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- The reduction in the size of a tissue or organ that occurs from an exposure to radiation, chemical or physical injury is called:
  - Cellulitis
  - Anemia
  - Atrophy
  - Desquamation
- The ability of ionizing radiation to produce a more intense biologic response in a tissue is related to all of the following EXCEPT:
  - An increase in the quality factor of the radiation
  - An increase in the oxygenation of the tissue
  - A decrease in the linear energy transfer
  - An increase in the proliferation rate
- At the present diagnostic exposure levels, which of the following early effects are likely to be seen after a patient has undergone a GI series with 4 minutes of fluoroscopy?
  - A reduction in the number of red blood cells
  - A reduction in the sperm count
  - The opacification of the lens of the eye
  - No early or late effects are likely
- Which of the following cells is most likely to demonstrate the greatest amount of radiation damage from a 25,000 mrem exposure to x-rays?
  - Oocyte
  - Chondrocyte
  - Neuron
  - Adipose cell
- The relative radiosensitivity of an individual is highest:
  - In the neonatal period
  - In early childhood
  - During adolescence
  - In the geriatric period
- A total dose equivalent of 20,000 mrem during a one year period, is most likely to increase the possibility of developing which of the following disorders?
  - Leukemia
  - Cataracts
  - Hepatitis
  - Pyloric stenosis
- The damage to the somatic tissues associated with sublethal exposure to radiation is considered:
  - Non-repairable or permanent in nature
  - Additive becoming more severe with each exposure
  - Relatively nondestructive resulting in little or no damage
  - Largely repairable through the regeneration of the tissues
- The normal process by which somatic cells proliferate is termed:
  - Metabolic synthesis
  - Osmosis
  - Enuresis
  - Mitosis
- Which of the following is one of the probable causes of death from the effects of the central nervous system syndrome?
  - Vasculitis*
  - Meningitis*
  - High intracranial pressure*
  - 1 only
  - 2 only
  - 3 only
  - 1, 2 & 3
- The symptoms of fever and malaise associated with a reduced number of leukocytes is one of the major characteristics of the:
  - Prodromal syndrome
  - Hematologic syndrome
  - Gastrointestinal syndrome
  - Central nervous system syndrome

11. A threshold dose-response relationship is normally characterized by a:
- A. Minimal dose above which the effects of an exposure are detectable
  - B. Small but noticeable effect to an exposure at any dose level
  - C. Failure to produce any detectable effect even at high dose levels
  - D. Progressive worsening of the effects over time
12. A somatic effect called erythema, which occurs from a large exposure of radiation, is most like what other condition?
- A. Premature hair loss
  - B. Anemia
  - C. Diabetes
  - D. Sunburn
13. Which of the following is considered a late effect following a large single exposure to radiation?
- A. Chromosomal aberration
  - B. Desquamation
  - C. Temporary sterility
  - D. Carcinogenesis
14. The most recent evidence seems to support the following statement concerning the damage to the genetic material of a human or animal cell:
- A. The damage occurring to the genetic material does not demonstrate any capacity for repair
  - B. The damage to the genetic material appears to be repaired over time
  - C. The damage to the genetic material is often manifested in beneficial traits
  - D. The damage to genetic material is apparent at extremely small exposure levels
15. The period of major organogenesis normally occurs during the \_\_\_\_\_ of fetal development.
- A. First two weeks
  - B. Second-eighth week
  - C. Twelfth-twentieth week
  - D. Last six weeks
16. Any response occurring in a tissue or organism in the absence of an identifiable stimulus is called a/an:
- A. Causative response
  - B. Indirect response
  - C. Manifest response
  - D. Ambient response
17. The deaths related to large exposure to radiation appear to be related to damage to all of the following EXCEPT:
- A. Central nervous system
  - B. Gastrointestinal system
  - C. Hematologic system
  - D. Reproductive system
18. The most sensitive organs to the effects of a radiation exposure of 200 rem, appears to be the:
- A. Thyroid gland and the kidney
  - B. Spinal cord and the brain
  - C. Liver and the lungs
  - D. Testes and the ovaries
19. The dose to the gonads that is expected to produce a measurable genetic change in the entire population is termed:
- A. Mean marrow exposure
  - B. Inherited radiation dose
  - C. Reproductive limiting exposure
  - D. Genetically significant dose
20. Cells such as the erythrocytes and spermatozoon that have a specialized function and are in the final stage of their maturation process are termed:
- A. Proliferation cells
  - B. Ground cells
  - C. Differentiated cells
  - D. Precursor cells

