الانسجة الحيوانية النظري

المحاضرة التاسعة: الجهاز الغطائي الجلد

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SKIN

INTRODUCTION

The skin is the largest single organ of the body, typically accounting for 15–20% of total body weight and, in adults, presenting 1.5–2m^2 of surface to the external environment. Also known as the **integument** (covering) or **cutaneous layer**, the skin is composed of the **epidermis**, an epithelial layer of ectodermal origin, and the **dermis**, a layer of mesodermal connective tissue. Epidermal derivatives include hairs, nails, and sebaceous and sweat glands. Beneath the dermis lies the **subcutaneous tissue** or **hypodermis**, a loose connective tissue that may contain pads of adipocytes. The subcutaneous tissue binds skin loosely to the underlying tissues and corresponds to the superficial fascia of gross anatomy. Skin is elastic and can expand rapidly to cover swollen areas and is self-renewing throughout life. In healthy individuals injured skin is repaired rapidly.

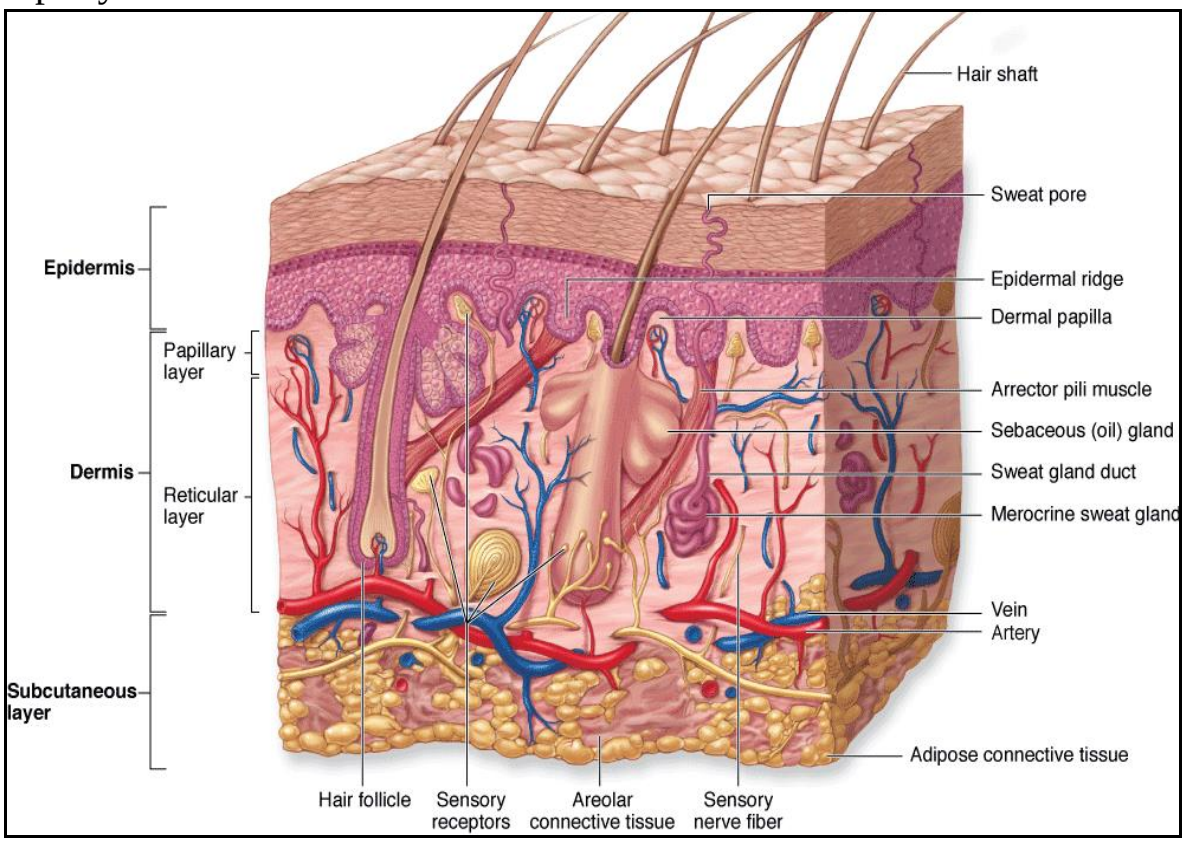

Diagram: skin layers shows their interrelationships and the locations of the epidermal appendages (hair follicles, sweat and sebaceous glands), the vasculature, and the major sensory receptors.

