It is divided into three sections: fundus, body, and neck.

(Madden 2007)

136. B—Minimize physiologic muscular uptake

This is particularly important in patients with head and neck cancer to minimize uptake in local laryngeal and masticatory muscles.

(Wahl 2009)

137. C—Neutropenia

Neutrophils in normal conditions make up 50–70% of circulating white blood cells and serve as the primary defense against infections by fighting bacteria in the blood.

(Frohlich 2001)

138. A—Auditory information

The temporal lobes are responsible for hearing, speech recognition, and music. They are also responsible for short-term memory and for help in sorting out new information.

(Christian et al. 2004)

139. A—Diagnosis

FDG-PET is rarely used in the diagnosis of lymphoma because most suspicious lesions usually proceed directly to biopsy for tissue diagnosis. A bone marrow biopsy may also be done to determine if the bone marrow has been affected.

(Andreoli et al. 2001)

140. C—0.9 ml

To solve this problem, first decay 14 mCi for 1 h to 14:00 h, which equals 9.6 mCi. Subtract 9.6 mCi from 14 mCi, which equals 4.4 mCi. 4.4 mCi is the amount you need to obtain from the other unit dose; however, the answer is needed in volume. To obtain the needed volume, first calculate the concentration; therefore, divide 9.6 mCi by 2 ml's, (since the original concentration was 14 mCi/2 ml at 13:00 h), which equals 4.8 mCi/ml at 14:00 h. Since the needed activity to obtain 14 mCi at 14:00 h is 4.4 mCi, the 4.4 mCi dose needs to be divided by the concentration of 4.8 mCi/ml (what you want/what you have) to obtain the volume needed, which is 0.9 ml.

(Formula 16A and 18)

141. B—Proximity to the breast

High uptake of FDG in the lactating breast appears to be related to suckling. There is, however, little secretion of activity into breast milk. The normal lactation schedule can be maintained with a breast pump during the 24-h period.

(Hicks et al. 2001)

142. A—Falling CEA levels in the absence of a known source

CEA (carcinoembryonic antigen) is a type of protein molecule that is typically associated with certain tumors—most frequently in cancer of the colon and rectum—a rising CEA level indicates progression or recurrence of the cancer.

(Kumar and Abbas 2010)

143. C—Granulocyte colony-stimulating factor (G-CSF) therapy

The stimulating effect that G-CSF therapy has on the spleen and bone marrow must be taken into account when performing a FDG-PET scan, as it can be an important source of false-positive results.

(Lin and Alavi 2009)

144. B—Relaxes patient

The most common anxiolytics—anti-anxiety medications—can be grouped in categories:

Antidepressants (Prozac, Paxil, Zoloft), antihistamines (Atarax, Benadryl), and benzodiazepines (Ativan, Valium, Xanax). Diazepam (Valium) is commonly used orally for the short-term management of anxiety disorders and acute alcohol withdrawal.

(Mycek and Harvey 2008)

145. A—Overestimated standardized uptake value (SUV)

The presence of contrast agent produces an erroneous increase in the Hounsfield units, and as a result, an overestimation of the attenuation in these areas. The increase is linear with increasing contrast agent concentration.

(Visvikis et al. 2004)

146. C—Symmetrical and increased

Increased FDG uptake is a result of physiologic activity associated with the lymphatic tissue in Waldeyer's ring (a ring of lymphatic tissue formed by the two palatine tonsils, the pharyngeal tonsil, the lingual tonsil, and intervening lymphoid tissue). Symmetry is helpful in evaluating FDG uptake in the head and neck.

(Lin and Alavi 2009)

147. D—Correction for table speed

Differences in detector efficiencies, detection geometry, and dead-time effects also need to be taken into account to ensure the accuracy of performed quantifications.

(Visvikis et al. 2004)

148. B—Region of interest

For quantitative assessment, computer-derived regions, or regions of interest (ROI), drawn by the software users', e.g., nuclear medicine physician or technologist, are commonly applied. Manual definitions, maximum pixel value, three-dimensional isocontour at a percentage of maximum pixel value or fixed-size ROI centered on maximum pixel value methods of ROI placement are used to measure SUV.

