

Study Outline Chapter 22

Structure and Function of the Nervous System (pp. 580-581)

- The central nervous system (CNS) consists of the brain, which is protected by the skull bones, and the spinal cord, which is protected by the backbone.
- The peripheral nervous system (PNS) consists of the nerves that branch from the CNS.
- The CNS is covered by three layers of membranes called meninges: the dura mater, arachnoid, and pia mater. Cerebrospinal fluid (CSF) circulates between the arachnoid and the pia mater in the subarachnoid space.
- The blood-brain barrier normally prevents many substances, including antibiotics, from entering the brain.
- Microorganisms can enter the CNS through trauma, along peripheral nerves, and through the bloodstream and lymphatic system.
- An infection of the meninges is called meningitis. An infection of the brain is called encephalitis.

Bacterial Diseases of the Nervous System (pp. 581-588)

Bacterial Meningitis(pp. 581-584)

- Meningitis can be caused by viruses, bacteria, fungi, and protozoa.
- The three major causes of bacterial meningitis are Hemophilus influenzae, Streptococcus pneumoniae, and Neisseria meningitidis.
- Nearly 50 species of opportunistic bacteria can cause meningitis.

Hemophilus influenzae Meningitis (pp. 581-582)

- H. influenzae is part of the normal throat microbiota.
- H. influenzae requires blood factors for growth; there are six types of H.influenzae based on capsule differences.
- H. influenzae type b is the most common cause of meningitis in children under 4 years old.
- A conjugated vaccine directed against the capsular polysaccharide antigen is available.

Neisseria Meningitis (Meningococcal Meningitis) (pp. 582-583)

- N. meningitidis causes meningococcal meningitis. This bacterium is found in the throats of healthy carriers.
- The bacteria probably gain access to the meninges through the bloodstream. The bacteria may be found in leukocytes in CSF.
- Symptoms are due to endotoxin. The disease occurs most often in young children.
- Military recruits are vaccinated with purified capsular polysaccharide to prevent epidemics in training camps.

Streptococcus pneumoniae Meningitis (Pneumococcal Meningitis) (p. 583)

- S. pneumoniae is commonly found in the nasopharynx.
- Hospitalized patients and young children are most susceptible to S. pneumoniae meningitis. It is rare but has a high mortality rate.

- The vaccine for pneumococcal pneumonia may provide some protection against pneumococcal meningitis.

Diagnosis and Treatment of the Most Common Types of Bacterial Meningitis (p. 583)

- Cephalosporins may be administered before identification of the pathogen.
- Diagnosis is based on isolation and identification of the bacteria in CSF.
- Cultures are usually made on blood agar and incubated in an atmosphere containing reduced oxygen levels.

Listeriosis (p. 584)

- *Listeria monocytogenes* causes meningitis in newborns, the immunosuppressed, pregnant women, and cancer patients.
- Acquired by ingestion of contaminated food, it may be asymptomatic in healthy adults.
- *L. monocytogenes* can cross the placenta and cause spontaneous abortion and stillbirth.

Tetanus (pp. 584-585)

- Tetanus is caused by a localized infection of a wound by *Clostridium tetani*.
- *C. tetani* produces the neurotoxin tetanospasmin, which causes the symptoms of tetanus: spasms, contraction of muscles controlling the jaw, and death resulting from spasms of respiratory muscles.
- *C. tetani* is an anaerobe that will grow in deep, unclean wounds and wounds with little bleeding.
- Acquired immunity results from DPT immunization that includes tetanus toxoid.
- Following an injury, an immunized person may receive a booster of tetanus toxoid. An unimmunized person may receive (human) tetanus immune globulin.
- Debridement (removal of tissue) and antibiotics may be used to control the infection.

Botulism (pp. 585-587)

- Botulism is caused by an exotoxin produced by *C. botulinum* growing in foods.
- Serological types of botulinum toxin vary in virulence, with type A being the most virulent.
- The toxin is a neurotoxin that inhibits the transmission of nerve impulses.
- Blurred vision occurs in 1-2 days; progressive flaccid paralysis follows for 1-10 days, possibly resulting in death from respiratory and cardiac failure.
- *C. botulinum* will not grow in acidic foods or in an aerobic environment.
- Endospores are killed by proper canning. The addition of nitrites to foods inhibits growth after endospore germination.
- The toxin is heat labile and is destroyed by boiling (100°C) for 5 minutes.
- Infant botulism results from the growth of *C. botulinum* in an infant's intestines.
- Wound botulism occurs when *C. botulinum* grows in anaerobic wounds.
- For diagnosis, mice protected with antitoxin are inoculated with toxin from the patient or foods.

Leprosy (pp. 587-588)

- *Mycobacterium leprae* causes leprosy, or Hansen's disease.

- *M. leprae* has never been cultured on artificial media. It can be cultured in armadillos.
- The tuberculoid form of the disease is characterized by loss of sensation in the skin surrounded by nodules. The lepromin test is positive.
- Laboratory diagnosis is based on observations of acid-fast rods in lesions or fluids and the lepromin test.
- In the lepromatous form, disseminated nodules and tissue necrosis occur. The lepromin test is negative.
- Leprosy is not highly contagious and is spread by prolonged contact with exudates.
- Untreated individuals often die of secondary bacterial complications, such as tuberculosis.
- Patients with leprosy are made noncommunicable within 4-5 days with sulfone drugs and then treated as outpatients.
- Leprosy occurs primarily in the tropics.

Viral Diseases of the Nervous System (pp. 588-594)

- Variola virus causes two types of skin infections: variola major and variola minor.
- smallpox is transmitted by the respiratory route, and the virus is moved to the skin via the bloodstream.
- The only host for smallpox is humans.
- smallpox has been eradicated as a result of a vaccination effort by the WHO.

Chickenpox (Varicella) and Shingles (Herpes Zoster) (pp. 567- 569)

Poliomyelitis (pp. 589-590)

- The symptoms of poliomyelitis are usually headache, sore throat, fever, stiffness of the back and neck, and occasionally paralysis (less than 1% of cases).
- Poliovirus is found only in humans and is transmitted by the ingestion of water contaminated with feces.
- Poliovirus first invades lymph nodes of the neck and small intestine. Viremia and spinal cord involvement may follow.
- Diagnosis is based on isolation of the virus from feces and throat secretions.
- The Salk vaccine (an inactivated polio vaccine, or IPV) involves the injection of formalin-inactivated viruses and boosters every few years. The Sabin vaccine (an oral polio vaccine, or OPV) contains three live, attenuated strains of poliovirus and is administered orally.
- Through vaccination, the WHO plans to eliminate polio by the year 2000.

Rabies (pp. 590-592)

- Rabies virus (a rhabdovirus) causes an acute, usually fatal, encephalitis called rabies.
- Rabies may be contracted through the bite of a rabid animal, by inhalation of aerosols, or invasion through minute skin abrasions. The virus multiplies in skeletal muscle and connective tissue.
- Encephalitis occurs when the virus moves along peripheral nerves to the CNS.
- Symptoms of rabies include spasms of mouth and throat muscles followed by extensive brain and spinal cord damage and death.

- Laboratory diagnosis may be made by direct immunofluorescent tests of saliva, serum, and CSF or brain smears.