EPIDERMIS

The epidermis consists mainly of a stratified squamous keratinized epithelium composed of cells called **keratinocytes**. Three less abundant epidermal cell types are also present: pigment-producing **melanocytes**, antigen-presenting **Langerhans cells**, and tactile epithelial cells or **Merkel cells.**

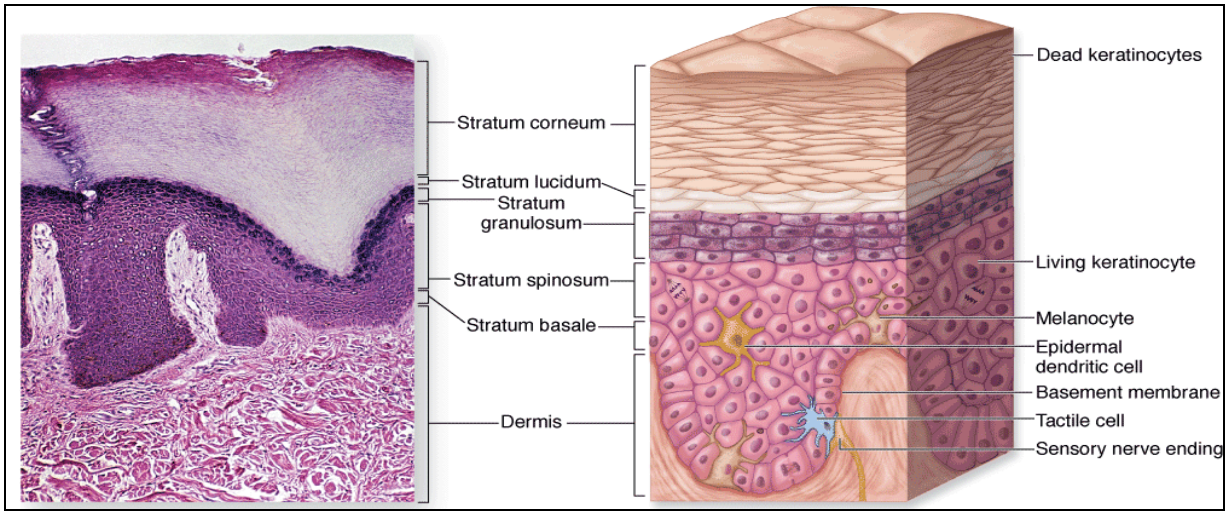

Figure: Layers (strata) of epidermis in thick skin.

The epidermis forms the major distinction between **thick skin**, found on the palms and soles, and **thin skin** found elsewhere on the body. The designations "thick" and "thin" refer to the thickness of the epidermal layer, which varies from 75 to 150μm for thin skin and from 400 to 1400μm for thick skin. Total skin thickness (epidermis plus dermis) also varies according to site.

From the dermis outward, the epidermis consists of four layers of keratinocytes, five layers in thick skin:

- The **basal layer** (**stratum basale**) is a single layer of basophilic columnar or cuboidal cells on the basement membrane at the dermal-epidermal junction. The stratum basale is characterized by intense mitotic activity and is responsible, in conjunction with the initial portion of the next layer, for constant production of epidermal cells. The human epidermis is renewed about every 15–30 days, depending on age, the region of the body, and other factors.
- The **spinous layer** (**stratum spinosum**), normally the thickest epidermal layer, consists of polyhedral or slightly flattened cells having central nuclei. The keratin filaments form microscopically visible bundles called **tonofibrils** which converge and terminate at

the numerous desmosomes, by which the cells are joined together strongly to resist friction. Cytoplasm is drawn into short cellular extensions around the tonofibrils on both sides of each desmosome, leading to the appearance of many short spines at the cell surfaces. The epidermis of areas subjected to continuous friction and pressure has a thicker stratum spinosum.

