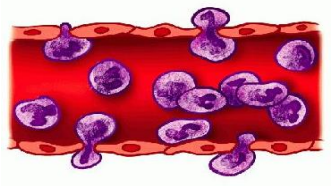
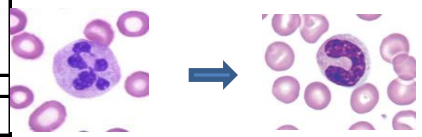
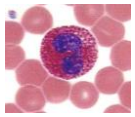
	BIOS 2015 ... CHAPTER 5 - INFLAMMATION AND HEALING
Page	**Note**
66	BODY DEFENSES:
	First Line-Skin and mucous membranes assisted by secretions (saliva, tears) that contain enzymes and chemicals that inactivate or destroy bacteria.
	Second Line - Non-specific: **1. Phagocytosis** (neutrophils and macrophages engulf bacteria, debris, and foreign matter); **2. Inflammation; 3. Interferons** protect uninfected cells from viral infection.
	Third Line - Specific antibodies and cell mediated immunity.
	CAPILLARIES are key to inflammation:
	In **normal cycling** of fluid out of and back into the capillaries:
	- At arteriolar end of the capillary, hydrostatic pressure moves fluid, oxygen, electrolytes and nutrients from the capilary to the interstitium.
	- At the venous end of the capilary, the osmotic pressure in the capillary is high due to fluid losses at the arterioloar end. This helps draw the fluid etc. back into the capillary.
69	**Inflammation is a non-specific body response** to injury and can be casued by infections or by non-infectious conditions like allergy and burns.
	The suffix "itis" means inflammation. *Example*:Laryngitis is inflammation of the larynx.
	Steps of Inflammation
	An injury to capillaries and tissue cells will result in the following reactions:
	Bradykinin is released from the insured cells.
	STEPS OF INFLAMMATION:
	1. Transient vasoconstriction
	2. Dilation of blood vessels
	3. Hyperemia (increased blood flow that causes redness).
	4. Increased permeability of blood vessels
	5. Migration of leukocytes to the area
70	Recruitment of leukocytes (white blood cells) to the site of inflammation is facillitated by inflammatory mediators known as **"chemotactic factors".** These actors causes inflammatory cells, like neutrophils, to engage in **"chemotaxis" -** movement up a chemical gradient toward the site of inflammation. The neutrophils must first exit the circulation, squeezing between endothelial cells in a process cassed **"diapedesis".**

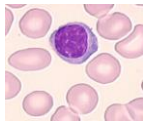


	Cardinal Signs of Inflammaion:
	Originally described in 1st century A.D. by Celsus: Calor, dolor, rubor, and tumor : Heat, pain, redness, and swelling. Later "functio laesa", loss of function, was added (by a debatable source).
71	**Exudate** refers to a collection of interstitial fluid formed in the inflamed area. The characteristics of the exudate vary with the cause of the trauma: • **Serous** or watery exudates consist primarily of fluid with small amounts of protein and white blood cells. Common examples of serous exudates occur with allergic reactions or burns. • **Fibrinous** exudates are thick and sticky and have a high cell and fibrin content. This type of exudate increases the risk of scar tissue in the area. • **Purulent** exudates are thick, yellow-green in color, and contain more leukocytes and cell debris as well as microorganisms. Typically, this type of exudate indicates bacterial infection, and the exudate is often referred to as "pus." • **An abscess** is a localized pocket of purulent exudate or pus in a solid tissue (e.g., around a tooth or in the brain). • A **hemorrhagic** exudate may be present if blood vessels have been damaged.
	Systemic Effects:
	Other general manifestations of inflammation include mild fever, malaise (feeling unwell), fatigue, headache, and anorexia (loss of appetite).
	Fever: caused by **"pyrogens"** (fever producing substances) released by inflammatory cells (like macrophages). These chemicals circulate in the blood and reset the body temerature by affecting the **hypothalamus** (the body's temperaure regulator).
72	Examination of the blood in a paient with inflammation may show:
	1. Leukocytosis - elevated white blood cell count.
	2. An altered differential count:
	- bacterial infections produce a "left shift" or increased number of immature neutrophils called "bands".
	- an allergy may increase the percentage of "eosinophils"
	- a viral infection may increase the percentage of "lymphocytes".
	3. Changes in plasma proteins: Increased fibrinogen and prothrombin.
	4. Acute Phase Reactants like "C-reactive protein" that appears 24-48 hours into inflammation.



