

Integumentary System

- includes the skin and its accessory organs, such as hair, nails, glands, and the various specialized receptors.
- The largest organ in the body..
- has a area of about 22 square feet
- Epidermis is replaced every 15-30 days
- Dermatology is the medical subspecialty that deals with skin disorders.

Integumentary System (cont)

Consist of two principal parts

- epidermis- the outer thinner portion composed of the epithelium
- dermis- the inner thicker portion composed of connective tissue to which the epidermis is attached.

Subcutaneous layer (hypodermis)- the layer beneath the dermis which attaches the dermis the underlying structures. It consist of adipose tissue and areolar connective tissue.

Integumentary System

Functions

- temperature regulation
 - sweat evaporation when hot
 - vascular constriction when cold
- Protection
 - provides barrier from microorganisms, dehydration, and UV radiation
- Sensation
 - has abundant nerve endings that sense for pain, touch, temperature
- Excretion
 - waste products are excreted, i.e., water, salts, and other organic compounds
- Immunity
 - Langerhans cells are important in body immunity
- Vitamin D synthesis
 - exposure to UV light helps with the production of vitamin D (aids in the absorption of calcium and phosphorus from the digestive system).

Integumentary System (cont.)

Epidermis

- composed of keratinized stratified squamous epithelium
- contains four types of cells
 - Keratinocyte- the main cell of the epidermis
 - are derived from the basal layer and are pushed up to the surface
 - as the cells move upward they simultaneously accumulate keratin along with cell death
 - in the process that takes two to four weeks, these cells are fluffed off and new cells take their place.
 - Melanocytes- cells located mostly in the epidermis that produces melanin (a pigment responsible for skin color and the absorption of UV light.

-Langerhans cells- functions in immune responses and are easily damaged by UV radiation

-Merkel cell- located in the epidermis of hairless skin and are thought to function in the sensation of touch

Integumentary System

Epidermis (cont.)

- has four layers in most parts of the body
- where skin is thicker due to exposure to friction, five layers may be seen
- callus- abnormal thickening of the skin

Integumentary System

Five Layers

- Stratum basale- single layer of cuboidal to columnar cells capable of continued cell division.
 - the cells multiply to produce keratinocytes
 - contains melanocytes and merkel cells
- Stratum Spinosum- has about ten rows of polyhedral shaped keratinocytes with spine like projections.
 - can have melanocytes here
- Stratum Granulosum- about five layer of cells with darkly stained granules.
- Stratum Lucidum- consist of about five layers of clear flat dead cells. Only the thick skin of the palms and soles has this layer.
- Stratum corneum- consist of about 30 rows of flat, dead cells completely filled with keratin.

Integumentary System (cont.)

Dermis- composed of collagen and elastic fibers giving strength, extensibility (ability to stretch), and elasticity (ability to return to normal shape after extension).

- Striae- small tears in the skin due to extensive stretching
- cells include fibroblast, macrophages, and adipocytes.
- Upper region of the dermis is increased by small, fingerlike projections called **dermal papillae**
 - responsible for ridges in fingers (finger prints) needed to help grip
 - some contain touch sensors (Meissener's corpuscles)
- lower dermis is composed of dense irregular connective tissue, adipose tissue, hair follicles, nerves, oil glands, and ducts of sweat glands.
- Dermis is attached to the underlying structures by the **subcutaneous layer**.
 - Subq contain nerve endings called lamellated (**Pancinian**) corpuscles, which are sensitive to touch.

Skin Color

- the number of melanocytes are about the same in all skin color.
- skin color due to the amount of melanin produced by melanocytes.
- Albinism**- inherited inability to produce melanin.
- freckles**- when melanin forms in patches.

- Carotene**- a pigment with a yellow orange color that is found in the stratum corneum. Along with melanin, carotene is responsible for the yellowish color of skin.
- Hemoglobin**- responsible for the pinkish color of skin
- Erythema**- redness of the skin caused by engorged blood vessels.

