Inflammation

Course
Pathophysiology

Unit III
Fundamentals of Pathophysiology

Essential Question
What is the effect of inflammation on the body during an injury?

TEKS
130.208 (c)
3 A
4 A,E
5 A,B,C,E

Prior Student Learning
Pathophysiology Basics

Estimated time
1-2 hours

Rationale
Inflammation is a normal response to infection or injury and is considered one of the body's defense mechanisms.

Objectives
Upon completion of this lesson, the student will be able to:

- Summarize inflammation
- Analyze the purpose of inflammation
- Analyze the inflammatory reaction
- Distinguish between the phases of response to injury

Engage
Show the picture of inflammation of the toes (attached to the end of this lesson). What are the signs of inflammation that you see in the picture? What are some reasons that this might happen?

Key Points

I. The Cell
   A. Most signs of disease can be traced back to damage of individual cells and their attempts at repair – in order to understand what is happening when a person is ill, you must first understand the events at the basic level of the cell, sometimes in the area of biochemistry.
   B. The cell is the foundation of the human body's structure. It is a self-sustaining factory that carries on all processes of life
      1. Respiration
      2. Use and production of energy
      3. Reproduction
      4. Elimination
   C. Large group of cells that join together for a specific activity are called tissue
   D. Different tissues that join together for a specific function are called an organ
   E. Organs that perform together for a specific function are called an organ system
   F. Cell Dysfunction = Organ Dysfunction = Clinical Disease

II. Cellular Injury
   A. Inflammation
      1. Definition – the body's response to injury
      2. Purpose – to contain or destroy the offending agent
      3. Goal – sets the stage for wound healing and repair by

removing cellular debris from the area

B. The limiting factor of inflammation – it cannot occur in tissue that does not have a blood supply
    1. This factor is important in forensic medicine because evidence of inflammation in tissue confirms that an injury occurred while the individual was alive.
    2. If no evidence exists, the pathologist can be assured that the person was dead when the injury was inflicted
    3. The inflammatory process will only occur along the borders of an injury where blood supply is maintained, i.e. gangrene
C. When tissue is destroyed by an injury
    1. Inflammation is a beneficial protective mechanism
    2. In some instances reaction may become so intense that it becomes harmful to tissues.
D. Inflammation vs. Infection
    1. Whereas inflammation is a response to injury, infection is the invasion of living tissue by pathogens.
    2. An infection causes inflammation, but tissue that is inflamed may not be infected. Therefore, inflammation may exist without the presence of microbial pathogens, i.e. sunburn
E. Inflammatory process
    1. The cells of the immune system are widely distributed throughout the body, but if infection or tissue damage occurs it is necessary to concentrate them and their products at the site of damage. Three major events occur during this response:
        a. Congestion phase – initially, the capillaries become engorged and dilated with blood; this increases capillary permeability caused by the reaction of the endothelial cells
        b. Leakage phase – congestion promotes the leakage of fluids and protein into the tissues and allows for infiltration of leukocytes into the area of injury. Leukocytes migrate out of the capillaries into the surrounding tissues.
            i. In the earliest stages of inflammation, neutrophils are particularly prevalent, but later monocytes and lymphocytes also migrate toward the site of infection
        c. Phagocytosis process – the leukocytes engulf and digest the bacteria
F. Two major categories of inflammation – acute and chronic
    1. Acute inflammation – a condition of sudden onset; if resolved, lasts a relatively short time
        a. Characteristic signs that accompany acute inflammation (referred to as *cardinal signs*)
            i. Redness

ii. Swelling
iii. Pain
iv. Increased warmth or heat
v. Loss of movement or function

2. Chronic inflammation – refers to a long duration (weeks, months, years, or even a lifetime)
    a. Example of chronic diseases – asthma, allergy or hay fever, diabetes, etc.
    b. Chronic conditions often worsen (chronic progressive diseases) as the result of aging process, environment, and cumulative damage of the inflammation process

G. Serous fluids associated with inflammation
    1. Serous Transudates – serum fluid that passes through membrane or tissue (very watery with low protein content)
        a. Due to increased hydrostatic or decreased osmotic pressure in the vascular system
        b. Example – pulmonary edema – fluid fills the lungs during congestive heart failure (the result of decreased osmotic pressure)
        c. Inflammatory reactions involving pleural, pericardial, and peritoneal cavities are associated with serous discharge
    2. Serous Exudates – serum fluid that is cloudy, thick, protein-rich fluid
        a. Created by decreased hydrostatic pressure and increased osmotic pressure
        b. Example – most common in acute inflammations such as minor burns (resulting in the formation of blisters)
        c. Fibrinous exudate produces a layer of fibrinogen, which forms a mesh of fibrin and becomes a scab
    3. Purulent Exudate – pus-producing fluid
        a. Referred to as pyogenic (pyo = pus; genic = producing); synonym – suppurative
        b. Thick, yellowish fluid composed primarily of dead leukocytes, tissue fluid, and the remnants of offending organism

