Chapter 21

Microbial Diseases of the Skin and Eyes

Structure and Function of the Skin

21-1 Describe the structure of the skin and mucous membranes and the ways pathogens can invade the skin.

The Structure of Human Skin

- Perspiration and sebum contain nutrients
- Salt inhibits microbes
- Lysozyme hydrolyzes peptidoglycan
- Fatty acids inhibit some pathogens
- Antimicrobial peptides: defensins

Mucous Membranes

- Line body cavities
- Epithelial cells are attached to an extracellular matrix
- Cells secrete mucus
- Often acidic
- Some cells have cilia
- In eyes, washed by tears with lysozyme

The moisture provided by perspiration encourages microbial growth on the skin. What factors in perspiration discourage microbial growth? 21-1

Normal Microbiota of the Skin

21-2 Provide examples of normal skin microbiota, and state the general locations and ecological roles of its members.

Gram-positive, salt-tolerant bacteria
- Staphylococci
- Micrococci
- Diphtheroids

Grow on oils
- Aerobes on surface
  - Corynebacterium xerosis
- Anaerobes in hair follicles
- Propionibacterium acnes
- Yeast
  - Malassezia furfur

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- Are skin bacteria more likely to be gram-positive or gram-negative? 21-2

12 Microbial Diseases of the Skin
- Exanthem: skin rash arising from another focus of the infection
- Enanthem: mucous membrane rash arising from another focus of the infection

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14 Bacterial Diseases of the Skin
- 21-3 Differentiate staphylococci from streptococci, and name several skin infections caused by each.
- 21-4 List the causative agent, mode of transmission, and clinical symptoms of Pseudomonas dermatitis, otitis externa, acne, and Buruli ulcer.

15 Staphylococcal Skin Infections
- Staphylococcus epidermidis
  - Gram-positive cocci, coagulase-negative
- Staphylococcus aureus
  - Gram-positive cocci, coagulase-positive

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17 Staphylococcus aureus
- Antibiotic resistant
- Leukocidin
- Resists opsonization
- Survives in phagolysosome
- Lysozyme resistant
- Exfoliative toxin
- Superantigen

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20 Staphylococcal Skin Infections
- Folliculitis: infections of the hair follicles
- Sty: folliculitis of an eyelash
- Furuncle: abscess; pus surrounded by inflamed tissue
- Carbuncle: inflammation of tissue under the skin
• Impetigo: crusting (nonbullous) sores, spread by autoinoculation

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22 Scalded Skin Syndrome
• Toxic shock syndrome (TSS)
  • Toxic shock syndrome toxin 1
• Scalded skin syndrome
  • Bullous impetigo
  • Impetigo of the newborn

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24 Streptococcal Skin Infections
• Streptococcus pyogenes
• Group A beta-hemolytic streptococci
• Hemolysins
• Hyaluronidase
• Streptolysins
• M proteins
  • Exotoxin A

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28 Streptococcal Toxic Shock Syndrome
• M proteins
• Complex with fibrinogen
• Binds to neutrophils
• Activates neutrophils
• Release of damaging enzymes
• Shock and organ damage

29 Infections by Pseudomonads
• Pseudomonas aeruginosa
  • Gram-negative, aerobic rod
  • Pyocyanin produces a blue-green pus
• Pseudomonas dermatitis
• Otitis externa, or “swimmer’s ear”
• Post-burn infections
• Opportunistic

30 Buruli Ulcer
• Caused by Mycobacterium ulcerans
• Deep, damaging ulcers
  • Exceeds incidence of leprosy

31 Classifications of Acne
  • Comedonal (mild) acne
  • Inflammatory (moderate) acne
  • Nodular cystic (severe) acne

32 Comedonal Acne
  • Mild
    • Sebum channels are blocked with shed cells
  • Treatment
    • Topical agents
    • Salicylic acid preparations
    • Retinoids
    • Adapalene

33 Inflammatory Acne
  • Propionibacterium acnes
    • Gram-positive, anaerobic rod
  • Treatment
    • Preventing sebum formation (isotretinoin)
    • Antibiotics
    • Benzoyl peroxide to loosen clogged follicles
    • Visible (blue) light (kills P. acnes)

34 Nodular cystic (severe) acne
  • Severe
  • Treatment
    • Isotretinoin

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• Which bacterial species features the virulence factor M protein? 21-3
• What is the common name for otitis externa? 21-4

37 Viral Diseases of the Skin
  • 21-5 List the causative agent, mode of transmission, and clinical symptoms of these skin infections: warts, smallpox, monkeypox, chickenpox, shingles, cold sores, measles, rubella, fifth disease, and roseola.