Neutrophil Band





Eosinophil Lymphocyte

5. Increased ESR - erythrocyte sedimentation rate. (Red blood cells in a tube naturally settle with the cell going to the bottom of the tube leaving the liquid part of the blood, plasma, above. The rate of settling can be measured in mm/hour)

6. Cell specific enzymes, **"isozymes"**, can identify the source of the inflammation or necrosis. *Example: Elevated CK(creatine kinase) is not specific and could be from inflammation or necrosis in the brain, skeletal muscle or heart; but if you fractionate it, CK-MB indicates the heart as the source of the inflammation or necrosis.*

Inflammation can lead to compromised function, infection, and muscle spasms.

Chronic Inflammation: Characteristics of chronic inflammation include less swelling and exudate but the presence of more lymphocytes, macrophages, and fibroblasts (connective tissue cells) than in acute inflammation. Frequently more tissue destruction occurs with chronic inflammation. More collagen is produced in the area, resulting in more fibrous scar tissue forming.

DRUGS to treat inflammation: The table below highlights the many functions of anti-inflammatory drugs, that they come from different chemical classes, that hey have different modes of action, and that they vary in their complications.

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Actions	ASA	Acetaminophen	NSAID	Glucocorticoid	COX-2
Antiinflammatory	Yes	*No*	Yes	Yes	Yes
Analgesia	Yes	Yes	Yes	*No*	Yes
Antipyretic	Yes	Yes	Yes	*No*	*No*
Adverse Effects					
Allergy*	Yes	*No*	Yes	*No*	*Yes*
Delays blood clotting	Yes	*No*	Yes	*No*	*No*
Risk of infection	*No*	*No*	*No*	Yes	*No*
GI distress	Yes	*No*	Yes	Yes	May occur
Stomach ulceration	Yes	*No*	Yes	Yes	May occur
Edema or Increased BP	*No*	*No*	*No*	Yes	May occur
MI or CVA	*No*	*No*	*No*	*No*	May occur
Liver damage	*No*	*No*	*No*	*No*	May occur

75	**First aid** directives for injury-related inflammation frequently recommend the RICE approach: Rest, Ice, Compression, and Elevation. Ice helps by causing vasoconstriction (that decreases blood flow and edema).
	Other therapy: compression stockings for fluid collection, mild exercise to increase blood flow, physical rehabilitation, rest , hydration, and nutrition.
	HEALING: Different ways to heal include:
76	**1. Resolution:** The tissue returns to normal in a short time.
	2. Regeneration: Cells of the damaged tissue type divide to replace the damaged or lost tissue.
	3. Replacement: Damaged tissue is replaced by a diferent tissue like scar tissue.
	HEALING PROCESS:
	Healing by first intention: A clean surgical wound closed with sutures. (fast, minimal scar)
	Healing by second intention: A large or contaminated wound that heals slowly and requires wound contraction to complete the process. This wound is left open and can not be sutured.
	Factors Promoting Healing
	1. Youth
	2. Good nutrition: protein, vitamins A and C
	3. Adequate hemoglobin
	4. Effective circulation
	5. Clean, undisturbed wound
	Factors Delaying Healing
	1. Advanced age, reduced mitosis
	2. Poor nutrition, dehydration
	3. Anemia (low hemoglobin)
	4. Circulatory problems
	5. Certain chronic diseases, such as diabetes
	6. Presence of other disorders such as diabetes or cancer
	7. Irritation, bleeding, or excessive mobility
	8. Infection, foreign material, or exposure to radiation
	9. Chemotherapy treatment
	10. Prolonged use of glucocorticoids

