

TISSUE RESPONSE TO INJURY – STUDENT COPY

- I. The Inflammatory Response – can be acute or _____
 - a. Signs of inflammation
 - i. _____ – redness
 - ii. Tumor – swelling
 - iii. _____ – heat
 - iv. Dolor – pain
 - v. _____ – loss of function
 - b. Acute inflammation – _____ phases
 - i. Phase I – _____ phase
 1. the 1st _____ days after injury
 2. is designed to _____, localize, and _____ the body of injurious agents in preparation for _____ and repair
 3. main causes of inflammation
 - a. _____
 - b. chemical agents
 - c. _____ extremes
 - d. pathogenic organisms
 4. _____ response – 1st hour
 - a. _____ occurs – causing decreased blood flow
 - b. _____ begins to seal off broken blood vessels
 - c. Vasoconstriction is replaced by _____ in immediate area of injury
 5. 2nd hour
 - a. increased blood viscosity, which leads to swelling(_____)
 - b. exudation of plasma and red blood cells
 - i. _____ – fluid with high protein content and containing cellular debris that comes from blood vessels and accumulates in the area of injury
 - c. redistribution of _____
 6. Cellular response
 - a. _____ cells – contain _____ and histamine (anticoagulant)
 - b. _____ – white blood cells that start _____ (ingesting microorganisms and foreign particles)
 7. Chemical mediators
 - a. _____ – dilation of arteries
 - b. Serotonin – vasoconstrictor
 - c. _____ – increase inflammation and cause pain
 - d. Heparin – prevents blood coagulation
 - e. Prostaglandins & leukotrienes – alter _____

- ii. Phase II – _____ & _____ phase
1. healing (repair)– extends from the inflammatory phase(_____)
 2. _____ – refers to restoration of destroyed or lost tissue
 3. occurs when the area has been cleaned of cellular _____, erythrocytes and fibrin clot
 4. tissue repair is accomplished through 3 processes
 - a. _____ – little tissue damage and normal restoration
 - b. formation of _____ tissue, occurring if resolution is delayed
 - c. _____ – the replacement of tissue by the same tissue
 5. formation of _____ tissue is common – the less scarring the better
 - a. mature scar tissue is firm, fibrous, _____, and devoid of _____ circulation.
 - b. Adhesion scar tissue can complicate the recovery of joint or organ disabilities.
 - c. Healing by scar tissue begins with an exudate, a fluid with a large content of cellular debris that collects in the area of the injury site.
 - d. From the exudates a highly vascular mass develops known as _____ tissue.
 - e. Infiltrating this mass is a proliferation of immature _____ tissue (fibroblasts) and endothelial cells.
 - f. Next, the _____ protein substance that stems from fibroblasts forms a dense fibrous _____.
 6. During this phase two types of healing occur
 - a. _____ healing – healing by first intention takes place in an injury that has even and _____ opposed edges, such as a cut or incision.
 - b. Secondary healing – healing by secondary intention, results when there is a _____ lesion and large tissue loss leading to replacement by scar tissue – _____ and musculoskeletal injuries commonly heal this way.
 7. Regeneration –The ability to regenerate is associated with _____, general health of the individual, and the type of tissue that has been injured.
 8. Repair and regeneration depend upon 3 factors
 - a. _____ of debris
 - b. Regeneration of _____ cells
 - c. Production of _____

iii. Phase III - _____ Phase

1. Remodeling depends on the amount of _____ tissue present
2. Remodeling overlaps with the repair and regeneration
3. First _____ weeks are characterized by increased production of scar tissue and increased _____ of its fibers.
4. Strength of scar tissue increases from 3 months to _____ years after injury.
5. Physiologic balance must be maintained between synthesis and _____ to avoid a nonyielding scar.
6. Synthesis is the process of forming or building up
7. Lysis is the process of breaking down.
8. Forces applied to the ligament during rehabilitative exercise will develop strength specifically in the direction the force is applied.
 - a. if rehab exercises applied too _____ the healing process can be extended.
 - b. If rehab exercises are applied later (immobilization delayed for too long) the _____ process can also be extended.
 - c. The ideal of collagen remodeling is to have the healed area contain a preponderance of _____ collagenous fibers that have a number of cross linkages.
 - d. Remember, _____ content and quality may be deficient for months after injury.

c. Chronic Inflammation

1. Subacute inflammation – an acute inflammation reaction that fails to be resolved in one month
2. Chronic inflammation – lasts for _____ or _____
 - a. Results from _____ microtraumas and _____
 - b. Distinct differences from acute inflammation is proliferation of connective tissue and tissue _____
 - c. Primary cells evident are lymphocytes, plasma cells, and macrophages (monocytes) in contrast to the neutrophil leukocytes found in acute inflammation.
 - d. Macrophages, present in both acute and chronic inflammation are phagocytic and actively engaged in repair and healing.
 - e. Major chemicals found are kinins (esp. _____), which cause _____, increased permeability and _____.
 - f. Prostaglandin can be inhibited by aspirin and nonsteroidal anti-inflammatory drugs.

