Microbial Diseases of the Urinary and Reproductive Systems
Females have distinct urinary and reproductive systems. Male urinary and reproductive systems share some components.
Structures of the Urinary System

- Kidneys remove waste from the blood and excrete it in urine
  - Nephrons are the functional unit of the kidneys
    - Filter the blood to form urine
- Ureters carry urine to the urinary bladder
- The urinary bladder stores urine until it can be eliminated
- Urine is excreted via the urethra
Figure 24.1a-b Urinary and reproductive systems.
Structures of the Urinary and Reproductive Systems

- **Structures of the Reproductive System**
  - Structures of the female reproductive system
    - Ovaries
    - Uterine tubes
    - Uterus
    - Vagina
    - External genitalia
  - Microorganisms enter through the vagina
Figure 24.1c Urinary and reproductive systems.
Structures of the Urinary and Reproductive Systems

• **Structures of the Reproductive System**
  - Structures of the male reproductive system
    - Testes
    - Scrotum
    - System of ducts
    - Accessory glands
    - Penis
  - Microorganisms enter through the urethra and skin of the penis
Figure 24.1d  Urinary and reproductive systems.
Structures of the Urinary and Reproductive Systems

- Microbiome of the Urinary and Reproductive Systems
  - Urinary system
    - Urethra supports colonization by some microorganisms
      - Include *Lactobacillus* and *Staphylococcus*
    - The other urinary organs are sterile
  - Male reproductive system
    - Regions above the prostate are sterile
  - Female reproductive system
    - The vagina is colonized by various microorganisms, depending on hormone levels
Structures of the Urinary and Reproductive Systems

- **Microbiome of the Urinary and Reproductive Systems**
  - Microorganisms in the urethra can move up to infect the kidneys.
  - Opportunistic and sexually transmitted microbes can infect the reproductive system.
Structures of the Urinary and Reproductive Systems

• **Tell Me Why**
  • Why are newborn girls less likely to contract vaginal infections than are three-year-olds?
Bacterial Diseases of the Urinary Systems

- **Bacterial Urinary Tract Infections**
  - Signs and symptoms
    - Frequent, urgent, painful urination
    - Urine may be cloudy with foul odor
  - Pathogens and virulence factors
    - Enteric bacteria are the most common cause
    - *Escherichia coli* causes most cases
    - Virulence factors include flagella and attachment fimbriae
Bacterial Diseases of the Urinary Systems

• **Bacterial Urinary Tract Infections**
  • Pathogenesis and epidemiology
    • Often results when fecal bacteria are introduced into urethra
    • More common in females
  • Diagnosis, treatment, and prevention
    • Diagnosis is based on urinalysis
    • Many cases resolve without treatment
      • Some treated with antimicrobial drugs
    • Prevented by limiting contamination by fecal microbes
Bacterial Diseases of the Urinary Systems

• **Leptospirosis**
  • Zoonotic disease seen primarily in animals
  • Signs and symptoms
    • Abrupt fever, myalgia, muscle stiffness, and headache
    • Rarely fatal
  • Pathogen
    • Caused by *Leptospira interrogans*
    • Normally lives in many wild and domestic animals
    • Virulent strains make adhesins, are motile, and can evade complement activity
Figure 24.2 *Leptospira interrogans.*
Bacterial Diseases of the Urinary Systems

• **Leptospirosis**
  • Pathogenesis
    • Transmitted by contact with urine of infected animal or urine-contaminated water
    • Spirochete travels via the bloodstream through the body
  • Epidemiology
    • Occurs throughout world but rare in the United States
  • Diagnosis, treatment, and prevention
    • Diagnosis is based on antibody test
    • Treated with antimicrobial drugs
    • Prevented by avoiding contaminated water
Streptococcal Acute Glomerulonephritis

- Some antibody-antigen complexes against group A streptococci strains are not removed from the body
- Complexes are deposited in the glomeruli of the kidneys
  - Cause inflammation of the glomeruli and nephrons
  - Produce hypertension and low urine output
- Irreversible kidney damage can occur in adults
Bacterial Diseases of the Urinary Systems

- Tell Me Why
  - Why does insertion of a urinary catheter increase the likelihood of cystitis (inflammation of the bladder)?
Staphylococcal Toxic Shock Syndrome

• Signs and symptoms
  • Sudden-onset fever, chills, vomiting, diarrhea, low blood pressure, confusion, and severe red rash
  • Individuals go into shock if untreated

• Pathogen and virulence factors
  • Caused by some strains of *S. aureus*
    • These strains produce toxic shock syndrome toxin
      • Cause excessive cytokine production by T cells
Nonvenereal Diseases of the Reproductive Systems

• **Staphylococcal Toxic Shock Syndrome**
  
  • Pathogenesis and epidemiology
    • Absorption of toxin into blood triggers toxic shock syndrome
    • Most cases occur in menstruating females
  
