

## Lecture 4

### The integumentary system I-II

Structure and functions of the skin. Dermal circulation. Structure and functions of the Cutaneous Glands. Skin Disorders.

#### Plan of the Lecture

1. The Skin and Subcutaneous Tissue
  - a. Functions of the Skin
  - b. The Epidermis
  - c. The Dermis
  - d. The Hypodermis
  - e. Skin Color
  - f. Skin Markings
2. Hair and Nails
  - a. Hair
  - b. Nails
3. Cutaneous Glands
  - a. Sweat Glands
  - b. Sebaceous Glands
  - c. Ceruminous Glands
  - d. Mammary Glands
4. Skin Disorders
  - a. Skin Cancer
  - b. Burns

#### LEARNING OUTCOMES

1. list the functions of the skin and relate them to its structure
2. describe the three classes of burns and the priorities in burn treatment
3. describe the normal and pathological colors that the skin can have, and explain their causes
4. describe the common markings of the skin
5. name two types of sweat glands, and relate the structure and function of each
6. describe the location, structure, and function of sebaceous and ceruminous glands
7. Describe the role of dermal circulation
8. describe the three most common forms of skin cancer, define them

The integumentary system consists of the skin, hair, nails, and their associated glands. The skin (integument) is the body's largest and heaviest organ. In adults, it covers an area of 1.5 to 2.0 m<sup>2</sup> and accounts for about 15% of the body weight. It

consists of two layers: a stratified squamous epithelium called the epidermis and a deeper connective tissue layer called the dermis (fig. 6.1). Below the dermis is another connective tissue layer, the hypodermis, which is not part of the skin but is customarily studied in conjunction with it. Functions of the Skin: resistance to trauma and infection (keratin, acid mantle), other barrier functions (waterproofing, UV radiation, harmful chemicals), vitamin D synthesis (skin first step, liver and kidneys complete process), sensation - skin is our most extensive sense organ, thermoregulation (thermoreceptors, vasoconstriction / vasodilation), nonverbal communication, transdermal absorption (administration of certain drugs steadily through thin skin – adhesive patches). The epidermis is a keratinized stratified squamous epithelium. That is, its surface consists of dead cells packed with the tough protein keratin. Like other epithelia, the epidermis lacks blood vessels and depends on the diffusion of nutrients from the underlying connective tissue. It has sparse nerve endings for touch and pain, but most sensations of the skin are due to nerve endings in the dermis.

Beneath the epidermis is a connective tissue layer, the dermis. It ranges from 0.2 mm thick in the eyelids to about 4 mm thick in the palms and soles. It is composed mainly of collagen, but also contains elastic and reticular fibers, fibroblasts, and the other cells typical of fibrous connective tissue. It is well supplied with blood vessels, cutaneous glands, and nerve endings. The hair follicles and nail roots are embedded in the dermis. In the face, skeletal muscles attach to dermal collagen fibers and produce such expressions as a smile, a wrinkle of the forehead, or the lifting of an eyebrow. The boundary between the epidermis and dermis is histologically conspicuous and usually wavy. The upward waves are fingerlike extensions of the dermis called dermal papillae, and the downward epidermal waves between the papillae are called epidermal ridges. Beneath the skin is a layer called the hypodermis or subcutaneous tissue. The boundary between the dermis and hypodermis is indistinct, but the hypodermis generally has more areolar and adipose tissue. It pads the body and binds the skin to the underlying tissues. Drugs are introduced into the hypodermis by injection because the subcutaneous tissue is highly vascular and absorbs them quickly.

The most significant factor in skin color is melanin. This is produced by the melanocytes but accumulates in the keratinocytes of the stratum basale and stratum spinosum. There are two forms of melanin: a brownish black eumelanin and a reddish yellow sulfur-containing pigment, pheomelanin. People of different skin colors have essentially the same number of melanocytes, but in dark skin, the melanocytes produce greater quantities of melanin, the melanin granules in the keratinocytes are more spread out than tightly clumped, and the melanin breaks down more slowly. Thus, melanized cells may be seen throughout the epidermis, from stratum basale to stratum corneum. In light skin, the melanin is clumped near the keratinocyte nucleus, so it imparts less color to the cells. It also breaks down

more rapidly, so little of it is seen beyond the stratum basale, if even there.

