Chapter 42

1. By far, during angiographic or cardiac catheterization procedures, the greatest amount

of skin exposure to the patient is received from:

a. rapid serial overhead exposures

b. regular overhead exposures

c. “spot-filming”

d. fluoroscopy

2. Which of the following most closely approximates the skin dose that a patient receives

from a two-view chest series?

a. 200 microgray

b. 1 milligray

c. 3.5 milligray

d. 5 milligray

3. Which of the following procedures would most likely deliver about 50 milligray to the

patient’s skin:

a. 1-view abdomen

b. 4-view skull series

c. 3-view lumbar spine series

d. Upper GI series with 3 minutes of fluoroscopy and 8 overheads and “spots”

4. Which of the following procedures delivers about 150 milligray to the patient’s surface, with a risk roughly equivalent to smoking 60 packs of cigarettes or driving one-way across the United States?

a. a 4-view dental series

b. a 5-view lumbar spine series

c. an 8-view small bowell follow-through

d. a barium enema series

5. Which of the following best approximates the average annual natural background

radiation dose:

a. 50-500 microgray

b. 1-3 milligray

c. 5-6 milligray

d. 10-100 milligray

6. Which of the following best approximates the total skin dose per breast from modern low-

dose mammography?

a. 100 microgray

b. 1 milligray

c. 10 milligray

d. 6 milligray

7. A “Caution – **High** Radiation Area” sign must be posted in controlled areas where the

exposure may exceed:

a. 100 microgray per week

b. 500 microray per hour

c. 50 microgray per hour

d. 1 milligray per hour

8. Most state bureaus for radiation control require that every institution utilizing ionizing

radiation equipment must designate a(n):

a. RSO

b. DLE

c. NRC

d. ARS

e. ACR

9. In the digital age, which of the following is allowing substantial reductions in patient dose

through the use of lower radiographic techniques:

a. Virtual grid software

b. Lower conventional grid ratios allowed by default digital processing

c. More procedures done non-grid because of scatter-effect clean-up in digital processing

d. All of the above

e. None of the above

10. What thickness of lead equivalent must be used in any primary radiation barrier?

a. 0.8 mm

b. 0.4 mm

c. 3.2 mm

d. 1.5 mm

11. Exposure time is related to total received dose in a(n) fashion:

a. inverse square

b. direct

c. inverse

d. half-value

12. When the monthly menstrual cycle is considered to begin at the onset of mensus,

reproductive women should be radiographed during which portion of this cycle?

a. first third

b. middle third

c. last third

d. none of the above

13. Which of the following devices, when used to reduce scatter radiation, can lead to an

increase in patient radiation exposure?

a. aperture diaphragm

b. collimator

c. grid

d. none of the above

14. When it is necessary to restrain a patient during a radiographic procedure, the least

acceptable person to do this is:

a. a 50-year old female radiology secretary

b. a 25-year old male radiographer

c. a 28-year old pregnant friend of the patient

d. an 18-year old orderly

15. A secondary radiation barrier must contain what amount of lead equivalent?

a. 2 mm

b. 1.5-1.6 mm

c. 0.75-0.8 mm

d. 0.5 mm

16. During a radiographic procedure, if the patient dose were increased by a factor of 2,

the occupational dose to the radiographer would:

a. increase by 2 times

b. increase by 4 times

c. decrease by a factor of 2

d. not be affected

17. What would a patient’s exposure be for 4 minutes and 45 seconds of accumulated

fluoro time at 5 mA with a beam intensity at the tabletop of 1.6 mGy per mA-

minute?

a. 3800 microgray

b. 3.8 mGy

c. 38 mGy

d. 38 microgray

18. How many HVLs would it take to reduce a beam of radiation from 4200 mGy/hour to

below 100 mGy/hour?

