Ch 16

Infectious Diseases Affecting the Skin and Eyes
• Describe the important anatomical features of the skin.
• List the natural defenses present in the skin.
• List characteristics of the skin’s normal microbiota.
• Explain the important features of the “Highlight Disease,” MRSA skin and soft-tissue infection.
• List the possible causative agents, modes of transmission, virulence factors, diagnostic techniques, and prevention/treatment for the “Highlight Disease,” maculopapular rash diseases.
• Discuss important features of other infectious skin diseases. These are impetigo, cellulitis, staphylococcal scalded skin syndrome, vesicular/pustular rash diseases, large pustular skin lesions, and cutaneous and superficial mycoses.
• Discuss the relative dangers of rubella and rubeola.
• Describe the important anatomical features of the eye and list the natural defenses.
• List the types of normal biota presently known to occupy the eye.
• List the possible causative agents, modes of transmission, virulence factors, diagnostic techniques, and prevention/treatment for the “Highlight Disease,” conjunctivitis.
• Discuss important features of keratitis caused by either HSV or by Acanthamoeba.
Integument (?)  Keratin (?)

Thickness from 1.5 mm at eyelids to 4 mm on soles of feet

Complete epidermis replaced monthly

In hospitable environment for most microbes *(why?)*

Sweat and sebum provide \( \text{H}_2\text{O}, \text{aa}, \text{and lipids} \) for some microbes

Salt inhibits many microbes

**Lysozyme** hydrolyzes peptidoglycan

Antimicrobial peptides
Cultivation-independent techniques lead to interesting discoveries of the HMP:

- **Hundreds of species** of microbes, including pathogens, inhabit the epidermis, dermis, and subcutaneous layers.
- Different species favor different areas of the body.
- Different people have different species.
- An individual’s microbiota remains relatively constant over time.
Normal Microbiota of the Skin

Prevent colonization by pathogens

Are opportunistic pathogens

Mostly Gram+, salt-tolerant bacteria:
1. Staphylococci
2. Micrococci, Streptococci
3. Diphtheroids: Corynebacterium, Propionibacterium

• Also present Fungi (Tiny lipohilic yeasts)
• Mostly harmless but can cause dandruff

<table>
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<th>Defenses and Normal Biota of the Skin</th>
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<td><strong>Defenses</strong></td>
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Microbial Diseases of the Skin

- Exanthem vs. enanthem
- Vesicles and bullae
- Macules
- Papules
- Pustules

What is pus?
Highlight Disease: MRSA Skin and Soft-Tissue Infection

• MRSA = ________________________________

• Common cause of skin lesions in non-hospitalized people

• Can be highly virulent, but also considered “normal” biota of skin in 1/3 of the population.

• Withstands 7.5 – 10% salt, extremes in pH, and high temperatures

• Remains viable after air drying.

• Resists the effects of many disinfectants and antibiotics.

• **coagulase-positive** (diagnostic!)
MRSA cont.

- Fever common
- Common contaminant (Gym equipment, airplane tray tables, electronic devices, razors, etc.
- Antibiotic resistance: Many strains of *S. aureus* produce penicillinase
- Diagnosis: Also PCR
- Often evades IS (e.g.: Leukocidin, resists lysozyme and survives in phagolysosome
- Treatment: Clindamycin + TMP/SMZ or doxycycline
Types of Staph Skin Infections

- **Folliculitis**: Infections of hair follicles
- **Sty**: Folliculitis of an eyelash
- **Furuncle (Boil)**: deep-seated infection in and around hair follicles. Type of abscess. Hard to treat.
- **Carbuncle**: Extensive invasion of neighboring tissues. Several openings for pus discharge. Generalized symptoms (fever etc.)
Type of skin lesion?

1) Sty
2) Abscess
3) Carbuncle
4) Impetigo
5) Folliculitis
6) Furuncle
Type of skin lesion?

1) Sty
2) Abscess
3) Carbuncle
4) Impetigo
5) Folliculitis
6) Furuncle
Measles (Rubeola) – Causative agent: Measles virus (MeV); ssRNA virus of family Paramyxoviridae.