Photoaging

Photoaging

- Chronic exposure to sunlight accentuates and accelerates many of the changes of intrinsic aging, including
 - Telangiectasia- superficial cutaneous vessels visible to the human eye.
 - blotchy pigmentation,
 - loss of elasticity,
 - and thinning
- Abnormal pigmentation
 - Indistinct and blotchy areas of hyper and **hypopigmentation** are commonly seen in chronically sun exposed skin.
 - more prominent components of photoaging in darker complected individuals
 - The blotchy pigment is probably due in part to uneven distribution of melanocytes and marked variation in their pigment production.
 - Solar lentigines** (liver spots)- are well circumscribed **hyperpigmented macules** or patches commonly seen in the heaviest areas of exposure in sun damaged individuals.
- The effects of photoaging accumulate over years of chronic sun exposure.
- At first, the effects may be invisible to the casual glance, even while they are on the increase.
- Photos taken with ultraviolet light will dramatically reveal the accumulative effects of chronic sun exposure.
- In the following series of photos the accumulative effects of chronic sun exposure are clearly seen.
- In each set of photos, the two pictures on the left were taken in ordinary light, the picture on the right in ultraviolet light:

Tanning

- Tanning only occurs after DNA damage has already occurred
- Essentially, DNA damage is the trigger for the tanning response, meaning that tanning doesn't begin until you have done at least some damage, leading to the conclusion that there really is no safe level of sun exposure.
- This damage is cumulative with time and the magnitude of the exposures.
- Over the years, total time in the sun is reflected by wrinkles, blotchy pigmentation, and with enough exposure, skin cancer.

Sunscreen

- Chemical sunscreens "block" the penetration of UV radiation through the epidermis by acting as filters and absorbing and reflecting high energy UV.

- A certain amount of UV light will enter the epidermis, and no chemical sunscreen blocks 100 percent of all incident UV radiation
- The protection provided by a sunscreen is indicated by the SPF
- A "sunblock" is considered to be any sunscreen with an SPF of 15 or more
 - SPF 15 sunscreen may absorb more than 92 percent of incident UVB radiation
 - An SPF 30 sunscreen may absorb 96.7 percent
 - SPF 40, 97.5 percent of incident UVB radiation

Sunscreen

- The SPF value of a sunscreen is defined as the ratio of the energy required to produce a minimal erythema dose (skin reddening or minimal sunburn) through the sunscreen compared to the energy required to produce the same reaction in the absence of the sunscreen
 - an individual who burns after 30 minutes of sun exposure can extend the period of time until a burn begins to 2 hours with an SPF 4 sunscreen.
- Animal studies have shown that sunscreens can prevent UV-induced wrinkling
- Studies show that the use of a sunscreen can result in a 36% reduction in the annual rate of the precancerous condition of actinic keratoses (AK).

Ultraviolet Radiation

- the major source of the damaging effects of sunlight stem primarily from the ultraviolet portion of the spectrum between 290 and 400 nm (UVB and UVA)
- The different ultraviolet wavelengths penetrate the skin to different depths and have different biologic consequences

Ultraviolet Radiation

- Ultraviolet A (UVA, commonly called "black light") is actually the most abundant component of solar ultraviolet radiation, accounting for approximately 95% of the ultraviolet energy striking the earth's surface at the equator.
- UVA is also the major wavelength produced by tanning beds
- evidence has made it clear that UVA exposure has significant risks, although it may not be as dangerous as UVB.
- UVA penetrates much deeper into the skin than any of the other ultraviolet wavelengths, and can potentiate the carcinogenic effects of UVB.
- because of its ability to penetrate deeply into the skin, UVA contributes substantially to chronic sun damage, wrinkling and can cause immunologic effects

Ultraviolet Radiation

- Although UVB makes up only 5% of the ultraviolet photons reaching the earth's surface, it is the most important component of sunlight for human skin.
- It is considered the major action spectrum for both melanoma and non-melanoma skin cancer formation
- Although it does not penetrate as deeply as UVA, it is the most biologically potent portion of the UV spectrum in terms of short and long term consequences.

Actinic Keratosis

- Here on the top outer edge of the ear is a palpably rough area, an **actinic** (sun induced) **keratosis** (rough spots) or **solar keratosis** in one of the more common presentation sites for men. (In women, the ear is often protected from excess sunlight by the hair).
- These **in-situ SCC**'s are commonly found on the chronically sun exposed skin of fair-skinned, middle-aged and older persons. The key clinical feature to diagnosis is a rough (keratotic) or sandpaper-like surface to palpation due to a localized increase in stratum corneum.

•**Hyperkeratosis**- (increased amount of keratin)

•**Parakeratosis**- (presence of cell nuclei in the keratin layer, this is a sign of decreased turnover time of the epidermis)

•**Acanthosis**- (thickening of the epidermal layer; in seborrheic keratosis this results from basaloid cell proliferation. Dysplasia is absent)

•**Dysplasia**- (abnormal maturation of the epidermis; the cells have atypical morphology cytologically)

•**solar elastosis**- (in which the dermis is stained blue rather than pink resembling the elastic tissue; this is a sign of sun damage)

•horn cyst-epidermal cysts filled with keratin. Some of these cysts resulted from infoldings of the epidermis (pseudohorn cysts).