- II. Soft tissue healing
- a. Cell structure and function
 - i. 4 types
 1. _____ skin, lining of vessels, and organs
 2. _____ – tendons, ligaments, cartilage, fat, blood vessels, bone
 3. _____ – skeletal, cardiac, smooth
 4. _____ – brain, spinal cord, nerves
 - ii. soft tissue adaptations
 1. metaplasia – conversion of one kind of tissue into a form that is not normal for that tissue
 2. _____ – abnormal development of tissue
 3. hyperplasia – excessive proliferation of normal cells in the normal tissue arrangement
 4. _____ – decrease in the size of tissue due to cell death or decreased cell proliferation
 5. _____ – an increase in the size of a tissue without necessarily increasing the number of cells
 - b. cartilage healing
 - i. _____ direct _____ supply
 - ii. healing is _____
 - c. ligament healing
 - i. follows same course as other vascular tissue
 - ii. it will undergo the _____, repair and _____ phases just as vascular tissue
 - iii. during the repair phase, _____ is arranged in a random pattern, which becomes a scar
 - iv. full ligament healing may take _____ months
 - d. skeletal muscle healing – follows soft tissue process, but regeneration of _____ fibers is _____
 - e. nerve healing
 - i. can _____ regenerate in the nerve _____
 - ii. the nerve _____ can regenerate
 - iii. nerves of the _____ do not regenerate as well as _____ nerves

- e. management concepts – use _____, thermal agents, therapeutic _____, and _____ rehab to help the healing process
 - i. drugs
 - 1. used to treat _____
 - 2. _____ – nonsteroidal anti-inflammatory drugs
 - 3. decrease _____ and capillary permeability
 - ii. _____ modalities
 - 1. heat and _____
 - 2. electrical modalities
 - a. penetrating _____ devices (ultrasound)
 - b. electrical stimulation
 - i. _____ – transcutaneous electrical nerve stimulation
 - ii. _____ – electrical muscle stimulation
 - iii. therapeutic _____ - goal is to establish pain _____ movement, _____ strength power, and full _____

III. Fracture Healing

- a. _____ is required for proper bone _____ to take place
- b. Acute fractures of bone – follows same 3 phases as soft tissue, but is more complex and generally is considered to have 5 stages
 - i. _____ formation
 - 1. inflammation lasts around 4 days
 - 2. there is trauma to the _____ and surrounding soft tissue
 - 3. a hematoma accumulates in the _____ canal from the _____
 - ii. cellular formation
 - 1. the hematoma begins its organization in _____ tissue and builds a fibrous _____ between the fractured ends
 - 2. capillaries carry _____ cells that form a fibrous callus, then cartilage, and finally bone
 - iii. callus formation
 - 1. _____ callus is unorganized woven bone at the ends of the broken bone that gets _____ and replaced by bone
 - 2. this brings an influx of _____ that begin to _____ the fracture site
 - 3. the calluses are formed by bone fragments that bridge the fracture gap
 - 4. beginning in _____ weeks and lasting _____ months the _____ callus forms
 - 5. hard callus is depicted by _____ connecting of bone filament to woven bone at the fractured ends
 - 6. _____ immobilization produces a _____ rather than bony union

