

1. A client with poor arterial circulation in the lower limbs has developed areas of inflammation and “weeping” clear serous exudate. Since chronic inflammation lasts for a long time, it has been associated with which of the following changes in physiological response? Select all that apply.
- A) Formation and development of new blood vessels
  - B) The death of one or more cells in the body within a localized area
  - C) Release of a number of potent inflammatory mediators, altering adhesive properties
  - D) Regulation and modulation of the immune response through synthesis and release of inflammatory mediators
  - E) Release of scavenger cells capable of engulfing bacteria through phagocytosis

Ans: A, B

**Feedback:**

*Chronic inflammation* is of a longer duration, lasting for days to years, and is often associated with the proliferation of blood vessels (angiogenesis), tissue necrosis, and fibrosis (scarring). Endothelial cells are also key players in the inflammatory response. They regulate leukocyte extravasation by expression of adhesion molecules and receptor activation and contribute to the regulation and modulation of immune responses through synthesis and release of inflammatory mediators. Activated platelets also release a number of potent inflammatory mediators, thereby increasing vascular permeability and altering the chemotactic, adhesive, and proteolytic properties of the endothelial cells. Neutrophils are scavenger cells capable of engulfing bacteria and other cellular debris through phagocytosis.

2. During a lecture on inflammation, the physiology instructor discusses the major cellular components involved in the inflammation response. The instructor asks, “Which of the following cells arrives early in great numbers?” The student with the correct response is:
- A) Basophils
  - B) Lymphocytes
  - C) Neutrophils
  - D) Monocytes

Ans: C

**Feedback:**

Neutrophils are the primary early arrival cells and are signified by an elevated neutrophil count that includes mature (PMNs) and immature (bands) cell forms. Basophils respond later. Lymphocytes have a slower arrival and stay longer. The half-life of circulating monocytes is about a day, after which they begin to migrate to the site of injury and mature into larger macrophages, which have a longer half-life and greater phagocytic ability than do blood monocytes.

3. A diabetic client has injured his foot while walking barefoot on the lawn. On admission, which of the following assessment findings would be considered a localized cardinal sign of acute inflammation?
- A) Temperature of 101°F
  - B) Fatigue with listlessness
  - C) Redness and edema at the injured site
  - D) Urine output of less than 500 mL/24 hours (low)

Ans: C

**Feedback:**

Localized manifestations include redness, swelling, and heat. Fever and fatigue are systemic manifestations of acute inflammation. Low urine output is not a localized sign but could be a systemic manifestation if the client goes into septic shock.

4. An older adult client has just sheared the skin on her elbow while attempting to boost herself up in bed, an event that has precipitated acute inflammation in the region surrounding the wound. Which of the following events will occur during the vascular stage of the client's inflammation?
- A) Outpouring of exudate into interstitial spaces
  - B) Chemotaxis
  - C) Accumulation of leukocytes along the epithelium
  - D) Phagocytosis of cellular debris

Ans: A

**Feedback:**

The vascular stage of acute inflammation includes the outpouring of exudate into the extravascular spaces. Margination (epithelial accumulation of leukocytes), chemotaxis, and phagocytosis take place during the cellular stage.

5. A client cuts herself with a sharp knife while cooking dinner. The client describes how the wound started bleeding and had a red appearance almost immediately. The nurse knows that in the vascular stage of acute inflammation, the vessels:
- A) Bleed profusely until the body can compensate and start to send fibrinogen to the wound
  - B) Vasodilate causing the area to become congested causing the red color and warmth
  - C) Constrict as a result of “fight/flight” hormone release resulting in pale-colored skin
  - D) Swell to the point of compromising circulation causing the limb to become cool to touch

Ans: B

**Feedback:**

Vasodilation allows more blood and fluid into the area of injury, resulting in congestion, redness, and warmth. Vasodilation is quickly followed by increased permeability of the microvasculature. The loss of fluid results in an increased concentration of blood constituents (red blood cells, leukocytes, platelets, and clotting factors), stagnation of flow, and clotting of blood at the site of injury. This aids in limiting the spread of infectious microorganisms. The loss of plasma proteins increases fluid movement from the vascular compartment into the tissue space and producing the swelling, pain, and impaired function that are the cardinal signs of acute inflammation.

