Skin and appendages

Lecture objectives

- briefly list the functions of the integumentary system.
- describe the two principal layer of the skin.
- list the layers of the epidermis.
- describe what are lines of cleavage and their role in reducing scars due to surgery
- list the accessory structures related to hair root (nerves, erector pilli muscle, sebaceous gland, etc.) and their functional relation to the hair follicle.
Lecture objectives continued

- list the different types of skin glands.
- describe the process of keratinization and the role of hormones in the process.
- explain the basis for skin color function and variation.
- describe the effect of chemotherapy on hair growth.
The organs of the **integumentary system** include the skin and its accessory structures including hair, nails, and glands, as well as blood vessels, muscles and nerves.

**Dermatology** is the medical specialty for the diagnosis and treatment of disorders of the integumentary system.
The skin (cutaneous membrane) covers the body and is the largest organ of the body by surface area and weight.

- Its area is about 2 square meters.
- It is 0.5 – 4 mm thick, thinnest on the eyelids, thickest on the heels; the average thickness is 1 – 2 mm.
Types of Skin

- There are two major types of skin:
  - thin (hairy) skin covers all body regions except the palms, palmar surfaces of digits, and soles
  - thick (hairless) skin covers the palms, palmar surfaces of digits, and soles
Structure of the Skin

- It consists of two major layers:
  - outer, thinner layer called the **epidermis**, consists of epithelial tissue
  - inner, thicker layer called the **dermis**
- Beneath the dermis is a **subcutaneous (subQ) layer** (also called **hypodermis**) which attaches the skin to the underlying tissues and organs.
**Structure of the Skin**

- The **epidermis** has a number of important characteristics:
- the epidermis is composed of keratinized stratified squamous epithelium
- it contains four major types of cells:
- **Keratinocytes** (90% of the cells) produce keratin which is a tough fibrous protein that provides protection
Structure of the Skin

- **Melanocytes**: which produce the pigment *melanin* that protects against damage by ultraviolet radiation

- **Langerhans cells**: involved in immune responses, arise from red bone marrow

- **Merkel cells**: which function in the sensation of touch along with the adjacent *tactile discs*
The epidermis contains four major layers (thin skin) or five major layers (thick skin):

- **Stratum basale** (deepest layer) or stratum germinativum, where continuous cell division occurs which produces all the other layers.
- **Stratum spinosum**, 8-10 layers of keratinocytes.
- **Stratum granulosum**, which includes keratohyalin and lamellar granules.

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**February 5, 2010 Dr Ibrahim**
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Epidermis

- **Stratum lucidum**: present only in thick skin (the skin of the fingertips, palms, and soles)
- **Stratum corneum**: composed of many sublayers of flat, dead keratinocytes called corneocytes or squames that are continuously shed and replaced by cells from deeper strata; constant friction can stimulate formation of a callus.
- **Keratinization**: the accumulation of more and more protective keratin, occurs as cells move from the deepest layer to the surface layer
- **Dandruff**: an excess of keratinized cells shed from the scalp

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(a) Four principal cell types in epidermis
(b) Photomicrograph of a portion of thick skin

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Dermis

The **dermis**: 

- is composed of connective tissue containing collagen and elastic fibers 
- consists of areolar CT containing collagen and elastic fibers, corpuscles of touch and free nerve endings
Dermis

- adipose cells, hair follicles, nerves, sebaceous (oil) glands, and sudoriferous (sweat) glands
- **Striae** or **stretch marks** can appear if the skin is stretched too much.
Dermis

- **Lines of cleavage** - “tension lines” in the skin indicate the predominant direction of underlying collagen fibers
- Surgery along these line heal without much scar

- **Epidermal ridges** reflect contours of the underlying dermal papillae and form the basis for **fingerprints** (and footprints); their function is to increase firmness of grip by increasing friction.
- **Dermatoglyphics** - the study of the pattern of epidermal ridges
Structural Basis of Skin Color

- Variations in skin color arise from variations in the amounts of three pigments: melanin, carotene, and hemoglobin
- **Melanin** - a yellow-red or brown-black pigment produced by melanocytes (located mostly in the epidermis, where it absorbs UV radiation)
- The amount of melanin causes the skin’s color to vary from pale yellow to red to tan to black
- The number of melanocytes are about the same in all people; differences in skin color is due to the amount of pigment produced
Structural Basis of Skin Color

