Chapter 21
Microbial Diseases of the Skin and Eyes

The Structure of Human Skin
- Perspiration and sebum contain nutrients
- Salt inhibits microbes
- Lysozyme hydrolyzes peptidoglycan
- Fatty acids inhibit some pathogens

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

Normal Microbiota of the Skin
- Gram-positive, salt-tolerant bacteria
  - Staphylococci
  - Micrococci
  - Diphtheroids

Normal Microbiota of the Skin
- Grow on oils
- Aerobes on surface
  - *Corynebacterium xerosis*
- Anaerobes in hair follicles
  - *Propionibacterium acnes*
- Yeast
  - *Malassezia furfur*

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

Skin Lesions

Bacterial Diseases of the Skin

Staphylococcal Skin Infections
- *Staphylococcus epidermidis*
  - Gram-positive coci, coagulase-negative
- *Staphylococcus aureus*
  - Gram-positive coci, coagulase-positive

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

11 Staphylococcal Biofilms

12 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

13 Nonbullous Lesions of Impetigo

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

15 Lesions of Skin Syndrome

16 Streptococcal Skin Infections
- *Streptococcus pyogenes*
- Group A beta-hemolytic streptococci
- Hemolysins
- Hyaluronidase
- Stretolysins
- M proteins

17

18 Streptococcal Skin Infections
- Necrotizing fasciitis
- Erysipelas

19 Invasive Group A Streptococcal Infections
- Exotoxin A, superantigen

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

21 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
22 Buruli Ulcer
- Caused by *Mycobacterium ulcerans*
- Deep, damaging ulcers
- Exceeds incidence of leprosy

23 Classifications of Acne
- Comedonal (mild) acne
- Inflammatory (moderate) acne
- Nodular cystic (severe) acne

24 Comedonal Acne
- Mild
  - Sebum channels blocked with shed cells
- Treatment
  - Topical agents
  - Salicyclic acid preparations
  - Retinoids
  - Adapalene

25 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*)

26 Nodular Cystic Acne
- Severe
- Treatment
  - Isotretinoin

27 Viral Diseases of the Skin

28 Warts
- Papillomaviruses
- Treatment
  - Removal
    - Cryotherapy
    - Electrodesiccation
    - Salicylic acid
  - Imiquimod (stimulates interferon production)
  - Bleomycin

29 Poxviruses
- Smallpox (variola)
  - Smallpox virus (orthopox virus)
    - Variola major has 20% mortality
    - Variola minor has <1% mortality
  - Eradicated by vaccination
- Monkeypox
  - Prevention by smallpox vaccination

30 Smallpox Lesions
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

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

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

Cold Sores Caused by Herpes Simplex Virus

HSV-1 in the Trigeminal Nerve Ganglion

Herpes Simplex
- HSV-2 can remain latent in sacral nerve ganglia
- HSV-2 encephalitis: 70% fatality
- Encephalitis treatment: Acyclovir

Measles (Rubeola)
- Measles virus
- Transmitted by respiratory route
- Macular rash and Koplik’s spots
- Prevented by vaccination

Measles (Rubeola)
- Encephalitis in 1 in 1,000 cases
- Subacute sclerosing panencephalitis in 1 in 1,000,000 cases

Reported U.S. Cases of Measles, 1960–2007

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

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

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

Fungal Diseases of the Skin and Nails

Cutaneous Mycoses
- Dermatomycoses
  - Also known as tinea or ringworm
  - Metabolize keratin

Dermatomycoses

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

Cutaneous Mycoses
- Tinea unguium
- Treatment
  - Itraconazole
  - Terbinafine

Subcutaneous Mycoses
- More serious than cutaneous mycoses
- Sporotrichosis
  - Most common U.S. disease of this type
  - *Sporothrix schenckii* enters puncture wound
  - Treated with potassium iodide (KI)

Candidiasis
- *Candida albicans* (yeast)
- Candidiasis may result from suppression of competing bacteria by antibiotics
- 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

Case of Oral Candidiasis

Systemic Candidiasis
- Fulminating disease can result in immunosuppressed individuals
- Treatment: Fluconazole

Parasitic Infestation of the Skin
56. **Scabies**
   - *Sarcoptes scabiei* burrows in the skin to lay eggs
   - Treatment with topical insecticides

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

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

59. **Microbial Diseases of the Eye**

60. **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

61. **Bacterial Diseases of the Eye**
   - 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

62. **Bacterial Diseases of the Eye**
   - *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

63. **Bacterial Diseases of the Eye**
   - *Chlamydia trachomatis*
     - Causes trachoma
     - Leading cause of blindness worldwide
     - Infection causes permanent scarring; scars abrade the cornea leading to blindness

64. **Trachoma**

65. **Trachoma**

66. **Other Infectious Diseases of the Eye**
   - Keratitis
     - Inflammation of the cornea
     - Bacteria (U.S.)
     - *Fusarium* and *Aspergillus* (Africa and Asia)
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

Other Infectious Diseases of the Eye

- Acanthamoeba keratitis
  - Transmitted via water
  - Associated with unsanitary contact lenses