6. A group of teenagers spent an entire day on the beach without using sunscreen. The first night, their skin was reddened and painful to touch. The second day, they awoke to find large fluid-filled blisters over several body areas. The nurse recognizes the development of blisters as which type of inflammatory response?
- A) Cellular response
  - B) Immediate transient response
  - C) Continuous response
  - D) Delayed response

Ans: D

**Feedback:**

The first pattern is an *immediate transient response*, which occurs with minor injury. It develops rapidly after injury and is usually reversible and of short duration (15 to 30 minutes). The second pattern is an *immediate sustained response*. The third pattern is a *delayed response*, in which the increased permeability begins after a delay of 2 to 12 hours, lasts for several hours or even days, and involves venules as well as capillaries. A delayed response often accompanies injuries due to radiation, such as sunburn. The cellular stage of acute inflammation is marked by changes in the endothelial cells lining the vasculature and movement of phagocytic leukocytes into the area of injury or infection.

7. During lecture on wound care, the instructor mentions the final stage of the cellular response of acute inflammation. Of the following statements, which describes what physiologically occurs in the final stage?
- A) Leukocytes accumulate and begin migration to the site of injury.
  - B) Chemokines direct the trafficking of leukocytes.
  - C) Mediators are transformed into inactive metabolites.
  - D) Neutrophils, monocytes, and macrophages engulf and degrade the bacteria/cellular debris.

Ans: D

**Feedback:**

During the final stage of the cellular response, neutrophils, monocytes, and tissue macrophages are activated to engulf and degrade the bacteria and cellular debris in a process called *phagocytosis*. During the early stages of the inflammatory response, signaling between blood leukocytes and the endothelial cells defines the inflammatory event and ensures arrest of the leukocytes along the endothelium. This process of leukocyte accumulation is called *margination*. Once leukocytes exit the capillary, they crawl through the tissue guided by a gradient of secreted chemoattractants, such as chemokines, bacterial and cellular debris, and fragments generated from activation of the complement system. Chemokines are small proteins that direct the trafficking of leukocytes during the early stages of inflammation or injury. Once activated and released from the cell, most mediators are short-lived. They may be transformed into inactive metabolites, inactivated by enzymes, or otherwise scavenged or degraded.

8. A client presents to the clinic with a swollen, painful “hang nail” on the index finger. There is a large pustule over the site that needs to be lanced. The health care worker knows that which mediator of inflammation causes this increase in capillary permeability and pain?
- A) Serotonin
  - B) Histamine
  - C) Bradykinin
  - D) Nitric oxide

Ans: C

**Feedback:**

Bradykinin causes increased capillary permeability and pain. Serotonin and histamine are released by the mast cell degranulation. Histamine causes arteriole dilation and increased permeability of venules. Serotonin has actions similar to those of histamine. Nitric oxide relaxes smooth muscle and reduces platelet aggregation and adhesion.

9. A client has an abscess in the mouth with a profuse amount of thick creamy white exudate. The nurse knows that this wound with necrotic cells is classified as:
- A) Serous
  - B) Fibrinous
  - C) Suppurative
  - D) Membranous

Ans: D

**Feedback:**

Membranous or pseudomembranous exudates develop on mucous membrane surfaces. It is an acute inflammatory response to a powerful necrotizing toxin with formation on a mucosal surface, of a false membrane composed of precipitated fibrin, necrotic epithelium, and inflammatory white cells. Serous exudate is a watery fluid. Fibrinous exudates contain fibrinogen and form a thick sticky meshwork. Suppurative exudate contains pus.

