ANATOMY & PHYSIOLOGY REVIEWER

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CHAPTER 5: Integumentary System

5.1 FUNCTIONS OF THE INTEGUMENTARY SYSTEM

1. Integumentary System - consists of the skin and accessory structures, such as hair, glands, and nails. Integument means covering, and the integumentary system is one of the more familiar systems of the body to everyone because it covers the out- side of the body and is easily observed.

Functions:

- **Protection**
- **Sensation**
- **Vitamin D production**
- **Temperature regulation**
- **Excretion**

5.2 SKIN

1. Skin – is the primary organ of the integumentary system and is the largest organ of the body.

2. Subcutaneous Tissue – it where the skin rests, which is a layer of connective tissue and is not part of the skin.

Two major tissue layers of the skin:

1. **Epidermis – is the most superficial layer of skin. It is a layer of epithelial tissue that rests on the dermis. is a stratified squamous epithelium; in its deepest layers, new cells are produced by mitosis.**

- **Dandruff – the excessive sloughing of stratum corneum cells from the surface of the scalp.**
- **Callus - In skin subjected to friction, it is called the number of layers in the stratum corneum greatly increases, producing a thickened area.**
- **Corn - Over a bony prominence, the stratum corneum can thicken to form a cone-shaped structure.**
- **Keratinization - process during their movement which the cells change shape and chemical composition.**

(Note: Although keratinization is a continuous process, the Epidermis is divided into distinct histological regions, or *strata* meaning layers that can be seen in the epidermis.)

Layers:

1. **Stratum Basale – is the deepest stratum of the epidermis. It consists of cuboidal or columnar cells that undergo mitotic divisions about every 19 days. As the daughter cells are formed, they are pushed upward, becoming part of the nest stratum.**
2. **Stratum Spinosum – is noted for its multilayer of distorted ("Spined") cells. The cells become distorted as they are pushed up from the deeper stratum basale and look somewhat "spiny" when stained and prepared for microscopy.**

(Note: Stratum basale and stratum spinosum are sometimes called *Stratum Germinativum*.)

3. **Stratum Granulosum – is superficial to stratum spinusom. It contains flattened cells pushed up from the deeper starta. As the cells are pushed up through this stratum, they form the protein granules that gives it the name *granulosum*.**
4. **Stratum Lucidum – is a very thin layer presents only in thick skin. The Thick skin is found only in high-wear areas, such as the palms and soles. The more flexible thin skin is found over most other areas of the body. This stratum's name comes from the fact that it is translucent, allowing light to pass through it easily.**
5. **Stratum Corneum - is the most superficial stratum of the epidermis. It consists of dead squamous cells filled with keratin. Keratin gives the stratum corneum its structural strength. The stratum corneum cells are also coated and surrounded by lipids, which help prevent fluid loss through the skin. is composed of 25 or more layers of dead squamous cells joined by desmosomes.**

(Note: *Keratin* gives the stratum corneum its structural strength.)

2. **Dermis - is composed of dense collagenous connective tissue containing fibroblasts, adipocytes, and macrophages. Nerves, hair follicles, smooth muscles, glands, and lymphatic vessels extend into the dermis.**

- **Cleavage lines - are tension lines, in the skin, and the skin is most resistant to stretch along these lines.**
- **Stretch marks - are lines develop when a person increases in size quite rapidly.**
- **Dermal papillae – projections in the upper part of the dermis, which extend toward the epidermis. It also contains many blood vessels.**

(Note: The dermal papillae in the palms of the hands, the soles of the feet, and the tips of the digits are arranged in parallel, curving ridges that shape the overlying epidermis into fingerprints and footprints. The ridges increase friction and improve the grip of the hands and feet.)