Seborrheic Keratosis (wart)

•the base of the seborrheic keratosis is flat and level with the base of the adjacent normal epidermis (ie. an exophytic appearance if the adjacent normal epidermis is included)

•**acanthosis** (thickening of the epidermal layer; in seborrheic keratosis this results from basaloid cell proliferation. Dysplasia is absent)

•**hyperkeratosis** (excess keratin)

•epidermal cysts filled with keratin (**horn cyst**) are common, some of these cysts resulted from infoldings of the epidermis (pseudohorn cysts).

•**hyperpigmentation** of the basaloid cells from melanin phagocytosis

•solar elastosis

AGE SPOTS (lentigines)

Basal Cell Carcinoma

Squamous Cell Carcinoma

Squamous Cell Carcinoma

Accessory Organs of the Skin

Hair

•functions to protect

•thread of fused keratinized cells

•anatomy

–**shaft**- portion that projects above the skin

–**root**- portion below the skin surface that penetrates down to the dermis and subcutaneous layers.

–**hair follicle**- two layers of cells that surround the hair root composed of the external and internal root sheaths.

–**Bulb**- the bulbous shaped structure at the base of the follicle

•**papilla**- indented area of the bulb where blood vessels enter the hair follicle to nourish the hair cells

•**matrix**- that region of the bulb where new hair is produced

•**Growth Cycle**- growth phase (three years) and resting phase (two years)

•**Arrector Pili Muscle**- contract under stresses of fright and cold.

•The hair follicle originates from the epidermis and the dermis.

•The **epidermis** is responsible for the **matrix** and **hair cells**.

•The **dermis** gives rise to the **papilla** which is composed of many **blood vessels** and **nerves**.

•Classification of hair

– Hairs that are long and fine and formed in the fetus at 20 weeks of birth are referred to as **Lanugo hairs**. These are normally shed before birth, but may remain on premature babies.

–**Vellus hairs** cover most of the surface area of our bodies and are colorful, short and fine. At puberty, the Vellus hairs are stimulated by androgens to form Terminal hairs.

–**Terminal hairs** are the longer, darker, thicker hairs found on the eyebrows, eyelashes, scalp, pubic and axillary regions.

–**Hirsutism**- excessive and undesirable hairiness in areas that are not usually hairy, especially in women and children

–**Vibrissae** (guard hair)- guard the nostrils, ear canals and eyes to prevent foreign particles from entering easily.

•The hair shaft is composed of an **outer cuticle** which encompasses a **cortex of keratinocytes**.

•In terminal hairs, the cortex contains an **inner medulla**.

•The **hair bulb** contains **germinative cells** which can be associated with **melanocytes** which produce pigment.

•Hair becomes erect, forming "goose bumps" when the **arrector pili muscle** (rudimentary in humans) contracts due to cold, fear and emotion.

Hair Color

•Hair color is determined by melanin from your pigment cells. The more pigment granules there are, and the more tightly packed, the darker the hair.

•Two kinds of melanin contribute to hair color.

–**Eumelanin** colors hair brown to black,

–an iron-rich pigment, **pheomelanin** colors it yellow-blonde to red.

•Whether hair is mousy, brown, brunette or black depends on the type and amount of melanin and how densely it's distributed within the hair.

•**Graying**- The loss of hair color due to a gradual fall in melanin production in the hair bulb.

