

DERMATOLOGY LECTURES– Prof. Dr. Khudair Al-Kayalli

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Dermatology:

Definition: It is the branch of medicine that concerned with the diagnosis and treatment of skin disorders .

Dermatologist : Is a physician that concerned with diagnosis and treatment of skin disorders , must have a good knowledge of internal medicine , external factors (chemicals , physicals , plants , animals , microorganisms , radiation ----- etc) and also pay attention to the psyche .

The dermatologists might face at least 2000 different conditions and they treated patients of different ages , from the neonate to the very old one , the conditions ranged from cosmetic problems (e.g. Dry skin) to a variety of acute and chronic diseases . In addition to the clinical work , all dermatologists are involved in teaching of nurses , undergraduate medical students , GPs and trainee dermatologists .

Anatomy : Skin is the largest organ in the body .

Normal human skin consists of three layers :

1. Epidermis (upper stratified squamous cellular layer) .
2. Dermis (middle connective tissue layer) .
3. Subcutaneous layer (panniculus adipose , lower fatty layer) .

The epidermis joined to the underlying dermis by what is called derma- epidermal junction , appears as undulating in section , i.e. the rete ridges of the epidermis project into the dermis , which provides mechanical support for the epidermis and acts as a partial barrier against exchange of cells and large molecules .

There are two main kinds of human skin :

a. Glabrous skin (non-hairy skin) is found on the palms and soles and is characterized by :

* It is grooved on its surface by continuously alternating ridges and sulci in individually unique configuration known as dermatoglyphics .

* It is characterized by a thick epidermis , divided in to several well-marked layers .

* The presence of encapsulated sense organs within the dermis .

* Lack of hair follicles , sebaceous glands and apocrine glands .

b. Hairy skin (hair bearing skin) is found on the other parts of skin , characterized by :

* Absence of dermatoglyphics .

* Thin epidermis with regional variation

* Lacks of encapsulated sense organs .

* The presence of hair follicles . sebaceous glands and in some areas apocrine glands e.g. axillae , groins .

Epidermis :- The normal epidermis is a terminally differentiated stratified squamous epithelium , its thickness is variable from 1.5mm (palm & sole) to 0.1mm (eye lid) . The major cell making up to 95% of the total number is keratinocyte , which move progressively from attachment to the epidermal basement membrane to word the skin surface , forming several well defined layers during its transit . These layers from done up ward are :-

1. **Stratum basale** (Stratum germinativum) :- It is a continuous layer of only one cell thick , but may be 2-3 cells thick in glabrous skin and hyperproliferative

epidermis . The cell is small , cuboidal (10-14 μ m) , have large , dark staining nuclei , dense cytoplasm containing ribosome and dense tonofilament bundles (the cell is keratinocyte) .

2. **Stratum spinosum** (Spinous or prickle cell layer) :- This layer is located immediately above the basal cell layer , about 5-10 cells thick , cuboidal in the lower layers and starting to flattened gradually as move up ward , it contains as well as to cytoplasmic structures , a keratohyalin granules (2 μ m size) , which is more prominent in the upper layers and also contain other lamellated granules (100-200nm in size) called lamellar or odland bodies . Both first and second layers called malpighian layer .

3. **Stratum granulosum** (granular cell layer) :- It is about 1-3 cells thick , small , slightly flattened , contains also keratohyalin granules and odland bodies as well as to the cytoplasmic structures .

4. **Stratum corneum** (Horny layer):- It is about 10-20 cells thick , the outermost layer of the epidermis (the cell called corneocyte) , have lost nuclei and cytoplasmic organelles , become severely flattened , compacted and containing keratin protein filaments , which represent the end result of keratohyalin granules .

5. **Stratum lucidum** ;:- Only present in thick palmo-planter skin between the third and fourth layers , still nucleated and may be referred as transitional cells .

There are several types of cellular junctions that link the adjacent keratinocyte , which are responsible for mechanical , biochemical and signaling interactions between cells , these include desmosomes , adherent junctions , gap junctions and tight junctions .

Derma-epidermal junction :- This is one of the largest epithelial junction in the body , it form an extensive interface between the dermis and epidermis and is continuous with the junction between the dermis and epidermal appendages , it is about 0.5-1 μ m in thickness and acting as a barrier and adhere the dermis to the epidermis and consisting of :-

- a. Plasma membrane of the basal keratinocytes , melanocytes , merkel cells and closely related structures including hemidesmosomes .
- b. Basement membrane zone : which is immediately beneath the basal plasma membrane and consisting of three layers [lamina lucida , lamina densa and the lamina fibroreticularis (Anchoring fibrils)] .

