CHAPTER 26 - Microbial Diseases of the Urinary and Reproductive System

Introduction

- The urinary system regulates the chemical composition of the blood and excretes nitrogenous waste.
- The reproductive system produces gametes for reproduction and, in the female, supports the growing embryo.
- Microbial diseases of these systems can result from infection from an outside source or from opportunistic infection by members of the normal microbiota.

I. Structure of the Urinary System

A. Urine is transported from the kidneys through ureters to the urinary bladder and is eliminated through the urethra.
B. Valves prevent urine from flowing back to the urinary bladder and kidneys.
C. The flushing action of urine and the acidity of normal urine have some antimicrobial value.

II. Structure and Function of the Reproductive System

A. The female reproductive system consists of two ovaries, two uterine tubes, the uterus, the cervix, the vagina, and the external genitals.
B. The male reproductive system consists of two testes, ducts, accessory glands, and the penis; seminal fluid leaves the male body through the urethra.

III. Normal Microbiota of the Urinary and Reproductive Systems

A. The urinary bladder and upper urinary tract are sterile under normal conditions.
B. Lactobacilli dominate the vaginal microbiota during the reproductive years.
C. The male urethra is normally sterile.

IV. Bacterial Diseases of the Urinary System

- Urethritis (urethra), cystitis (bladder), and ureteritis (ureters) are terms describing inflammations of tissues of the lower urinary tract.
- Pyelonephritis (kidney) can result from lower urinary tract infections (ascending) or from systemic bacterial infections (descending).
- Opportunistic gram-negative bacteria from the intestines often cause urinary tract infections.
- Nosocomial infections following catheterization occur in the urinary system. *E. coli* causes more than half of these infections.
- >100,000 orgs/ml, or more than 1000 bacteria/ml of one species, or 100 coliforms/ml of urine, indicates an infection. \[\text{Inoculum} = .001, \text{so} 10 \text{ colonies} \times 1000 = 10,000 \text{ orgs/ml}, 100 \text{ colonies} \times 1000 = 100,000 \text{ orgs/ml}.\]
- Treatment of urinary tract infections depends on the isolation and antibiotic sensitivity testing of the causative agents.
- Glomerulonephritis is an immune-complex disease of the kidneys.

A. Cystitis

1. Inflammation of the urinary bladder, or cystitis, is common in females.
2. Microorganisms at the opening of the urethra and along the length of the urethra, careless personal hygiene, and sexual intercourse contribute to the high incidence of cystitis in females.
3. Symptoms include dysuria (difficult urgent urination) and pyuria (leukocytes in the urine).
4. The most common etiologies are *E. coli* and *S. saprophyticus*. Trimethoprim-sulfamethoxaxazole clears cases quickly.

B. Pyelonephritis

1. Inflammation of the kidneys, or pyelonephritis, is usually a complication of lower urinary tract infections.
2. About 75% of pyelonephritis cases are caused by *E. coli*. Can be potentially life threatening so aggressive treatment is implemented.

C. Leptospirosis: *Leptospira interrogans*

1. A disease of domestic and wild animals that can be spread by urine contaminated water to humans and cause liver and kidney disease.
2. Incubates 1-2 weeks, then headaches, chill, fever, and then maybe serious kidney (Weil’s disease) or liver disease.

V. Diseases of the Reproductive System

A. Bacterial Diseases of the Reproductive System

1. Most diseases of the reproductive system are sexually transmitted diseases (STDs).
2. Most STDs can be prevented by the use of condoms and are treated with antibiotics.

B. Gonorrhea - *Neisseria gonorrhoeae*
1. *Neisseria gonorrhoeae* causes gonorrhea.
2. See as gram neg. diplococci within phagocytic cells. Survives poorly outside the body and requires special handling.
3. Gonorrhea is a common reportable communicable disease in the United States.
4. *N. gonorrhoeae* attaches to mucosal cells of the oral-pharyngeal area, genitals, eyes, and rectum by means of fimbriae.
5. Symptoms in males are painful urination and pus discharge. Blockage of the urethra and sterility are complications of untreated cases.
6. Females might be asymptomatic unless the infection spreads to the uterus and uterine tubes (see pelvic inflammatory disease).
7. Gonorrheal endocarditis, gonorrheal meningitis, and gonorrheal arthritis are complications that can affect both sexes if gonorrheal infections are untreated.
8. Ophthalmia neonatorum is an eye infection acquired by infants during passage through the birth canal of an infected mother.
9. 1 % silver nitrate for G.C, *Erythromycin* for *C. trachomatis*, Tetracycline covers both *G.C. and C trachomatis*
10. Gonorrhea is diagnosed by Gram stain, ELISA, or DNA probe.
11. Resistant: use fluoroquinolone (ciprofloxacin) + tetracycline for chlamydia.