**Skin Markings.** Friction ridges – the markings on the fingertips that leave oily fingerprints on surfaces we touch. Everyone has a unique pattern formed during fetal development and remain unchanged throughout life, not even identical twins have identical fingerprints, allow manipulation of small objects. Flexion lines (flexion creases) – lines on the flexor surfaces of the digits, palms, wrists, elbows. Marks sites where the skin folds during flexion of the joints. Freckles and moles – tan to black aggregations of melanocytes. Freckles are flat, melanized patches, Moles (nevus) are elevated melanized patches often with hair. • moles should be watched for changes in color, diameter, or contour, may suggest malignancy (skin cancer). Hemangiomas (birthmarks) – patches of discolored skin caused by benign tumors of dermal blood capillaries, some disappear in childhood, others last for life. Capillary hemangiomas, cavernous hemangiomas, port-wine stain.

Compared with other mammals, the relative hairlessness of humans is so unusual that it raises the question, Why do we have any hair at all? What purpose does it serve? There are different answers for the different types of hair; furthermore, some of the answers would make little sense if we limited our frame of reference to industrialized societies, where barbers and hairdressers are engaged to alter the natural state of the hair. It is more useful to take a comparative approach to this question and consider the purposes hair serves in other species of mammals.

Most hair of the human trunk and limbs is probably best interpreted as vestigial, with little present function. Body hair undoubtedly served to keep our ancestors warm, but in modern humans it is too scanty. Stimulation of the hair receptors, however, alerts people to parasites crawling on the skin, such as fleas and ticks, and to remove them. Thus, we are less likely to become unknowingly infested with parasites.

The skin has five types of glands - merocrine sweat glands (3 to 4 million in adult skin, simple tubular glands, myoepithelial cells – contract in response to stimulation by sympathetic nervous system and squeeze perspiration up the duct), apocrine sweat glands (in groin, anal region, axilla, areola, bearded area in mature males, ducts lead to nearby hair follicles, produce sweat that is thicker, milky, and contains, fatty acids, scent glands that respond to stress and sexual stimulation, develop at puberty), sebaceous glands, ceruminous glands, mammary glands.

**Skin cancer.** Consequently, most tumors occur on the head, neck, and hands, where exposure to the sun is greatest. It is most common in fair-skinned people and the elderly, who have had the longest lifetime UV exposure (see Deeper Insight 6.4). The ill-advised popularity of suntanning, however, has caused an alarming increase in skin cancer among younger people. Skin cancer is one of the most common cancers, but it is also one of the easiest to treat and has one of the highest survival

rates when it is detected and treated early. There are three types of skin cancer named for the epidermal cells in which they originate: basal cell carcinoma, squamous cell carcinoma, and melanoma. The three types are also distinguished from each other by the appearance of their lesions (zones of tissue injury).

Burns are usually caused by fires, kitchen spills, or excessively hot bath water, but they also can be caused by sunlight, ionizing radiation, strong acids and bases, or electrical shock. Burn deaths result primarily from fluid loss, infection, and the toxic effects of eschar - the burned, dead tissue.

Check yourself! The questions for self-control

1. What is the major histological difference between thick and thin skin? Where on the body is each type of skin found?
2. How does the skin help to adjust body temperature?
3. List the five cell types of the epidermis. Describe their locations and functions.
4. List the five layers of epidermis from deep to superficial.
5. What are the distinctive features of each layer? Which layer is often absent?
6. What are the two layers of the dermis? What type of tissue composes each layer?
7. Name the pigments responsible for normal skin colors and explain how certain conditions can produce discolorations of the skin.
8. What is the difference between vellus hair and terminal hair?
9. State the functions of the hair papilla, hair receptors, and piloerector.
10. State some reasonable theories for the different functions of hair of the eyebrows, eyelashes, scalp, nostrils, and axilla.
11. Define or describe the nail plate, nail fold, eponychium, hyponychium, and nail matrix.
12. How do merocrine and apocrine sweat glands differ in structure and function?
13. What other type of gland is associated with hair follicles? How does its mode of secretion differ from that of sweat glands?
14. What is the difference between the breast and mammary gland?
15. What types of cells are involved in each type of skin cancer?
16. Which type of skin cancer is most dangerous? What are its early warning signs?
17. What are the differences between first-, second-, and third-degree burns?
18. What are the two most urgent priorities in treating a burn victim? How are these needs addressed?

Recommended readings:

1. Kenneth S Saladin - Anatomy & Physiology. The Unity of Form and Function (2016, McGraw-Hill Education)

2. Barbara Gylys - Medical Terminology Systems (2012, F.A. Davis Company)