Dermis:- It is the middle layer bounded externally by its junctions with the epidermis and internally by subcutaneous fat . Its thickness varies from about 5mm on the back and thighs to 1mm on the eye lids and contributes about 15-20% of the total body weight of the human . It provides nutriment to the epidermis and its appendages and cushioning the body against mechanical injuries .

The dermis consists of two layers :-

1. **Superficial papillary dermis** : is a thin layer separated from the epidermis by basement membrane .
2. **Lower reticular dermis** : it represented 9/10 of thickness of dermis , it blends with subcutaneous fat and in certain regions contain smooth muscles (e.g. nipple , penis , scrotum and perineum) .

The dermis consists of two structures :-

- a. **Ground substance** (matrix) : which consists of polysaccharides and proteins coexist and interact to produce hygroscopic proteoglycan macromolecules , which strongly attract and retain water .

- b. **Protein fibers** : which run through and attached to the matrix , it includes the collagen and elastin . There are 17 type of collagen , represents 75% of the dry weight and 18-30% of the volume of dermis , more than 70% is type one collagen and 15% type three collagen . The elastic fibers form an extensive network which intermeshes with collagen fibers .

Subcutaneous layer (Panniculus adipose) :- Is the fatty layer , located just below the dermis and separated from the rest of the body by vestigial layer of striated muscle called panniculus carnosus .

Blood supply of the skin:- The blood vessels of the skin consists of two plexus :

- a. **Cutaneous network** (intermediate plexus): located on the border between the subcutaneous tissue and the dermis , which received arteries from the underlying deep plexus (fascial network , present in fascia lata) . The intermediate plexus gives branches to the various skin appendages and provides ascending arterioles to supply the subpapillary plexus .
- b. **Subpapillary plexus** : located on the border between the papillary and reticular dermis , which it self forms capillary loops in the papillary layer between the ridges of the derma-epidermal frontier , from these capillary the blood is drained by venules which descend to intermediate plexus .

Lymphatic system :- consists of interconnecting lymphatic spaces arise from terminal bulbs in the papillary dermis and ultimately form the system which drains into the regional lymph nodes , it serves to transport particulate and liquid materials , such as leaked protein from the extravascular compartment of the dermis .

Nerves and sense organs : Are divided into motor and sensory enervation.

- A. **Motor enervation** : is autonomic and include both :
 - * **Cholinergic** (parasympathetic) to eccrine sweat glands .
 - * **Adrenergic** (sympathetic) to both eccrine and apocrine glands , smooth muscles , arterioles and to erector pili muscles .
- B. **Sensory nerve endings** : are originated from posterior root ganglia and when the main nerve trunk entering the subdermal tissue each divided in to smaller bundles , which form groups of networks of myelinated fibers , from which ascending non-myelinated nerve fibers accompanying blood vessels ascend to the superficial dermis and it is of two main kinds :-
 - 1.**Corpuscular**- which embrace non-nervous elements and subdivided in to :-
 - a. **Encapsulated receptors**- it occurs in the dermis and including :
 - pacinian corpuscle – located at the border between dermis and subcutaneous layer .
 - Golgi-Mazzoni corpuscle – located in the subcutaneous tissue of the human fingers .
 - Krause end bulb – situated in the superficial layers of the dermis .
 - Meissner corpuscles – situated in the papillary ridges of glabrous skin .
 - Rufini corpuscle – related directly to collagen fibers in digits .
 - b. **Non-encapsulated** – is exemplified by Merkel's 'touch spot' which is epidermal in location .
 2. **Free nerve endings** : is derived from non-myelinated fibers , occur in the superficial dermis and overlying epidermis and also supplying the hair follicles .

Histology of the skin :-

1. **Epidermis** – contains two types of cells : the **resident cells** are :
 - **Keratinocyte** – is the major cell of the epidermis , represented about 95% of the cellular mass and is stratified squamous epithelial cell .
 - **Melanocyte** – is pigment producing cell ,dendritic , located in the basal cell layer of about 1/10 , having small dark-staining nucleus , with large clear cytoplasm , it form epidermal-melanin unite (1 melanocyte to 36 keratinocyte) , which synthesis melanin and transformed to the adjacent keratinocytes through dendritic processes .
 - **Langerhan's cell** – also it is a dendrite cell similar to melanocyte , but free from pigment and dopa negative but ATP positive , found in the human epidermis , pilary canals and outer route sheath of the hair follicles . It has lobulated nucleus with clear cytoplasm and contain Birbeck granules , mesenchymal in origin from bone marrow , has an important role in cutaneous immune reactions as a specialized antigen –presenting cell .
 - **Merkel cell** – it has a lobulated nucleus and characteristic granules in the cytoplasm and distally embedded in the basal layer , with nerve plate underlies it (touch spot) . There are two hypothesis about its origin , one postulates that they are derived from neural crest and the other assume that they arise in situ i.e. derived from epithelial cells , which is the mostly suggested and its function is a touch sensation .
 - **Non specific cell** – (undeterminate cell) it is also dendritic cell of unknown origin and function .

