THE INTEGUMENTARY SYSTEM

Chapter 5

Anatomy and Physiology Lecture

THE INTEGUMENTARY SYSTEM

Integumentary System – Consists of the skin and accessory structures such as hair, nails, and glands.

Integument means covering.

Overview of the Integumentary System

Major Functions of the Integumentary System

1. Protection
2. Sensation
3. Temperature regulation
4. Vitamin D production
5. Excretion

HYPODERMIS

Hypodermis – Attaches the skin to the underlying bone and muscles and supplies it with blood vessels and nerves.

Main types of cells within the hypodermis are fibroblast, adipose cells, and macrophages.

Subcutatneous tissue of Superficial fascia – Hypodermis that is not part of the skin.

SKIN

Skin is one of the largest organs of the body in terms of surface area and weight.

Dermatology - is the medical specialty that deals with the diagnosis and treatment of skin disorders.

Two Major Tissue Layers of Skin:

a. Epidermis - The outer, thinner portion, composed of stratified squamous epithelium (epithelium). Lack blood vessels, lymphatic vessels, and connective tissue.

b. Dermis - The inner, thicker portion, composed of connective tissue.

DERMIS

Dermis is the second principal part of the skin, composed of connective tissue containing collagenous and elastic fibers.

Collagen - a protein, the main organic constituent of connective tissue.

a. Papillary Region or Layer. Upper region of the dermis.

-Consists of loose (areolar) connective tissue containing fine elastic fibers.

-Its surface area is greatly increased by small, fingerlike projections called Dermal Papillae.

Dermal Papillae project into the epidermis, and may contain loops of capillaries.

-Some dermal papillae also contain corpuscles of touch, also called Meissner's Corpuscles, nerve endings that are sensitive to touch.

b. Reticular Region or Layer. Remaining portion of the Dermis.

-Consists of dense, irregularly arranged connective tissue containing interlacing bundles of collagenous and coarse elastic fibers.
-Combination of collagenous and elastic fibers in the reticular region

provides the skin with strength, extensibility, and elasticity.

Extensibility is the ability stretch.

Elasticity is the ability to return to original shape after extension or contraction.

*(Ability of the skin to stretch can readily be seen during conditions of pregnancy, obesity, and edema.)

*(The small tears that occur during extreme stretching are initially red and remain visible afterward as silvery white streaks called striae.)

-Reticular region is attached to underlying organs, such as bone and muscle, by the subcutaneous layer, also called Hypodermis or superficial fascia.

Subcutaneous Layer also contains nerve ending called Lamellated or Pacinian Corpuscles that are sensitive to pressure.

EPIDERMIS

Is composed of stratified squamous epithelium and consists four distincttypes of cells.

(1) Keratinocytes, (2) Melanocytes, (3) Langerhans, and (4) Merkel cell

1. **Keratinocyte** - Is the most numerous type of epidermis, and undergoes keratinization.

- Production of the Protein Keratin, which helps water-proof and protect the skin and underlying tissues.

- Participate in immunity.

2. **Melanocyte**. A second type of cell in the Epidermis.

-Located at the base of the epidermis.

-Produces melanin, one of the pigments responsible for skin color and the absorption of ultraviolet (UV) light.

3. **Langerhans' Cell**: Nonpigmented granular dendrocytes.

-Are a small population of dendrocytes that arise from bone marrow and migrate to the epidermis, and other areas of the body that contain stratified squamous epithelial tissue.
-Are sensitive to UV radiation.
-Interact with cells called Helpe T Cells to assist in the immune response.

4. **Merkel Cell** - located in the deepest layer (stratum basale)

-Makes contact with flattened portion of the ending of a sensory neuron (nerve cell), called a Tactile (Merkel) Disc.

Five Layers (Strata) of Epidermis - From the Deepest to The Most Superficial

a. **Stratum Basale** - the deepest of the Epidermis.

