Chapter 12

Integumentary System

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Introduction

• The integumentary system consists of the skin, hair, nails, and related glands
• Skin:
  – Defines our parameters by covering our body
  – Is the largest organ in the body
  – Forms natural openings, such as the mouth, nose, ears, urethra, vagina, and anus
  – Receives stimuli—heat, cold, movement, touch, pressure, pain

Anatomy

• Hair
• Nails
• Oil glands
• Skin
• Sweat glands

Physiology

• Protection
  – Physical, biological, and chemical barrier
  – Protects from infection, UV irradiation,
  – Waterproofs
• Absorption
  – Absorbs fat, fat-soluble vitamins, salts
  – Medicated transdermal patches are based on skin absorption

• Sensation
  – Pressure, pain, temperature, touch
• Body temperature regulation
  – Blood circulation through skin is a major component of temperature regulation
  – Evaporation of sweat helps cool body
• Waste elimination
  – Perspiration is 98% water and 2% solids

• Vitamin D synthesis
  – Sunlight converts precursor molecules to active vitamin D for calcium and phosphorus absorption
• Immunity
  – Specialized cells in the skin attach to and destroy pathogens
Body Temperature Regulation

Regions of the Skin

- Epidermis
  - Four or five layers containing unique cells
- Dermis
  - Located under the epidermis
  - Contains blood vessels, nerve receptors, hair follicles, and skin glands

Epidermis

- Derived from ectoderm (same embryonic layer that gives us brain, spinal cord, and special senses)
- Contains melanocytes
- Pores allow passage of oxygen and nutrients
- Composed of epithelial tissue; relatively avascular
- Life cycle of skin is 21–27 days

Specialized Epidermal Cells

- Keratinocytes
  - Produce keratin—tough, fibrous
  - Protect skin by waterproofing surface
  - Form principal structures of outer skin

- Melanocytes
  - Produce melanin, or skin pigment
  - Contribute to color of skin, hair, and iris of eye
  - UV protection
- Albinism—no melanin production
- Vitiligo—melanin production in patches
- Chloasma—pigmentation caused by pregnancy hormones

Specialized Epidermal Cells

- Langerhans cells
  - Originate in bone marrow but migrate to deeper layers of epidermis in early life
  - With helper T cells trigger immune reactions
Epidermal Layers

• Stratum germinativum (basale)
  – Deepest layer
  – Generates all other cell layers
  – Receives superficial pressure via Merkel disks
• Stratum spinosum
  – Bonding/transitional layer between stratum granulosum and stratum germinativum
• Stratum granulosum
  – Marks beginning of change before tissue dries

Epidermal Growth

• Cells of stratum corneum are lost
• New cells are formed at same rate as loss
• Cells
  – Push upward from stratum germinativum into each consecutive layer
  – Die
  – Become keratinized
  – Desquamate

Dermis

• Also known as true skin
• Contains blood vessels, muscles, hair follicles, sweat and oil glands, nerves and nerve endings
  – Thicker on men than on women
  – Thicker on posterior than anterior aspect of body
  – Thickest on palms of hand and soles of feet
  – Thinnest on eyelids

Dermal Growth and Repair

• Fibroblasts reproduce after injury to form scar tissue
• Langer’s cleavage lines are based on the arrangement of white collagenous fibers found in deeper sections of the dermis
• Stretch marks result in the overstretching of the elastic fibers found in the dermis
Langer’s Cleavage Line Map

Subcutaneous Layer
- Also called the hypodermis
- A layer rich in fat and areolar connective tissue

Skin Color
- Causes of variations in skin color:
  - Melanin
  - Amount of oxygen in capillaries
  - Presence of bilirubin
  - Presence of carotene

Skin Appendages
- Hair
- Nails
- Glands

Hair and Related Structures
- Hair is made up of keratin filaments arising from hair follicles
- Hair protects scalp, eyes, nose, and ears
- Hair follicles can become irritated by excess friction from insufficient lubricant, allergic reaction to massage lubricant, or pulling of hair
- Arrector pili—muscles that pull hair upright

Skin Glands
- Sebaceous glands (oil glands)
  - Secrete sebum, a mixture of triglycerides, waxes, fatty acids, and cholesterol
  - Massage stimulates sebum production
- Sudoriferous glands (sweat glands)
  - Secrete sweat
  - Regulate temperature and eliminate waste
- Ceruminous glands
  - Secrete waxy cerumen
Sweat Glands

• Eccrine sweat glands
  – Most numerous, widespread, important
  – Produce sweat rich in slats, ammonia, uric acid, urea, and other wastes
• Apocrine sweat glands
  – Located in deep subcutaneous layer in axillary regions, areola of breast, pigmented skin around anus
  – Larger than eccrine glands; join hair follicles

Eccrine and Apocrine Glands

Nails

• Heavily keratinized distal features of the fingers and toes
• Protect ends of fingers and toes
• Digging, scratching, and manipulation of objects