(Lin and Alavi 2009)

149. D–Polarity of charge

Positively charged positrons (e^+), which are produced when radioactive substances decay, are the antimatter equivalents of electrons (e^-).

(Christian et al. 2004)

150. B–C

The image illustrates the principles of a positron emission tomographY (PET). It shows how during the annihilation process two photons are emitted in $\sim 1,800$ opposing directions.

(Lin and Alavi 2009)

151. B–Weekly

An area 10 cm x 10 cm should be wiped with cotton swab or a filter paper disk; wipes should be then counted in well counter and data should be recorded in disintegrations per min. The survey frequency may be increased if the RSO deems that contamination has increased to levels that could pose an exposure problem or cause regulatory concern.

(Christian et al. 2004)

152. C–Vascular system

The vascular system plays an ultimate role in the pathogenesis of the cardiovascular disease and cancer and is a crucial element in inflammatory processes.

(Miles et al. 2007)

153. C–A coincidence event

Each PET detector records an incident photon and generates a timed pulse. Consequently these pulses are then combined in coincidence circuitry, and if the pulses fall within a narrow time-window, they are considered to be coincident.

(Wahl 2009)

154. C–Insulin

Insulin is produced within the body in a proportion to remove excess glucose from the blood. When blood glucose levels fall below a certain level, the glycogen stored in the liver and muscles is broken down and can then be utilized as an energy source (glucogenolysis).

(Mycek and Harvey 2008)

155. C–Oral

The same delay time used with iv administration before imaging can be applied after oral dosing. However, because of the considerable amount of F-18 FDG preserved in the gut, cautious interpretation will be needed when disease of the GI tract is being evaluated.

(Nair et al. 2007)

156. C—nitroglycerine

The combination of pharmacological action of nitroglycerine is very effective in reducing myocardial ischemia: venodilation causes the amount of blood returning to the heart to decrease myocardial oxygen demand, while arterial dilation produces an increase to the amount of blood flowing to the myocardium.

(Mycek and Harvey 2008)

157. D—Valium administration

Elimination of artifactual collection of FDG in the colon and urinary system is essential if primary cancer, associated adenopathy, or faint recurrences are to be evaluated in FDG-PET imaging of the abdomen and pelvis.

(Lin and Alavi 2009)

158. D—Decreased biological half-life of the radiopharmaceutical

Lowered counting statistics results in a poor quality study and changed distribution can cause uptake in lymph nodes.

(Burrell and MacDonald 2006)

159. C—More equivocal reports

Improved image quality leads to more assurance in reporting, and less frequent equivocal reports.

(Zaret and Beller 2005)

160. A—518 MBq

Since $1 \text{ Ci} = 37 \text{ GBq}$, it is easy to convert 14 mCi to 0.014 Ci and multiply it by 37 which will give you 0.518 GBq , which then multiply by 1,000 to obtain 518 MBq.

Another easier conversion is as follows, $1 \text{ mCi} = 37 \text{ MBq}$, so all you have to do is multiply $14 \text{ mCi} \times 37 \text{ MBq/mCi} = 518 \text{ MBq}$.

(Formula 7A and B)

161. A—Degree of cell differentiation

Blood forming organs and reproductive organs are more sensitive to radiation than highly specialized (differentiated) tissues of the nervous system.

(Lombardi 1999)

162. C—Necrosis

Non-metabolically active constituents, that is, necrotic tissue, fibrotic scar, or mucin, may reduce FDG uptake in tumors and lead to false negative in PET/CT scanning.

(Kumar et al. 2009)

163. B—Reduce the dose venous retention

The glucose measurement, F- 18FDG administration with 20- to 30-mL saline flush, and postinjection activities should be performed with minimal interruption.

(Hamblen and Lowe 2003)

164. A—The angle of orientation of the LOR

The values along a particular horizontal row in the sinogram represent counts acquired along matching LORs at the angle that relates to that row. Angular location of the given point can be determined from the phase of the sine wave (y-axis).