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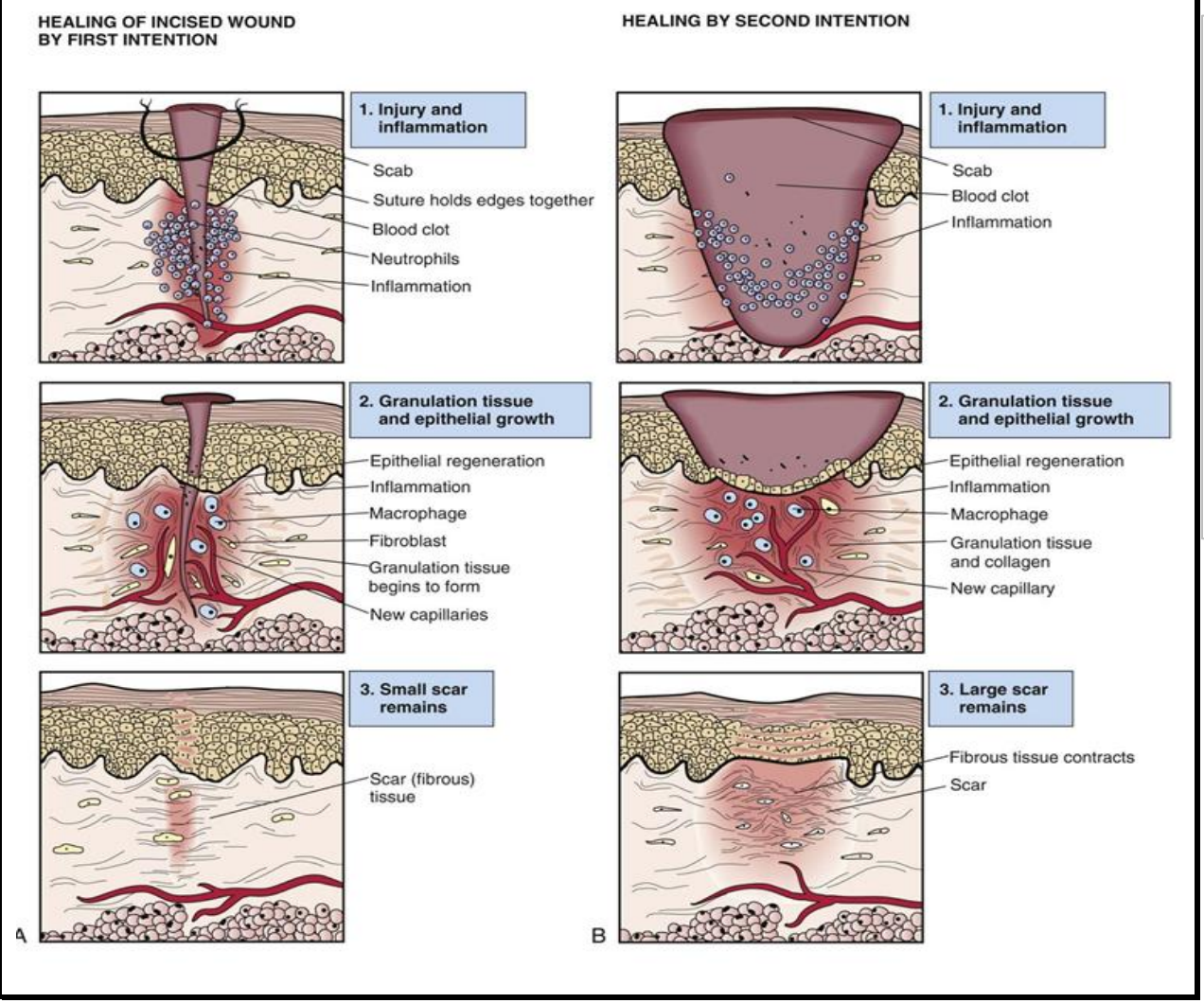