-Stratum Basale is sometimes referred to as the stratum germination to indicate its role in germinating new cells.
-Is a single layer of cuboidal to columnar cells capable of continued cell division.
-Stratum basale of hairless skin contains nerve endings sensitive to touch called Tactile (Merkel's) discs.

b. **Stratum Spinosum**

-Contains 8 to 10 layers of polyhedral (many-sided) cells that fit closely together.
-The surfaces contain spinelike projections that join the cells

together.

c. **Stratum Granulosum**

-Consists of three to five row of flattened cells contain darkly staining granules of a substance called Keratohyalin, involved in the first step of Keratin formation. (Consists of substance called keratohyalin)

Keratin is a water proofing protein found in the top layer of the epidermis.

d. **Stratum Lucidum**

-Normally found only in the thick skin of the palms and soles and is absent in thin skin.
-Consists of three to five rows of clear, flat, dead cells that contain droplets of a substance called eleidin.

Eleidin is translucent, formed from keratohyalin and is eventually transformed to keratin.

e. **Stratum Corneum** - the outermost layer.

-Consists of 25 to 30 layers of flat, dead cells completely filled with keratin.
-Are continuously shed and replaced.
-Serves as an effective barrier against light and heat waves, bacteria, and many chemicals.

*(In the process of Keratinization, newly formed cells produced in the basal layers are pushed up to more superficial layers.)
*Epidermal Growth Factor (EGF) is a protein hormone that functions as a growth factor.

THICK AND THIN SKIN

Thick Skin – Has all five epithelial strata, and the stratum cornuem has many layers of cells.

Found in areas subject to pressure or friction, such as palm of the hands, the soles of the feet, and the fingertips.

Thin Skin – Covers the rest of the body and is more flexible than thick skin.

SKIN COLOR

Color of Skin is due to:

i Melanin - a pigment in the epidermis;
ii Carotene - a pigment mostly in the dermis; and
iii Blood - in capillaries in the dermis.

Melanin is synthesized in cells called Melanocytes.

Melanocytes - are produced from Melanoblasts.

-Are most plentiful in the mucous membranes, penis, nipples of the breasts and the area just around the nipples (areola), face, and extremities.

-Melanin gives color to the skin. Varies skin color from pale yellow to black.

-The amount of Melanin (black pigment) accounts for the color differences among the races.

*(Since the number of melanocytes is about the same in all races, differences in skin color are due to the amount of pigment the melanocytes produce and disperse.)

*-That is, individuals with darker skin possess more active melanocytes, not

a greater number of melanocytes.

-The presence of Melanin in the epidermis is vital for protection against the harmful effects of Ultraviolet Radiation, which can manifest themselves as skin cancer.

Albinism - an inherited inability of an individual of any race to produce melanin.

Albino - an individual affected with albinism.

Vitiligo - the partial or complete loss of melanocytes from areas of skin producing patchy, white spots.

*In some people, melanin tends to form in patches called freckles.

Carotene - a pigment found in the stratum corneum of epidermis and fatty areas of the dermis in people of Asian origin.

-Carotene and Melanin together account for the yellowish hue of their skin.

Pink color of Caucasian skin is due to blood in capillaries in the dermis.

(The redness of the vessels is not heavily masked by pigment.)

*The Epidermis has no blood vessels, a characteristic of all Epithelia.

Hemoglobin - pigment that carries oxygen in blood; gives blood its red color.

Clinical Application: Malignant Melanoma

Caused by overexposure of the skin to the ultraviolet light of the sun leading to skin cancer.

EPIDERMAL RIDGES AND GROOVES

(The outer surface of the skin of the palms and fingers and soles and toes is marked by a series of ridges and grooves that appear either as fairly straight lines or as a pattern of loops and whorls, as on the tips of the digits.)

Epidermal Ridges

-(Develop during the third and fourth fetal months as the epidermis conforms to the contours of the underlying dermal papillae

-The function of the ridges is to increase the grip of the hand or foot by increasing friction and acting like tiny suction cups.

-(Since the ducts of sweat glands open on the summits of the epidermal ridges, as sweat pores, fingerprints (or footprints) are left when a smooth object is touched.) The sweat helps form fingerprints (or footprints) when smooth object is touched.

*The ridge pattern is genetically determined, and is unique for each individual; and does not change throughout life, except to enlarge.

*Serves as the basis for identification through fingerprints or footprints.

ACCESSORY SKIN STRUCTURES

Are structures developed from the embryonic epidermis e.g. Hair, skin glands (sebaceous, sudoriferous, and ceruminous), and nails.

1. **Hair**

Are epidermal growth that function in protection.

Consist of a shaft above the surface, root that penetrates the dermis and subcutaneous layer, and a hair follicle.