(Fahey 2002)

165. C—Is a normal variant

Diffuse symmetric uptake can be seen in the normal thyroid gland in about 2% of scans. Diffuse thyroid uptake can occur in association with thyroiditis (particularly Hashimoto thyroiditis) or Graves' disease.

(Lin and Alavi 2009)

166. A—Perfusion study

Perfusion study is the most important single index that can be measured. In wash-out studies the time–concentration curve for an agent during its passage out of a tissue bed is analyzed.

(Miles et al. 2007)

167. B—In 2D mode

Septa are thin rings (~1 mm thick) of lead or tungsten. The outer diameter of the septal rings is equal to the ring diameter of the scanner, with the difference between the inner and outer diameters of the septa varying from 7 to 10 cm, depending on the manufacturer.

(Wahl 2009)

168. A—Fourier transform

This approach is comparable to an equalizer in a sound system. An equalizer exchanges the incoming sound signal into its constituent frequency bands creating a frequency spectrum from the low, or bass, frequencies to the high, or treble, frequencies.

(Groch and Erwin 2000)

169. C—The electrocardiogram

The electrocardiogram (ECG or EKG) registers cardiac electrical currents (voltages, potentials) by measures of metal electrodes placed on the surface of the body.

(Goldberger 2006)

170. C—Non-attenuation corrected

171. D—500 mrem/year (5 mSv/year)

The whole-body dosimeter, worn at workers' chest or waist, is required by any worker who is likely to receive 10% of the occupational dose limit.

(Lombardi 1999)

172. B—High radiation burden

PET-FDG scanning can be completed in approximately 2 h from the injection with high quality of images (resolution of 4–8 mm for PET vs. 10–15 mm for SPECT) and does not require handling of potentially infected blood products (WBC).

(Balink and Collins 2009)

173. C—Thymus

The thymus is a specific organ of the immune system. The thymus produces and “instructs” T-lymphocytes (T cells)—each T cell targets a foreign substance which it identifies with its receptor.

(Kumar and Abbas 2010)

174. C—Vasodilation

Adenosine acts by inducing vasodilatation (A₂ receptors) of precapillary sphincters in the arterioles and increasing in myocardial blood flow and oxygen supply.

(Mycek and Harvey 2008)

175. A—Baseline PET-FDG scan

To monitor response to therapy and to reduce the risk of false-negative and false-positive readings, it is recommended that a baseline scan be available for assessment.

(Lin and Alavi 2009)

176. C—Hypoglycemia

In general hypoglycemia is present at a fasting plasma glucose concentration of <60 mg/dL. The most common forms of hypoglycemia occur as a complication of treatment of diabetes mellitus with insulin or oral medications. Hypoglycemia is less common in nondiabetic persons and can occur at any age.

(Andreoli et al. 2001)

177. D—Patient has hemoptysis

Lesion's spiculated margin, smoking, and lesion diameter >3.0 cm are suggestive of malignancy.

(Houseni et al. 2011)

178. B–100/min

The number of chest compressions delivered per minute during CPR is an important determinant of return of spontaneous circulation (ROSC) and survival with good neurologic function.

(AHA 2011)

179. A–Screening

Medicare coverage for solitary pulmonary nodule imaging is approved, if the scan is performed for characterization of nodules indeterminate on CT.

(CMS 2012)

180. D–12.3 mCi

(Formula 19A)

181. D–Produces the beam of X-ray

X-ray photons are produced by bombarding the target in the vacuum tube with the stream of fast moving electrons; a cathode emits electrons into the vacuum and an anode collects the electrons and consequently establishing a flow of electrical current.

(Prokop and Galanski 2003)

182. C–True negative

A study demonstrating a focal localized disease process, confirmed by additional investigations, as being the cause of fever of unknown origin (FUO) or malignancy is called true positive.

(Munro 2005)

183. A–Contrast

Image contrast to demarcate a lesion relies on its size relative to system resolution and its surrounding background. If a minimum size of a lesion does not grow bigger than system resolution, contrast may not be sufficient to appreciate the lesion, even at higher count density.