a. 4

b. 6

c. 8

d. 12

19. For a fixed radiographic unit, the tube-to-tabletop distance must never be less than:

a. 12 cm

b. 15 cm

c. 30 cm

d. 38 cm

20. The protective housing around the x-ray tube for a diagnostic x-ray unit should

reduce leakage radiation to less than at a distance of one meter in all circumstances:

a. 50 microgray/hr

b. 10o microgray/hr

c. 500 microgray/hr

d. 1000 microgray/hr

21. When fluoroscopy is performed, a lead apron worn by the operator must have a lead equivalency of at least:

a. 0.25 mm

b. 0.5 mm

c. 2.5 mm

d. 5.0 mm

22. Which of the following radiographic techniques should be utilized if a reduction in patient

dose is desired?

a. 80 kVp,100 mA, 0.5 sec.

b. 80 kVp, 400 mA, 0.25 sec.

c. 90 kVp, 400 mA, 0.07 sec.

d. 90 kVp, 200 mA, 0.5 sec.

23. Which of the following help reduce patient exposure?

*1. low mAs*

*2. added filtration*

*3. slow speed class processing*

*4. high kVp*

*5. use of grids*

a. 1, 3 & 5

b. 3 & 4

c. 2 & 4

d. 1, 2 & 4

e. All of the above

24. The bucky slot cover and the protective fluoroscopy curtain must both contain what

amount of lead equivalent?

a. 0.25 mm

b. 2.5 mm

c. 1.5 mm

d. 2.0 mm

25. The total intensity of the x-ray beam should never be greater than at the tabletop for a

fluoroscopy unit:

a. 12 microgray/mA-minute

b. 12 milligray/mA-minute

c. 21 milligray/mA-minute

d. 21 microgray/mA-minute

26. Typical entrance skin exposure (ESE) for a patient during fluoroscopy averages

about:

a. 1 milligray/minute

b. 10 milligray/minute

c. 20 milligray/minute

d. 50 milligray/minute

e. 100 milligray/minute

27. As the filtration in an x-ray beam is reduced, what happens to the HVL of the beam?

a. It remains the same

b. It decreases

c. It increases by the inverse square

d. It increases by direct proportion

28. A primary protective barrier must extend upward from the floor to a height of at least:

a. 1.5 meters

b. 2.4 meters

c. 2.1 meters

d. 3 meters

29. What type of lead shielding device would be used when a sterile field around the

patient must be maintained?

a. contact shield

b. shadow shield

c. shaped gonadal shield

d. leaded rubber sheets

e. no shielding

30. Which of the following most closely approximates the skin dose received by the

patient for a single-view abdomen radiograph?

a. 1 milligray

b. 5 milligray

c. 15 milligray

d. 50 milligray

31. Which of the following best describes a health risk equivalent to that of the radiation

exposure from a barium enema series:

a. a drive across the United States (4800 kilometers)

b. a drive from El Paso to Houston (800 kilometers)

c. a drive from Fort Worth to Dallas (64 kilometers)

d. a jet flight from New York to Paris

32. To minimize a radiographer’s radiation exposure during fluoroscopic procedures, the

shielded operator’s booth must be so constructed that x-rays must scatter at least

how many times before entering the booth?

a. one time

b. two times

c. three times

d. four times

e. five times

33. By NCRP guidelines, the minimum occupational exposure rate at which an x-ray

machine operator must wear a lead apron is:

a. 10 microgray/hour

b. 30 microgray/hour

c. 50 microgray/hour

d. 1 milligray/hour

34. The maximum allowable leakage for the walls, floors and ceiling of a controlled area

is:

a. 1 mGy per week

b. 3 mGy per week

c. 5 mGy per week

d. 10 mGy per week

35. To prevent x-rays from exiting through the ceiling to floors above, the fluoroscopy

tower including the “spot-filming” system must have a shielding equivalency of

of lead:

a. 0.25 mm

b. 0.5 mm

c. 2.0 mm

d. 2.5 mm

36. Which of the following is *always* defined as a secondary barrier?

a. the chest-board wall in an R & F room

b. the operator’s control booth

c. the floor

d. the fluoroscopy tower

37. A two-view chest series carries a health risk roughly equivalent to:

a. driving 32 kilometers or smoking 10 cigarettes

b. driving 6.4 kilometers or smoking 1 cigarette

c. driving 480 kilometers or smoking 6 packs of cigarettes

d. driving 960 kilometers or smoking a carton of cigarettes

38. If 2 mm of aluminum is required to reduce the exposure rate of a particular x-ray

beam to 25% of the original rate, the half-value layer (HVL) of the beam must be:

a. 1 mm Al

b. 2 mm Al

c. 4 mm Al

d. None of the above

39. The BEIR Report (Biological Effects of Ionizing Radiation) was published by the:

a. NAS

b. ACR

c. RSNA

d. ASRT

e. EPA

40. For a half-value layer test, the following exposures are measured on a densitometer

with increasing amounts of aluminum absorber:

*0 mm Al: 16 mGy*

*1 mm Al: 10 mGy*

*2 mm Al: 6 mGy*

*3 mm Al: 3 mGy*

What is the HVL for this x-ray beam?

a. 0.5 mm Al

b. 1.5 mm Al

c. 2.0 mm Al

d. 2.5 mm Al

e. 3 mm Al

41. Which of the following is the oldest and the largest medical imaging organization in the

world:

a. The ACR of the AMA

b. RSNA

c. ASRT

d. UNSCEAR

42. A particular x-ray beam has an HVL of 2 mm Al. If 4 mm of aluminum absorber is

added to this beam, its intensity will be reduced to:

a. 75%

b. 50%

c. 40%

d. 25%

e. 10%

43. For a controlled area, regulations state that fixed barriers must keep the exposure

rate below:

a. 1 mGy per year

b. 100 microgray per week

c. 1 mGy per week

d. 100 microgray per hour

44. Agencies may generate reports, make recommendations, or enforce legal regulations.

In the U.S., which of the following enforce legal regulations:

a. UNSCEAR & BEIR

b. CRCPD, ICRP & NCRP

c. NRC, FDA & EPA

d. NAS & ACR

45. On average, a single lead apron with 0.5 mm of lead will absorb about what percentage of 70-kVp x-rays:

a. 50%

b. 75%

c. 85%

d. 99%

46. A reading of “M” on a radiation dosimetry report, in place of a numerical value,

indicates:

a. the badge could not be read

b. minimal exposure

c. maximum exposure

d. mandatory exposure

e. zero exposure

47. In terms of its radiation shielding capability, 1.6 mm of lead is approximately equal

to:

a. 10 cm (4”) of concrete

b. 6.4 mm (¼”) of specially leaded glass

c. neither of these

d. both of these

48. A personal radiation monitoring device is required whenever any worker’s exposure

could be reasonably expected to exceed of the occupational DEL for

radiation workers:

a. 5%

b. 25%

c. 50%

d. 67%

49. Patient dose during fluoroscopy may be minimized by:

a. leaving the fluoro shutters as wide open as possible

b. increasing the fluoro mA

c. restricting the field size

d. reducing the SID

50. When specially leaded glass is used for the observation window at the control booth,

it should be at least how thick?

a. 0.8 mm (1/32”)

b. 1.6 mm (1/16”)

c. 3.2 mm (1/8”)

d. 6.4 mm (1/4”)

e. 12.8 mm (1/2”)

51. To protect the unborn fetus of a pregnant radiographer, which of the following

recommendations is the most reasonable level of response?

a. Quit work immediately

b. Do not work within the x-ray department

c. Work only in low radiation areas and procedures

d. No special precautions are necessary

52. During radiographic examinations, the primary source of scatter radiation is:

a. the x-ray tube

b. the patient being radiographed

c. the floor of the radiographic room

d. the x-ray tabletop

53. A secondary protective barrier must have at least how much lead thickness

equivalency?