Aerosol transmission by respiratory route → viremia

- **Raised Maculopapular exanthem** and **Koplik's spots** on oral mucosa.
- Induction of **syncytia**
- Before MMR: Common childhood disease with high death rate
- Complications of measles:
  - Middle ear infections, 2° bacterial infections; Pneumonia or encephalitis (1 in 100)
  - **SSPE** (1 in 1Mio) 1° in male children or adolescents
pathognomonic of measles!

Typically involve the buccal and labial mucosa. Irregular, patchy erythema with tiny central white specks → 'grains of salt‘ appearance.
Measles Prevented by attenuated vaccine (MMR)

2015 Measles Cases in the U.S.
January 1, 2015 to January 2, 2016

Reported number of cases

Year

Cases*:
- 0
- 1-4
- 5-9
- 10-19
- 20+

*Provisional data reported to CDC's National Center for Immunization and Respiratory Diseases
### 2015 Recommended Immunizations for Children from Birth Through 6 Years Old

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<th>RV</th>
<th>DTaP</th>
<th>Hib</th>
<th>PCV</th>
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*Is your family growing? To protect your new baby and yourself against whooping cough, get a Tdap vaccine in the third trimester of each pregnancy. Talk to your doctor for more details.*

Shaded boxes indicate the vaccine can be given during shown age range.
Rubella - German Measles (3-day Measles)

Causative agent: Rubivirus of *Togaviridae*

Postnatal rubella: Typically mild and of little consequence, sometime joint pain, often unrecognized.

Congenital rubella: Serious complications if infected during early pregnancy: **Teratogenic**

Attenuated vaccine (MMR)

Diagnosis: Harder to diagnose clinically than measles → ELISA (IgM or IgG)
Impetigo

Highly contagious superficial skin infection; spread by direct contact, fomites, and mechanical vectors

Most often around nose and mouth

**S. aureus and/or S. pyogenes**

*S. aureus*: Localized form of exfoliative exotoxins A and B

Lesions are crusty, flaky scabs

Common in newborns (*esp. S. pyogenes*), and children (*esp. S. aureus*).

Peak incidence at 2-5 years of age.

Autoinoculation

Usually self limiting
Cellulitis

Fast-spreading infection in dermis and in subcutaneous tissues

Causative Agents:

- Healthy individuals: *S. aureus* or *S. pyogenes*
- Immunocompromised: Almost any bacterium and some fungi
- Infants: Group B streptococci (GBS)

- **Lymphangitis:**
- **Bacteremia** may develop; uncomplicated cellulitis has good prognosis
- Diagnosis through clinical signs and symptoms
- Antibiotics effective against *S. aureus* and *S. pyogenes*
- Surgical **debridement**
Staphylococcal Scalded Skin Syndrome – (S)SSS:

- Phage encoded **Exfoliative exotoxins A and B**: circulate to distant sites \(\Rightarrow\) Toxemia
- Can affect 100% of body surface
- Large blisters = **bullous lesions**. Clear fluid contains no *S. aureus*
- Dermolytic condition \(\Rightarrow\) Desquamation
- Danger of 2 ° infections
- Epidemiology: \(\sim 5\%\) of *S. aureus* produce A or B exfoliatin exotoxins
SSSS
Superficial desquamation.
No inflammation.
Smallpox

Orthopox virus, 2 types:
- variola major (> 20% mortality)
- variola minor (since 1900; < 1% mortality)

Respiratory transmission. Viremia to skin
From macules to papules to vesicles to pustules
→ Pitted scars = pocks

Human only host; eradicated due to vaccination effort by WHO

Bioterrorism!
**Chickenpox – VZV or HHV-3**

*Herpesviridae* family: *ds* DNA, enveloped

Respiratory transmission. Viremia to skin, then to sensory neurons

**Macule to papule to vesicle to pustule** in 24 h (reminiscent of ___________)

Pruritic (____) lesions – scratching may lead to serious 2° infections (*S. pyogenes* and *S. aureus*)

Complications: encephalitis and Reye’s syndrome.