10. In contrast to acute inflammation, chronic inflammation is characterized by which of the following phenomena?
- A) Profuse fibrinous exudation
  - B) A “shift to the left” of granulocytes
  - C) Metabolic and respiratory alkalosis
  - D) Lymphocytosis and activated macrophages

Ans: D

**Feedback:**

Chronic inflammation requires lymphocytes and macrophages to remain in large numbers for the high use of immune cells. Chronic inflammation is associated with fibroblast proliferation instead of exudations. A “shift to the left” is characteristic of acute inflammation with a high neutrophil count. Inflammation, with continued cell injury, is a source of metabolic and respiratory (if the lungs are the site of inflammation) acidosis.

11. Which of the following individuals most likely has the highest risk of experiencing chronic inflammation? A client who:
- A) Has recently been diagnosed with type 2 diabetes
  - B) Is a carrier of an antibiotic-resistant organism
  - C) Is taking oral antibiotics for an upper respiratory infection
  - D) Is morbidly obese and who has a sedentary lifestyle

Ans: D

**Feedback:**

Obesity has been linked to chronic inflammation. Acute infections, diabetes, and being a carrier of a microorganism are not circumstances that are noted to cause chronic inflammation.

12. The nurse notes the client has developed a systemic response of inflammation based on assessment findings. Which of the following clinical manifestations support this diagnosis? Select all that apply.

- A) Temperature of 100.9°F, lethargy
- B) Pulse rate 130 beats/minute (high)
- C) Generalized achiness
- D) Low urine output
- E) Pounding, throbbing headache

Ans: A, B, C

**Feedback:**

Manifestations of the acute-phase response include fever, increased heart rate, anorexia, somnolence, and malaise. Low urine output and throbbing headache are not an acute response.

13. Which of the following lab results confirm the client has developed an acute-phase inflammatory response? Select all that apply.

- A) Erythrocyte sedimentation rate (ESR) 175 mm/h (high).
- B) Red blood cell count (RBC) 3.11 cells/ $\mu$ L (low).
- C) Leukocytes (WBC) 18.7 cells/ $\mu$ L (high).
- D) C-reactive protein (CRP) 10.0 mg/L (high).
- E) Fibrinogen level 1.5 g/L (normal).

Ans: A, C, D

**Feedback:**

During the acute-phase response, the liver dramatically increases the synthesis of acute-phase proteins such as fibrinogen, C-reactive protein (CRP), and serum amyloid A protein (SAA) that serve several different defense functions. The synthesis of these proteins is stimulated by cytokines, especially TNF- $\alpha$ , IL-1 (for SAA), and IL-6 (for fibrinogen and CRP). The accelerated erythrocyte sedimentation rate (ESR) that occurs in disease conditions is characterized by the systemic inflammatory response.

*Leukocytosis*, or the increase in white blood cells, is a frequent sign of an inflammatory response, especially those caused by bacterial infection. In acute inflammatory conditions, the white blood cell count commonly increases from a normal value of 4000 to 10,000 cells/ $\mu$ L.

14. A client asks why his temperature is always below 98.6°F. The nurse responds:
- A) Some people maintain a core body temperature of 41°C and that is normal for them.
  - B) Normal core temperature varies between individuals within the range of 97.0°F to 99.5°F.
  - C) A person's highest point of core temperature is usually first thing in the morning.
  - D) The best way to bring your body temperature up to normal is to live in a warmer climate.

Ans: B

**Feedback:**

Core temperature is normally maintained within a range of 36.0°C to 37.5°C (97.0°F to 99.5°F). A core temperature greater than 41°C (105.8°F) or less than 34°C (93.2°F) usually indicates that the body's thermoregulatory ability is impaired. Body heat is generated in the tissues of the body, transferred to the skin surface by the blood, and then released into the environment surrounding the body. The thermoregulatory center regulates the temperature of the deep body tissues, or “core” of the body, rather than the surface temperature. Internal core temperatures reach their highest point in late afternoon and evening and their lowest point in the early morning hours.