C. Nongonococcal Urethritis (NGU): *Chlamydia trachomatis*, *Ureaplasma urealyticum* and *Mycoplasma hominis*.

1. Nongonococcal urethritis (NGU), or nonspecific urethritis (NSU), is any inflammation of the urethra not caused by *N. gonorrhoeae*.
2. Most cases of NGU are caused by *Chlamydia trachomatis*.
3. *C. trachomatis* infection is the most common STD.
4. Symptoms of NGU are often mild or lacking, although uterine tube inflammation and sterility may occur.
5. *C. trachomatis* can be transmitted to infant’s eyes at birth.
6. Diagnosis is based on the detection of chlamydial DNA in urine.
7. *Ureaplasma urealyticum* and *Mycoplasma hominis* also cause NGU.
8. All are sensitive to tetracycline.

D. Pelvic Inflammatory Disease (PID) - *N. gonorrhoeae, Chlamydia trachomatis*

1. Extensive bacterial infection of the female pelvic organs, especially of the reproductive system, is called pelvic inflammatory disease (PID).
2. PID is caused by *N. gonorrhoeae, Chlamydia trachomatis*, and other bacteria that gain access to the uterine tubes. Infection of the uterine tubes is called salpingitis.
3. 1 in 10 reproductive age women get PID. Can mitigate by using a barrier protection to prevent sperm migration.
4. PID can result in blockage of the uterine tubes and sterility and lead to ectopic pregnancy.
E. Syphilis - *Treponema pallidum*

1. Syphilis is caused by *Treponema pallidum*, a spirochete that has not been cultured in vitro. Laboratory cultures are grown in cell cultures.
2. Other strains cause tropical skin disease, yaws.
3. *T. pallidum* is transmitted by direct contact and can invade intact mucous membranes or penetrate through breaks in the skin.
4. Coiled like metal spring axial filaments assists in penetrating tissue.
5. Primary lesion: a small, hard-based chancre at the site of infection. The bacteria then invade the blood and lymphatic system, and the chancre spontaneously heals.
6. Secondary stage: The appearance of a widely disseminated rash on the skin and mucous membranes. Spirochetes are present in the lesions of the rash.
7. The patient enters a latent period after the secondary lesions spontaneously heal.
8. Tertiary stage: At least 10 years after the secondary lesion, lesions called gummas can appear on many organs.
9. Congenital syphilis, resulting from *T. pallidum* crossing the placenta during the latent period, can cause neurological damage in the newborn.
10. *T. pallidum* is identifiable through darkfield microscopy of fluid from primary and secondary lesions.
11. Many serological tests, such as VDRL (Veneral Disease Research Lab), RPR (Rapid plasma regain), and FTA-ABS, can be used to detect the presence of antibodies against *T. pallidum* during any stage of the disease.

VI. Viral Diseases of the Reproductive System

A. Genital Herpes –dsDNA *Family Herpesviridae* *Herpes simplex virus type 2* (HSV-2)

1. Herpes simplex virus type 2 (HSV-2) causes genital herpes.
2. Symptoms of the infection are painful urination, genital irritation, and fluid-filled vesicles.
3. Neonatal herpes is contracted during fetal development or birth. It can result in neurological damage or infant fatalities.
4. The virus might enter a latent stage in nerve cells. Vesicles reappear following trauma, stress, and hormonal changes.
5. Genital herpes is associated with cervical cancer.
6. The drug acyclovir has proven effective in treating the symptoms, but it does not cure the disease.

B. Warts - *Papillomavirus* dsDNA *Family: Papillomaviridae Genus: Papillomavirus*
1. Papillomaviruses cause genital warts (condylomas). Vary in appearance from smooth and flat to projecting and cauliflower-like.
2. A few serotypes of papillomaviruses that cause genital warts have been associated with cancer of the cervix (or rarely the penis).
3. Pap smears are used to monitor for cancer of the cervix. Tests to identify cancerous serotypes are available. A vaccine may available soon.

C. AIDS - HIV Human immunodeficiency virus 1, RNA retro, Family: Retroviridae Genus: Lentivirus

1. AIDS is a sexually transmitted disease that degrades the immune system (see Chapter 19, pp. 545-552). Male to female transfer is more likely than the reverse.

VII. Fungal Disease of the Reproductive System

A. Candidiasis - Candida albicans, a yeast

1. Candida albicans causes and vulvovaginal candidiasis, or yeast infection, in females. 75% of all women experience at least one case. Uncommonly a cause of NGU in males
2. Vulvovaginal candidiasis is characterized by lesions that produce itching and irritation, yellow cheesy discharge, yeasty or no odor.
3. Predisposing factors are oral contraceptives/pregnancy, diabetes, and broad-spectrum antibacterial chemotherapy.
4. Diagnosis is based on observation of the fungus and its isolation from lesions.
5. Topical application of clotrimazole and miconazole is the treatment.

VIII. Protozoan Disease of the Reproductive System

A. Trichomoniasis – Trichomonas vaginalis

1. Trichomonas vaginalis causes trichomoniasis when the pH of the vagina increases.
2. May be a normal inhabitant of female vagina & male urethra in small numbers, but the infections is generally passed by sexual contact.
3. Protozoa outgrow normal flora in increased pH
4. Diagnosis is based on observation of the protozoa in purulent discharges from the site of infection.
5. In females discharges are profuse, greenish/yellow and have bad odor, leading to irritation and itching. Males are generally asymptomatic.
6. Metronidazole is treatment both sex partners.