The epidermis – may contain other transient cells i.e. not resident or permanent e.g. neutrophils , lymphocyte , monocyte , eosinophiles -----etc .

2. **Dermis** – also contains two types of cells : **resident cells** which include :-
 - **Fibroblast** – is the basic cell of the dermis , mesenchymal in origin , it is active cells forming and secreting collagen and suspiciously elastic fibers , spindle in shape with abundant cytoplasm , also produce ground substance .
 - **Mast cell** – is connective tissue cell , larger than eosinophile and basophile , occur in most of tissues , but numerous in skin , bronchus , nasal mucosa and the gut . It is of two types , mucosal and connective tissue and contains granules . Degranulation of the cell occurs as a result of IgE mediated reaction and results in release of histamine and other mediators , it is hematopoietic stem cell in origin . Mast cells are distributed close to blood vessels , nerves , skin appendages and are most numerous in the subpapillary dermis . Dermal mast cell is ovoid or spindle in shape , mononuclear or occasionally binuclear , rarely show signs of mitosis in normal skin .
 - **Histiocyte , macrophage and lymphocyte** .
 - **Basophile** - small , round multilobed nuclei , with cytoplasmic granules like mast cell .

Skin appendages are :-

1. Hair follicles .
2. Sebaceous glands .
3. Eccrine glands
4. apocrine glands .
5. Nails .

Functions of the skin :-

- a. **Barrier functions** – the skin acts as two – way barrier , it is the function of the epidermis and performed by the stratum corneum and melanin pigment , to prevent the inward and outward passage of water , electrolyte and other physical and chemical substances and microorganisms . The epidermis is impermeable , which is due to the presence of intercellular cement , which is a cornified material produced by odland (lamellar) bodies , present in the keratinocytes from spinous layer up to horny layer . Cement consists of neutral sugars linked to lipids and proteins , free sterols , hydrolytic enzymes and ceramides . An example of disturbance of this function is atopic dermatitis and using of topical therapy .
- b. **Temperature regulation** – the skin provides a sensory imputes to thermoregulation to allow heat loss or conservation . This function is performed throw warm and cold sensitive thermoreseptors , distributed over the skin cells , through which an impulse of temperature sense is sent to the hypothalamus , leading to either inhibition of sweating or stimulation of shivering . The rich blood supply of the dermis is the important factor in this mechanisms , the heat loss through the skin surface is by radiation , convection conduction and evaporation . The term **skin failure** is the loss of normal temperature control with inability to maintain the core temperature , failure to prevent percutaneous loss of fluid , electrolytes and protein , which result in imbalance and failure of the mechanical barrier to prevent entry of foreign materials , the term was used to bring the attention of non-dermatologists to dermatological emergencies e.g. Steven-Johnson syndrome , TEN, burns , pustular psoriasis , erythroderma , PV, GVHD and EP. bullosa .
- c. **Mechanical functions** – the dermis and subcutaneous fat have a role in the protective functions of the skin against hard blows with blunt objects (due to the collagen and elastic fibers) , this function is lost in Ehlers-Danlos syndrome and striae distencea .
- d. **Immunological functions** – it is performed by those cells residing in (keratinocytes and Langerhan's cells) or passing through (T-lymphocytes) the epidermis , as an antigen presenting cells and inducer cells respectively for e.g. ACD .
- e. **Sensory and autonomic functions** – sensations of touch , vibration , pressure , change in temperature , pain and itching , both sympathetic and parasympathetic nerves are involved in maintaining of cutaneous homeostasis by regulating vasomotor functions , pilomotor activity and eccrine sweat gland secretion .
- f. **Biosynthesis** – vitamin –D synthesis and its effects on calcium and bone metabolism .
- g. **Nails and hair** – has cosmetic importance , hair has a role in heat regulation and nails has protective and aid in performing delicate tasks.
- h. **Sociosexual communication** – the skin by virtue of its visual appear , smell and feel has an important role in social and sexual communication in humans , as dose in other animals .