Nails

• Structures of the nails:
  – Body—main visible parts of nail
  – Root—produces nail, about 1 mm per week
  – Bed—skin beneath nail body
  – Lateral nail folds—where nail meets skin
  – Cuticle (eponychium)—ridge of skin growing out over nail’s base
  – Lunula—whitish half-moon shape at base
  – Free nail edge—portion that is trimmed

Cross Section of Nail

Nervous System’s Role in Touch

• Brain detects touch in parietal lobe of the cerebral cortex (postcentral gyrus)
• Homunculus indicates areas devoted to specific body areas
Nervous System’s Role in Touch

• Meissner corpuscles
  – Also called tactile corpuscles
  – Discriminates light vs. deep pressure
• Ruffini’s corpuscle
  – Deep or continuous pressure
  – Detects high range of temperatures; also called heat receptors
• Pacinian corpuscles
  – Deep pressure and vibration
  – Proprioception

Nervous System’s Role in Touch

• Krause end bulb
  – Discriminatory touch, low-frequency vibration, cooler temperatures
  – Also called cold receptors
• Merkel disk
  – Light touch and discriminative touch
• Hair root plexus
  – Light-touch receptors of hair movement

Mole Changes

• Asymmetry
  – Common moles are symmetrical and round; malignant moles are asymmetrical
• Border
  – Common moles have even borders; malignant melanomas have uneven borders
• Color
  – Common moles are evenly shaded brown; malignant moles are black or varying shades

Mole Changes

• Diameter
  – Common moles are usually less than ¼ inch in diameter; melanomas tend to be larger
• Elevated
  – Common moles are smooth; malignant moles are elevated
• Fast growing
  – Common moles do not grow fast, if at all; malignant moles change size rapidly

Pathological Conditions of the Skin

• Acne
  – Bacterial infection of hair follicles and sebaceous glands
• Athlete’s foot
  – Contagious superficial fungal infection
• Boils
  – Staphylococcal bacteria in the dermis or hair follicle
• Bruise
  – Injury that does not break the skin

Pathological Conditions of the Skin

• Burns
  – First-degree burns:
    • Redness, mild pain, involves epidermis only
    • Heals in 2–3 days
  – Second-degree burns:
    • Blistering, swelling, pain, involves epidermis and part of dermis
    • Heals in 1–4 weeks
  – Third-degree burns:
    • Destroys epidermis and entire dermis
    • Skin grafts usually needed
Pathological Conditions of the Skin

- **Cancer (skin)**
  - Basal cell carcinoma
  - Squamous cell carcinoma
  - Melanoma
- **Cellulitis**
  - Acute infection of subcutaneous tissue
- **Contact dermatitis**
  - Skin irritation due to allergic reaction to contact with an allergen

Pathological Conditions of the Skin

- **Corns or calluses**
  - Thickened cone-shaped layer of epidermis
- **Decubitus ulcers**
  - Local ischemia of tissues subjected to prolonged pressure
- **Eczema**
  - Acute or chronic inflammatory disorder of the skin; involved redness, watery discharge, crusting, scaling, itching, and burning

Pathological Conditions of the Skin

- **Folliculitis**
  - Inflamed hair follicles often caused by *Staphylococcus aureus*
- **Herpes simplex**
  - Highly contagious viral infection; flare-ups involve cold sores on mucous membranes
- **Hives**
  - Inflammatory disorder involving localized edema and wheals

Pathological Conditions of the Skin

- **Impetigo**
  - Highly contagious inflammatory skin infection caused by staphylococci or streptococci bacteria
- **Lice**
  - Parasitic insects; contagious
- **Pigmentations (skin)**
  - Age spots, albinism, birthmarks, chloasma, freckles, vitiligo

Pathological Conditions of the Skin

- **Psoriasis**
  - Chronic form of dermatitis; red, flaky skin elevations covered by thick, dry silvery scales
- **Ringworm**
  - Contagious group of fungal diseases characterized by itching, scaling, and raised, round lesions
- **Rosacea**
  - Chronic inflammatory disorder affecting the blood vessels and hair follicles of the face

Pathological Conditions of the Skin

- **Scabies**
  - Parasitic mites that burrow under skin’s surface; contagious
- **Scars**
  - Tissue resulting from the healing process
- **Scleroderma**
  - Autoimmune disorder affecting blood vessels and connective tissue
Pathological Conditions of the Skin

- Sebaceous cysts
  - Common benign swelling beneath skin lined by keratinizing epithelium and filled with sebum and epithelial debris
- Seborrheic dermatitis
  - Dandruff and cradle cap; dry, scaly material from the scalp
- Shingles
  - Acute infection of peripheral nervous system caused by reactivation of herpes zoster virus

Pathological Conditions of the Skin

- Skin tags
  - Tiny flaps of skin usually located around the neck, upper chest, armpit, and groin
- Stretch marks
  - Tearing, thinning, or overstretched of skin
- Warts
  - Thickening of epidermis resulting in a mass of cutaneous elevations caused by papillomavirus; contagious

Summary

- The skin is much more than a covering
- Offers protection, heat exchange, vitamin synthesis, waste removal
- Regions of skin include epidermis and dermis; subcutaneous layer lies below dermis
- Skin appendages include hair, nails, and glands