STEPS IN HEALING

1. A **blood clot** forms

2. **phagocytes** remove foreign material and cell debris

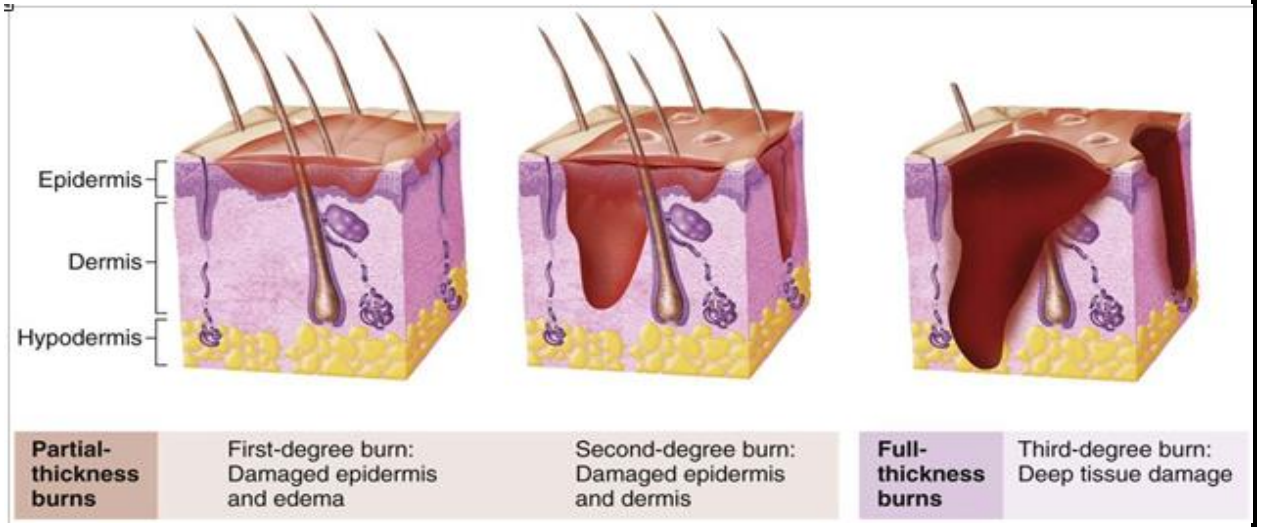
3. **granulation tissue** grows into the gap

4. new blood vessels form;

5. collagen fibers promote formation of a tight, strong

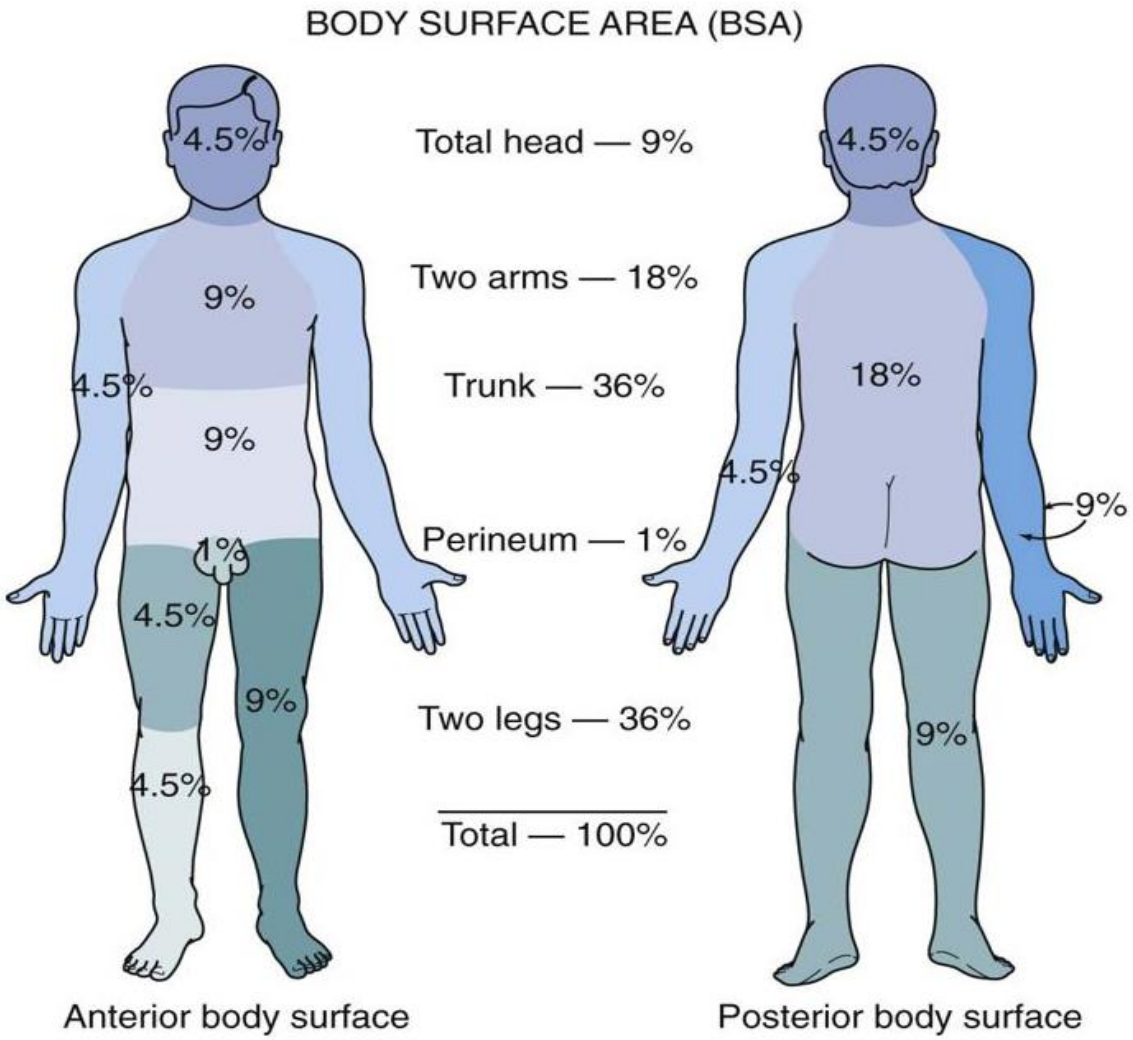
78 **Scar can limit function in a number of ways:**