(Wahl 2009)

184. C–Blood glucose and insulin levels increase

FDG-PET imaging in uncontrolled diabetic patients may result in false-negative studies.

(Kumar et al. 2009)

185. B–Rubidium Rb-82

Rb-82 has the highest, 1.48 MeV, kinetic energy of the commonly used PET tracers, but the related long positron range of 2.6 mm reduces the spatial resolution with PET imaging.

(Zaret and Beller 2005)

186. B—Scattered foci of hypometabolism

The scattered regions of hypometabolism are corresponding to the areas of prior infarct(s).

(Mittra and Quon 2009)

187. A—Water O-15

The absence of FDA approval has limited water O-15 to research applications in the USA

(NCD 2012)

188. D—Colorectal cancer

Hepatomegaly, ascites, and cachexia indicate presence of metastatic disease.

(Abeloff and Armitage 2008)

189. B—96% and 77%

By incorporating the CT component into PET acquisition, the number of false-positive lesions is decreased, and overall specificity of PET/CT reaches 85% (sensitivity ~97%).

(Kim et al. 2007)

190. B—Electronic ventricular pacemaker

When a ventricular pacemaker fires, it produces a sharp vertical deflection (the pacemaker spike) followed by a QRS complex (representing depolarization of the ventricle).

(Goldberger 2006)

191. A—2.5 rems

1 sievert = 100 rems, you have 25 millisieverts, which is 0.025 Sieverts; therefore, if 1 Sievert = 100 rems, then 0.025 Sieverts = 2.5 rems.

(Formula 7D)

192. C—Using Luer-activated device

Luer-activated device, prepierced septum/blunt catheter, and pressure activated safety valve devices are available needless systems.

(Perry and Potter 2010)

193. C—>3 cm

The term “mass” usually indicates a solid or partly solid opacity; its contour, border, or density characteristics can be evaluated with CT.

(Hansell et al. 2008)

194. D—Patient age

In the most common approach, SUV is defined as the tracer activity concentration within a volume of interest, divided by the injected dose per unit body weight. The patient's weight and height are needed for the estimation of parameters such as the lean body mass and SUVLBM or body surface area and SUVBSA.

(Lucignani et al. [2004](#))

195. B—8.2 m

The answer required is in meters; therefore, it is very important to convert to the appropriate units. You must read the question carefully and determine which units are requested. It is very easy to come up with a wrong answer that is presented as one of the multiple-choice answers; therefore, special attention must be paid to problems containing varying units.

(Formula 12)

196. A—Contrast media

Iodine and barium are the most common types of contrast agents for enhancing X-ray-based imaging methods (CT). Gadolinium is used in magnetic resonance imaging as a MRI contrast agent and microbubble contrast agents are used to aid the sonographic imaging, e.g., echocardiograms in the detection of a cardiac shunt.

(Prokop and Galanski [2003](#))

197. A—Noise equivalent count rate (NECR)

NECR or effective count rate is comparative to the signal-to-noise ratio in the ending reconstructed images and works as a good parameter to evaluate the performances of different PET machines. NECR is given by: $NECR = T^2 / (T + S + R)$ where T , R , and S are the true, random, and scatter coincidence count rates accordingly.

(Saha [2005](#))

198. B—Dementia

Alzheimer's disease is by far the most common cause of dementia and accounts for two-thirds of dementia cases.

(Newberg and Alavi [2010](#))

199. D—Magnotherapy

Radioimmunotherapy, with highly specific monoclonal antibodies directed at lymphoma cells, and high-dose chemotherapy, with bone marrow or stem cell transplantation, are new treatment options; they are being used in initial treatments and for select patients who relapse after standard treatment.

(Andreoli et al. [2001](#))

200. C–25 mR/h

This problem is a representation of the Inverse Square Law—radiation exposure is reduced to three-quarters of the original intensity by doubling the distance from the radiation source. The exposure rate is 100mR/h at 3 m and 25mR/h at 6 m.

(Formula 12)

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