MICROBIAL DISEASES OF THE NERVOUS SYSTEM

HUMAN NERVOUS SYSTEM:

Basic unit:
- Nerve cells – neurons
- Supporting cells – neuroglia

Two main systems:
- Central nervous system (CNS) – Brain & spinal cord
- Peripheral nervous system (PNS) – branch off from the CNS

Meninges – cover the brain & spinal cord (cerebrospinal fluid): 3 membranes (dura mater, arachnoid, pia mater)
Cerebrospinal fluid (CSF): a water cushion protecting the brain and spinal cord from physical impact
Ventricles – space within the brain
Blood – brain barrier – capillaries that permit certain substances to pass from the blood into the brain but restrict others

- Meningitis – an inflammation of the meninges
- Encephalitis – an inflammation of the brain
- Poliomyelitis – an inflammation of the spinal cord

MENINGITIS:
An inflammation that results in swelling & an excess of cerebrospinal fluid
Caused by bacteria, viruses, fungi, some protozoan – complication

BACTERIAL

A) Neisseria (meningococcal) meningitis: Cerebrospinal fever
- Pathogen: N. meningitidis – aerobic, non – motile, encapsulated, G- cocci, normal flora of the throat
- Route & symptom:
  - Throat infection → bacteremia → meningitis
- Symptom: Common cold
  - Purplish (also spot on the skin) – fever, severe headache pain (because of the swelling of the meningitis & excess fluid) – convolution, deafness, blindness & paralysis
  - Younger children – severe, because of less immunity
- Control & treatment: Penicillin, Chloroamphenicol, Rifampin

B) Hemophilus influenzae meningitis
- Pathogens: H. influenzae type B
  - Non – motile, pleomorphic, coccobacilli, G-
  - Encapsulated require X & V factors from blood
- Route: normal flora of the throat (respiratory infection) → blood → meninges
  - If not treated, fatality 100%
- Symptoms: Usual meningitis symptom
- Control & Treatment: Hib vaccination

C) Pneumococcal (streptococcal) meningitis:
- Pathogen: S. pneumoniae, G+, diplo, encapsulated
  - Normal flora in the nasopharyngeal region
- Symptom: Usual meningitis
- Diagnosis: G+ diplo in spinal & blood quelling test
- Treatment: penicillin
VIRAL

Often called, “Aseptic meningitis;” likely caused by enteroviruses; generally milder symptoms

FUNGAL

*Cryptococcus neoformans meningitis (Cryptococcosis)*  
**Pathogen:** *C. neoformans*, rod, yeast like cells, capsule (PS)  
**Route:** Inhalation of dried, infected bird droppings  
- lung infection  
- blood  
- brain & meninges (Chronic meningitis)

**Treatment:** Amphotericin B, but high mortality

BACTERIAL DISEASES OF THE NERVOUS SYSTEM

**Tetanus (spastic paralysis):**  
**Pathogen:** *C. tetani*, obligate anaerobic, G+ rod, endospore formers, soil with animal wastes, exotoxin – neurotoxin (tetanospasmin)  
**Route & symptom:** Wound infection  
- neurotoxin  
- muscle spasm  
- death  
Spastic paralyses (because of the spasm of the respiratory muscle)  
**Control:** Combined vaccine (DPT)  
**Treatment:** antitoxin

**Botulism (food poisoning, flaccid paralysis)**  
**Pathogen:** *C. botulinum*, obligate anaerobic, G+ rod, endospore formers, and exotoxin – neurotoxin (botulinal toxin)  
**Route & symptom:** Ingestion  
- neurotoxin (Type A, B & E toxins)  
- blocks the release of acetyl choline, at the synaptic end of the nerve  
- flaccid paralysis – death of respiratory or cardiac failure  
**Treatment:** Trivalent (A, B & E) antitoxin

**Leprosy (Hansen’s disease)**  
**Pathogen:** *Mycobacterium leprae*  
Acid fast rod, non- motile, grows on the skin & in the peripheral nervous system (5 - 7°C lower than the body temperature) not grown in the artificial media.  
**Route & symptom:** *Needs direct contact*  
- Discharge from lesion of the patient  
- skin cut of the recipient  
- long incubation time  
**Two forms:**  
1) **Tuberculoid (neutral) form:**  
- lost sensation, skin region surrounded by a border of nodules,  
- lepromin test: like the tuberculin test – positive  
2) **Lepromatous (progressive) form:**  
- severe form, nodules all over the body, lepromin test: negative
VIRAL DISEASES OF THE NERVOUS SYSTEM

**Poliomyelitis (polio): infantile paralysis**  
**Pathogen:** *Poliovirus* (*picorna* virus)  
**Route & Symptom:** fecal-oral transmission  
  Ingestion ➔ throat & intestine ➔ tonsils & lymph nodes  
  Grows in the motor nerve cells ➔ CNS ➔ viremia  
  (e.g., gray matter of the spinal cord)  
  Cell death ➔ various paralysis: bulbar, spinal, and encephalitic paralysis  
  “iron lung”  
**Control:** three different serotype (I, II, & III) – pooled (trivalent) vaccine  
  Salk vaccine – 1954: killed, inactivated poliovirus (IPV)  
  Sabin vaccine – 1963: live attenuated polio (OPV)

**Encephalitis:**  
**Pathogens:** *Arboviruses; HSV, JC viruses*  
  Commonly vector-mediated (e.g., mosquitoes – arboviruses)

**Rabies:** zoonotic disease  
**Pathogen:** Rabies virus  
**Route:** Parenteral (through animal bites)  
**Prevention/Treatment:** HDCV (inactivated vaccine)/postexposure passive and active vaccination

**Prions:** Proteinaceous infectious particles  
  *Transmissible spongiform encephalopathies (TSE’s)*  
  *Creutzfeldt-Jacob disease (CJD)*

PROTOZOAN DISEASES OF THE NERVOUS SYSTEM

**Toxoplasmosis:**  
**Pathogen:** *Toxoplasma gondii*, flagellated parasite  
**Route (Zoonosis):** cat’s feces ➔ human ingestion/contact ➔ serious complication  
  in pregnant women (fetus)  
**Prevention/Treatment:** hygiene practice/pyrimethamine

**Trypanosomiasis:** African sleeping sickness  
**Pathogen:** *Trypanosoma brucei*  
**Route:** tse tse fly ➔ blood vessels ➔ lymphatic system ➔ CNS  
**Prevention/Treatment:** vector control /suramin, pentamidine, melarsopol  
  Sleep disturbance or coma