- **Contracture** - limits the movement of a joint and hold a limb position like flexion.
- **Stenosis -** scar that compomises a hollow organ like intestine and produces a narrowing.
- **Adhesions** - scars that hold tissues together that are normally separated.
- **Hypertrophic scar (Keloid)** - large mass like scar.
- **Compromise blood flow** and lead to an ulcer (and subsequent infection).

	BURNS:
	A burn is a thermal (heat) or nonthermal (electrical or chemical) injury to the body, causing acute inflammation and tissue destruction.
79	**Types of Burns:**
	Partial-thickness burns involve the epidermis and part of the dermis (Fig. 5-10). Superficial partial-thickness burns (formerly known as **first-degree burns**) damage the epidermis and may involve the upper dermis. They usually appear red and painful but heal readily without scar tissue. Examples include **sunburn or a mild scald.**
	Deep partial-thickness burns (formerly second-degree burns) involve the destruction of the epidermis and part of the dermis. May have blister. Treat with skin grafts if large. Can become infected and scarred.
	Full-thickness burns (formerly third- and fourth-degree burns) result in destruction of all skin layers and often underlying tissues as well. The appearance is dry, firm, charred, or hard white surface. Skin grafts are required. Cuts to relieve pressure may be needed.
80	

82	**BSA (Body Surface Area)** affected by burns is estimated using the rule of 9's. See the diagram below to see how the estimates are done.

FIGURE 5-12 Assessment of burn area using the rule of nines.



	Emergency Care For Burns Stop, Drop, and Roll! • When clothes are on fire, stop what you are doing, drop to the floor, cover up if possible, and roll to extinguish flames. • Call emergency services (911) if the burn appears to be extensive or a major burn. • Ensure that electrical power is off before caring for an electrical burn injury! • Cool the burned area by soaking it with cool or tepid water. Remove nonsticking clothing if possible, and continue with cool water. Do not apply lotions, fats, or lubricants! • Cover loosely with a clean cloth (e.g., the inside of a folded sheet) or sterile gauze. • For a chemical burn, remove any affected clothing and flush the burn area well with cool water, then
82	cover with a clean cloth.
	Shock in a Burn Patient
	- burned tissue does not bleed (heat coagulated) but underlying tissue gets inflammed and edematous.
	- severe burns can lead to "**hypovolemic shock**". Marked shifts of water (and protein) from the intravascular space to the extravascular space can result in decreased circulating blood volume, hypotension (low blood pressure),and hemoconcentration (with an elevated hematocrit). Kidney failure can result.
	Respiratory Problems:
	- from smoke inhalation that may have toxic chemical as well as carbon monoxide.
	- carbon monoxide binds to hemoglobin and displaces oxygen.
	- thermal injuries may occur.
83	**Pain**- requires pain medicaion.
	Infections - a major concern with large areas for bacteria to gain entrance.
	Nutrition - increased needs for calories to include protein and carbohydrates.