Animal Anatomy and Physiology 1

Webinar
Chapter 5

Skin and Related Structures
The Integument and Related Structures
Chapter 5
Pages 131-152
List the cell types that make up the epidermis and describe the function of each cell type.

List the five layers of the epidermis.

Describe the process of keratinization.

List the structures that constitute the dermis and describe the function of each.

List the structures of the hypodermis.

Describe the unique features of the paw pads and planum nasale.

Describe the parts of the hair follicle and explain how hair grows.

List and describe the three types of hair.

Describe the structure and location of sebaceous glands.

Differentiate between eccrine and apocrine sweat glands.
Describe the structures and functions of the three layers of skin
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Overview

• **Dermatology**

• Integumentary System
  - Skin
  - **Adnexa** (related structures)
    - Hair, hooves, horns, claws, skin-related glands

• **Skin** continuous with **mucous membranes** that line body openings

• Remarkable ability to regenerate & heal
Functions of Skin

- Covering (waterproofing) for animal body
  - Part of animal body’s first line of defense
- Protection from trauma, temperature change, entrance of pathogens
- Makes vitamin D
- Sensory organ
- Heat-regulating organ in cats, horses
- Excretes water & salt
Integumentary System

Figure 5-1, Page 132

- Consists of three layers:
  - Epidermis
  - Dermis
  - Hypodermis
Anatomy of Canine Skin

- 3 distinct layers
  - Epidermis
  - Dermis
  - Hypodermis (subcutaneous)
- Adipose tissue
- Related structures
Free nerve endings (respond to painful stimuli, temperature, itch, or movement)

Merkel’s disks (detect light touch and superficial pressure)

Hair follicle receptor (detects light touch)

Epidermis

Meissner’s corpuscles (involved in fine, discriminative touch)

Dermis

Ruffini’s end organ (detects continuous touch or pressure)

Pacinian corpuscle (detects deep pressure, vibration, and position)
Epidermis

• Most **superficial** layer
  - Thin, cellular
  - Nerve supply, no blood supply
  - Constantly growing, constant mitosis
Epidermis
5 Layers of Epidermis
1. Stratum Germinativum

- Deepest layer
- Consists of a single row of keratocytes attached to epithelial basement membrane
- Merkel cells, melanocytes, keratocytes, found in this layer
2. Stratum Spinosum

- Contains several layers of cells held together by desmosomes
- Langerhans cells found in this layer
3. Stratum Granulosum

Figure 5-2, Page 134

- Composed of two to four layers of flattened, diamond-shaped keratocytes that contain lamellated granules of glycolipids

- These glycolipids play a role in helping waterproof the skin and slowing water loss across the epidermis
4. Stratum Lucidum

Figure 5-2, Page 134

- Found in very thick skin
- Composed of a few rows of flattened dead cells
- Contents of the keratogranules combine with intracellular tonofilaments to form keratin fibrils
5. Stratum Corneum

Figure 5-2, Page 134

- Horny outermost layer
- Composed of 20 to 30 rows of keratocyte "remnants"
  - Sometimes called *horny* or *cornified* cells
Epidermis of Hairy Skin

• **Hairy skin** usually consists of three epidermal layers rather than five (stratum basale, stratum spinosum, and stratum corneum)

• The surface of hairy skin is covered in scalelike folds

• A knoblike elevation can be seen periodically
  ▪ Tactile elevation or epidermal papilla
  ▪ Usually associated with a tactile hair (tylotrich hairs)
Epidermis Gives Rise To Following Structures

- Hair
- Feathers
- Glands
- Paw pads
- Nails, horns, beaks
Dermis

• **Greatest portion of integument**
• Much fibrous connective tissue
  ▪ Few cells, lots of matrix
  ▪ Gives strength to skin
• Good nerve & blood supply
• Used to make leather (the “hide”)
Dermis

• Also includes hair follicles, nerve endings, glands, smooth muscle, blood vessels, and lymphatics

• Two layers:
  ▪ Papillary layer
  ▪ Reticular layer
Papillary Layer
Figure 5-4, Page 138

- Underneath the epithelial layer of the epidermis
- **Dermal papillae** help cement the epidermis and the dermis together
- Blood vessels, pain, temperature, and touch receptors also present
Reticular Layer
Figure 5-4, Page 138

- Consists of dense irregular connective tissue
Hypodermis

- Subcutaneous layer
- **Thick** layer
- Permits free movement of skin
- 24% of body weight of newborn puppy
- 12% of adult body weight
Hypodermis

- Composed of areolar tissue containing adipose, blood and lymphatic vessels, and nerves
- Contains special touch receptor – the *pacinian corpuscle* (sensitive to heavier pressure than Meissner's corpuscle)
- Fibers of hypodermis are continuous with those of dermis
- Hypodermal layer permits skin to move freely over underlying bone and muscle without putting tension on skin
Clinical Application! What Is Mange Anyway?