- **Intradermal Injection - is administered by drawing the skin taut and inserting a small needle at a shallow angle into the dermis; an example is the tuberculin skin test.**
- **Subcutaneous Injection - is achieved by pinching the skin to form a "tent" and inserting a short needle into the adipose tissue of the subcutaneous tissue; an example is an insulin injection.**
- **Intramuscular Injection - is accomplished by inserting a long needle at a 90-degree angle to the skin into a muscle deep to the subcutaneous tissue. Intramuscular injections are used for most vaccines and certain antibiotics.**

(Note: The dermis contains many sensory nerve ending. Sensation such as heat, cold, touch, and pressure are mediated by the dermal nerve endings.)

There are two regions of the dermis:

1. **Reticular layer – is a thick region of irregularly arranged protein fibers. Most of the fibers are collagenous, but a few are made of elastin.**
2. **Papillary layer – is the bum by superficial portion of the dermis attached to the epidermis.**

(Note: The bumps, called *papillae* (meaning "nipples"), from regular rows in the thick skin but are rather irregularly arranged in the skin.)

Skin Color:

(Note: Factors that determine skin color include pigments in the skin, blood circulating through the skin, and the thickness of the stratum corneum.)

The two primary pigments are:

1. **Melanin - is the group of pigments primarily responsible for skin, hair, and eye color. Most melanin molecules are brown to black pigments, but some are yellowish or reddish. It also provides protection against ultraviolet light from the sun.**

(Note: Exposure to ultraviolet light—for example, in sunlight— stimulates melanocytes to increase melanin production. The result is a suntan.)

- **Albinism - is a recessive genetic trait that causes a deficiency or an absence of melanin. Albinos have fair skin, white hair, and unpigmented irises in the eyes.**
- **Melanocytes – produces melanin, which are irregularly shaped cells with many long processes that extend between the epithelial cells of the deep part of the epidermis.**
- **Melanosomes - a vesicle that packages the melanin from the Golgi apparatus of the melanocytes, which move into the cell processes of the melanocytes.**
- **Cyanosis - a decrease in the blood O2 content produces a bluish color of the skin.**
- **Jaundice – Yellow skin.**

2. **Carotene - is lipid-soluble; when consumed, it accumulates in the lipids of the stratum corneum and in the adipocytes of the dermis and subcutaneous tissue. It is also a yellow pigment found in plants such as squash and carrots.**

5.3 SUBCUTANEOUS TISSUE

1. **Subcutaneous tissue – it sometimes called *Hypodermis*, attaches the skin to the underlying bone and muscle and supplies it with blood vessels and nerves.**
   - **Is a loose connective tissue, including adipose tissue that contains about half the body's stored lipids, although the amount and location vary with age, sex, and diet.**
   - **Adipose tissue in the subcutaneous tissue functions as padding and insulation, and it is responsible for some of the differences in appearance between men and women as well as between individuals of the same sex.**

5.4 ACCESSORY SKIN STRUCTURES

Hair:

1. **Hair – in humans, it is found everywhere on the skin, except on the palms, the soles, the lips, the nipples, parts of the genitalia, and the distal segments of the fingers and toes.**
2. **Hair Follicle – It is where hair arises, an extension of the epidermis that originates deep in the dermis.**
3. **Hair Shaft – portion that has been pushed out of the follicle that protrudes above the surface of the skin, whereas the root and hair bulb are below the surface.**
4. **Hair Root – portion of each hair within the follicle.**

5. **Cortex – a hard portion that surrounds a softer center, the medulla.**
6. **Medulla – a soft portion in the center covered by the cortex.**
7. **Cuticle - a single layer of overlapping cells that holds the hair in the hair follicle and covers the cortex.**
8. **Hair Bulb – it is where the hair is produce, which rest on the hair papilla.**
9. **Hair Papilla – is an extension of the dermis that produces into the hair bulb and contains blood vessels.**
10. **Growth stage – it is formed by mitosis of epithelial cells within the hair bulb. These cells, like the cells of the stratum basale in the skin, divide and undergo keratinization.**
11. **Resting stage - growth stops and the hair is held in the hair follicle.**
12. **Arrector pili muscle – it is a strap of smooth muscle sells that is attached to each hair follicle, which can contract and cause the hair to become perpendicular to the skin's surface.**

