

- 1  **Chapter 22**  
Microbial Diseases of the Nervous System
- 2  **The Nervous System**
- 3  **The Human Nervous System**
- 4  **The Nervous System**
  - Meninges protect brain and spinal cord
    - Dura mater: Outermost layer
    - Arachnoid mater: Middle layer
      - Subarachnoid space contains *cerebrospinal fluid* (CSF)
    - Pia mater: Innermost layer
  - Blood–brain barrier
- 5  **The Meninges and CSF**
- 6  **The Nervous System**
  - Meningitis: Inflammation of meninges
  - Encephalitis: Inflammation of the brain
  - Meningoencephalitis: Inflammation of both
- 7  **Bacterial Diseases of the Nervous System**
- 8  **Bacterial Meningitis**
  - Initial symptoms of fever, headache, and stiff neck
  - Followed by nausea and vomiting
  - May progress to convulsions and coma
  - Diagnosis by Gram stain and latex agglutination of CSF
  - Treatment: Cephalosporins, vancomycin
- 9  **Spinal Tap (Lumbar Puncture)**
- 10  ***Haemophilus influenzae* Meningitis**
  - Occurs mostly in children (6 months to 4 years)
  - Gram-negative aerobic bacteria, normal throat microbiota
  - Capsule antigen type b
  - Prevented by Hib vaccine
- 11  ***Neisseria* Meningitis**
  - Also called meningococcal meningitis
  - Caused by *N. meningitidis*
    - Gram-negative, aerobic cocci with a capsule
  - 10% of people are healthy nasopharyngeal carriers
  - Begins as throat infection, rash
  - Serotypes B, C, Y, W-135 in U.S.
  - Serotype B in Europe
  - Serotype A in Africa, China, and Middle East
  - Vaccination (B, C, Y, W-135 capsule) recommended for college students
- 12  ***Neisseria* Meningitis**
- 13  ***Streptococcus pneumoniae* Meningitis**
  - Also called pneumococcal meningitis
  - Caused by *S. pneumoniae* (a gram-positive diplococcus)

- 70% of people are healthy nasopharyngeal carriers
- Most common in children (1 month to 4 years)
- Mortality: 30% in children, 80% in elderly
- Prevented by vaccination

14  **Listeriosis**

- Caused by *Listeria monocytogenes*
- Gram-negative aerobic rod
- Usually foodborne; it can be transmitted to fetus
- Reproduce in phagocytes

15  **Bacterial Diseases of the Nervous System**

16  **Tetanus**

- Caused by *Clostridium tetani*
- Gram-positive, endospore-forming, obligate anaerobe
- Grows in deep wounds
- Tetanospasmin released from dead cells blocks relaxation pathway in muscles
- Prevention by vaccination with tetanus toxoid (DTP) and booster (dT)
- Treatment with tetanus immune globulin

17  **An Advanced Case of Tetanus**

18  **Botulism**

- Caused by *Clostridium botulinum*
- Gram-positive, endospore-forming, obligate anaerobe
- Intoxication comes from ingesting botulinum toxin
- Botulinum toxin blocks release of neurotransmitter, causing flaccid paralysis
- Prevention
  - Proper canning
  - Nitrites prevent endospore germination in sausages

19  **Botulism**

- Treatment: Supportive care and antitoxin
- Infant botulism results from *C. botulinum* growing in intestines
- Wound botulism results from growth of *C. botulinum* in wounds

20  **Botulinum Types**

- Type A toxin
  - 60–70% fatality
  - Found in CA, WA, CO, OR, NM
- Type B toxin
  - 25% fatality
  - Europe and eastern United States
- Type E toxin
  - 25% fatality
  - Found in marine and lake sediments
  - Pacific Northwest, Alaska, Great Lakes area

21  **Diagnosing Botulism by Toxin ID**

22  **Leprosy**

- Also called Hansen's disease
- Caused by *Mycobacterium leprae*
- Acid-fast rod that grows best at 30°C.
- Grows in peripheral nerves and skin cells

