

The Integumentary System

The integumentary system includes the skin and its associated structures - nails, hair, skin glands. Its functions include: (pp 149 – 150)

- protection from physical, chemical and biological assaults on the body. It is extremely rare that microorganisms are capable of penetrating intact skin.
- regulation of body temperature. Sweat glands cool the skin by evaporation. Blood vessels within the skin dilate if body temperature is too warm allowing heat to radiate of the skin. If too cold, these vessels constrict to conserve body heat.
- sunlight on the skin can convert certain steroids into some other useful compounds and thus the skin serves a metabolic function.
- excretion. Some salts and nitrogenous wastes are excreted through the skin though most are excreted in the urinary system.
- the blood vessels of the skin act as a blood reservoir. The body can shunt blood to other parts where it may be needed.

Structure

The skin has two main layers, the more superficial epidermis and the deeper dermis. The most abundant stratified squamous cells of the epidermis are keratinocytes (containing the tough fibrous protein keratin). There are also melanocytes which make melanin, the pigment that protects against ultraviolet rays and accounts for skin color differences among people. All people have approximately the same number of melanocytes in the skin but these cells produce varying amounts of melanin.

The epidermis is composed of four or five layers or strata:

1. The deepest layer of the epidermis is the stratum basale. It is a single row of highly mitotic cells. As the cells divide, they push outward toward the surface. About 1 in 10 to 1 in 4 cells of the stratum basale are melanocytes.
2. The next layer (going towards the surface) is the stratum spinosum. It is a few cells thick and mitosis may also occur here but with less frequency. In this layer we find most of the Langerhans' cell which are modified white blood cells and phagocytes of foreign material.
3. The stratum granulosum is the third layer and is only a few cells thick. Because cells are now some distance from a blood supply, cells here begin to die. These cells, as are the cells above it are very flattened.
4. The stratum lucidum is a band of clear, dead keratinocytes found only in the palms, soles and fingertips. Because of this extra layer the skin here is referred to as "thick" skin, all other skin is "thin" skin.
5. The stratum corneum is the most superficial layer. It is comprised of about two dozen dead, flattened keratinocytes. Although made of dead cells, this is the most protective layer.

Under the epidermis is the dermis, a well-vascularized and well-innervated layer, in which are the skin glands and hair follicles. There are two layers of the dermis:

1. The thinner, more superficial papillary layer appears as “egg crates”, having many projections called dermal papillae. Many nerve endings sensitive to pressure and pain are here. On the palms and soles, these papillae are atop of larger mounds called dermal ridges. These cause the epidermis to form ridges causing fingerprints.
2. The deeper and by far thicker layer of the dermis is the reticular layer and includes dense connective tissue containing a lot of collagen. In this layer is found many of the skin appendages. Beneath the dermis is the hypodermis consisting primarily of a layer of adipose tissue. This layer is not actually considered a part of the skin.

Skin Appendages

Sudoriferous glands (sweat glands) are distributed over almost the entire skin surface. Eccrine sweat glands are coiled glands secrete their product through pores on the skin surface. Sweat is mostly water but may contain small amounts of salts, nitrogenous wastes, antibodies and a naturally occurring antimicrobial substance. It is secreted as a response to heat but may also be a response to stress and certain emotional states. A second kind of sweat gland, apocrine sweat glands are confined to the axillary and genital areas and become active beginning at puberty. Their ducts empty into hair follicles and their product consists of sweat and some lipids and proteins which might act as sex pheromones. Ceruminous (earwax) glands and mammary glands are modified sweat glands.

Sebaceous glands secrete an oily substance, sebum, usually into a hair follicle. It softens and lubricates the skin and retards water loss. It also has antimicrobial properties. These glands are activated during puberty. Bacteria that grow in these glands, particularly during puberty, may cause an inflammation that we call acne.

Pili (hairs) consist mostly of dead, keratinized cells. It is a hard keratin that is also found in nails. Each hair has a shaft projecting from the skin surface and a root embedded in the skin. There are three concentric layers: a core or medulla surrounded by a cortex and an outermost cuticle. Hair follicles are invaginations of the epidermis that enclose the roots. This in turn is wrapped in a connective tissue sheath. The hair bulb (the expanded bottom of the follicle) is surrounded by a network of nerve fibers, the root hair plexus. The hair papilla is dermal tissue that protrudes into the hair bulb and contains small blood vessels. Melanocytes in the papilla account for hair color. Attached to each hair follicle is a small muscle called the arrector pili. Certain emotional states will cause the contraction of the muscle causing the hair to become upright, perpendicular to the skin. (Think of a cat.) When this happens, the hair pushes against the epidermis causing it to pucker as a “goose bump”.

There are two basic types of hair: vellus hair, a finer hair that covers most of the body (except the palms and soles) and terminal hair that is coarser and is found on the scalp, eyebrows, axillary and pubic areas. It also grows in response to testosterone (male hormone) and so may be found in other areas on men (beard, etc.) Vendugo is fetal hair that is usually lost by the eighth month of gestation but may sometimes be seen for a short time after birth. Hirsutism (excessive hairiness) may occur sometimes as a result of hormone imbalance. Alopecia is a term used to describe baldness or hair thinning in both sexes. This is not to be confused with male pattern baldness which is a sex-linked trait.

A nail consists of a free edge (which you periodically cut), a body attached to the nail bed, and a root embedded in the skin. The thickened, proximal portion of the nail bed is the nail matrix which produces hard keratin causing the nail to grow. The white, crescent-shaped area at the base of the nail is called the

lunula. The skin overlapping the base of the nail is referred to as the proximal fold and on the sides is referred to as the lateral folds. The cuticle adjacent to the proximal fold is called the eponychium.

Skin Cancers

Ultraviolet light from the sun can cause a buckling in the DNA in skin cells and may ultimately lead to skin cancer. The most common form is a basal cell carcinoma which rarely metastasizes and are easily removed. Squamous cell carcinomas, arising from keratinocytes of the stratum spinosum, also show high rates of cures. The most dangerous skin cancers are melanomas, arising from melanocytes. These cancers are highly metastatic. Some develop from pre-existing moles.

Burns

Burns due to intense heat, electricity, chemicals or radiation are classified according to the depth of tissue destruction. First degree burns only affect the epidermis and is characterized by redness, swelling and pain. Second degree burns involve the upper part of the dermis as well as the epidermis and in addition to the above symptoms, the skin blisters. Blisters occur when the epidermis and dermis separate and the space between becomes filled with serous fluid. Often 1st degree and 2nd degree burns together are referred to as partial-thickness burns. Third degree burns, or full-thickness burns, involve the entire skin. Because nerve endings are destroyed, the burned area is painless. These burns may result in loss of body fluid and shock, hypothermia, and greatly enhance the possibility of infection.

Emergency medical workers often use the “rule of nines” to make a quick estimate of the extent of burned areas on the skin. Certain areas are estimated to be 9% or multiples of 9% : each arm = 9%, anterior leg = 9%, posterior leg = 9%, head & neck = 9%, anterior trunk = 18%, posterior trunk = 18% and perineal area = 1%.

Alterations of Skin Color (p 43)

Erythema – reddened skin. May be due to such things as infectious disease, hypertension or allergy.

Jaundice – yellowish skin tone usually caused by a liver disorder.

Cyanosis – bluish or ashen-colored skin usually in the nail beds and mucous membrane. Caused by lack of oxygen.

Ecchymosis (bruises) – black and blue marks where blood has escaped the vessels (extravasation) and clotted beneath the skin.