Alopecia and Pattern Baldness

- Thinning of hair or baldness caused mostly by age and heredity.
- Sex-influenced trait
- Influenced by the presence of highly active form of testosterone called DHT (dihydrotestosterone)
 - influences many aspects of manly behavior, from sex drive to aggression.
- The conversion from testosterone to DHT is driven by an enzyme called 5-alpha reductase**, which is produced in the prostate, various adrenal glands, and the scalp.
- Over time, the action of DHT causes
 - the **hair follicle to degrade and shortens the anagen phase**.
 - Some **follicles will gradually die**, but most will simply shrink to the size they were when you were born which produce weaker hairs.
- With a steadily shorter anagen growing cycle, more hairs are shed, the **hairs becoming thinner and thinner** until they are too fine to survive daily wear and tear.
- Balding hair gradually changes** from long, thick, coarse, pigmented hair **into fine, unpigmented vellus sprouts**.
- the **sebaceous gland** attached to it **remains the same size**. As the hair shafts become smaller, the gland **continues to pump out about the same amount of oil**. So as your hair thins, you will notice that your **hair becomes flatter and oilier**.
- Studies show that while **balding men** don't have higher than average circulating testosterone levels, they do **possess above-average amounts of dihydrotestosterone in the scalp follicles**.
- In male balding, **genetically primed follicles convert circulating testosterone to dihydrotestosterone**
- It is believed that excessive sebum often accompanying thinning hair is attributed to an enlargement of the sebaceous gland.
- It is thought that **excessive sebum causes an high level of 5-alpha reductase and pore clogging, thus malnutrition of the hair root**.
- Most doctors agree that if you have a oily scalp with thinning hair, **frequent shampooing is advised. shampooing can reduce surface sebum, which contains high levels of testosterone and DHT** that may reenter the skin and affect the hair follicle.

Three Kinds of Glands of the Skin

Sebaceous (Oil) Glands

- the secretory portion lie in the dermis and open into the neck of the hair follicle (rarely, directly onto the skin surface)
- secrete oily substance called **sebum**
 - prevents hair from drying, excessive water evaporation, keeps skin soft, and inhibits certain microbial growth
- Blackhead**- glogged and engorged sebaceous gland which can lead to **pimples** or **boils**.

Acne vulgaris,
(common acne)

- skin disorder of the pilosebaceous unit that generally develops in adolescence and improves in adulthood.
- At least four factors are important in the development of acne:
 - plugging of the hair follicle** with abnormally cohesive desquamated cells,
 - sebaceous gland hyperactivity**,
 - proliferation of bacteria** (especially *Propionibacterium acnes*) within sebum and inflammation

Whiteheads

Glands (cont.)

Sudoriferous (Sweat) Glands- produce perspiration or sweat which functions in temperature regulation and waste elimination.

Two types

•Apocrine

- found in the axilla, pubic region, and areolae.
- open into hair follicles
- begin to function at puberty
- produce a viscous sticky secretion
- stimulated during emotional stress and sexual excitement (cold sweat)

•Eccrine

- distributed throughout the skin except as margins of the lips, nail beds of the fingers and toes, and eardrums
- most numerous in palms and soles
- ducts terminate at pores at epidermal surface
- function throughout life
- produce a more watery fluid than apocrine gland

Glands (cont.)

Ceruminous Glands

- present in the external auditory canal
- ducts open onto the epidermal surface or into ducts of sebaceous glands
- the combined secretion of the ceruminous and sebaceous glands is called **cerumen**
- cerumen and hair provides a barrier against foreign bodies

Mammary Glands

- Modified apocrine sweat glands
- Milk producing glands that develops during pregnancy and lactation.
- Mammae**- breast (men have breast but not mammary glands)

Polythelia

- thick strips of ectoderm extending from the axillary to the inguinal regions called **mammary ridges**.
- The development of additional nipples or mammae along the milk line

Accessory Organs of the Skin

Nails- plates of tightly packed, hard, keratinized cells of the epidermis

- Consist of three parts

- body (plate)- portion that is visible and that lies over the nail bed

- free edge- extends past the end of the finger or toe

- nail root- portion that is not visible

- nails are pink because of underlying vessels

- whitish semilunar area near the root is call **lunula**. It appears white because vascular tissue underneath does not show through due to thickened stratum basale.

- nail growth occurs by the transformation of superficial cells of the nail matrix into nail cells.

Lesion

Eruption (Rash)

Macules

Papule

Plaques

Scales

Ulcer

circumscribed area of skin loss extending through the epidermis and at least part of the dermis (papillary).

Crust

Erosion

Lichenification

Atrophy

Scar

Cyst

Pustule

Nodule

Vesicle (Blister)

Tinea

- "Tinea" refers to a skin infection with a dermatophyte (ringworm) fungus.

- Depending on which part of the body is affected, it is given a specific name.