H. Inflammatory Lesions – inflammatory reactions result in the production of lesions – lesions vary according to the level of severity
    1. Types of lesions
        a. Abscess – localized spherical lesion filled with pus and pyogenic bacteria (usually staphylococci)
        b. Found in many areas of the body including the skin (boils: furuncles and carbuncles), teeth, appendix, bowel, breast, and lungs
        c. Empyema – pus that fills the pleural cavity
    2. Cellulitis – spreading, diffuse infection most commonly involving streptococcal infection of subcutaneous tissues (the

body is unable to confine an infection to a localized area) – characterized by congestion and edema

3. Ulcers – depressed or excavated lesions on skin or mucosa
    a. May appear almost anywhere in the body and may involve many types of organs
    b. The stomach and duodenum may be ulcerated by gastric acids
    c. Pressure sores (decubitus ulcers) result from the wasting away of tissue in bedridden patients

I. Tissue Repair
    1. Definition – the body's attempt to return to normal
    2. Two primary types of repair – regeneration and fibrous connective tissue repair
        a. Regeneration – replacement of dead tissue with new tissue that is identical in structure and function
            i. The most desirable form of repair
            ii. Complex cells found in the lungs and kidneys do not regenerate (injury to these structures is usually permanent)
        b. Fibrous connective tissue repair – tissue that has undergone necrosis is replaced with a dense, tough mass of connective tissue (scar)
            i. The less preferred method of repair
            ii. The original structure and function of the cell is not restored

Activity

I. Read the "Snake Bite" scenario and complete a Disease Report.

II. Select an injury or inflammatory disease and present a multimedia presentation to the class showing the site of injury, the signs of inflammation and the healing response.

III. Design a diagram on stages of tissue repair.

Assessment

Successful completion of the Inflammation Quiz.
Disease Report Rubric
Multimedia Rubric

Materials

Copies of Key Terms.
Inflammation of the toes graphic

Accommodations for Learning Differences
For reinforcement, the student will define Key Terms.

For enrichment, the student will research and report over one of the following:

- Effects of vitamin E on wound repair,
- *Silverlon* for healing,
- Steroid injections to reduce scarring,
- Hyperbaric oxygen and wound healing,
- Effects of prednisone on wound healing,
- Low-level lasers for quicker healing,
- Can *Creatine* prevent UV damage and repair skin tissue?

National and State Education Standards
National Health Science Cluster Standards
HLC01.01 Academic Foundations: Use a knowledge of diseases and disorders Compare selected diseases/disorders including respective classification(s), causes, diagnoses, therapies and care/rehabilitation to include biotechnological applications; Analyze body system changes in light of diseases, disorders and wellness

TEKS
130.208(c)(3)(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student
130.208(c)(4)(A) identify biological and chemical processes at the cellular level
130.208(c)(4)(E) analyze how the body attempts to maintain homeostasis when changes occur
130.208(c)(5)(A) identify pathogenic organisms using microbiological techniques,
130.208(c)(5)(C) analyze the body's natural defense systems against infection such as barriers, the inflammatory response and the immune response
130.208(c)(5)(D) evaluate the effects of chemical agents, environmental pollution and trauma on the disease process
130.208(c)(5)(E) research stages in the progression of disease

Texas College and Career Readiness Standards
English- Writing

A. 2. Generate ideas and gather information relevant to the topic and purpose, keeping careful records of outside sources.

3. Evaluate relevance, quality, sufficiency and depth of preliminary ideas and information, organize material generated and formulate theses.

Listening

B. 1. Identify new words and concepts acquired through study of their relationships to other words and concepts

Speaking

A. 1. Understands how style and content of spoken language varies in different contexts and influences the listener's understanding.

2. Adjust presentation (delivery, vocabulary, length) to particular audiences and purposes.

Scientific- Foundation Skills

C. 1. Prepare and present scientific/technical information in appropriate formats for various audiences

D. 1. Use search engines, databases and other digital electronic tools effectively to locate information

2. Evaluate quality, accuracy, completeness, reliability, and currency of information from any source

Snake Bite

Read the following scenario and complete a Disease Report.

Morgan, a 20 year old college student at Colorado University was mountain biking in the foothills near Morrison, Colorado. While stopped at the side of the trail to allow another rider to pass, he felt a sudden “electric shock” in his right ankle. He looked down and saw a 3-foot long rattlesnake slither into the bush.

