

## Chapter 5 Outline

### I. INTRODUCTION

- A. The skin and its accessory structures make up the integumentary system.
- B. The integumentary system functions to guard the body's physical and biochemical integrity, maintain a constant body temperature, and provide sensory information about the surrounding environment.

### II. STRUCTURE OF THE SKIN

- A. The *skin* consists of different tissues that are joined together to perform specific functions and is the largest organ of the body.
  - 1. Structurally the skin consists of two parts.
    - a. The superficial portion of the skin is the *epidermis* and is composed of epithelial tissue.
    - b. The deeper layer of the skin is the *dermis* and is primarily composed of connective tissue.
    - c. Deep to the dermis is the *subcutaneous layer* or hypodermis.
      - 1) It is not a part of the skin.
      - 2) It consists of areolar and adipose tissue.
      - 3) It serves as a fat storage area, an area for blood vessel passage, and an area of pressure nerve endings.
- B. Epidermis
  - 1. The *epidermis* is composed of stratified squamous epithelium and contains four principal types of cells: *keratinocytes*, *melanocytes*, *Langerhans cells*, and *Merkel cells*.
    - a. *Keratinocytes* produce the protein keratin, which helps protect the skin and underlying tissue from heat, microbes, and chemicals, and lamellar granules, which release a waterproof sealant.

- b. *Melanocytes* produce the pigment melanin which contributes to skin color and absorbs damaging ultraviolet (UV) light. UV light stimulates tyrosinase which converts the amino acid tyrosine into melanin.
  - c. Langerhans cells participate in immune responses.
  - d. Merkel cells contact a sensory structure called a tactile (Merkel) disc and function in the sensation of touch.
2. There are four or five layers of the epidermis, depending upon the degree of friction and mechanical pressure applied to the skin. From deepest to most superficial the layers of the epidermis are stratum basale (stratum germinativum), stratum spinosum, stratum granulosum, stratum lucidum (only in palms and soles), and stratum corneum.
- a. The *stratum basale* is the deepest layer of the epidermis and contains some stem cells capable of undergoing cell division to form new cells.
    - 1) Keratinocytes with a cytoskeleton of tonofilaments are found in this layer.
    - 2) This layer is sometimes called the *stratum germinativum* to indicate its role in the formation of new cells.
  - b. The *stratum spinosum* provides strength and flexibility to the skin.
  - c. The *stratum granulosum* marks the transition between the deeper, metabolically active strata and the dead cells of the more superficial strata. This layer also shows the formation of a water repellent sealant between the cells.
    - 1) This layer consists of keratinocytes that are undergoing apoptosis.
    - 2) This layer is characterized by the presence of keratohyalin which converts tonofilaments into keratin.
  - d. The *stratum lucidum* is present only in the fingers, palms, and soles.
  - e. The *stratum corneum* is the most superficial layer and consists of dead cells.

1) Lamellar granules in this layer make it water-repellent.

### 3. Keratinization and Growth of the Epidermis

- a. *Keratinization*, replacement of cell contents with the protein keratin, occurs as cells move to the skin surface over 2-4 weeks.

## C. Dermis

1. The *dermis* is composed of connective tissue containing collagen and elastic fibers and has two regions.

- a. The *papillary layer* is areolar connective tissue containing fine elastic fibers, dermal papillae, corpuscles of touch (Meissner's corpuscles), and free nerve endings for sensations of heat, cold, pain, tickle, and itch.

- b. The deeper part of the dermis is the *reticular region* consisting of dense, irregular connective tissue containing bundles of collagen fibers and some elastic fibers.

1) Spaces between the fibers may contain adipose cells, hair follicles, sebaceous glands, and sudoriferous glands.

2) The collagen and elastic fibers provide strength, extensibility (ability to stretch), and elasticity (ability to return to original shape after stretching) to skin.

2. *Epidermal ridges* increase friction for better grasping ability and provide the basis for fingerprints and footprints. The ridges typically reflect contours of the underlying dermis.

## D. The Structural Basis of Skin Color

1. The wide variety of colors in skin is due to three pigments - melanin, carotene, and hemoglobin (in blood in capillaries) - in the dermis.

2. *Albinism* is the inherited inability of an individual to produce melanin. The gene which codes for tyrosinase is mutated. *Vitiligo* is the complete or partial loss of melanocytes from patches of the skin resulting in irregular white spots.
3. The color of skin and mucous membranes can provide clues for diagnosing certain problems, such as cyanosis, jaundice, and erythema (Clinical Application).

#### E. Types of skin

1. Thin *skin* covers all parts of the body except for the palms, palmar surfaces of the digits, and soles.
  - a. Thin skin lacks epidermal ridges.
  - b. It has a sparser distribution of sensory receptors than thick skin.
2. Thick *skin* covers the palms, palmar surfaces of the digits, and soles.
  - a. It features a stratum lucidum and thick epidermal ridges.
  - b. It lacks hair follicles, arrector pili muscles, and sebaceous glands, and has more sweat glands than thin skin.