- A benign localized overgrowth of melanocytes is a **nevus** or mole
- **Albinism** is an inherited inability to produce melanin - **vitiligo** is a condition in which there is a partial or complete loss of melanocytes from patches of skin
Subcutaneous Layer

Subcutaneous (subQ) layer (also called hypodermis) is not part of the skin but, among its functions, it attaches the skin to the underlying tissues and organs; this layer (and sometimes the dermis)
contains lamellated (pacinian) corpuscles which detect external pressure applied to the skin.
End of part One
Accessory Structures of the Skin

- include hair, skin glands, and nails
- **Hairs (pili)** have a number of important functions:
  - protection
  - reduction of heat loss
  - sensing light touch
Hair is composed of dead, keratinized epidermal cells.

Hair consists of:

- **Shaft** which mostly projects above the surface of the skin.
- **Root** which penetrates into the dermis.
Accessory Structures of the Skin

- **Hair color** is determined by the amount and type of melanin
- **Sebaceous (oil) glands** are connected to hair follicles
- There are different types of hairs including:
  - Lanugo
  - vellus
  - Terminal

- Response to hair growth due to sex hormones
Skin Glands

- Sebaceous glands secrete an oily substance called **sebum** which prevents dehydration of hair and skin, and inhibits growth of certain bacteria

- **Sudoriferous (sweat) glands** - 2 types:
  - *Eccrine* sweat glands
  - *Apocrine* sweat glands
Sudoriferous (Sweat) Glands

- Numerous **eccrine** (or **merocrine**) **sweat glands** helps to cool the body by evaporating, and also eliminates small amounts of wastes.

- **Apocrine sweat glands**, located mainly in the skin of the axilla, groin, facial regions.
  - this sweat is secreted during emotional stress and sexual excitement.
Ceruminous Glands

- Modified sweat glands located in the ear canal

- Along with nearby sebaceous glands, they are involved in producing a waxy secretion called **cerumen** (earwax) which provides a sticky barrier that prevents entry of foreign bodies into the ear canal.
Functions of the Skin

- protection
- regulation of body temperature
- blood reservoir
- cutaneous sensations
- excretion and absorption
- synthesis of vitamin D
When there is little damage to underlying collagen fibres
- Basal cell proliferate
- Migrate to fill up the defect
- Healing with very little scar

(a) Division of basal epithelial cells and migration across wound
(b) Thickening of epidermis

Epidermal wound healing

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Deep Wound Healing

When there is much damage to underlying collagen fibres
• Blood phagocytes remove dead tissue
• Fibroblasts migrate to fill up the defect with new collagen
• Healing with scar
the epidermis of a fetus is protected by a fatty substance called **vernix caseosa**
Aging and the Integumentary System

Effects:

- wrinkling
- decrease of skin’s immune responsiveness
- decreased numbers of functional melanocytes resulting in gray hair and atypical skin pigmentation
Aging and the Integumentary System

- loss of subcutaneous fat
- a general decrease in skin thickness
- Growth of hair and nails decreases; nails may also become more brittle with age.
Discussion topics on forum

- What are the effects of exposure to the sun on the skin?
- What are the effect of cancer chemotherapy on hair growth?
- What are the role of hormones in the growth and loss of hair?
- briefly list the functions of the integumentary system.
- describe the two principal layer of the skin.
- discuss the structure and function of the subcutaneous layer.
- list the layers of the epidermis.
- describe what are lines of cleavage and their role in reducing scars due to surgery.
- list the accessory structures related to hair root (nerves, erector pilli muscle, sebaceous gland, etc.) and their functional relation to the hair follicle.
- list the different types of skin glands.
- describe the process of keratinization and the role of hormones in the process.
- explain the basis for skin color function and variation.
- discuss the effects of exposure to the sun on the skin.
- describe the effect of chemotherapy on hair growth.
- discuss the role of hormones in the growth and loss of hair.
- list the two kinds of skin wound healing, based on the depth of the injury.
- describe the development of the epidermis, its derivatives, and the dermis.