Pages 136-137
Sarcoptic Mange

- Burrows through epidermis
- Zoonosis
  - “Scabies”
Demodectic Mange

- Lives at base of hair follicles
- Not a zoonosis
Topic 21

Discuss the special features found in the integument
Special Features of the Integument

• Pigmentation
• Paw Pads
• Planum Nasale
• **Ergots and Chestnuts**
• Cutaneous Pouches in Sheep
Pigmentation

• Result of presence or absence of melanin granules in the extensions of melanocytes
  ▪ No pigmentation if granules are concentrated around nucleus of the melanocyte
  ▪ As granules move into the cellular extensions and into surrounding tissue, pigmentation becomes macroscopically apparent

• The more granules present, the darker the pigmentation
Paw Pads
Figure 5-5, Page 140

- Thick layers of fat & connective tissue
- Outer surface is toughest & thickest skin in animal’s body
- Often pigmented; composed of all five epidermal layers
  - **Stratum corneum** is thicker than all other layers combined
- Exocrine & sweat glands
Paw Pads

Figure 5-5, Page 140
Planum Nasale
Figure 5-6, Page 141

- Top of the nose in cats, pigs, sheep, and dogs
- Wet or dry not a health indicator
- Usually pigmented
  - ("Collie Nose")
Ergots and Chestnuts

Figure 5-7, Page 141

- Dark horny structures found on inside legs of horses, ponies, and other equidae
- Thought to be vestiges of carpal and tarsal pads of second and fourth digits
  - ("splint bones")
Cutaneous Pouches in Sheep

Figure 5-8, Page 141

- Infoldings of skin
- Infraorbital, interdigital, and inguinal pouches
- Contain fine hairs and numerous sebaceous and oil glands
- Secrete a fatty yellow substance which covers and sticks to the skin when dry
Topic 22

Discuss the adnexa (related structures) found in the integument
Related Structures of Integument

• Hair
  ▪ Hair strands and follicles
  ▪ Types of hair

• Glands of the skin
  ▪ Sebaceous and sweat glands
  ▪ Tail glands
  ▪ Anal glands

• Claws and dewclaws

• Hoof

• Horns
Hair

• Functions in maintaining body temperature; camouflage
• Thickens in cooler weather
  ▪ More hair shafts per hair follicle
Hair
Figure 5-9A, Page 143

• Occurs as fur in most mammals
• Thickest on most exposed areas

**Hair follicle**
- Shaft
- Pore
- Root
- Hair bulb
- Dermal papilla

• Vibrissae
Hair Follicle Anatomy

Figure 5-9, Page 143

- **Hair shaft**: visible above the skin
- **Hair root**: buried within the skin
- **Hair follicle**: anchors the hair
  - Deepest part of hair follicle expands to form a **hair bulb**
  - At base of hair bulb is mound of dermal cells called **papilla**
  - **Hair strands** are formed as epithelial cells mature, fill with keratin, and move away from papilla
  - **Root hair plexus**: web of sensory nerve endings
    - Touch receptor
Hair Color

- **Melanocytes** at base of hair follicle
- Less melanin in older dogs (gray hair)
- White hair is formed when the cortex loses its pigment entirely and the medulla becomes completely filled with air
Hair Growth

• Hair growth – 0.18 mm per day
• Shedding
  ▪ Genetics
    • “Groomer” dogs
  ▪ Environment
    • Season change
    • Bitch after whelping
Hair Coat Length

- **Secret of Life!**
  - Normal
    - Same as wild **Canidae** (German Shepard)
  - Short
    - Boxers, Chihuahuas, Doberman Pinschers
  - Long (often an “undercoat”)
    - Chow Chow, Malamute, Husky
- Seasonal changes – more hairs per follicle
Arrector Pili Muscles

• Small, smooth muscle attached to each hair follicle

• Innervated by **sympathetic** nervous system
  - “Fight or flight”

• Best erected on dorsal neck, back, & tail

• Not on vibrissae

• “**Goosebumps**” in people
Glands of the Skin

- Sebaceous Glands
- Sweat Glands (Sudoriferous Glands)
- Tail Glands
- Anal Sacs
Sebaceous Glands