He felt a stinging, burning sensation radiating up his right leg. Just above his sock, he saw 2 small bleeding puncture wounds. Morgan realized that he had been bitten by a rattlesnake.

By now, Morgan’s friends had realized something was wrong. His friend, Trent, who had taken first aid and wilderness courses rushed to his side. Knowing that time was of the essence, he instructed Morgan to remain calm and avoid excessive movement.

Trent told Morgan to sit on his bike but not to pedal. Another of Morgan’s friends pushed his bike back to the trailhead. A person in the parking lot with a cell phone called 911.

Trent instructed Morgan to lie on the ground and remain calm. About 5 minutes later, an ambulance arrived. Morgan was placed on a stretcher and lifted into the ambulance.

In the ambulance, paramedics started an I.V. line and took Morgan’s vital signs. The ambulance arrived at the emergency room. Because he was very sick, Morgan was brought into the ER immediately.

The triage nurse noted that Morgan’s leg was very swollen. She took his vital signs and placed him in a room where he was hooked up to a heart monitor and a pulse oximeter which measured his oxygen level. She also made sure that his I.V. line was working.

The doctor came into the room, took a medical history, and gave Morgan a physical. He confirmed that Morgan was bitten by a rattlesnake and could tell by the puncture wounds and swelling that his condition was very serious. He ordered blood tests to help further determine the severity of the snake bite.

Because the doctor determined that Morgan’s wound was severe, he ordered antivenin. The nurse carefully administered this through the I.V. line. Morgan began to feel relief shortly after the antivenin was given. The pain was less and the swelling in his leg began to go down.

His condition was stabilized, and he was admitted to the hospital. His condition was monitored to make sure that the snake bite would continue to resolve and that there was no reaction to the antivenin.

After one day in the hospital Morgan was discharged. After several days, his wound was almost completely healed.

Morgan follows up with his family doctor in one week to have his leg checked. This is to insure that the wound has healed properly and that there is no sign of infection.

Two weeks after the incident, Morgan was fully recovered, but it could be a long time before he goes to snake-infested Morrison for a bike ride

Disease Report Template

Disease
Alternate Names
Definition
Etiology
Signs & Symptoms
Diagnostic Tests
Treatment
Complications
Prognosis
Bibliography

Disease Report Rubric

Criteria	Possible Points	Points Awarded
Disease Correctly names the disease/disorder.	**3**	
Alternate Names If applicable, includes any alternate names for the disease/disorder.	**2**	
Definition Includes in-depth discussion of the history and general description of the disease/disorder with interesting facts	**10**	
Etiology Includes the cause or origin of the disease/disorder.	**15**	
Signs & Symptoms Accurately describes its common physical and medical symptoms.	**15**	
Diagnostic Tests Identifies the tests performed to aid in the diagnosis or detection of the disease/disorder.	**15**	
Treatment Identifies the mode or course pursued for remedial ends for the disease/disorder.	**15**	
Complications Identifies any other diseases or injuries that may develop during the treatment of the disease/disorder.	**10**	
Prognosis Includes the prediction of the probable course, outcome, frequency, and life expectancy of the disease/disorder.	**10**	
Bibliography Follows proper format and includes more than 3 sources.	**5**	
TOTAL	**100**	

Inflammation Key Terms

1. Gangrene -
2. Pathogens -
3. Microbe -
4. Capillary -
5. Permeability –
6. Endothelial cells or endothelium -
7. Leukocytes -
8. Neutrophils -
9. Monocytes -
10. Lymphocytes -
11. Serum fluid or serum -
12. Hydrostatic -
13. Osmotic pressure
14. Pleural -
15. Pericardial -
16. Peritoneal -
17. Transudates -
18. Exudates -
19. Purulent -
20. Lesion -
21. Pyogenic -
22. Abscess -

23. Cellulitis
24. Empyema
25. Edema -
26. Decubitus ulcers -
27. Furuncles -
28. Carbuncles –
29. Duodenum -
30. Necrosis -

KEY: Inflammation Key Terms

1. Gangrene – local death and decay of soft tissues of the body as a result of lack of blood to the areas

2. Pathogens – things that can cause disease, such as a virus, bacterium, fungus, etc.; germs

3. Microbe – a microscopic organism

4. Capillary – an extremely narrow thin-walled blood vessel that connects small arteries with small veins to form a network throughout the body

5. Permeability – the rate at which something such as a liquid passes through a membrane or other medium

6. Endothelial cells or Endothelium – a layer of cells that lines the inside of certain body cavities (e.g. blood vessels)

7. Leukocytes – white blood cells which help protect the body against infection in the immune response

8. Neutrophils – the most common type of white blood cell; engulf bacteria and cellular debris; an increase occurs in acute infections

