Chapter 26

Microbial Diseases of the Urinary and Reproductive Systems

Structure and Function of the Urinary System

- 26-1 List the antimicrobial features of the urinary system.

- Valves that prevent backflow to kidneys
- Acidity of urine
- Mechanical flushing

Structure and Function of the Urinary System

- Urinary system
  - Two kidneys
  - Two ureters
  - One urinary bladder
  - One urethra
- Infection prevented by
  - Valves that prevent backflow to kidneys
  - Acidity of urine
  - Mechanical flushing

The Reproductive Systems

- 26-2 Identify the portals of entry for microbes into the female and male reproductive systems.

The Female Reproductive System

- Female
  - Two ovaries
  - Two uterine (fallopian) tubes
  - The uterus, including the cervix; the vagina
  - External genitals
The Male Reproductive System

- Male
  - Two testes
  - Accessory glands
  - Penis
  - Epididymis
  - Ductus (vas) deferens
  - Ejaculatory duct
  - Urethra

Normal Microbiota

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- Urinary bladder and upper urinary tract are sterile
- Lactobacilli are predominant in the vagina
  - Produce H2O2
  - Grow on glycogen secretions
- Infection is indicated by
  - >10,000 bacteria/ml
  - 100 coliforms/ml
  - Positive urine leukocyte esterase (LE) test
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- Does the pH of urine facilitate the growth of most bacteria? 26-1
- Look at Figure 26.2. Is a microbe entering the female reproductive system (the uterus, etc.) necessarily also entering the bladder, causing cystitis? 26-2
- What is the association between estrogens and the microbiota of the vagina? 26-3

15 **Bacterial Diseases of the Urinary System**
- 26-4 Describe the modes of transmission for urinary and reproductive system infections.
- 26-5 List the microorganisms that cause cystitis, pyelonephritis, and leptospirosis, and name the predisposing factors for these diseases.
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16 **Urinary System Infections**
- Cystitis
  - An inflammation of the urinary bladder
- Urethritis
  - An inflammation of the urethra
- Pyelonephritis
  - An inflammation of one or both kidneys

17 **Cystitis**
- Usual causative agents
  - E. coli
  - S. saprophyticus
- Symptoms
  - Dysuria (difficult or painful urination)
  - Pyuria (pus in urine)
- Diagnosis: >100 CFU/ml of potential pathogens and positive LE test
• Treatment: trimethoprim-sulfamethoxazole

18 Pyelonephritis
• Causative agent: usually E. coli
• Symptoms: fever; back or flank pain
• Diagnosis: 10,000 CFU/ml and positive LE test
• Treatment: cephalosporin

19 Leptospirosis
• Causative agent: Leptospira interrogans
• Reservoir: dogs and rats
• Transmission: skin/mucosal contact from urine-contaminated water

20 Leptospirosis
• Symptoms: headaches, muscular aches, fever; kidney failure a possible complication
• Diagnosis: serological test
• Treatment: doxycycline

21 Diseases in Focus: Bacterial Diseases of the Urinary System
• A 20-year-old woman feels a stinging sensation when urinating and feels an urgent need to urinate, even if very little urine is excreted.
• Can you identify infections that could cause these symptoms?

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23 Why is urethritis, an infection of the urethra, frequently preliminary to further infections of the urinary tract? 26-4
• Why is E. coli the most common cause of cystitis, especially in females? 26-5

24 Bacterial Diseases of the Reproductive System
• 26-6 List the causative agents, symptoms, methods of diagnosis, and treatments for gonorrhea, nongonococcal urethritis (NGU), pelvic inflammatory disease (PID), syphilis, lymphogranuloma venereum (LGV), chancroid, and bacterial vaginosis.
Sexually Transmitted Infections (STIs)
- Prevented by condoms
- Bacterial infections are treated with antibiotics

Gonorrhea
- Caused by Neisseria gonorrhoeae
- Attaches to oral or urogenital mucosa by fimbriae
- Opa proteins prevent proliferation of CD4+ T cells
- Anal gonorrhea, pharyngeal gonorrhea
- If left untreated, may result in
  - Endocarditis
  - Meningitis
  - Arthritis
  - Ophthalmia neonatorum

Gonorrhea
- Symptoms
  - Men: painful urination and discharge of pus
  - Women: few symptoms but possible complications, such as PID
- Diagnosis: Gram stain, ELISA, PCR
- Treatment: cephalosporins