1. C An exposure to radiation or other type of stimulus can result in a number of biologic effects. One of the more common is a reduction in the size of an irradiated tissue called atrophy.
2. C The classic laws of cellular sensitivity as proposed by Bergonié and Tribondeau relate cellular response to a chemical stimulus of radiation exposure to the cellular maturity (age), metabolic activity ( $O_2$  consumption) and proliferation rate and the degree of tissue differentiation. Research has shown that cells that create new cells rapidly and have a short life span termed young cells are much more sensitive to the radiation than older cells. Basal cells of the epidermis crypt cells of the intestines and erythroblasts are classified as young cells. The metabolism or the rate at which food is converted into energy will also effect the sensitivity of the cell. Tissues with a high metabolic rate (neoplasms) are generally more sensitive than less active tissues. Cells that have a higher proliferation rate will also be more radiosensitive. Cells that are undifferentiated will also be more radiosensitive than differentiated tissues.
3. D In a modern fluorographic system, the amount of exposure received during a GI series with 4 minutes of fluoro time is about 6-10 rem. At this level of exposure, no visible signs of radiation damage will be apparent.
4. A Of the cells listed, the female reproductive cell, the oocyte, is the most sensitive to the effects of an irradiation.
5. D The relative radiosensitivity in man is relatively constant from early infancy to late adulthood. See the graph for questions 51-52. The radiosensitivity increases dramatically in the more easily compromised geriatric patient.
6. A At a dose of 20,00 mrem (20 rem) there is no evidence to support the development of any type of somatic effects in an exposed individual. Evidence from the survivors of the atomic bombings in Japan, does indicate that an increase in the number of cases of leukemia has been seen following this and higher levels of exposure.
7. D Even following relatively large exposures as long as the stromal or germ tissues survive, the cells that are regenerated are likely to be normal.
8. D The usual process by which all somatic tissues reproduce or proliferate is called mitosis. During mitosis, the chromosomes are replicated to enable the formation of two daughter cells containing the same number of chromosomes at the original parent cell.
9. D The acute radiation syndrome associated with the central nervous system is only apparent at extremely high radiation dose levels. At these levels, the majority of the damage is due to the destruction of the cell membranes of the nerve cells and blood vessels. This can lead to vasculitis, meningitis and an increase in the intracranial pressure.
10. B The acute radiation syndrome associated with the blood and blood forming tissues is called the hematologic syndrome. Following an exposure of over 300 rem, a reduction in the number of all types of blood cells is seen. This will lead to anemia, clotting problems and depleted immune system. The fever and malaise are just two of many symptoms related to these effects.
11. A A threshold effect by definition is an effect that is only apparent after some amount of stimulus has been received. For most somatic conditions, the radiation threshold is usually above 150 rem.
12. D Erythema is the term used to describe the reddening of the skin following an exposure to ionizing radiation. It is similar in appearance to a sunburn.
13. D A late effect is defined as one that occurs only after a few months or years have passed following an irradiation. It has been found that carcinogenesis will normally not occur for 2-30 years following an exposure and is therefore classified as a long-term effect.
14. B The ability to damage genetic tissues was clearly demonstrated in radiation experiments in the mid 1900's. Since then, it has been discovered that DNA has the capacity to repair most defects in the genetic material over a relatively short period of time following an irradiation.

15. B The most important time in the development of the embryo/fetus is the period of major organogenesis. Beginning around the second week of gestation, the individual organs begin to develop. During this six-week process, the embryo is extremely sensitive to the effects of chemical or radiation stimuli.
16. D A response that occurs in the absence of an identifiable stimulus is called an ambient effect. These can be caused by background radiation or any number of spontaneous genetic or chromosomal abnormalities.
17. D Any exposure to radiation above the 300 rem level will cause a number of recognizable symptoms that are related to damage to organs that are sensitive to radiation. Depending on the amount of radiation that is absorbed, three systems have been identified with the death of the individual. These are the hematologic or blood forming tissues, the tissues of the gastrointestinal tract, and with massive doses the tissues of the central nervous system.
18. D The testes and ovaries that contain the immature sperm and developing ova consist largely of undifferentiated tissues that are acutely sensitive to the effects of a radiation exposure.
19. D In order to help estimate the genetic impact of low-dose radiation on large population group, an estimation of the actual value of the gonadal dose received by this population must be determined. This value is termed the genetically significant dose (GSD).
20. C In biologic terms, cells or tissues that have a specialized function and are at the end of the cellular maturation process, and do not undergo any further mitotic activity, are called differentiated tissues. The erythrocyte and spermatozoon are two example of differentiated cells. These cells tend to have a low sensitivity to the effects of chemical stimuli or radiation. Cells are considered undifferentiated when they are not specialized and are involved in reproductive processes. Immature or undifferentiated cells, such as erythroblasts and spermatogonia, are much more sensitive to the effects of chemicals of radiation.