Embryology (origin) of the skin :-

The skin arises by the Juxtaposition of two major embryological elements , the **prospective epidermis** , which originates from a surface area of the early gastrula and the **prospective mesoderm** , which is brought into contact inner surface of the epidermis during gastrulation , which give rise to the dermis . *Neural crest* give rise to the pigment cells .

Epidermis is ectodermal in origin , in about third week of gestation the epidermis consists of no more a single layer of undifferentiated glycogen filled cells , in about 4-6 weeks of gestation two layers of cells formed , periderm (epitrachial layer) and stratum germinativum . The *periderm* is a purely embryonic structure and ultimately lost in utero as the true epidermis keratinized beneath it .

- Between 8-11weeks , a middle layer start to form , glycogen abundant in all layers and few microvillus projections occur at the surface of the periderm
- By 12-16 weeks , there are one or more intermediate layers , their cells contain mitochondria , Golgi complexes and few tonofilaments .
- Between 16-26 weeks the intermediate layers increased in number and by 21 weeks keratohylin granules appear in the upper most layer and by 24 weeks the periderm cells start to separate from the embryo , which with lanngo hair , sebum and other materials , they form the vernix caseosa .

Hair follicles and apocrine glands :-

By 9 weeks of gestation hair rudiments occurs in the regions of upper lip and chin of embryo . The first sign of hair follicle formation is a crowding of nuclei in the basal layer of the epidermis , the so called :

1. **Primitive hair germ** (pregerm stage) , which pass rapidly to :
2. **Hair germ stage** – in which the basal cells become high , elongated nuclei and start to grow down ward in to the dermis , at the same time mesenchymal cells and fibroblasts increase in number to form the rudiment of the hair papilla beneath the hair germ , these events forms :
3. **Hair pig stage** – it grows obliquely and the advancing extremity becomes bulbous and gradually enveloping the mesodermal papilla to form :
4. **Bulbous hair pig stage** – which enhanced proliferation and differentiation with down ward growth . The first cells of the inner root sheath began to form above the region of the matrix , the matrix continues to burrow deeper and above the root sheath the inner cells of the follicle grow upwards into the epidermis to form the hair canal . **No** hair follicle formed after birth .

At this bulbous hair pig stage , two epithelial swelling appears on the posterior wall of the hair follicle . The lower one is the bulge to which the erector Pilli muscle becomes attached and the upper is the rudiment of the sebaceous gland . In many follicles a third bud latter appears above the sebaceous gland , which is the rudiment of the apocrine gland , which developed on the scalp , face , chest , abdomen , back , legs , axilla , mons pubis , external auditory meatus , eyelids , circumanal area , areola , labia minora , prepuce and scrotum , where they survive in the adult life .

Sebaceous gland :- at first it arise as solid bud on the posterior surface of the hair pegs and bulbous hair pegs , it's cells contains moderate amount of glycogen , but soon replaced by droplet of lipid , so the cell become larger and foamy . The differentiation of sebaceous gland started at 13-15 weeks of gestation .

Eccrine gland :- started to develop on the palms and soles at about 3months and on the other parts of the body at 5months . **At 12weeks** of gestation , the eccrine sweat gland rudiment first identifiable as regularly spaced undulations of the stratum

germinativum , **by 14-15** weeks the tips of the eccrine gland rudiments have penetrated deeply into the dermis and begun to form the coils and in the overlying epidermis , columns of cells that are destined to form the intraepidermal sweat ducts .

Nail :- begin to develop in the 3rd month of gestation , by 16-18 weeks keratinizing cells form both dorsal and ventral matrices .

Melanocyte :- originate from the neural crest , although neural crest can be identified in the early human embryos , but pigmented melanocytes can not be identified before 4-6 months of gestation .

Langerhan's cell :- is derived from the monocyte – macrophage – histiocyte lineage and enter the epidermis at about 12 weeks .

Merkel cell :- appears at about 16 weeks on glabrous skin , finger tips , gingival , nail bed and other regions .

Dermis :- the dermis and its constituent as well as the subcutaneous fat are mesenchymal in origin . **At about 2months** of gestation both dermis and subcutis are not distinguishable from each other , collagen fibers are evident by the end of the 3rd month . **By 5th** month connective tissue sheath are formed around the hair follicles .

By 22 weeks elastic fibers are first detectable , **by 6-14** weeks 3types of cells have been described in the dermis , stellate cells , phagocytic macrophages and granulosecretory cells (melanoblast or mast cells) . **By 14-21 weeks** fibroblast are numerous and active .

Dermal-epidermal junction :- **by 2nd month** the lamina densa of the basement membrane becomes evident and by the 3rd month the hemidesmosomes appears .