- iv. _____
1. with proper immobilization and compression the bone ends become crossed with a new _____ system that lays down _____ bone
 2. this bridges and firmly unites the bone
 3. _____ callus is reabsorbed by _____
- v. _____
1. occurs after the callus is reabsorbed
 2. may take many _____
 3. is complete when fractured bone is restored to its former _____ or can withstand imposed _____

c. management of acute fractures

- i. bones must be _____ completely until the hard callus forms
- ii. immobilization depends on the _____ and _____ of fracture
- iii. certain conditions can interfere with the healing process
 1. _____ blood supply
 - a. the bone will _____ and healing will not take place
 - b. this is called _____
 - i. occurs in the head of the femur, navicular or _____ bone in the wrist, and talus
 - ii. condition is rare in young and healthy athletes except at the _____ bone
 2. poor _____ of the fracture site
 - a. resulting from poor casting by the physician and permitting _____ between the bone parts
 - b. proper union may be prevented or _____ will develop
 3. infection
 - a. particularly in a _____ fracture
 - b. can result in severe streptococcal or _____ infection
 - c. _____ help prevent this
 - d. can interfere with proper union of bone
 4. soft tissue that becomes _____ between severed ends of bone
 - a. like muscle or connective tissue
 - b. can _____ bone union and often require surgical _____

- d. healing of stress fractures
 - i. just like acute fractures, it involves restoring a balance between _____ and _____ activity
 - ii. unhealed stress fractures can result in full _____ fractures
 - iii. a _____ in activity will allow the bone to remodel and withstand _____

IV. Pain – the experience of pain is an _____ experience and is _____

- a. _____
 - i. Pain receptors known as nociceptors or free _____ endings are sensitive to extreme _____, thermal, and chemical energy
 - ii. Found in the meninges, _____, _____, teeth, and some organs
 - iii. The nociceptive neuron transmits _____ to the spinal cord via the unmyelinated _____ fibers and the _____ A-delta fibers
 - iv. When a nerve fiber is stimulated it sends an _____ impulse to the _____ cord
 - v. They travel to the _____, which processes the pain
 - vi. Which nerve fibers move faster? Unmyelinated or _____
 - vii. The A fibers give _____ location and perceive the pain as bright, sharp, or stabbing
 - viii. The C fibers are concerned with pain that is diffused, _____, _____ or unpleasant

- b. endogenous _____
 - i. 2 types of neurotransmitters that mediate pain
 - 1. _____
 - 2. _____
 - ii. they activate _____ of pain transmission

- c. Pain Categories
 - i. Pain sources
 - 1. _____ – sharp, bright, and burning with fast or slow onset (skin)
 - 2. deep _____ – stems from tendons, muscles, joints, periosteum, and blood vessels
 - 3. visceral – originates from internal _____, it is diffused at first but may become localized
 - 4. _____ – feel pain but the cause is emotional not physical
 - ii. fast vs slow pain
 - 1. fast is carried through _____-delta fibers (myelinated)
 - 2. slow is by the _____ fibers and is dull and aching (_____)

iii. acute vs chronic

1. acute is less than ____ months in duration – tissue damage occurs and warns the athlete
2. _____ is greater than 6 months – it continues beyond normal healing time

iv. referred pain

1. pain occurs _____ from the site of _____
2. response may be sensory, motor, or both
3. three types
 - a. _____ pain
 - i. _____ points are small hyperirritable areas within a muscle
 - ii. can cause acute and chronic pain
 - iii. also called fibrositis, myositis, myalgia, myofascitis, and muscular strain
 - b. _____ and dermatomic pain
 - i. deep pain from nerve irritation or injury
 - ii. sclerotomes – area of _____ or fascia supplied by _____ nerve root (C fibers)
 - iii. _____ – area of _____ supplied by single nerve root (____ fibers)

v. Variations in pain sensitivity

1. pain modulation – is a major _____ and in most cases is acute
2. pain assessment – the patient's _____-report is the best reflection of pain and discomfort
 - a. keep in mind pain is _____
 - b. you must know your athletes pain _____
3. pain treatment
 - a. _____ and _____
 - i. heat – _____, reduces nociception and ischemia
 - ii. cold – _____, decrease nerve transmission and _____ pain
 - b. induced _____ – reduce pain through _____ and _____
 - i. the gate theory
 - A. the gate is controlled by T cells and substantia gelatinosa
 - B. if a stimulus is too _____, pain is _____
 - C. impulses from TENS machine can _____ the pain impulses, thus closing the _____ against small pain

- ii. acupuncture – developed by ancient China
 - A. can cause analgesia when _____ are applied to specific points on the body
 - B. maybe it follows the _____ pathway? – which might slow nerve transmission
- c. pharmacological agents – _____ or injectable medications to control pain
 - i. _____
 - ii. anti-_____ agents
- d. Psychological aspect of pain
 - i. Pain is _____
 - ii. Various pain _____ for the individual, thus it is different for every athlete
 - iii. _____ can cause differences in pain
 - iv. Through _____ the athlete learns to endure pain and _____ out minor injury