Epidermis

✓ the doctor mentioned at the begging of the lecture that the slides is from different sources and has information and details that is enough for us so we don’t have to go back and read from the book (unless you want to revise some terms or definitions that helps you to understand the slides). And since the slides has a lot of details, we will highlight just the main or the major points so please go back and make sure to read all the information in the slides.

Let's get started ....

Integumentary system

Today's lecture we will take about one of the different systems that build up the human body which is the integumentary system which includes the skin and its accessory structure like the hair follicle and the nails or the blood vessels and nerves that is found in or underneath the skin.

So what exactly is the skin??

The skin is an organ and indeed it is the largest organ of the body by surface area and weight and makes about 16% of entire body weight and sometimes it is called the *cutaneous membrane*.

- Divisions of skin and it embryonic origin:
  - Epidermis and derivatives(and the glands) –(ectoderm)

since the ectoderm is the most superficial layer of the embryo so it is common sense that it will give rise to the epithelium(keratinized stratified squamous epithelium) and the glands that is imbedded in it. So the ectoderm will start to proliferate and makes an invagination with the deeper layer then it will start to differentiate in to epithelium and hair, nails, etc.
• Dermis – Corium -(mesoderm)
Since the mesoderm is the germ layer which will give rise to all the connective tissue of the body so surly it will give origin to the dermis which is built of **Papillary layer** (loose CT) and **Reticular layer** (dense CT)

• There is another deep layer which is not considered a part of the skin but still part of the Integumentary system which is **subcutaneous (hypodermis) layer** -(originates from mesoderm).

  - The subcutaneous (hypodermis) layer: from the name amplifies it is underneath the skin (or the cutaneous membrane) so it will support the skin also it contains a fatty compartment so it will act as a fat storage too.

**The functions of the skin:**
They are simple and obvious like **protection** (mainly considered first line of defense). Also; it takes part in **the regulation of the body temperature** (by the action of the sweat glands and by vasodilatation or vasoconstriction) and surly it takes part in the sensation process too.

We can see the importance of the skin when it got disrupted like in the burn victims where they suffer mainly from fluid and ions imbalance (which will disturb the hemostasis of the patient body) and from Bacterial and fungal infections increase since the skin is the first line of defense.

**Now let's go deep in to the epidermis structure:**
The epidermis is most superficial layer of skin (and as we said it is mainly made of keratinized stratified squamous epithelium) and we can divide it in to two major types depend on the thickness of this layer in general (or more precisely according to the presence of the hair follicle):
- Thick skin on non hairy surfaces (like in the palm of the hand).
- Thin skin on most hairy surfaces of the body.
Thick vs. thin does not reflect true thickness of skin including dermis like for example: the skin on the back called thin but actually is thickest when dermal layer is included.

**Cells of Epidermis:** there are four cell types in the epidermis:

- Keratinocytes (squames) – and its main function is production of keratin and water barrier. And it makes more than 90% of cells in epidermis.
- Melanocytes – and its function is pigment production, and it makes less than 5% of cells in epidermis
- Langerhans cells – derived from white BC and it is sometimes called "الخليه الزباله" because it cleans up the cell debris and dead cell, its concentration is fluctuating according to the human health state and considered an immune response but it makes mainly (1-3%) of cells in epidermis
- Merkel cells – it has some sensory reception and local endocrine control, makes 1-3% cells of epidermis.

**Differentiation of keratinocytes:** as we said the main cells that is found in the epidermis is the keratinocytes but they are not all mature and found as a single layer, instead it will be in divided in to sublayers (or strata) and goes throw some differentiation process, but in general the old cells will be at the top and the young cells will be at the bottom and generally whenever the cells become mature and goes up they will:

- Change shape (become more flatten)
- Lose organelles
- Form fibrous proteins
- **Become dehydrated** and act as a water barrier
- Produce products that thicken plasma membranes and we will explain how later on.
These sublayers are (from down to up):

1. **Stratum Basale**: which is one single layer of cuboid cells that connect the epidermis with the dermis by hemidesmosome junction and it contains mainly two types of cells:
   - Stem cells: which is *mitotically active* and will give rise to keratinocytes and their derivatives (i.e. Merkel cells) (stem cells can be found in other layers but a large number of them is found in the basale layer)
   - Keratinocytes (and its ultimate goal is to produce the **keratin** which is a mixture of tonofiber and keratohyalin).