  • Diagnosis, treatment, and prevention
    • Diagnosis is based on signs and symptoms
    • Considered medical emergency
    • Requires removal of foreign material and antimicrobial drugs
    • Avoiding tampons or using less absorbent tampons reduces risk
Figure 24.3 The incidence of staphylococcal toxic shock syndrome in the United States, 1979–2015.
Nonvenereal Diseases of the Reproductive Systems

• **Bacterial Vaginosis**
  • Signs and symptoms
    • White vaginal discharge with a “fishy” odor
  • Pathogens
    • Caused by various anaerobic bacteria
  • Pathogenesis and epidemiology
    • Associated with multiple sexual partners and vaginal douching
  • Diagnosis, treatment, and prevention
    • Diagnosed is based on signs and symptoms
    • Treated with oral or vaginal metronidazole
Figure 24.4 Clue cell.

Nucleus of clue cell

Bacteria

Normal, non-clue cell

LM 5 μm
Nonvenereal Diseases of the Reproductive Systems

• Vaginal Candidiasis
  • Signs and symptoms
    • Severe vaginal itching and burning
  • Pathogen
    • Most commonly caused by *Candida albicans*
      • Normal microbiota of skin and mucous membranes
Nonvenereal Diseases of the Reproductive Systems

• Vaginal Candidiasis
  • Pathogenesis and epidemiology
    • Candida overgrows if vaginal pH becomes alkaline or normal microbial populations are reduced
    • Can become systemic in immunocompromised people
  • Diagnosis, treatment, and prevention
    • Identification of Candida and presence of symptoms are diagnostic
    • Treated with azole or fluconazole
    • Prevent by avoiding persistent moisture in genital area
Nonvenereal Diseases of the Reproductive Systems

• **Dr. Bauman’s Microbiology Video Tutor**
  • For more information, listen to the Disease in Depth video tutor on candidiasis.
Tell Me Why

Why does *Candida albicans*, which is a member of the normal microbiome, sometimes cause disease?
Sexually Transmitted Infections (STIs) and Diseases (STDs)

- STIs occur from the sexual transmission of potential pathogens.
  - Resulting disease is an STD.
- STDs are common worldwide.
- Young people who experiment with sex are at risk.
- Presence of lesions from STDs is a risk factor for transmission of HIV.
Sexually Transmitted Infections (STIs) and Diseases (STDs)

• Female adolescents are at risk because the cervical lining is prone to bacterial infection
  • Can cause pelvic inflammatory disease
• Prevention includes abstinence or mutual monogamy
• Condoms must be used properly and consistently to provide protection
Sexually Transmitted Infections (STIs) and Diseases (STDs)

• **Tell Me Why**
  • Why have STIs and STDs become pandemic over the past 50 years?
Bacterial STDs

• **Gonorrhea**
  • Signs and symptoms
    • Men experience painful urination and a purulent discharge
    • Women are often asymptomatic
      • Pelvic inflammatory disease may develop
  • Pathogen and virulence factors
    • Caused by *Neisseria gonorrhoeae*
    • Virulence factors include fimbriae, capsule, and endotoxin
Bacterial STDs

- **Gonorrhea**
  - **Pathogenesis**
    - Bacteria attach to epithelial cells of the mucous membranes.
    - Infections outside the reproductive tract also occur.
    - Babies delivered vaginally by infected mothers can become infected.
  - **Epidemiology**
    - Gonorrhea occurs only in humans.
    - Cases in the United States have been declining.
    - Risk increases with frequency of sexual encounters.
Figure 24.5 The incidence of civilian gonorrhea in the United States.
Bacterial STDs

- **Gonorrhea**
  - Diagnosis, treatment, and prevention
  - Genetic probes are used to diagnose asymptomatic infection
  - Treated with ceftriaxone and azithromycin
  - Spread of gonococcal strains resistant to many antimicrobials has complicated treatment
  - Prevented with safe sex practices
Bacterial STDs

• **Syphilis**
  • Signs and symptoms
    • Four phases of syphilis
      • Primary syphilis
      • Secondary syphilis
      • Latent syphilis
      • Tertiary syphilis
Figure 24.6  The lesions of syphilis.
Bacterial STDs

- **Syphilis**
  - Pathogen and virulence factors
    - *Treponema pallidum* causes syphilis
      - Lives only in humans
    - Virulence factors have been difficult to identify
  - Pathogenesis
    - Transmitted mostly via sexual contact
    - Sometimes transmitted from mother to child
    - Most individuals do not develop tertiary syphilis
Bacterial STDs

• **Syphilis**
  
  • Epidemiology
    • Syphilis occurs worldwide
    • Endemic among sex workers, men who have sex with men, and users of illegal drugs
  