15. A postsurgical client who is recovering in the postanesthetic recovery unit states that she is “freezing cold.” Which of the following measures is likely to be initiated in the client's hypothalamus in an effort to reduce heat loss?
- A) Opening of arteriovenous (AV) shunts
  - B) Reduced exhalation of warmed air
  - C) Contraction of pilomotor muscles
  - D) Decreased urine production

Ans: C

**Feedback:**

Contraction of the pilomotor muscles reduces the surface area available for heat loss. Opening of the AV shunts exacerbates heat loss. The body does not normally adjust urine production or decrease exhalation in response to heat loss.

16. An elderly client is dressed only in a hospital gown and complains of a draft in her room. Consequently, she has requested a warm blanket while she sits in her wheelchair. Which of the following mechanisms of heat loss is most likely the primary cause of her request?
- A) Evaporation and conduction
  - B) Radiation and convection
  - C) Conduction and convection
  - D) Convection and evaporation

Ans: B

**Feedback:**

Approximately 60% of heat loss typically occurs through radiation to the surrounding air. Convection is heat loss related to air currents, such as those in a drafty room.

17. Which of the following clients have a pathophysiologic process capable of causing fever by inducing the production of pyrogens? Select all that apply.
- A) A farmer who cut his arm while sharpening his tools coming to clinic because of acute inflammation signs like fever and redness
  - B) A middle-aged obese client complaining of “knees hurting and swelling by the end of the day”
  - C) An older adult recuperating following a myocardial infarction
  - D) A newly diagnosed Hodgkin lymphoma client
  - E) A 30-year-old end-stage renal failure client receiving hemodialysis three times per week

Ans: A, C, D

**Feedback:**

Inflammation, myocardial infarction, and malignancies are all processes that result in the production and release of pyrogens. Obesity and renal failure are not noted to directly result in pyrogen production and consequent fever.



18. Exogenous pyrogens (interleukin-1) and the presence of bacteria in the blood lead to the release of endogenous pyrogens that:
- A) Stabilize thermal control in the brain
  - B) Produce leukocytosis and shivering
  - C) Block viral replication in cells
  - D) Inhibit prostaglandin release

Ans: B

**Feedback:**

Exogenous pyrogens induce host cells, such as blood leukocytes and tissue macrophages, to produce fever-producing mediators called *endogenous pyrogens* (e.g., IL-1). For example, the breakdown products of phagocytosed bacteria that are present in the blood lead to the release of endogenous pyrogens. The endogenous pyrogens are thought to increase the set point of the hypothalamic thermoregulatory center through the action of prostaglandin E<sub>2</sub> (PGE<sub>2</sub>). In response to the sudden increase in set point, the hypothalamus initiates heat production behaviors (shivering and vasoconstriction) that increase the core body temperature to the new set point, and fever is established. Pyrogens are not capable of blocking viral replication or prostaglandin release.

19. Which of the following clients is most likely to be susceptible to developing a neurogenic fever? A client who has:
- A) Stage II Alzheimer disease
  - B) Sustained a head injury in a bicycle crash
  - C) Become delirious after the administration of a benzodiazepine
  - D) Begun taking a selective serotonin reuptake inhibitor (SSRI) for the treatment of depression

Ans: B

**Feedback:**

Neurogenic fever is the result of damage to the hypothalamus caused by central nervous system trauma, intracerebral bleeding, or an increase in intracranial pressure. All these problems may be precipitated by a head injury. Alzheimer disease and drug administration are not typical causes of a neurogenic fever.

20. A client has sought care because of recent malaise and high fever. Upon assessment, the client states that his current fever began 2 days earlier, although he states that for the last 2 weeks he is in a cycle of high fever for a couple of days followed by a day or two of normal temperature. Which of the following fever patterns is this client experiencing?
- A) Recurrent fever
  - B) Remittent fever
  - C) Sustained fever
  - D) Intermittent fever

Ans: D

**Feedback:**

A recurrent or relapsing fever pattern is one in which there is one or more episodes of fever, each lasting as long as several days, with one or more days of normal temperature between episodes. An intermittent fever is one in which temperature returns to normal at least once every 24 hours, whereas sustained and remittent fevers do not involve a return to normal temperature range.