- The **granular layer (stratum granulosum)** consists of 3–5 layers of flattened polygonal cells undergoing terminal differentiation. Their cytoplasm is filled with basophilic masses called **keratohyaline granules.** Other characteristic features in cells of the granular layer are the membrane-coated **lamellar granules,** small ovoid structures containing many lamellae composed of various lipids. The layer of lipid envelopes is a major component of the epidermal barrier against the loss of water from skin.
- The **stratum lucidum** is only seen in thick skin, where it consists of a thin, translucent layer of extremely flattened eosinophilic cells. The nuclei and organelles have been lost and the cytoplasm consists almost only of packed keratin filaments embedded in an electron-dense matrix.
- The **stratum corneum** consists of 15–20 layers of flattened, nonnucleated keratinized cells whose cytoplasm is filled with filamentous keratins. After keratinization, the cells contain only fibrillar and amorphous proteins with thickened plasma membranes and are called **squames** or horny, cornified cells.

DERMIS

The **dermis** is the connective tissue that supports the epidermis and binds it to the subcutaneous tissue (hypodermis). The surface of the dermis is very irregular and has many projections (dermal papillae) that interdigitate with projections of the epidermis. Dermal papillae are more numerous in skin that is subjected to frequent pressure.

A **basement membrane** is always found between the stratum basale and the papillary layer of the dermis. The basement membrane consists of the **basal lamina** and the **reticular lamina** and can usually be seen with the light microscope. Nutrients for

keratinocytes must diffuse into the avascular epidermis from the dermis vasculature through this basement membrane.

The dermis contains two layers the outermost **papillary layer** and the deeper **reticular layer**. The thin papillary layer, which constitutes the major part of the dermal papillae, is composed of loose connective tissue, with fibroblasts and other connective tissue cells, such as mast cells and macrophages. The reticular layer is thicker, composed of irregular dense connective tissue, and has more fibers and fewer cells than the papillary layer. A network of elastic fibers is also present, providing elasticity to the skin. The dermis is the site of such epidermal derivatives as the hair follicles and glands. There is also a rich supply of nerves in the dermis.

SUBCUTANEOUS TISSUE

The **subcutaneous layer** consists of loose connective tissue that binds the skin loosely to the subjacent organs, making it possible for the skin to slide over them. This layer, also called the **hypodermis** or **superficial fascia**, often contains fat cells that vary in number in different regions of the body and vary in size according to nutritional state. An extensive vascular supply in the subcutaneous layer promotes rapid uptake of insulin or drugs injected into this tissue.

SENSORY RECEPTORS

A variety of sensory receptors are present in skin, including both simple nerve endings with no glial or collagenous covering and more complex structures with sensory fibers enclosed by glia and delicate connective tissue capsules.

The *unencapsulated* receptors include the following:

- **Tactile discs** associated with the epidermal tactile cells, which function as receptors for light touch.
- **Free nerve endings** in the papillary dermis and extending into lower epidermal layers, which respond primarily to high and low temperatures, pain, and itching, but also function as tactile receptors.
- **Root hair plexuses**, a web of sensory fibers surrounding the bases of hair follicles in the reticular dermis that detects movements of the hairs.

The following *encapsulated* receptors are tactile mechanoreceptors:

- **Tactile corpuscles** (also called **Meissner corpuscles**) are elliptical structures. They detect light touch.
- **Lamellated (Pacinian) corpuscles** are large oval structures, found deep in the reticular dermis or hypodermis, with an outer capsule and 15 to 50 thin, concentric lamellae of flat Schwann-type cells and collagen surrounding a highly branched, unmyelinated axon. Lamellated corpuscles are specialized for sensing coarse touch, pressure, and vibrations.
- **Krause corpuscles** and **Ruffini corpuscles** are other encapsulated, pressure-sensing mechanoreceptors in dermis, but are more poorly characterized structurally.

HAIR

Hairs are elongated keratinized structures derived from invaginations of the epidermal epithelium called hair follicles. The color, size, shape and texture of hairs vary according to age, genetic background, and region of the body. All skin has at least minimal hair except that of the palms, soles, lips, and some areas. Hairs grow discontinuously, with periods of growth followed by periods of rest. The duration of the growth and rest periods also varies according to the region of the body. A **dermal papilla** inserts into the base of the hair bulb and contains a capillary network required to sustain the hair follicle. Loss of this blood flow results in death of the follicle. The epidermal cells covering this dermal papilla form the **hair root** that produces and is continuous with the **hair shaft** protruding beyond the skin surface.

