Chapter 1: Computed Tomography: An Overview

TRUE/FALSE

1. The British Department of Health and Social Security assisted in the development of the first clinically useful computed tomography scanner.

   ANS: T
   With encouragement from the British Department of Health and Social Security, an experimental apparatus was constructed to investigate the clinical feasibility of the technique suggested by Hounsfield.

   REF: 7

2. Ambrose received the Nobel Prize in 1979 with Hounsfield.

   ANS: F
   In 1979, Hounsfield shared the Nobel Prize in medicine and physiology with Allan MacLeod Cormack.

   REF: 8

3. In the original experiments in computed tomography, the computer took 9 hours to process one image.

   ANS: F
   The computer needed 2.5 hours to process the 28,000 measurements collected by the detector. It took 1 day to produce a picture.

   REF: 8

4. Cardiac computed tomography applications include, but are not limited to, quantitative assessment of coronary artery calcifications and ventricular function assessment.

   ANS: T
   Cardiac computed tomography applications include quantitative assessment of coronary artery calcifications, ventricular function assessment, and coronary angiography assessment of pulmonary veins.

   REF: 25

5. Computed tomography is not well established in the study of diseases of the central nervous system.

   ANS: F

Computed tomography became well established in the diagnosis of diseases of the central nervous system, and in some cases it eliminated the need for examinations such as pneumoencephalography and reduced the frequency of cerebral angiography.

REF: 17

6. Isodose curves are a dose descriptor used in reporting radiation doses in computed tomography.

   ANS: T
   Dose descriptors include the single-scan dose profile, multiple-scan dose profile, computed tomography dose index, multiple-scan average dose, and isodose curves.

   REF: 18

7. Three-dimensional algorithms, or rendering techniques, transform the transaxial computed tomography data into simulated three-dimensional images.

   ANS: T
   These algorithms, or rendering techniques, transform the transaxial computed tomography data into simulated three-dimensional images.

   REF: 22

8. Quality control is well established in computed tomography.

   ANS: T
   Because the computed tomography system consists of several mechanical and electronic components, many quality control tests are currently available.

   REF: 18

9. Computed tomography has been applied to the study of internal log defects and Egyptian mummies.

   ANS: T
   Computed tomography can be used for both the study of internal log defects and the study of Egyptian mummies.

   REF: 19

10. Processing images by computer is referred to as digital image processing.

    ANS: T
    Digital image processing involves the use of a digital computer to process and manipulate digital images.

    REF: 21

11. In 1996, the U.S. Food and Drug Administration approved real-time computed tomography fluoroscopy as a clinical tool for use in radiology.

    ANS: T
    In 1996, the Food and Drug Administration did approve computed tomography fluoroscopy for use in radiology.

    REF: 22

12. Determining tissue types in computed tomography slices is referred to as volume formation.

    ANS: F
    Volume formation involves stacking images to form a volume with some preprocessing. Classification refers to determining the tissue types in the slices.

    REF: 23

13. PACS is an acronym for picture archiving and communications systems.

    ANS: T
    Computed tomography departments now operate in a picture archiving and communications systems (PACS) environment.

    REF: 16

MULTIPLE CHOICE

1. Sectional images are obtained from all of the following *except:*
   A. tomography
   B. transverse axial tomography
   C. conventional radiography
   D. computed tomography

   ANS: C
   Conventional radiography cannot obtain sectional images.

   REF: 2

2. The radiation source is outside the patient in all of the following *except:*
   A. emission computed tomography
   B. transmission computed tomography
   C. ultrasonography
   D. magnetic resonance imaging

   ANS: A
   The radiation source for emission computed tomography is inside the patient. The radiation source for transmission CT, ultrasonography, and magnetic resonance imaging is outside the patient.

REF: 3

3. Which acronym has been established by the Radiological Society of North America for use in major American radiology journals?
   A. CAT
   B. CT
   C. CTAT
   D. RT

   ANS: B
   The term *computed tomography* was established by the Radiological Society of North America in their major journal *Radiology*.

   REF: 3

4. Data acquisition refers to:
   A. collecting x-ray transmission readings from the patient
   B. subjecting data to computer processing
   C. changing the data before they are displayed on a monitor
   D. storing the data collected from the patient onto magnetic tapes or disks

   ANS: A
   The term *data acquisition* refers to the collection of x-ray transmission measurements from the patient.

   REF: 3

5. Which term describes the systematic motion of the x-ray tube as it rotates around the patient to collect x-ray transmission readings?
   A. sampling
   B. data processing
   C. scanning
   D. generation

   ANS: C
   This process of translate-rotate-stop-rotate, referred to as scanning, is repeated 180 times.

   REF: 4

6. Which of the following refers to modifying computed tomographic data to make the images more useful to the observer?
   A. image manipulation
   B. image reconstruction
   C. data collection
   D. pattern recognition

   ANS: A
   Images can be modified through image manipulation to make them more useful to the observer.

   REF: 5

7. Who developed the first clinically useful computed tomography scanner?
   A. Cormack
   B. Roentgen
   C. Hounsfield
   D. Siemens Medical Systems

   ANS: C
   Dr. Hounsfield's research resulted in the development of a clinically useful CT scanner for imaging the brain.

