Chapter 5: The Integumentary System

Chapter Objectives

FUNCTIONS OF SKIN

1. List the functions of skin.

STRUCTURE OF THE SKIN

2. Describe the two principal layer of the skin.
3. List the layers of the epidermis.
4. Discuss the two layers of the dermis in terms of the connective tissue cells and matrix, as well as the host of sensory receptors, immune cells, adipocytes, and functional extensions of the epidermis.
5. Discuss the structure and function of the subcutaneous layer.

GLANDS

6. Define a gland and distinguish between exocrine and endocrine glands.
7. Show how functional classification of exocrine glands is related to the mode used by the cells to deliver their secretory products.

ACCESSORY STRUCTURES OF THE SKIN

8. Explain what is meant by epidermal derivative, and the organs that are in this category.

SKIN COLOR

9. List the components that contribute to skin color.

DISORDERS; HOMEOSTATIC IMBALANCES

10. Discuss the types of skin cancer.
11. Distinguish between the characteristics of first, second, and third degree burns, and their treatment.

TISSUE REPAIR: RESTORING HOMEOSTASIS

12. Outline the steps involved in tissue damage and repair.
13. List the hallmarks of inflammation.

Chapter Lecture Notes

Functions of the Skin

Protection against bacteria, chemicals, UV, and physical abrasion

Regulates body temperature (sweat glands)
Sensation reception - nerve receptors supplies information about the environment

Synthesis of Vitamin D from cholesterol

Blood reservoir - 8 - 10% of total blood volume found in dermis of skin

Structure of Skin

Epidermis - Keratinized stratified squamous epithelium (Fig 5.1 & 5.3 & Table 5.1)

- Stratum basale – cell division
- Stratum spinosum
- Stratum granulosum
- Stratum lucidum – fingertips, palms, and soles
- Stratum corneum

Dermis - Irregular Dense connective tissue (Fig 5.1 & Table 5.2)

- Papillary layer projects into epidermis and produces fingerprints
- Reticular layer
  - predominant orientation of collagen produces lines of cleavage - stretching collagen can tear it resulting in silver, white scars which shows through epidermis as stretch marks

Dermis contains:

- blood vessels - supplies nutrients to epidermis
- nerve endings (pain, Meissner's, Pacinian)
- sweat glands
- hair follicles (follicle = sac) (hair is keratinized cells cemented together) (Fig 5.4)
- sebaceous (oil) glands
- arrector pili muscle

Leather is dermis only

Subcutaneous layer = hypodermis

- below the skin but not considered part of the skin
made of areolar connective tissue and adipose (1/2 of fat reserve located here)

Dermatology – branch of medicine that specializes with diagnosis and treatment of skin disorders

Glands

Endocrine - ductless glands - secrete hormones into interstitial fluid and then picked up by blood vessels

Exocrine - have ducts and include the following kinds of glands: (Fig 4.7)

merocrine - watery secretion released by exocytosis
  saliva
  sweat

apocrine - a portion of the glandular cell pinches off to become a part of the secretion
  mammary glands
  apocrine sweat glands
  ceruminous glands

holocrine - whole cell becomes the secretion
  sebaceous gland

Epithelium Derivatives

Sweat glands (Table 5.3)

  Eccrine of merocrine type - function in temperature regulation

  Apocrine - in axillary & anogenital areas - scent glands (due to action of bacteria on rich secretions from glands)

  Ceruminous - secrete earwax

  Mammary - secrete milk

Sebaceous gland – holocrine

Hair

Nails (Fig 5.5)
Skin Color

melanin - brown pigment produced by melanocytes
  Absorbs UV radiation protecting DNA in stratum basale cells from damage
carotene - yellow-orange pigment found in Stratum corneum & subcutaneous layer
hemoglobin from red blood cells

Skin Cancer

Skin cancer: generally due to overexposure of skin to UV which causes pyrimidine dimers
carcinoma - cancer of epithelium (most common cancer)
sarcoma - cancer of connective tissue
Basal Cell Carcinoma - BCC - 78% of all skin cancers
  arises from abnormal growth of Stratum basale in which cells lack ability to produce keratin
  generally does not metastasize (spread via blood vessels and lymph to other tissues)
Squamous Cell Carcinoma - SCC - 20% of all skin cancers
  arises from stratum spinosum
  may metastasize
Malignant melanoma (mal = bad) 3% of all skin cancers, but most dangerous (Fig 5.8)
  metastasizes rapidly and can kill a person within months of diagnosis
  arises from melanocytes of preexisting moles
    mole = nevus = nest of melanocytes, but is benign

Burns

Burns: caused by heat, chemicals, electrical, radioactivity - classify by depth of burn (Fig 5.9)
1st degree - involves only epidermis
  blood vessels in dermis dilate causing edema & redness
  heal in 2 - 3 days
  no scarring, no blisters, tender
2nd degree - damage to both epidermis and varying depths of dermis

Blisters - tissue fluid accumulates between epidermis and dermis

Pain - usually quite painful

epidermis regenerates from edge of burn

epithelium from hair follicle and sweat glands usually takes 2 - 3 weeks to heal and may result in some scarring

2nd degree burns are critical if > 30 % of surface area is burned

3rd degree - epidermis, dermis, hair follicles, sweat glands, pain receptors, subcutaneous layer all destroyed

painless but life threatening because of fluid loss and bacterial infections

Skin regenerates only from the edges, so skin grafts may be necessary

3rd degree burns are critical if >10% of surface area is burned

Rule of Nines (Fig 5.10) to determine percentage of surface burned

Tissue Damage and Repair

Inflammation – occurs when tissues are damaged (includes clot formation) (Fig 5.6)

vascular and cellular response in preparation for tissue repair

mobilizes body's defenses

isolates and destroys microorganisms

removes damaged cells so repair can proceed

4 major symptoms of inflammation: (unpleasant, but benefit recovery)

Redness

Heat

Swelling – edema

Pain

Chemical mediators of inflammation released or activated by damaged tissues include:

histamine (from mast cells)
prostaglandins (from damaged cells)

Their actions:

vasodilation of blood vessels - produces redness and heat (increases speed by which blood and other substances used for fighting infection are brought to site of injury)

stimulate pain receptors (mostly from prostaglandins)

increases permeability of vessels so products of blood can deal with injury (as proteins leave blood, water follows by osmosis and tissue swells)

Also during inflammation, a blood clot forms to wall off site of injury from rest of body

clot is formed from the protein, fibrin, which comes from the blood

Phagocytosis to clear area for repair

neutrophils arrive as part of inflammation response

injured tissue and bacteria release chemicals that attract white blood cells to area

ingest bacteria and cellular debris

neutrophils killed in process and accumulates as a mixture of dead cells and fluid = pus

macrophages (from monocytes) remove dead neutrophils and cellular debris

Migratory gratory phase

clot becomes scab

extensive growth of epithelial cells beneath scab occurs

epithelium cells from sides of wound migrate beneath scab, eventually meeting and covering wound

fibroblasts from surrounding migrate to the clot along the fibrin threads and synthesize scar tissue

scar = collagen that is denser than normal

damaged blood vessels begin to regrow
Granulation tissue – tissue filling the wound

Proliferation phase

- extensive growth of epithelial cells beneath the scab
- collagen deposition in random patterns
- continued regrowth of blood vessels

Maturation phase

- scab sloughs off once epidermis is restored to normal thickness
- collagen fibers become more organized
- blood vessels are restored to normal