a. 0.8 mm (1/32”)

b. 1.6 mm (1/16)

c. 3.2 mm (1/8”)

d. 6.4 mm (1.4”)

54. In diagnostic ranges of kVp, the least amount of scatter radiation occurs at an angle

of from the patient or scattering object?

a. 30 degrees

b. 45 degrees

c. 60 degrees

d. 90 degrees

e. 180 degrees

55. Most radiographic units have a short or fixed exposure switch. This ensures that the

operator:

a. will not use excessive prep time

b. will use appropriate radiographic technique

c. remains behind the shielded booth during exposures

d. remains as far away from the patient as possible

e. all of the above

56. At one meter from the patient, the intensity of scattered radiation is generally

estimated to be about what percentage of the patient’s own skin exposure from

the primary x-ray beam?

a. 0.1%

b. 0.5%

c. 1.0%

d. 10.0%

57. The plotted diagram which shows exposure levels at different distances from the x-

ray table is called a(n):

a. H & D curve

b. gamma curve

c. isotope curve

d. isoexposure curve

58. At a particular location in the x-ray room, the intensity of the scatter radiation during

fluoroscopy is 35 mGy/hour. If the radiographer stands at this spot for 2½

minutes, what will his or her total exposure be?

a. 1.45 mGy

b. 14.5 mGy

c. 14 Gy

d. 145 mGy

59. For non-abdominal/pelvic procedures, (such as a femur series), as long as lead gonadal

shielding for the patient does not interfere with diagnosis, it should be used whenever the

primary beam falls within of the patient’s gonads:

a. 1 cm

b. 2 cm

c. 5 cm

d. 10 cm

60. What is the minimum length which the exposure switch cord for a mobile x-ray unit

must be able to extend?

a. 60 cm

b. 120 cm

c. 2 meters (6 ft)

d. 2.5 meters (8 ft)

61. Criteria for designating a particular room as a controlled area include all of the

following **except**:

a. the room must have 3 or more exits

b. the average occupancy of the room must be known

c. any radiation equipment in the room must be periodically inspected for safety

d. working conditions in the room are supervised

62. The minimum overlapping of sheet lead at the corner seams for primary barrier walls

is:

a. 1 mm

b. 5 mm

c. 1 cm

d. No overlap is required

63. A sign displaying the international “cloverleaf-pattern” radiation symbol and stating

“CAUTION – RADIATION AREA” must be displayed at the entrance to any

controlled area in which personal dose could exceed:

a. 1 mGy/minute

b. 1 mGy/hour

c. 1 mGy/work week

d. 1 mGy/month

64. Scientific guidelines for equipment design, barrier requirements, personnel

monitoring, DELs and radiation warning signs are found in a series of reports

published by the:

a. NAS

b. NRC

c. EPA

d. BRH

e. NCRP and ICRP

65. For a mobile C-arm fluoroscopy unit, the x-ray tube must not be closer than

from the focal spot to the patient:

a. 24 cm (10”)

b. 30 cm (12”)

c. 38 cm (15”)

d. 46 cm (18”)

66. Which of the following combinations of factors are multiplied together to determine

the workload of a radiographic unit?

a. occupancy X cumulative exposure time X number of exams per week

b. use factor X cumulative exposure time X number of exams per week

c. milliamperes per exam X cumulative exposure time X number of exams per

week

d. milliamperes per exam X use factor X number of exams per week

67. The fraction of a typical workday during which personnel are present in an area is

referred to as the:

a. use factor

b. occupancy factor

c. workload

d. diffusion factor

e. fudge factor

68. Which of the following is most likely to assure minimum patient exposure:

a. *always* use optimum kVp

b. *always* use automatic exposure control

c. *always* use lead gonadal shielding

d. *always* use positive beam limitation

69. Which of the following is **not** one of the NCRP guidelines:

a. Radiographers *shall* know the average doses to patients for common procedures

b. Radiographers *shall* collimate the x-ray beam **smaller** than the image receptor

plate when practical

c. Technique charts *shall* be available in each radiographic room

d. Radiographers *shall* know the limits of misalignment for an x-ray field

70. The use factor for any wall in a radiographic room is assumed to be at least:

a. 0

b. 1/8

c. ¼

d. ½

e. 1

71. It is estimated that 100 mGy to the gonads would increase the risk of congenital defects

by about 1%. What diagnostic procedure could most conceivably deliver this

amount to the gonads of either a male or female patient?