9. Monocytes – white blood cells that function in the gestation of bacteria and other foreign particles

10. Lymphocytes – white blood cells that occur in two forms: B-cells and T-cells

11. Serum fluid or serum – clear, watery fluid exuded by serous membranes

12. Hydrostatic – relating to fluids that are at rest, and the forces and pressures they exert

13. Osmotic pressure – pressure that must be applied to a solution to stop the inward diffusion of a solvent by osmosis through a semipermeable membrane

14. Pleura – the thin transparent membrane that lines the chest wall and doubles back to cover the lungs, thereby forming a continuous sac enclosing the narrow pleural cavity

15. Pericardial – pertaining to the fibrous membrane that forms a sac surrounding the heart and attached portions of the main blood vessels

16. Peritoneal – pertaining to the smooth, transparent membrane that lines the abdomen and doubles back over the surfaces of the internal organs to form a continuous sac

17. Transudates – fluid that passes through a membrane into intercellular space or the capillary wall

18. Exudates – the slow escape of fluids and cellular matter from blood vessels or cells through small pores or breaks in cell membranes (sometimes the result of inflammation)

19. Purulent – containing or consisting of pus

20. Lesion – general term used to describe any local abnormality of tissue

21. Pyogenic – pus-producing

22. Abscess – a pus-filled cavity resulting from inflammation and usually caused by bacterial infection

23. Cellulitis – inflammation of tissue, especially that below the skin (subcutaneous tissue); characterized by redness, pain, and swelling; treated with antibiotics

24. Empyema – pus in the lung (or other cavity) usually due to bacterial infection; treated with antibiotics and surgical drainage

25. Edema – swelling due to an abnormal buildup of serous fluid between tissue cells

26. Decubitus ulcers – an inflammation or sore on skin over a bony prominence; “bed sore”

27. Furuncle – a boil in the skin that has a core of dead tissue and surrounding inflammation; caused by bacterial infection through sweat glands or hair follicle

28. Carbuncle – a multi-headed boil

29. Duodenum – the first short section of the small intestine that branches off the stomach

30. Necrosis – the death of cells in tissue or an organ caused by disease or injury

Quiz: Inflammation

_____ 1. The process where leukocytes engulf and digest bacteria is called
- a. leukocytosis
- b. pathogenolysis
- c. hydrostatic pressure
- d. phagocytosis

_____ 2. Disease-causing microorganisms are known as
- a. pathogens
- b. bacteria
- c. microbes
- d. monocytes

_____ 3. Inflammation is designed to be a protective defensive mechanism.
- a. true
- b. false

_____ 4. Acute inflammation can be defined as
- a. a purulent exucate
- b. a condition of long duration
- c. a condition of sudden onset
- d. an asthmatic incident

___|___5. Two types of boils are
- a. carbuncles
- b. furuncle
- c. abscess
- d. mynocyte

_____ 6. Pus in the lung is called
- a. emphysema
- b. empyema
- c. pyogenic
- d. endothelium

_____ 7. Which of the following is a *lesion*?
- a. boil
- b. burn
- c. cut
- d. all

_____ 8. A decubitus ulcer can be described as
- a. a sublingual attrition
- b. a mucosal erosion
- c. a gastric lesion
- d. a bed sore

_____ 9. The inflammatory process will only occur along borders of injury that have a blood supply.
- a. true
- b. false

_____ 10. A localized spherical lesion filled with pus and pyogenic bacteria describes
- a. cellulitis
- b. a pressure sore
- c. gangrene
- d. an abscess

Key: Inflammation Quiz

1. **d**

2. **a**

3. **a**

4. **c**

5. **a**, **b**

6. **b**

7. **d**

8. **d**

9. **a**

10. **d**

Multimedia Rubric

Student:_____ Class:_____

Title:_____ Date: _____

Other Group Members: _____

Scoring criteria	5 Excellent	4 Good	3 Needs Some Improvement	2 Needs Much Improvement	1 N/A
Clearly and effectively communicates an introduction of the theme/objective of the project.					
Clearly and effectively communicates the content throughout the presentation.					
Integrates a variety of multimedia resources to create a professional presentation (transition, graphics).					
The presentation holds the audience's attention and relates a clear message.					
Timing between the slides is beneficial for the viewer to read or observe content.					
Each image and font size is legible to the entire audience.					

Scale:
26-30 A Excellent
21-25 B Good
16-20 C Needs Some Improvement
11-15 D Needs Much Improvement
6-10 F Not Appropriate
TOTAL=

Comments

Inflammation of the Toes

www.righthealth.com/topic/pictures_of_inflammation/overview/wiki_detailed?medp=inflammation