Microbiology

2025-2024

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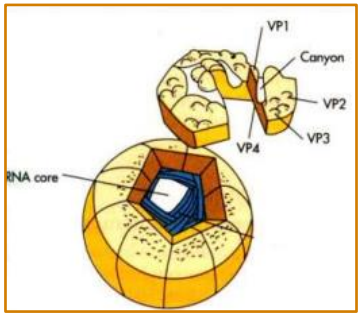
Enteroviruses, Rotaviruses and Caliciviruses

- **Objectives**
  - Understand the structure, properties, classification, pathogenesis, epidemiology, clinical presentation, laboratory diagnosis, and treatment of:
    1. Enteroviruses
    2. Polioviruses
    3. Coxsackie viruses
    4. Echoviruses

- **Enteroviruses**
  - Family: Picornaviridae
  - Characteristics:
    - ✓ Single-stranded RNA virus
    - ✓ Capsid: Icosahedral symmetry (capsid made of 60 copies each of 4 proteins: VP1, VP2, VP3, VP4 arranged around a positive sense genome)
    - ✓ Non-enveloped
    - ✓ Replicate primarily in the gut
  - Groups: Enteroviruses are classified into five groups:
    1. Polioviruses
    2. Coxsackie A viruses
    3. Coxsackie B viruses
    4. Echoviruses
    5. Enteroviruses



- **Poliovirus**
  - Serotypes: Three serotypes (1, 2, and 3), each with distinct antigens, Have identical physical properties but only share 36- 52% nucleotide homology.
  - Host: Humans are the only susceptible hosts.
  - Epidemiology: Before vaccination, poliovirus was widespread globally. Immunization efforts and campaigns have significantly reduced its incidence, with ongoing efforts to eradicate it worldwide. Poliovirus is on course of being eradicated worldwide
  - Pathogenesis of Poliovirus
    - ✓ Incubation period: 7-14 days.
    - ✓ Infection pathway:
      - The virus enters via ingestion and multiplies in the oropharyngeal and intestinal mucosa.
      - It spreads to the lymphatic system, including tonsils and Peyer's patches in the ileum, entering the bloodstream, resulting in transient viremia.
      - In rare cases, the virus spreads to the CNS.
  - Clinical Manifestations
    - ✓ There are 3 possible outcomes of infection:
      - Subclinical infection (90-95%): No symptoms or mild symptoms.
      - Abortive infection (4-8%): Influenza-like symptoms (headache, sore throat, fever) with recovery in a few days and the diagnosis can only be made by the laboratory.
      - Major illness (1-2%): Aseptic meningitis and flaccid paralysis, which may progress to the anterior horn cells lead to flaccid paralysis, and Involvement of the medulla may lead to respiratory paralysis and death.

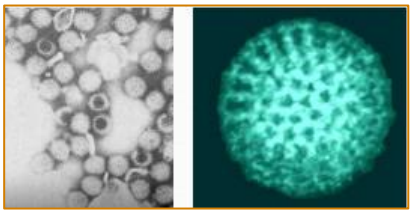
- ✓ Paralytic Poliomyelitis
  - Prodrome: Headache, malaise, and meningeal signs.
  - Symptoms:
    - Severe myalgia, meningismus, weakness, and flaccid paralysis, often asymmetric, affecting proximal muscles more than distal ones.
    - Sensory function is typically intact.

- ➢ Diagnosis: PCR, virus isolation, and serology.
- ➢ Prevention:
  - A. Inactivated Poliovirus Vaccine (IPV)
  - B. Oral Poliovirus Vaccine (OPV)

- **Coxsackieviruses**
  - ➢ Classification: [on the basis of the lesions observed in suckling mice]
    - ✓ Group A viruses cause diffuse myositis with acute inflammation and necrosis of fibers of voluntary muscles.
    - ✓ Group B viruses cause focal brain degeneration, necrosis in the skeletal muscles, and inflammatory changes in the dorsal fat pads, the pancreas and occasionally the myocardium
    - ✓ Each of the 23 group A and 6 group B coxsackieviruses have a type specific antigen.
  - ➢ Clinical presentation: These viruses may cause a wide range of illnesses, from mild to severe, depending on the organ systems involved.