• All over body in dermis except paw pads & planum nasale
• Duct empties into hair follicle
• Sebum – oily, lipid substance
  ▪ **Lanolin** in sheep
• Sebaceous cysts
  ▪ What dog breed?
Sebum

• **Arrector pili muscle** contracts and compresses sebaceous gland, forcing **sebum** through the duct into the hair follicle

• Coats the base of the hair and surrounding skin
  - Helps trap moisture, keeps hair soft, pliant, and somewhat waterproof
  - Sebum also helps reduce the skin's risk of infection
Sweat Glands
Figure 5-11, Page 146

• AKA “Sudoriferous Glands”
• Found over entire body of most domestic species
• Sweat helps cool animal body through evaporation
• 2 type of sweat glands
  ▪ **Eccrine** – watery, found in footpads
  ▪ **Apocrine** – thicker, smellier secretion
    • Found only with hairs
**Eccrine Sweat Glands:**
- Excretory portion consists of a simple coiled tube located in the dermis or hypodermis
- Empty onto surface of skin through a long duct

**Apocrine Sweat Glands:**
- Coiled excretory portion buried in the dermis or hypodermis; single excretory duct
- Empty into hair follicles
Tail Glands

Figure 5-12, Page 147

- **Oval region** at the dorsal base of the tails of most dogs and cats
- Contains **coarse, oily hairs**
- Very large apocrine and sebaceous glands present
- Thought to assist with recognition and identification of individual animals
Tail Glands

• Sex hormone influence?
• Wild Canidae a lot
Anal Glands (Sacs)

- Cats and dogs have anal sacs similar to musk glands of skunks
- Located at 4 and 8 o'clock positions relative to anus
- Connected to lateral margin of the anus by a small single duct
- When an animal defecates or becomes frightened, some or all of the anal sac contents are expressed
Anal Glands (Anal Sacs)

- 4 & 8 o'clock
Claws, Nails, Hooves, Horns

From the Epidermis
Claws
Figure 5-13, Page 147

• Retractable or non-retractable

• Anatomy
  ▪ Nail bed attached to distal phalanx (P3)
Claws and Dewclaws

**Claws**

- Hard outer coverings of the distal digits
- Usually pigmented
- Function in maintaining traction and serve as tools for defense and catching prey
- Claws are non-retractable except in most cat species

**Dewclaws**

- Evolutionary remnants of digits
- In the dog, the dewclaw is the first digit
- In the cow, pig, and sheep, the medial and lateral dewclaws are the second and fifth digits, respectively
Hoof
Figure 5-14, Page 148

• Horny outer covering of digits of some animals
• Another name for “hoof” is *ungula*
  ▪ Hoofed animals are called *ungulates*
The skeletal foot of horse includes:
- Distal part of the second phalanx
- Distal sesamoid bone (navicular bone)
- Entire third phalanx (coffin bone).

The equine hoof is generally divided into three parts: the wall, the sole, and the frog.
Hoof

**The wall:**
- External portion of the hoof

**The sole:**
- Plantar, or palmar, surface of the hoof; outer layers are avascular and lack innervation

**The frog:**
- Triangular horny structure located between the heels on the underside of the hoof
Horns

Figure 5-19, Page 150

- Epidermal in origin
- Structurally similar to hair
- Composed of keratin
Discus some of the skin pathology commonly seen in veterinary practice
Common Skin Pathology

- Dermatitis
- Alopecia
- Pruritis
- “Hot spots”
- Seborrhea
- Ectoparasites
  - Fleas
  - Mites
Alopecia? 😊
Fleas!

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"Listen, before we take this guy, let me ask you this: You ever kill a flea before, Dawkins? It ain't easy."
Flea Allergy Dermatitis (FAD)

Sequence of flea-allergy dermatitis:
- Flea punctures skin to feed.
- Flea saliva sets up an antigen-antibody reaction.
- Excoriation and inflammation result from self-inflicted trauma.
- Bacteria invade causing pustules.

Self-inflicted trauma results in erythema (redness), papules (bumps), pustules (pus-filled bumps), crusts (scabs) and hair loss in the areas where the fleas feed.
Clinical Applications

• Skin Cancer (Page 133)
• Allergies: Itchy Business (Page 145)
• Laminitis: A Painful Health Risk to Horses (Page 152)
Review of the Skin
Test Yourself
KNOW THESE IN EVERY CHAPTER!

Pages 138, 139, 145, 147