  • Diagnosis, treatment, and prevention
    • Antibody test is used to diagnose primary, secondary, and congenital syphilis
    • Tertiary syphilis is difficult to diagnose
    • Penicillin G is used to treat all but tertiary syphilis
    • Prevented with safe sex practices
Figure 24.7 The incidence of syphilis in the United States.
Bacterial STDs

• **Chlamydial Infections**
  • Signs and symptoms
    • Women are usually asymptomatic
    • Men have painful urination and pus discharge from penis
    • Causes numerous diseases
      • Epididymitis: inflammation of the epididymis
      • Orchitis: inflammation of the testes
      • Trachoma: disease of the eye
      • Lymphogranuloma venereum: formation of a genital lesion and bubo in the groin
Figure 24.8 An advanced case of lymphogranuloma venereum in a man.
Bacterial STDs

• **Chlamydial Infections**
  
  • Pathogens and virulence factors
  
  • Caused by *Chlamydia trachomatis*
    
    • All strains but one are pathogens of humans
    
    • Grow only within vesicles inside host cells
    
    • Developmental cycle
      
      • Elementary bodies are the infective form
      
      • Reticulate bodies are the reproductive form
Figure 24.9 The developmental forms and life cycle of *Chlamydia*.
Bacterial STDs

- **Chlamydial Infections**
  - **Pathogenesis**
    - Microbes enter body through scrapes or cuts
    - Infect conjunctiva or cells lining mucous membranes
    - Spread to the lymphatic system, causing proctitis
    - Adolescent infection increases cervical cancer risk
  - **Epidemiology**
    - Most common reportable STD in the United States
    - Eye infections endemic in poor, crowded areas
  - **Diagnosis, treatment, and prevention**
    - Detection of chlamydial DNA by PCR is diagnostic
    - Treated with antimicrobial drugs
    - Prevented by abstinence or mutual monogamy
Bacterial STDs

• **Tell Me Why**
  
  • Why is erythromycin substituted for tetracycline in treatment of chlamydial infections in children? Why are penicillins and cephalosporins useless against *Chlamydia*?
Viral STDs

• **Genital Herpes**
  - Signs and symptoms
    - Small blisters on or around the genitals or rectum
  - Pathogen and virulence factors
    - *Human herpesvirus* 2 causes most cases
    - *Human herpesvirus* 1 causes remainder of cases
    - Virus can become latent in nerve cells
  - Pathogenesis
    - Herpesvirus kills epithelial cells at infection site
    - Blisters may form at sites far from initial infection
    - Babies can become infected during birth
Figure 24.10 Sites of events in genital herpesvirus infections.
Figure 24.11 Herpes lesions of the eyes and skin.
Viral STDs

• **Genital Herpes**
  • Epidemiology
    • Genital herpes quadruples the risk of HIV infection.
  • Diagnosis, treatment, and prevention
    • Diagnosis is based on characteristic lesions.
    • Acyclovir or other antiviral agents can lessen symptoms.
    • Circumcised males are at lower risk of infection.
    • Condoms often provide little protection.
    • Infected pregnant women should deliver by C-section.
Viral STDs

• **Genital Warts**
  
  • Pathogen, signs, and symptoms
    
    • Papillomas, or warts, are growths of skin epithelium
    
    • May form on the face, trunk, hands, feet, elbows, knees, or genitalia
    
    • Large growths called **condylomata acuminata**
    
    • Caused by human papillomaviruses (HPV)
Viral STDs

• **Genital Warts**
  • Pathogenesis and epidemiology
    • Most common STD in the United States
    • Cause nearly all cervical cancers
  • Diagnosis, treatment, and prevention
    • Diagnosis is made by presence of warts
    • Variety of methods available to remove warts
    • Vaccine is available against HPV strain associated with cervical cancer
Viral STDs

• Tell Me Why
  • Why are DNA viruses, such as herpesviruses and papillomaviruses, more likely to cause recurrent diseases and cancers than are RNA viruses?
Protozoan STDs

• **Trichomoniasis**
  • Signs and symptoms
    • Females have vaginal discharge and irritation
    • Males are typically asymptomatic
  • Pathogen and virulence factors
    • Caused by *Trichomonas vaginalis*
  • Pathogenesis and epidemiology
    • Transmitted primarily via sexual intercourse
    • Most common curable STD in women
    • Trichomoniasis increases risk of infection by HIV
    • Various virulence factors contribute to disease
Protozoan STDs

- **Trichomoniasis**
  - Diagnosis, treatment, and prevention
    - Diagnosed by presence of *Trichomonas* in clinical samples
    - Treated with a single dose of oral metronidazole or tinidazole
    - Prevented by avoiding sexual intercourse with infected persons
Protozoan STDs

• **Tell Me Why**
  
  • Why might a course of antibacterial drugs trigger a case of trichomoniasis in a female patient?