21. Which assessment findings of a client with an elevated temperature would be considered a “normal” finding? Select all that apply.
- A) Flushed skin
  - B) White, cheesy patches on oral mucous membranes
  - C) Pain when moving joints to sit up in bed
  - D) Unusual fatigue and drowsiness
  - E) Complaining of “spots before the eyes”

Ans: A, C, D

**Feedback:**

Common manifestations of fever are anorexia, myalgia, arthralgia, and fatigue. These discomforts are worse when the temperature rises rapidly or exceeds 39.5°C (103.1°F). Respiration is increased, and the heart rate usually is elevated. Dehydration occurs because of sweating and the increased vapor losses caused by the rapid respiratory rate. White, cheesy patches in the mouth are usually associated with a fungal infection. Spots before one's eyes are unrelated to fever.

22. While sponging a client who has a high temperature, the nurse observes the client begins to shiver. At this point, the priority nursing intervention would be to:
- A) Administer an extra dose of aspirin
  - B) Stop sponging the client and retake a set of vital signs
  - C) Increase the room temperature by turning off the air conditioner and continue sponging the client with warmer water
  - D) Place a heated electric blanket on the client's bed

Ans: B

**Feedback:**

Modification of the environment ensures that the environmental temperature facilitates heat transfer away from the body. Sponge baths with cool water or an alcohol solution can be used to increase evaporative heat losses. More profound cooling can be accomplished through the use of a cooling blanket or mattress, which facilitates the conduction of heat from the body into the coolant solution that circulates through the mattress. Care must be taken so that cooling methods do not produce vasoconstriction and shivering that decrease heat loss and increase heat production.

23. A client arrived in the emergency department following 2 days of general malaise. The temperature is 103.8°F. The nurse administers the prescribed aspirin, an antipyretic. Which of the following statements relates to the rationale for this action?
- A) Temperatures in excess of 37.5°C (99.5° F) can result in seizure activity.
  - B) Lower temperatures inhibit the protein synthesis of bacteria.
  - C) These medications protect vulnerable organs, such as the brain, from extreme temperature elevation.
  - D) Most common antipyretics have been shown to have little effect on core temperature.

Ans: C

**Feedback:**

There is little research to support the belief that fever is harmful unless the temperature rises to extreme levels; it has been shown that small elevations in temperature, such as those that occur with fever, enhance immune function. Antipyretics are effective in lowering core body temperature.

24. A febrile, 3-week-old infant has been brought to the emergency department by his parents and is currently undergoing a diagnostic workup to determine the cause of his fever. Which of the following statements best conveys the rationale for this careful examination?
- A) The immature hypothalamus is unable to perform normal thermoregulation.
  - B) Infants are susceptible to serious infections because of their decreased immune function.
  - C) Commonly used antipyretics often have no effect on the core temperature of infants.
  - D) Fever in neonates is often evidence of a congenital disorder rather than an infection.

Ans: B

**Feedback:**

Younger children have decreased immunologic function and are more commonly infected with virulent organisms. Neonates are at particularly high risk for serious bacterial infections that can cause bacteremia or meningitis. Neonates are capable of thermoregulation, and fever is not necessarily indicative of a congenital disorder. Antipyretics are effective in the treatment of fever in infants.

25. An 84-year-old client's blood cultures have come back positive, despite the fact that his oral temperature has remained within normal range. Which of the following phenomena underlies the alterations in fever response that occur in the elderly?
- A) Disturbance in the functioning of the thermoregulatory center
  - B) Increased heat loss by evaporation
  - C) The presence of comorbidities that is associated with lowered core temperature
  - D) Persistent closure of arteriovenous shunts

Ans: A

**Feedback:**

The probable mechanisms for the blunted fever response in older adults include a disturbance in sensing of temperature by the thermoregulatory center in the hypothalamus. Heat loss by evaporation tends to decrease with age, and the closure of AV shunts results in increased core temperature. The presence of comorbidities is not noted to contribute to reduced fever response in older adults.