- Tina barbae (beard)

- Tina capitis (head)

- Tina corporis (body)

- Tinea cruris (groin)

- Tinea faciei (face)

- Tinea manuum (hand)

-Tinea pedis (foot)
-Tinea unguium (nail)
Tinea barbae
Fungal beard infection
Typical tinea capitis
Tinea corporis (body)
Tinea cruris (groin)
Tinea cruris (groin)
Tinea faciei (face)

Tinea manuum (hand)

Tinea unguium (nail)

Dermatitis (Inflammation of the Skin)

- Dermatitis affects about one in every five people at some time in their lives. It results from a variety of different causes and has various patterns.
 - The terms "dermatitis" and "eczema" are often used interchangeably
 - Dermatitis can be "acute" or "chronic" or both
 - Acute eczema refers to a rapidly evolving red rash which may be blistered and swollen.
 - Chronic dermatitis refers to a longstanding irritable area. It is often darker than the surrounding skin, thickened (lichenified) and much scratched.
 - Appears to be contributable to an abnormal response of the body's immune system
- Irritant contact dermatitis
Allergic contact dermatitis
- Allergic contact dermatitis is an itchy skin condition caused by an allergic reaction to material in contact with the skin. It arises some hours after contact with the responsible material, and settles down over some days providing the skin is no longer in contact with it.
 - Contact dermatitis should be distinguished from contact urticaria, in which a rash appears within minutes of exposure and fades away within minutes to hours.
- Seborrhoeic Dermatitis
- Seborrhoeic dermatitis is a common, harmless, scaling rash affecting the face, scalp and other areas.
 - Is believed to be related to a proliferation of a normal skin inhabitant, a yeast called *Pityrosporum ovale* (also known as *Malassezia*).
 - Increased layer of sebum on the skin, quality of the sebum, and the immunological response of the patient favor the growth of *Pityrosporum* yeast.
 - Degradation of the sebum irritates the skin and causes eczema.
 - Dandruff** (also called *pityriasis capitis*) is seborrhoeic dermatitis of the scalp.
 - Seborrhoeic dermatitis may appear at any age after puberty. It fluctuates in severity and may persist for years. It may predispose to psoriasis.

Seborrhoeic Dermatitis

DANDRUFF

Dandruff

- It is a natural process, caused by the turnover and renewal of skin on the scalp (and elsewhere, for that matter).
- It becomes a cosmetic problem when shedding of old skin exceeds our ability to remove it, showing up as dry flakes on our collar and clogging our comb.
- Itching can be a problem too.
- On average the scalp skin replaces itself about once every 28 days. If turnover speeds up to every 11 days the net result is obvious dandruff.
- we can control it either by **removing scale faster** than it is produced or by **slowing it down**, or possibly, where malassezia yeast is involved, by **reducing its colonization**.

Dandruff Treatment

- Zinc pyrithione shampoos (Suave Dandruff Control Shampoo, Head & Shoulders).** These contain the antibacterial and antifungal agent zinc pyrithione, which has been shown to reduce the fungus that causes dandruff and seborrheic dermatitis.
- Tar-based shampoos (Neutrogena T/Gel, Tegrin).**-slowing cell turnover
- Shampoos containing salicylic acid (Ionil T)**- These are "scalp scrubs" that help eliminate scale
- Selenium sulfide shampoos (Selsun, Exsel)**- prevent cell turnover and may also reduce the number of malassezia.
- Ketoconazole shampoos (Nizoral)**- a broad-spectrum antifungal agent that may work when other shampoos fail.

Impetigo

- Impetigo is a **skin infection caused by bacteria**. It is often called "school sores" because it affects children and is **quite contagious**.
- The term impetigo derives from the French and Latin words meaning "a scabby eruption that attacks".
- Streptococcus pyogenes and/or Staphylococcus aureus are the micro-organisms responsible for impetigo.**
- Impetigo most often occurs on exposed areas such as the hands and face.
- It presents with pustules and round, crusted oozing patches which grow larger day by day.
- Impetigo **may be caught from someone else** with impetigo or boils, or appear "out of the blue".
- It **often starts at the site of a minor skin injury** such as a graze, an insect bite, or scratched eczema.

Impetigo

Vitiligo

Rosacea

- Rosacea is a common face rash of adults.

- not related to your general health.
- has three stages.
 - first stage the face gets red.
- With time, small blood vessels develop making the redness more noticeable.
 - In the second stage of rosacea, the redness covers a larger area of the face.
- Slight swelling, pimples, and pustules develop.
 - The third stage is characterized by swelling and growth of the nose and central facial areas.
- This stage is known as **rhinophyma**.
 - Most patients do not progress to the third stage of rosacea.

Keloids

- A keloid is a greatly enlarged scar that projects above the skin surface.
- It is unknown why keloids form.
- occur more frequently in dark-skinned people.
- There is no satisfactory treatment for keloids.