Glands: The skin has 2 major glands

1. **Subaceous gland – are simple, branched acinar glands most are connected by a duct to the superficial part of a hair follicle.**
- **Sebum – a fatty substance that is produce in the subaceous gland.**
2. **Sweat glands - also known as *sudoriferous* or *sudoriparous glands*, from Latin sudor, meaning '*sweat*', are small tubular structures of the skin that produce sweat.**

There are two kinds of sweat glands:

1. **Eccrine sweat glands - are simple, coiled, tubular glands and release sweat by merocrine secretion.**
2. **Apocrine sweat glands - are simple, coiled, tubular glands that produce a thick secretion rich in organic sub- stances.**

Nails:

1. **Nail - is a thin plate, consisting of layers of dead stratum corneum cells that contain a very hard type of keratin.**
2. **Nail body - the visible part of the nail.**
3. **Nail root - part of the nail covered by skin.**
4. **Cuticle or *Eponychium* - is stratum corneum that extends onto the nail body. The nail root extends distally from the nail matrix.**
5. **Nail bed – is located distal to the nail matrix.**
6. **Nail Matrix and bed - are epithelial tissue with a stratum basale that gives rise to the cells that form the nail.**
7. **Lunula - can be seen through the nail body as a whitish, crescent- shaped area at the base of the nail.**

(Note: Cell production within the nail matrix causes the nail to grow.)

5.5 PHYSIOLOGY OF THE INTEGUMENTARY SYSTEM

Protection: The integumentary system performs many protective functions.

1. **Reduction in body water loss.**
2. **Acts as a barrier that prevents microorganisms and other foreign substances from entering the body.**
3. **Protects underlying structures against abrasion.**
4. **Melanin absorbs ultraviolet light and protects underlying structures from its damaging effects.**
5. **Hair protection.**
6. **The nails protect the ends of the fingers and toes from damage and can be used in defense.**

Sensation:

(Note: Many sensory are associated with the skin. Although hair does not have a nerve supply, sensory receptors around the hair follicle can detect the movement of a hair.)

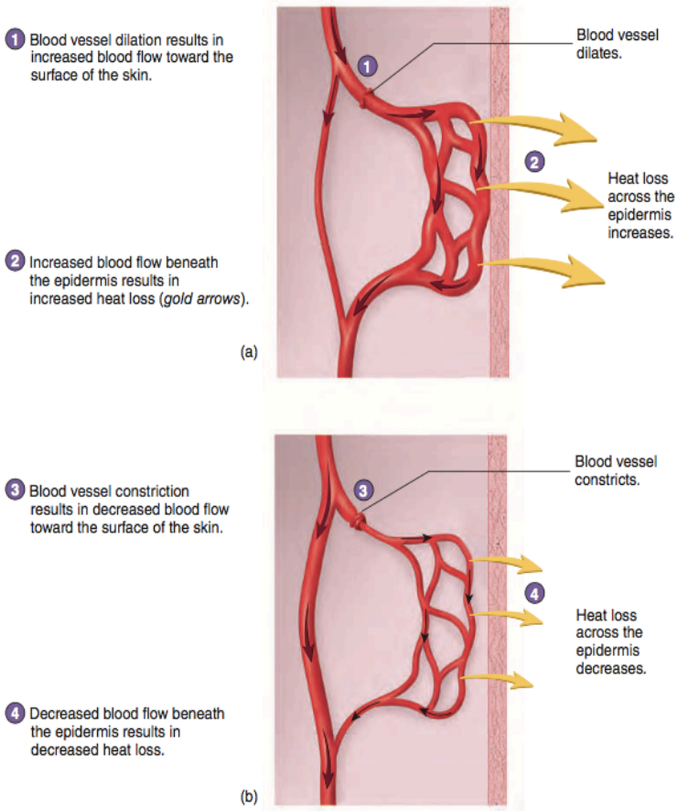
Vitamin D Production:

1. **UV light causes the skin to produce a precursor molecule of vitamin D.**
2. **The precursor molecule is carried by the blood to the liver where it is enzymatically converted.**
3. **The enzymatically converted molecule is carried by the blood to the kidneys where it is converted again to the active form of vitamin D.**
4. **Vitamin D stimulates the small intestine to absorb calcium and phosphate for many body functions.**

Excretion:

(Note: In addition to water and salts, sweat contains small amounts of waste products, such as urea, uric acid, and ammonia. Even though the body can lose large amounts of sweat, the sweat glands do not play a significant role in the excretion of waste products.)