a. Upper GI

b. Barium enema

c. Coronary arteriogram

d. Lumbar spine

72. Which of the following radiographic examinations, as a whole series, produces the

highest entrance skin dose (ESE) for the patient?

a. pelvis

b. skull

c. breast

d. dental bitewing

73. Which of the following x-ray examinations produces the highest average **gonadal**

dose for a **male** patient, assuming that proper collimation is used?

a. pelvis

b. abdomen

c. lumbar spine

d. gall bladder

74. A radiation monitoring report expresses the radiographers’ dose equivalents in:

a. C/kg

b. gray

c. sievert

d. becquerel

75. Within **agreement states**, the group that has the responsibility for enforcing radiation

protection regulations is the:

a. federal government

b. local police department

c. state health department

d. NCRP

76. When it comes to the thickness of an absorbing material, x-ray attenuation is a(n) process:

a. exponential

b. inverse square

c. linear

d. proportional

77. Which of the following is measured in milliampere-minutes?

a. RBE

b. occupancy factor

c. use factor

d. workload

e. maximum equipment capability

78. The exposure to a radiographer standing 1 meter from the patient is approximately

what fraction of the patient’s in-beam skin exposure?

a. 1/10th

b. 1/100th

c. 1/1000th

d. 1/4000th

79. The occupancy factor for public corridors is assumed to be:

a. 1/10

b. 1/5

c. 1/2

d. 1

80. Radiation exposure to people in an “uncontrolled area” must be kept below per

week:

a. 20 microgray

b. 250 microgray

c. 500 microgray

d. 1 mGy

81. According to NCRP guidelines, which of the following is true:

a. a standard x-ray machine may be used to perform mammography, if the added

filtration is first removed

b. fluoroscopy may be used to localize anatomy prior in preparation for overhead

exposures

c. the positive beam limitation (automatic collimator) should be over-ridden by

the radiographer when anatomy is significantly smaller than the receptor

plate size

d. metal rails or a plastic cylinder on the front of the collimator of a C-arm unit

may be removed if needed for proper positioning during a surgical

procedure

82. Several personnel monitoring companies continue to us the older unit mrem

(millirem) for monthly reports: To convert mrem to μSv (microsieverts), simply:

1. divide by 2
2. multiply by 2
3. divide by 10
4. multiply by 10

83. Which of the following is a reasonable reaction to studies of occupational radiation

exposure levels for diagnostic radiographers and radiologists conducted over the

last 50 years?

a. wearing ring badges during overhead radiography

b. wearing thyroid shields during cardiovascular fluoroscopy

c. wearing eye shield glasses during gastrointestinal fluoroscopy

d. restricting pregnant radiographers to performing only chest procedures

84. The maximum fluoroscopic x-ray intensity rate at the tabletop is limited to:

a. 50 mGy/min

b. 80 mGy/min

c. 100 mGy/min

d. 150 mGy/min

85. Each scattering event reduces radiation intensity by a factor:

a. that is inversely proportional to the number of events

b. that is inversely proportional to the square of the number of events

c. of about 1000

d. of about 1 million

86. Which of the following are taken into consideration when determining the necessary

thickness of lead for a fixed radiation barrier?