### III. ACCESSORY STRUCTURES OF THE SKIN

- A. Accessory structures of the skin develop from the embryonic epidermis and include hair, glands, and nails.
- B. *Hairs*, or pili, are present on most skin surfaces except the palms, palmar surfaces of the digits, soles, and plantar surfaces of the digits.
  1. Anatomy of Hair
    - a. Hair consists of a *shaft* above the surface, a *root* that penetrates the dermis and subcutaneous layer, the *cuticle*, and a *hair follicle*.
    - b. New hairs develop from cell division of the matrix in the bulb.
    - c. Associated with hairs are sebaceous (oil) glands, arrectores pilorum muscles, and root plexuses.
  2. Hair Growth

- a. The hair growth cycle consists of a growing stage and a resting stage.
- b. Both rate of growth and the replacement cycle can be altered by illness, diet, high fever, surgery, blood loss, severe emotional stress, and gender.

### 3. Hair Color

- a. Hair color is due primarily to the amount and type of melanin.
  - b. Graying of hair occurs because of a progressive decline in tyrosinase.
4. Functions of hair include protection, decrease in heat loss, and sensing light touch.
5. Hormones influence the growth and loss of hair.

## C. Skin Glands

1. *Sebaceous (oil) glands* are usually connected to hair follicles; they are absent in the palms and soles.
- a. Sebaceous glands produce sebum, which moistens hairs, waterproofs and softens the skin, and inhibits bacterial growth.
2. *Sudoriferous (sweat) glands* are divided into apocrine and eccrine types.
- a. *Eccrine sweat glands* have an extensive distribution; their ducts terminate at pores at the surface of the epidermis.
    - 1) The main function of eccrine sweat glands is to help regulate body temperature through evaporation.
    - 2) They also help eliminate wastes such as urea.
  - b. *Apocrine sweat glands* are limited in distribution to the skin of the axilla, pubis, and areolae; their duct open into hair follicles.
3. *Ceruminous glands* are modified sudoriferous glands that produce a waxy substance called cerumen.
- a. These glands are found in the external auditory meatus.

## D. Nails

1. *Nails* are hard, keratinized epidermal cells over the dorsal surfaces of the terminal portions of the fingers and toes.
2. The principal parts of a nail are the body, free edge, root, lunula, eponychium, and matrix.
3. Cell division of the matrix cells produces new nails.
4. Functionally, nails help in grasping and manipulating small objects in various ways and provide protection against trauma to the ends of the digits.

#### IV. FUNCTIONS OF SKIN

- A. Thermoregulation, the homeostatic control of body temperature, is due to the skin liberating sweat at its surface and by adjusting the flow of blood in the dermis.
- B. The skin provides *protection* through physical, chemical and biological barriers.
- C. *Cutaneous sensations*, including touch, pressure, vibration, tickle, heat, cold, and pain arise in the skin.
- D. The skin plays minor roles in *excretion*, the elimination of wastes from the body, and *absorption*, the passage of material from the external environment into body cells.
- E. *Synthesis of Vitamin D* requires activation of a precursor molecule in the skin by UV light, with enzymes in the liver and kidneys modifying the activated molecule to produce calcitriol, the most active form of vitamin.

#### V. MAINTAINING HOMEOSTASIS: SKIN WOUND HEALING

- A. Epidermal Wound Healing
  1. In an epidermal wound (e.g., an abrasion or a first-degree or second-degree burn), the central portion of the wound usually extends deep down to the dermis, whereas the wound edges usually involve only superficial damage to the epidermal cells.
  2. Epidermal wounds are repaired by enlargement and migration of basal cells, *contact inhibition*, and division of migrating and stationary basal cells.

3. Epidermal growth factor stimulates basal cells to divide and replace the ones that have moved into the wound.

## B. Deep Wound Healing

1. When an injury extends to tissues deep to the epidermis, the repair process is more complex than epidermal healing, and scar formation results.
2. Phases of Deep Wound Healing
  - a. During the *inflammatory phase*, a blood clot unites the wound edges, epithelial cells migrate across the wound, vasodilatation and increased permeability of blood vessels deliver phagocytes, and fibroblasts form.
  - b. During the *migratory phase*, epithelial cells beneath the scab bridge the wound, fibroblasts begin scar tissue, and damaged blood vessels begin to grow. During this phase, tissue filling the wound is called *granulation tissue*.
  - c. During the *proliferative phase*, the events of the migratory phase intensify.
  - d. During the *maturation phase*, the scab sloughs off, the epidermis is restored to normal thickness, collagen fibers become more organized, fibroblasts begin to disappear, and blood vessels are restored to normal.
3. *Scar tissue formation (fibrosis)* can occur in deep wound healing.