2. **Stratum Spinosum**: Their spiny-أشواك- (Latin, spinosum) appearance is due to the **desmosomes** (which will be connected with the cytoskeleton of the cells) that connect between the cells of the strata and that’s will give them a polyhedral shape (شكل خماسي او سداسي الخ...). These cells take part in synthesis of two major things:
   1. tonofilaments (which will form the tonofiber) which provides cytoskeletal framework and connect with the desmosomes.
   2. membrane-coated granule (MCG): these granule contain lamellar disks that are formed by lipid bilayers (Key to formation of effective water barrier)

3. **Malpighian layer**: is the skin layers with mitotic activity and it includes the **stratum basale** and **stratum spinosum** (that’s indicate that there is stem cells in the stratum spinosum)

4. **Stratum Granulosum**: its name indicates that the cells in this stratum contain a lot of granules which are basophilic (The basophilia is due to RNA within the granules which indicate active sites of filaggrin synthesis), these **filaggrin** will give the dark color of the dense, refractile, basophilic granules of keratohyalin. And on the other hand, Tonofilaments have condensed into tonofibrils which are anchored in the matrix of the granules (that’s all indicates that the process of making keratin is close).

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[69x776]These sublayers are (from down to up):

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Also at this stratum MCG (which are synthesized at the previous stratum) are released into extracellular space forming a water barrier taking the role (or the function) of the zonula occludens.

✓ Zonula occludens: tight junctions formed by the fusion of integral proteins of the lateral cell membranes of adjacent epithelial cells (of the internal organ mainly), limiting transepithelial permeability. It is absent in the skin.

4- Stratum Lucidum (lucidum means transparent): this stratum is not always present sometimes it can be absent (mainly found in thick skin). It is transparent because the substance or the protein inside the cells which is called the eleidin (intermediary in formation of keratin from keratohyaline granules and tonofibrils) is clear.

5- Stratum Corneum: the cells at this stratum start to die and the cells at the apex will start shedding, while the Plasma membranes thickened by Previous emptying of MCG into intercellular space in the subjacent layer.

✓ The time taken by the cell to complete the cycle of (Proliferation, Differentiation, and Exfoliation) is one to one and half month.

✓ Thin skin lacks well developed: Stratum corneum– Stratum lucidum– Stratum granulosum.

Pigmentation system: is the system that is responsible for giving the color of the skin by the action of the melanocyte.

-melanocyte originates from neural crest and it produce melanin then Transfer melanin to keratinocytes by Cytocrine secretion (exocytosis coupled with endocytosis) where the melanin exit the melanocyte by exocytosis then enter the keratinocytes by endocytosis.

-melanin formation (melanogenesis) simply: there is vacuole which pinch out from the golgi apparatus which called the melanosome and it include the melanin precursor and the Tyrosinase enzyme which will
convert the precursor to melanin then the Melanin accumulate on sunny side of nucleus or( above the nucleus )to protect the nucleus from UV.

- Racial differences due to: how fast the melanin is degraded not due to different number of the melanocytes (the black people degrade the melanin slower that the white people and more susceptible for melanoma cancer).

✓ There is a student who asked the doctor about the how the jaundice can affect the skin color??

The doctor answered simply the bilirubin will not affect the melanin it just accumulate in the skin and gives a yellowish color.

✓ The last 3 slides the doctor didn’t add any information on them he just read them sp please go back and make sure to read them...

Best of luck!