- **Echoviruses**
  - ➢ Discovery: Initially discovered in human feces during poliovirus epidemiological studies.
    - ✓ These viruses were produced CPE in cell cultures, but did not induce detectable pathological lesions in mice.
    - ✓ Altogether, There are 32 echoviruses (types 1-34; echovirus 10 and 28 were found to be other viruses and thus the numbers are unused)
  - ➢ Clinical Significance: These viruses can cause aseptic meningitis, febrile illness, or gastrointestinal symptoms.

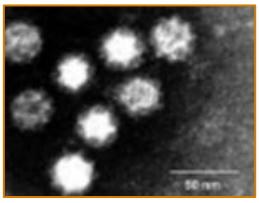
- **Rotavirus**
  - ➢ Structure:
    - ✓ 70 nm in diameter, with a double-shelled capsid enclosing an 11-segmented dsRNA genome.
    - ✓ Icosahedral symmetry, double capsid (outer and inner capsid)
    - ✓ Non-enveloped.
    - ✓ EM appearance: "wheel" with radiating spokes.



  - ➢ Groups:
    - ✓ Group A subtypes 1, 2, 3, 4 (main human pathogens)
      (Further 7 subtypes) also infect animals (monkey, calf, mouse)
    - ✓ Group B, C*, D, and E (affect animals) [C in some causes affect human]
  - ➢ Epidemiology of Rotavirus
    - ✓ Incubation period: 1-3 days.
    - ✓ Affected groups: Primarily affects infants and children (1-24 months), but can also affect older children and adults, especially the elderly.
    - ✓ By the age of 4 years, more than 90% of individuals have humoral antibodies, suggesting a high rate of virus infection early in life
    - ✓ Transmission: Fecal-oral route.

- Clinical Manifestations
  - ✓ Symptoms:
    - Abrupt vomiting, followed within hours by frequent, copious, watery, brown stools, fever [low grade], and dehydration.
    - In severe cases, the stools may become clear; the Japanese refer to the disease as hakuri, the "white stool diarrhea"
    - Vomiting may persist for 1 to 3 days, and diarrhea for 4 to 8 days.
    - Diarrhea may last 4-8 days, and vomiting 1-3 days.
    - Severe cases may lead to dehydration with hypernatremia, requiring medical intervention.
- Diagnosis
  - ✓ Methods:
    - Detection of viral particles or antigens in stools (electron microscopy, enzyme immunoassay [EIA methods]).
    - PCR can be used to confirm the diagnosis
    - Stool examination typically shows no RBCs or WBCs.
- Treatment and Prevention
  - ✓ Treatment: Fluid and electrolyte replacement, especially in severe cases.
  - ✓ Prevention: Rotavirus vaccines (introduced in 1998) are highly effective (about 80% efficacy). Hygiene measures also help prevent outbreaks.

- **Caliciviruses**
  - Structure:
    - ✓ Small ssRNA viruses
    - ✓ Non-enveloped, with icosahedral symmetry [Naked icosahedral capsid].
    - ✓ Characteristic surface morphology consisting of hollows
    - ✓ 35 nm in diameter.



  - Epidemiology of Caliciviruses
    - ✓ Unlike rotaviruses, caliciviruses are much more common causes of gastrointestinal illness in older children and adults.
    - ✓ The prevalence of antibodies rises slowly, reaching approximately 50% by the fifth decade of life, a striking contrast to the frequent acquisition of antibodies to rotaviruses early in life.
  - Transmission: Fecal-oral route; outbreaks are linked to contaminated food, water, or shellfish.
  - Commonly affected: Older children and adults, especially in community outbreaks.
  - Incubation period: 10-51 hours.
  - Clinical Manifestations
    - ✓ Symptoms: Abrupt onset of vomiting and diarrhea [a syndrome clinically indistinguishable from that caused by rotaviruses]
    - ✓ Illness duration is usually brief (1-2 days).
    - ✓ Respiratory symptoms are rare.
  - Diagnosis
    - ✓ Methods: Detection via electron microscopy, immunoelectron microscopy in stools during the acute phase of illness EIA and PCR methods
  - Treatment and Prevention
    - ✓ Treatment: No specific antiviral treatment. Fluid and electrolyte replacement is essential.
    - ✓ Prevention: Emphasis on good hygiene practices and proper food handling to prevent contamination.

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