38 Warts
  • Papillomaviruses
    • Treatment
• Removal
  • Cryotherapy
  • Electrodesiccation
  • Salicylic acid
  • Imiquimod (stimulates interferon production)
  • Bleomycin

39 **Poxviruses**
  • Smallpox (variola)
    • Smallpox virus (orthopoxvirus)
      • Variola major has 20% mortality
      • Variola minor has <1% mortality
    • Eradicated by vaccination
  • Monkeypox
    • Prevention by smallpox vaccination

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41 **Chickenpox**
  • Varicella-zoster virus (human herpesvirus 3)
  • Transmitted by the respiratory route
  • Causes pus-filled vesicles
  • Virus may remain latent in dorsal root ganglia
  • Prevention: live attenuated vaccine
  • Breakthrough varicella in vaccinated people

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43 **Shingles**
  • Reactivation of latent HHV-3 releases viruses that move along peripheral nerves to skin
  • Postherpetic neuralgia
  • Prevention: live attenuated vaccine
  • Acyclovir may lessen symptoms

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45 **Herpes Simplex**
  • Human herpesvirus 1 (HSV-1) and 2 (HSV-2)
  • Cold sores or fever blisters (vesicles on lips)
  • Herpes gladiatorum (vesicles on skin)
  • Herpetic whitlow (vesicles on fingers)
  • Herpes encephalitis
  • HSV-1 can remain latent in trigeminal nerve ganglia
48  **Herpes Simplex**
- HSV-2 can remain latent in sacral nerve ganglia
- HSV-2 encephalitis: 70% fatality
- Encephalitis treatment: acyclovir

49  **Measles (Rubeola)**
- Measles virus
- Transmitted by respiratory route
- Macular rash and Koplik’s spots
- Encephalitis in 1 in 1000 cases
- Subacute sclerosing panencephalitis in 1 in 1,000,000 cases
- Prevented by vaccination

52  **Rubella (German Measles)**
- Rubella virus
- Macular rash and fever
- Congenital rubella syndrome causes severe fetal damage
- Prevented by vaccination

53  **Fifth Disease**
- Name derived from a 1905 list of skin rashes, which included
  - 1. Measles
  - 2. Scarlet fever
  - 3. Rubella
  - 4. Filatov Dukes’ disease (mild scarlet fever), and
  - 5. Fifth disease, or erythema infectiosum
    - Human parvovirus B19 produces mild flulike symptoms and facial rash

54  **Roseola**
- Caused by human herpesvirus 6 (HHV-6) and 7 (HHV-7)
  - High fever and rash lasting for 1–2 days

56  **Diseases in Focus: Macular Rashes**
• A 4-year-old boy with a history of cough, conjunctivitis, and fever (38.3°C) now has a macular rash that starts on his face and neck and is spreading to the rest of his body.
• Can you identify infections that could cause these symptoms?

57 Diseases in Focus: Vesicular and Pustular Rashes
• An 8-year-old boy has a rash consisting of vesicular lesions of 5 days’ duration on his neck and stomach. Within 5 days, 73 students in his elementary school have illness matching the case definition for this disease.
• Can you identify infections that could cause these symptoms?

58 Fungal Diseases of the Skin and Nails
• 21-6 Differentiate cutaneous from subcutaneous mycoses, and provide an example of each.
• 21-7 List the causative agent and predisposing factors for candidiasis.