Associated with hairs are sebaceous (oil) glands, arrectores pullorum muscles, and hair root plexuses.

New hair develop from cell division of the matrix in the bulb; hair replacement and growth occur in a cyclic pattern.

"Male-pattern" baldness is caused by androgens and heredity.
-Color of hair is due primarily to melanin.

Primary function is protection:
-Protect scalp from injury.
-From sun rays.
-Decrease heat loss.
-Eye from foreign particles.
-In nostrils
-In ears

Electrolysis - the hair bulb is destroyed by an electric current so that the hair cannot regrow.

2. **Glands**

i) **Sebaceous (Oil) Glands** are usually connected to hair follicles; they are absent in the palm and soles.

-Produce sebum which moistens hairs and waterproofs the skin.

*Enlarged sebaceous glands may produce blackheads, pimples, and boils.

ii) **Sudoriferous (Sweat) Glands** are divided into apocrine and eccrine.

a. Apocrine Sweat Glands are limited in distribution to the skin of the axilla, pubis, and areolae; their ducts open into hair follicles.

b. Eccrine Sweat Glands have an extensive distribution.
-Produce perspiration, which carries small amounts of wastes to the surface; thereby
-Assists in maintaining body temperature.
*Their ducts terminate at pores at the surface of the epidermis.

iii) Ceruminous Glands are modified sudoriferous glands that secrete cerumen.

-Are found in the external auditory meatus.

3. **Nails**

-Nails are hard, keratinized epidermal cells over the dorsal surfaces of the terminal portions of the fingers and toes.
-The principal parts of a nail are the body, free edge, root, lunula, eponychium (cuticle), and matrix.
-Cell division of the matrix cells produces new nails.

*Functionally, nails help us to grasp and manipulate small objects in various ways and provide protection against trauma to the ends of the digits.

THERMOREGULATION: HOMEOSTASIS OF BODY TEMPERATURE

1. One of the functions of the skin is the maintenance of a normal body temperature [37≅C (98.6≅F).

   (If environmental temperature is high, skin receptors sense the stimulus (heat) and generate impulses that are transmitted to the brain. The brain then causes the sweat glands to produce perspiration. As the perspiration evaporates, the skin is cooled.)

2. The skin-cooling response is a negative feedback mechanism.

3. Temperature maintenance is also accomplished by adjusting blood flow to the skin, regulating metabolic rate, and regulating skeletal muscle contractions.

AGING AND THE INTEGUMENTARY SYSTEM

1. Most effects of aging occur when an individual reaches the late forties.

2. Among the effects of aging are wrinkling, loss of subcutaneous fat, atrophy of sebaceous glands, and decrease in the number of melanocytes.

DEVELOPMENTAL ANATOMY OF THE INTEGUMENTARY SYSTEM

1. The epidermis is derived from ectoderm. Hair, nails, and skin glands are epidermal derivatives.

2. The dermis is derived from wandering mesodermal cells.

DISORDERS: HOMEOSTATIC IMBALANCES

1. Acne is an inflammation of sebaceous (oil) glands and usually begins at puberty.

2. Systemic lupus erythematosus (SLE) is an autoimmune inflammatory disease of connective tissue.

3. Psoriasis is a chronic skin disease characterized by reddish, raised plaques or papules.

4. Decubitus ulcers are caused by a chronic deficiency of blood to tissue subjected to prolonged pressure. (or bedsores or pressure sores)

5. Sunburn is a skin injury resulting from prolonged exposure to the UV rays of sunlight.

6. Skin Cancer can be caused by excessive exposure to sunlight. Types include Basal cell Carcinoma (BCC), Squamous cell Carcinoma (SCC), and Malignant Melanoma.

7. Burn is a tissue damage that destroys protein.

   a. First-degree burn involves only the surface epidermis.

   b. Second-degree burn involves the entire epidermis or varying portions of the dermis, and skin functions are lost.

   *First-and second-degree burns are collectively referred to as Partial-thickness burns.

   c. Third-degree burn or Full-thickness burn involves destruction of the epidermis, dermis, and the epidermal derivatives, and skin functions are lost.

   Methods for determining the extent of a burn:

   a. The Lund-Browder
   b. The "Rule of Nines"

Note: *Medical Terminology associated with the integumentary system.