Nongonococcal Urethritis (NGU)
• Nonspecific urethritis
  • Chlamydia trachomatis
  • Mycoplasma hominis
  • Ureaplasma urealyticum
• Symptoms: painful urination and watery discharge; in women, possible complications, such as PID
• Diagnosis: culture, PCR
• Treatment: doxycycline, azithromycin

**33 Pelvic Inflammatory Disease (PID)**
• Polymicrobial, usually:
  • N. gonorrhoeae
  • C. trachomatis
• Salpingitis (infection of uterine tubes)
• Symptoms: chronic abdominal pain
• Treatment: doxycycline and cefoxitin

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**37 Syphilis**
• Caused by Treponema pallidum
• Invades mucosa or through skin breaks

**38 Syphilis**
• Primary stage: chancre at site of infection
• Secondary stage: skin and mucosal rashes
• Latent period: no symptoms
• Tertiary stage: gummas on many organs
• Treatment: benzathine penicillin
• Congenital: neurological damage
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40 **Diagnosis of Syphilis**
- Direct diagnosis
  - Staining with fluorescent-labeled monoclonal antibodies
- Indirect, rapid screening
  - VDRL, RPR, EIA
- Confirming
  - FTA-ABS tests for anti-treponemal antibodies

41 **Lymphogranuloma Venereum (LGV)**
- Causative agent: Chlamydia trachomatis
- Initial lesion on genitals heals
- Bacteria spread through lymph
- Symptoms: swelling in lymph nodes in groin
- Diagnosis: microscopic identification and culture
- Treatment: doxycycline

42 **Chancroid (Soft Chancre)**
- Causative agent: Haemophilus ducreyi
- Symptoms: painful ulcers of genitals, swollen lymph nodes in groin
- Diagnosis: culture
- Treatment: erythromycin; ceftriaxone

43 **Bacterial Vaginosis**
- Causative agent: Gardnerella vaginalis
- Symptoms: copious fishy, gray-white, thin, frothy discharge
- pH: >4.5
- Diagnosis: clue cells
- Treatment: metronidazole
45 Why is the disease condition of the female reproductive system, principally featuring growth of Gardnerella vaginalis, termed vaginosis rather than vaginitis? 26-6

46 Viral Diseases of the Reproductive Systems
26-7 Discuss the epidemiology of genital herpes and genital warts.

47 Genital Herpes
• Caused by herpes simplex virus 2 (human herpesvirus 2, or HSV–2)
• Painful vesicles on genitals
• Neonatal herpes transmitted to fetus or newborns
• Recurrences from viruses latent in nerves
• Suppression: acyclovir

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49 Genital Warts
• Human papillomaviruses
• Warts in genital area
• HPV serotype 16 causes cervical cancer and cancer of the penis
• Treatment: podophlox; imiquimod
• Prevention: vaccination against HPV strains

50 Both genital herpes and genital warts are caused by viruses; which one is the greater danger to a pregnancy? 26-7

51 Fungal Disease of the Reproductive Systems
26-8 Discuss the epidemiology of candidiasis.

52 Candidiasis
• Causative agent: Candida albicans
Grows on mucosa of mouth, intestinal tract, and genitourinary tract
- NGU in males
- Vulvovaginal candidiasis, yeasty discharge
- pH: <4
- Diagnosis: microscopic and culture
- Treatment: clotrimazole; fluconazole

What changes in the vaginal bacterial microbiota tend also to favor the growth of the yeast Candida albicans? 26-8

Protozoan Disease of the Reproductive Systems

- Discuss the epidemiology of trichomoniasis.
- List reproductive system diseases that can cause congenital and neonatal infections, and explain how these infections can be prevented.

Trichomoniasis
- Causative agent: Trichomonas vaginalis
- Found in semen or urine of male carriers
- Vaginal infection causes irritation and profuse foul, greenish yellow frothy discharge
- pH: 5–8
- Diagnosis: microscopic identification, DNA probe
- Treatment: metronidazole

The TORCH Panel of Tests
- Toxoplasmosis
- Other (such as syphilis, hepatitis B, enterovirus, Epstein-Barr virus, varicella-zoster virus)
• Rubella
• Cytomegalovirus
• Herpes simplex virus

59 Diseases in Focus:
Diseases of the Reproductive System
• A 26-year-old woman has abdominal pain, painful urination, and a fever. Cultures grown in a high-CO2 environment reveal gram-negative diplococci.
• Can you identify infections that could cause these symptoms?

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• What are the symptoms of the presence of Trichomonas vaginalis in the male reproductive system? 26-9
• What is the intent of the TORCH panel of tests? 26-10