Treatment with acyclovir, vidarabine *etc.*
Chickenpox Vaccine

• 1995: attenuated chickenpox vaccine released in US (Varivax)

• 2001: mandated in CA for kindergarten / school

• 85% effective

• **Breakthrough varicella** in vaccinated people

• 2006: Zostavax for older adults (> 60 years) to prevent
About 20% of people who have had chicken pox will get zoster at some time during their lives. Most people will get zoster only once.
Latentency \implies \text{Reoccurrence when cell mediated immunity weak}

May result in chronic pain $\implies$ 
Post-herpetic neuralgia (lasting for years)
Herpes Simplex Virus Types 1 and 2

- *Herpesviridae* family
- New names: **HHV-1** and **HHV-2**
- HHV-1 can remain latent in trigeminal nerve ganglia
- HHV-2 can remain latent in sacral nerve ganglia.
- Infection during childhood very common. May be subclinical. > 90% of Americans infected.
- If symptoms: most common *fever blisters/cold sores*
- Recurrent outbreaks
- Treatment: **Acyclovir**, vidarabine *etc.*
HSV-1 in the Trigeminal Nerve Ganglion

- Trigeminal nerve
- Ganglion
- Site of viral latency
- Site of active lesion
Additional Manifestations of HSV 1 and 2

- **Herpetic whitlow** (occupational hazard for health care professionals)
- **Herpes gladiatorum**: Scrum Pox in wrestlers
- **Herpes encephalitis**: Via ____________ nerve. Up to 70% fatality rate with HHV-2
- **Neonatal herpes** passage though infected birth canal (→ encephalitis). May also cross placenta.
- **Asymptomatic carriers**
- **Can be transmitted** through contact with secretions from symptomatic person ..... or

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**Additional Manifestations of HSV 1 and 2**

Common in children, medical personnel, and people who do IPL bikini hair removal.
Fungal Diseases of the Skin and Nails

• Cutaneous mycoses
• Candidiasis
Athlete’s foot is also known as

1. *Tinea capitis*
2. *Tinea cruris*
3. *Tinea pedis*
4. *Tinea unguium*
Cutaneous Mycoses – Ringworm

Also known as *tineas*.

**Dermatophytes:** *Microsporum*, *Trichophyton*, and *Epidermophyton* colonize the outer layer of the epidermis (stratum corneum)

Metabolize keratin $\Rightarrow$ epidermis, hair, skin, nails

Diagnosis: microscopic examination of skin scrapings or culture.

Treatment usually topical (e.g.: Miconazole)
Dermatomycoses

(a) Ringworm

(b) Athlete’s foot
Candidiasis

- *Candida albicans* (yeast)
- May result from suppression of competing bacteria by antibiotics
- Occurs on skin; mucous membranes of genito-urinary tract and mouth.
- **Thrush:** Infection of mucous membranes of mouth
Eye Overview

• Defense: _________

• Normal Microbiota of eye: Generally sparse; what is cultured resembles the normal biota of the skin. (?)

• Microbial diseases of the eye
  1. Conjunctivitis (pinkeye)
  2. Ophthalmia neonatorum
  3. Keratitis
Infectious Conjunctivitis

**Bacterial**
From skin and upper respiratory tract flora
Most common bacterial cause: *S.e.*, *S.p.*, *S.p.*, and *Haemophilus influenzae*
Also: *Pseudomonas* and many others
Increased incidence due to unsanitary contact lenses. Also autoinoculation from STD.

**Viral**
Most common viral cause: *Adenovirus*

*Difference in clinical presentation?*
Ophthalmia Neonatorum

Causative agents: *Neisseria gonorrhoeae*, and *Chlamydia trachomatis*

Transmitted to a newborn's eyes during passage through birth canal. Can lead to blindness.

Antimicrobial eye drops are administered to all newborn babies in US.
Other Infectious Diseases of the Eye

Herpetic Keratitis: Inflammation of the _____________

• Herpes simplex virus 1 (HSV-1) via misdirected activation (via ophthalmic branch of trigeminal nerve)

• Leading cause of infectious blindness in US

• Can recur

• Treated with trifluridine

Acanthamoeba Keratitis

Protozoa

transmitted via water (tap water, freshwater lakes), and contact solutions!
• Case File: A Rash of Symptoms

• Inside the Clinic: Erythema Multiforme

Who will present?