   REF: 8

8. Which company pioneered the development of the first clinically useful computed tomography scanner?
   A. General Electric
   B. Siemens
   C. Elscint
   D. EMI

   ANS: D
   In 1971 the first clinical prototype computed tomography brain scanner (EMI Mark 1) was installed at Atkinson-Morley's Hospital.

   REF: 8

9. The radiation used by Hounsfield in his original experiments was
   A. gamma rays
   B. x rays
   C. beta particles
   D. electrons

   ANS: A
   The radiation used was from an americium gamma source coupled to a crystal detector.

   REF: 7

10. Who shared the Nobel Prize in Medicine and Physiology with Hounsfield for his contribution to the computed tomography technique?
    A. Kuhl
    B. Edwards
    C. Ledley
    D. Cormack

    ANS: D
    Hounsfield shared the Nobel Prize in medicine and physiology with Allan MacLeod Cormack.

    REF: 8

11. What contribution did Cormack make to the development of clinical computed tomography?

A. He developed Britain's first business computer.
B. He developed programs to calculate doses to patients.
C. He developed the solutions to the mathematical problems in computed tomography.
D. He performed a practical reconstruction of an image of the sun.

ANS: C
Professor Cormack developed solutions to the mathematical problems in computed tomography.

REF: 9

12. Who developed the first whole-body computed tomography scanner?
A. Ledley
B. Kuhl
C. Cormack and Hounsfield
D. Oldendorf

ANS: A
In 1974, Dr. Robert Ledley, a professor of radiology, physiology, and biophysics at Georgetown University, developed the first whole-body computed tomography scanner.

REF: 9

13. When a large set of transmission measurements is collected from the patient at different locations and is used to build up an image of internal anatomy, it is referred to as:
A. tomography
B. image reconstruction from projections
C. pattern recognition
D. digital image processing

ANS: B
Image reconstruction from projections had its theoretical roots in 1917 when the Austrian mathematician Radon proved it possible to reconstruct or build up an image of a two- or three-dimensional object from a large number of its projections from different directions.

REF: 2

14. The following developments in computed tomography were introduced during the period between 1973-1983 *except:*
A. image quality improvements
B. quality control
C. detectors
D. spiral/helical computed tomography

ANS: D
In 1989 a new generation of computed tomography scanners was introduced, called spiral/helical.

REF: 14

15. Which of the following is best used to describe patient dose in computed tomography?
    A. CTDI and MSAD
    B. isometric curves
    C. exposure doses
    D. collective doses

    ANS: A
    Dose descriptors include the single-scan dose profile, multiple-scan dose profile, computed tomography dose index, multiple-scan average dose, and isodose curves.

    REF: 18

16. Currently, the electron-beam computed tomography scanner is marketed by:
    A. EMI
    B. General Electric
    C. Toshiba
    D. Siemens

    ANS: B
    As of 2005, the electron-beam computed tomography scanner is marketed by General Electric Healthcare under the name e-Speed, and it features proprietary technologies that play a significant role in imaging the heart.

    REF: 11

17. Which of the following are dual-source computed tomography scanners primarily used for imaging?
    A. virtual colonoscopy
    B. cardiac imaging
    C. biopsy procedures
    D. pulmonary imaging

    ANS: B
    Dual-source computed tomography scanners feature two x-ray tubes and two detectors specifically intended for imaging cardiac patients in a very short time.

    REF: 15

18. All these elements can be used during data acquisition to reduce patient dose *except:*
    A. combined applications
    B. ultrafast ceramic detectors
    C. decreased pitch
    D. on-line dose modulation

    ANS: C
    One scheme uses three elements to keep the patient dose to a minimum during data acquisition: combined applications to reduce exposure, new ultrafast ceramic detectors, on-line dose modulation.

    REF: 18

19. The detectors convert the attenuation data into _____ signals.
    A. digital
    B. electrical
    C. light
    D. mechanical

    ANS: B
    The detectors convert the x-ray photons (attenuation data) into electrical signals, or analog signals.

    REF: 6

20. The mathematical techniques used by the computer to reconstruct the computed tomography image are known as:
    A. computer programs
    B. image reconstruction algorithms
    C. manipulation of images
    D. pattern recognition

    ANS: B
    After enough transmission measurements have been collected by the detectors, they are sent to the computer for processing. The computer uses special mathematical techniques to reconstruct the computed tomography image in a finite number of steps called *image reconstruction algorithms.*

    REF: 5

21. In computed tomography,
    A. a computer is used to reconstruct images of sectional anatomy.
    B. a computer is used to calculate radiation dose to the patient.
    C. a computer is not required because the physicist calculates the image, which the computer then prints out.
    D. special detectors are used to reconstruct sectional images.

    ANS: A
    Computed tomography overcomes limitations in detail and clarity by using image reconstruction from projections to produce sharp, clear images of cross-sectional anatomy.

    REF: 2

MATCHING

Please match the following computed tomography concepts. All answer selections will be used just once.

A. Determine tissue types in computed tomography slices
B. Algorithms
C. Image storage
D. Computed tomography dose descriptor
E. Converting electrical signals into digital data
F. Surface-based rendering

1. 3D technique
2. 3D classification
3. Image reconstruction
4. Optical disks
5. ADC
6. MSAD

1. ANS: F REF: 22 | 23
2. ANS: A REF: 23
3. ANS: B REF: 5
4. ANS: C REF: 5
5. ANS: E REF: 6
6. ANS: D REF: 18