Heat Exchange in the skin:



5.6 INTEGUMENTARY SYSTEM AS A DIAGNOSTIC AID

Diagnostic Aid:

(Note: The integumentary system is useful in diagnosis because it is observed easily and often reflects events occurring in other parts of the body. Rashes and lesions in the skin can be symptoms of problems elsewhere in the body.)

5.7 BURNS

1. **Burns - is injury to a tissue caused by heat, cold, friction, chemicals, electricity, or radiation.**

Burns are classified according to their depth:

1. **Partial-thickness burns - part of the stratum basale remains viable, and regeneration of the epidermis occurs from within the burn area, as well as from the edges of the burn. Partial-thickness burns are divided into first- and second- degree burns.**

- **First-degree burns - involve only the epidermis and are red and painful. They can be caused by sunburn or brief exposure to very hot or very cold objects, and they heal without scarring in about a week.**

- **Edema – or swelling, is the abnormal accumulation of fluid in certain tissues within the body.**

- **Second-degree burns - damage both the epidermis and the dermis.If dermal damage is minimal, symptoms include redness, pain, edema, and blisters. Healing takes about 2 weeks, and no scarring results. However, if the burn goes deep into the dermis, the wound appears red, tan, or white; can take several months to heal; and might scar.**

2. **Full-Thickness or Third-Degree burns - the epidermis and the dermis are completely destroyed, and recovery occurs from the edges of the burn wound. It appears white, tan, brown, black, or deep cherry red.**

Burn Healing:

In all second-degree burns, the epidermis, including the stratum basale where the stem cells are found, is damaged.

The epidermis regenerates from epithelial tissue in hair follicles and sweat glands, as well as form the edges of the wound.

Deep partial-thickness and full-thickness burns take a long time to heal, and they form scar tissue with disfiguring and debilitating wound contractures.

Treatment of burns:

In a procedure called a split skin graft, the epidermis and part of the dermis are removed from another part of the body and placed over the burn.

When it is not possible or practical to move skin from one part of the body to a burn site, physicians sometimes use artificial skin or graft from human cadavers.

- **Debridement - the removal of dead tissue from the burn, helps prevent infections by cleaning the wound and removing tissue in which infections could develop.**
- **Venous thrombosis - the development of a clot in a vein, is another complication of burns. Blood normally forms a clot when exposed to damaged tissue, such as at a burn site, but clotting can also occur elsewhere, such as in veins, where clots can block blood flow, resulting in tissue destruction.**

5.8 SKIN CANCER

1. **Skin cancer - is the most common type of cancer that is mainly caused by UV light exposure. Fair-skinned people are more prone, prevented by limiting sun exposure and using sunscreen.**

Types of Skin Cancer:

1. **Basal cell carcinoma - the most frequent type, begins with cells in the stratum basale and extends into the dermis to produce an open ulcer. This is removed by surgery.**
2. **Squamous cell carcinoma - develops from cells immediately superficial to the stratum basale. This may cause death.**
3. **Malignant melanoma - is a rare form of skin cancer that arises from melanocytes, usually in a preexisting mole. This may also cause death.**

5.9 INTEGUMENTARY SYSTEM AS A DIAGNOSTIC AID

Aging in the integument:

Blood flow decreases and skin becomes thinner due to decreased amounts of collagen.

Decrease activity of sebaceous and sweat glands make temperature regulation more difficult.

Loss of elastic fibers cause skin to sag and wrinkle.