59 Cutaneous Mycoses
• Dermatomycoses
  • Also known as tineas or ringworm
  • Metabolize keratin

60 Cutaneous Mycoses
• Genera of fungi involved
  • Trichophyton: infects hair, skin, and nails
  • Epidermophyton: infects skin and nails
  • Microsporum: infects hair and skin
• Treatment
  • Topical miconazole
  • Topical allylamine
  • Oral itraconazole (tinea unguium)
  • Oral terbinafine (tinea unguium)

61 Subcutaneous Mycoses
• More serious than cutaneous mycoses
• Sporotrichosis
  • Most common U.S. disease of this type
  • Sporothrix schenkii enters puncture wound
  • Treated with potassium iodide (KI)
65 Candidiasis
- Candida albicans (yeast)
- Candidiasis may result when antibiotics suppress competing bacteria
  - Occurs in skin and mucous membranes of genitourinary tract and mouth
  - Thrush: an infection of mucous membranes of mouth
  - Topical treatment with miconazole or nystatin
- In immunosuppressed individuals, fulminating disease can result
  - Treatment: fluconazole

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- How do sporotrichosis and athlete’s foot differ? In what ways are they similar? 21-6
- How might the use of penicillin result in a case of candidiasis? 21-7

68 Parasitic Infestation of the Skin
- 21-8 List the causative agent, mode of transmission, clinical symptoms, and treatment for scabies and pediculosis.

69 Scabies
- Sarcoptes scabiei burrows in the skin to lay eggs
- Treatment with topical insecticides

70 Pediculosis (Lice)
- Pediculus humanus capitis (head louse)
- P. h. corporis (body louse)
  - Feed on blood
  - Lay eggs (nits) on hair
  - Treatment with topical insecticides

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- What diseases, if any, are spread by head lice, such as Pediculus humanus capitis? 21-8

74 Diseases in Focus:
  Patchy Redness and Pimple-Like Conditions
- An 11-month-old boy comes to the clinic with a 1-week history of an itchy red rash under his arms. He seems more bothered at night and has no fever.
- Can you identify infections that could cause these symptoms?
Microbial Diseases of the Eye

• 21-9 Define conjunctivitis.
• 21-10 List the causative agent, mode of transmission, and clinical symptoms of these eye infections: ophthalmia neonatorum, inclusion conjunctivitis, trachoma.
• 21-11 List the causative agent, mode of transmission, and clinical symptoms of these eye infections: herpetic keratitis, Acanthamoeba keratitis.

Bacterial Diseases of the Eye

• Conjunctivitis
  • An inflammation of the conjunctiva
  • Also called pinkeye or red eye
  • Commonly caused by Haemophilus influenzae
  • Various other microbes can also be the cause
  • Associated with unsanitary contact lenses

Conjunctivitis

An inflammation of the conjunctiva
Also called pinkeye or red eye
Commonly caused by Haemophilus influenzae
Various other microbes can also be the cause
Associated with unsanitary contact lenses

Ophthalmia neonatorum

Caused by Neisseria gonorrhoeae
Transmitted to a newborn’s eyes during passage through the birth canal
Prevented by treating a newborn’s eyes with antibiotics

Chlamydia trachomatis

Causes inclusion conjunctivitis, or chlamydial conjunctivitis
Transmitted to a newborn’s eyes during passage through the birth canal
Spread through swimming pool water
Treated with tetracycline

Keratitis

Inflammation of the cornea

Bacterial Diseases of the Eye

Chlamydia trachomatis

Causes chlamydial conjunctivitis
Transmitted to a newborn’s eyes during passage through the birth canal
Spread through swimming pool water
Treated with tetracycline

Chlamydia trachomatis

Causes trachoma
Leading cause of blindness worldwide
Infection causes permanent scarring; scars abrade the cornea, leading to blindness

Other Infectious Diseases of the Eye

Keratitis

Inflammation of the cornea
• Bacterial (U.S.)
• Fusarium and Aspergillus (Africa and Asia)

83 □ Other Infectious Diseases of the Eye
• Herpetic keratitis
  • Caused by herpes simplex virus 1 (HSV-1)
  • Infects cornea and may cause blindness
  • Treated with trifluridine

84 □ Other Infectious Diseases of the Eye
• Acanthamoeba keratitis
  • Transmitted via water
  • Associated with unsanitary contact lenses

85 □
• What is the common name of inclusion conjunctivitis? 21-9
• Why have antibiotics almost entirely replaced the less expensive use of silver nitrate for preventing ophthalmia neonatorum? 21-10
• Of the two eye diseases herpetic keratitis and Acanthamoeba keratitis, which is the more likely to be caused by an organism actively reproducing in saline solutions for contact lenses? 21-11

86 □ Diseases in Focus: Microbial Diseases of the Eye
• A 20-year-old man has eye redness with dried mucus crust in the morning. The condition resolves with topical antibiotic treatment.
• Can you identify infections that could cause these symptoms?