- Transmission requires prolonged contact with an infected person

23  **Leprosy**

- Tuberculoid (neural) form: Loss of sensation in skin areas; positive lepromin test
- Lepromatous (progressive) form: Disfiguring nodules over body; negative lepromin test

24  **Leprosy Lesions**

25  **Leprosy Lesions**

26  **Viral Diseases of the Nervous System**

27  **Poliomyelitis (Polio)**

- Poliovirus
- Transmitted by ingestion
- Initial symptoms: Sore throat and nausea
- Viremia may occur; if persistent, virus can enter the CNS
- Destruction of motor cells and paralysis occurs in <1% of cases
- Prevention: vaccination (enhanced-inactivated polio vaccine)

28  **Worldwide Annual Incidence of Poliomyelitis**

29  **Rabies**

- Caused by the rabies virus
- Transmitted by animal bite
- Furious rabies: Animals are restless then highly excitable
- Paralytic rabies: Animals seem unaware of surroundings

30  **Pathology of Rabies Infection**

31  **Reported Cases of Rabies in Animals**

32  **Reported Cases of Rabies in Animals**

33  **Rabies Virus**

- Virus multiplies in skeletal muscles and then brain cells, causing encephalitis
- Initial symptoms may include muscle spasms of the mouth and pharynx and hydrophobia

34  **Prevention of Rabies**

- Preexposure prophylaxis: Injection of human diploid cells vaccine (HDCV)
- Postexposure treatment: Vaccine plus rabies immune globulin (RIG)

35  **Arboviral Encephalitis**

- Arboviruses
- Arthropod-borne viruses that belong to several families
- Prevention: controlling mosquitoes

36  **California Serogroup Arbovirus Cases, 1964–2006**

37  **Arboviral Encephalitis**

38  **Arboviral Encephalitis**

39  **Fungal Diseases of the Nervous System**

40  ***Cryptococcus neoformans* Meningitis**

- Also called cryptococcosis

- Soil fungus associated with pigeon and chicken droppings
- Transmitted by the respiratory route; spreads through blood to the CNS
- Mortality up to 30%
- Treatment: Amphotericin B and flucytosine

41  ***Cryptococcus neoformans***

42  **Protozoan Diseases of the Nervous System**

43  **African Trypanosomiasis**

- *Trypanosoma brucei gambiense*
  - Chronic (2 to 4 years)
- *T. b. rhodesiense* infection
  - Acute (few months)
- Transmitted from animals to humans by tsetse fly

44  **African Trypanosomiasis**

- Prevention: Elimination of the vector
- Treatment: Eflornithine blocks an enzyme necessary for the parasite
- Parasite evades the antibodies through antigenic variation

45  **How Trypanosomes Evade the Immune System**

46  ***Naegleria fowleri***

- Protozoan infects nasal mucosa from swimming water

47  **Prion Diseases of the Nervous System**

48  **Prion Diseases of the Nervous System**

49  **Transmissible Spongiform Encephalopathies**

- Caused by prions
- Typical diseases
  - Sheep scrapie
  - Creutzfeldt-Jakob disease
  - Kuru
  - Bovine spongiform encephalopathy
- Chronic and fatal

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51  **Prion Diseases of the Nervous System**

- Acquired by
  - Ingestion
  - Inherited
  - Transplant
- Difficult to destroy
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52  **Preventing Prion Diseases**

- Surgical instruments sterilized by
  - NaOH
  - + extended autoclaving at 134°C
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53  **Disease Caused by Unidentified Agents**

54  **Chronic Fatigue Syndrome**

- Also called myalgic encephalomyelitis (ME)
- Unexplained fatigue that lasts at least 6 months + 4 of these symptoms:
  - Sore throat
  - Tender lymph nodes
  - Muscle pain
  - Pain in multiple joints
  - Headaches
  - Unrefreshing sleep
  - Malaise after exercise
  - Impaired short-term memory or concentration

55  **Chronic Fatigue Syndrome**

- Experimental treatment promotes antiviral interferons
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