a. Distance from the radiation unit to the barrier wall

b. Use factors

c. Occupancy

d. Peak operating kVp of the unit

e. All of these

87. By NCRP guidelines, the minimum exposure rate at which a lead apron should be

worn is:

a. 10 microgray/hour

b. 30 microgray/hour

c. 50 microgray/hour

d. 1 mGy/hour

88. The DEL for a controlled area requires that a person working within the area not

receive more than:

a. 50 microgray/week

b. 100 microgray/week

c. 500 microgray/week

d. 1 mGy/week

89. Which of the following is considered as a controlled area?

a. a radiology waiting room

b. a radiology department hallway

c. an ultrasound room

d. an x-ray room

e. none of these

90. When measuring the HVL of an x-ray beam, if an absorber material with a higher

atomic number is used to make the measurement, how will the resulting HVL

change?

a. It will increase

b. It will decrease

c. It will remain unchanged

d. It will increase at first, then later decrease

91. Which of the following is the amount of protective lead required in an x-ray tube

housing?

a. 0.25 mm

b. 0.5 mm

c. 2.0 mm

d. 2.5 mm

92. During fluoroscopy, the mA read-out on the mA meter should generally not exceed:

a. 1 mA

b. 2 mA

c. 5 mA

d. 10 mA

e. 20 mA

93. The maximum reporting period for personnel monitoring is:

a. 1 week

b. 1 month

c. 1 quarter

d. 1 year

94. Which of the following x-ray examinations produces the highest average **gonad** dose

for a **female** patient?

a. pelvis

b. abdomen

c. lumbar spine

d. stomach and upper GI

95. By NCRP guidelines, any fluoroscopist placing his or her hands within the primary

x-ray beam in order to hold a patient in place must wear lead gloves with at least

of lead equivalence:

a. 0.25 mm

b. 0.5 mm

c. 2.5 mm

d. 1.5 mm

96. Which of the following suggests to referring physicians the most appropriate imaging

modality to use based on over 200 clinical conditions:

1. The *NEXT (Nationwide Evaluation of X-ray Trends)*
2. The *ACR Appropriateness Criteria*
3. The *BEIR Report*
4. The *ICRP Guidelines for Radiologic Procedures*

97. If we increase the SID by 10 cm, then use the square law to compensate the mAs, entrance

skin dose to the patient is still reduced *because*:

1. The SSD (source-to-skin distance) was increased by a greater ratio (percentage)
2. The SSD was increased by a greater raw amount
3. The SSD remains unchanged
4. The SSD was decreased

98. The extraordinary exposure latitude of digital equipment allows the SID to be increased by

10-15% …

1. Only if the mAs is compensated
2. Only if the kVp is compensated
3. Only if exposure time is compensated
4. Without compensating radiographic technique

99. For tabletop procedures, radiographers should use:

a. The average SID for the equipment default

b. The longest SID allowed by the equipment

c. The shortest SID allowed by the equipment

d. 100 cm in all cases

100. Which of the following are advantages of increased SID:

a. More anatomy can be included within the field-of-view (FOV) of the image receptor

b. Patient dose is reduced even when the mAs is compensated for the SID change

c. With digital processing, patient dose can be further reduced by NOT compensating the

mAs for SID increases up to 15%

d. All of the above

1. None of the above

101. Since 2019, the AAPM, the ACR, and the NCRP have all adopted the position that for

patients, lead gonadal shielding should no longer be used for:

1. Pediatric patients
2. Pelvic and abdominal procedures
3. Any anatomy within 5 cm of the gonads
4. Extremities with the IR placed in the patient’s lap while seated

102. Especially for female patients, a significant portion of dose to the gonads comes from

\_\_\_\_\_\_\_ that cannot be blocked with lead shielding:

1. X-rays scattered from the tabletop
2. X-rays scattered from the IR
3. X-rays scattered from the patient’s skin
4. X-rays scattered from internal organs

103. Regarding the 2019 position statement of the AAPM regarding the use of gonadal shielding,

which of the following is false:

a. genetic effects were found to be higher than previously estimated

b. improvements in technology were found to have reduced gonadal dose

c. gonadal shielding was found to interfere with both AEC and digital processing

d. gonadal shielding was found to frequently obscure diagnostic findings