The epithelial cells (keratinocytes) that make up the hair bulb are similar to those in the basal and spinous layers of epidermis. They divide constantly and then undergo keratinization, differentiating into specific cell types. In certain types of thick hairs, the cells of the central region of the root at the apex of the dermal papilla produce large, vacuolated, and moderately keratinized cells that form the **medulla** of the hair. Other cells differentiate into heavily keratinized, compactly grouped fusiform cells that form the hair **cortex**. The most peripheral cells produce the hair **cuticle,** a thin layer of heavily keratinized, shingle-like cells covering the cortex.

Melanocytes in the hair bulb transfer melanin granules into the epithelial cells that will later differentiate to form the hair color.

Separating the hair follicle from the dermis is an acellular hyaline layer, the thickened basement membrane called the **glassy membrane**. The surrounding dermis forms a connective tissue sheath. Running from a midpoint on this sheath and to the dermal papillary layer is a small bundle of smooth muscle cells, the **arrector pilimuscle**.

Cells in the hair root differentiate into the cell types of the hair medulla, cortex, and cuticle which differ somewhat in ultrastructure, histochemical characteristics, and function. Keratin of hair has a harder and more compact nature than that of stratum corneum, maintaining its structure much longer.

NAILS

A similar process of keratinization produces the **nails**, which are hard, flexible plates of keratin on the dorsal surface of each distal phalanx. The keratinized **nail plate** is bound to a bed of epidermis called the **nail bed**. The nail plate arises from the **nail matrix**, which extends from the nail root. Cells of the matrix divide, move distally, and become keratinized, forming the nail root. These matures as the nail plate, which continuous growth in the matrix pushes forward over the nail bed at about 3mm/month for fingernails and 1mm/month for toenails.

GLANDS OF THE SKIN

Sebaceous Glands

Sebaceous glands are embedded in the dermis over most of the body surface, except the thick, hairless (glabrous) skin of the palms and soles. Sebaceous glands are branched acinar glands with several acini converging at a short duct which usually empties into the upper portion of a hair follicle. The acini consist of a basal layer of undifferentiated flattened epithelial cells on the basal lamina. These cells proliferate and are displaced toward the middle of the acinus, undergoing terminal differentiation as distinctly large, lipid-producing **sebocytes** which have their cytoplasm filled with small fat droplets. Cells release the lipids via holocrine secretion. The

product of this process is **sebum,** which is gradually moved to the surface of the skin along the hair follicle or duct.

Sweat Glands

Sweat glands are epithelial derivatives embedded in the dermis which open to the skin surface or into hair follicles. Eccrine sweat glands and apocrine sweat glands have different distributions, functions, and structural details.

Eccrine sweat glands are widely distributed in the skin and are most numerous on the soles of the feet. Both the secretory portions and ducts of eccrine sweat glands are coiled and have small lumens. The secretory part is generally more pale-staining than the ducts and has stratified cuboidal epithelium consisting of three cell types. Pale pyramidal or columnar **clear cells** produce the sweat, having abundant mitochondria and microvilli to provide large surface areas. Interstitial fluid from the capillary-rich dermis around the gland is transported through the clear cells, either directly into the lumen or into intercellular canaliculi that open to the lumen. As numerous as the clear cells are pyramidal **dark cells** which line most of the luminal surface and do not touch the basal lamina. Dark cells are mucoid and filled with glycoprotein-containing granules whose bactericidal activity. The ducts of eccrine sweat glands consist of two layers of more acidophilic epithelial cells filled with mitochondria. Besides its important cooling role, sweat glands also function as an auxiliary excretory organ, eliminating small amounts of nitrogenous waste and excess salts.

Apocrine sweat glands are largely confined to skin of the axillary and perineal regions. Their development (but not functional activity) depends on sex hormones and is not complete until puberty. The most obvious histological difference between the two kinds of sweat glands is the much larger lumen of apocrine glands. The secretory portions of apocrine sweat glands consist of simple cuboidal, eosinophilic cells with numerous apical secretory granules that undergo exocytosis. Lumens of apocrine glands often show stored, protein-rich product, which myoepithelial cells help move into ducts opening into hair follicles. The wall of the ducts is similar to that of the eccrine glands.