

GIT Module: Viral Gastroenteritis

MICROBIOLOGY

HASHEMITE UNIVERSITY, FACULTY OF MEDICINE, THIRD YEAR

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Recap

TABLE S-11 Features of Infectious Gastrointestinal Syndromes

ORGANISM	COMMON DISTRIBUTION	CLINICAL SYNDROME	PATHOGENIC MECHANISM	STOOL MICROSCOPY	LABORATORY DIAGNOSIS*				
					CULTURE			SEROLOGY	
					STOOL ^b	BLOOD	TOXIN IN STOOLS	ANTIBODY DETECTION	ANTIGEN DETECTION
<i>Salmonella</i> serotypes	Worldwide	Dysentery	Mucosal invasion	PMNs	+	-	-	-	-
<i>Salmonella</i> serovar Typhi	Tropical, developing countries	Enteric fever	Penetration, spread	Monocytes	+	+	-	+	-
<i>Shigella</i> spp.	Worldwide	Dysentery	Mucosal invasion, cytotoxin	PMNs, RBCs	+	-	-	-	-
<i>Shigella dysenteriae</i> (Shiga)	Tropical, developing countries	Dysentery	Mucosal invasion, cytotoxin	PMNs, RBCs	+	+	-	-	-
<i>Campylobacter jejuni</i>	Worldwide	Dysentery	Unknown	PMNs, RBCs	+	-	-	-	-
<i>Escherichia coli</i> (EIEC)	Worldwide	Dysentery	Mucosal invasion	PMNs, RBCs	+ ^c	-	-	-	-
<i>E coli</i> (ETEC)	Worldwide ^d	Dysentery	Enterotoxin(s)	-	+ ^c	-	-	-	-
<i>E coli</i> (EHEC)	Worldwide	Watery diarrhea	Cytotoxin	RBCs	+ ^c	-	-	-	-
<i>E coli</i> (EPEC)	Worldwide ^d	Watery diarrhea	Adherence	-	+ ^c	-	-	-	-
<i>Vibrio cholerae</i>	Asia, Africa, Middle East, Central and South America, Louisiana, Texas	Watery diarrhea	Enterotoxin	-	+	-	-	-	-
<i>Vibrio parahaemolyticus</i>	Seacoast	Watery diarrhea	Unknown	-	+	-	-	-	-
<i>Yersinia enterocolitica</i>	Worldwide	Enteric fever ^e	Penetration, spread	-	+	+	-	-	-
<i>Clostridium difficile</i>	Worldwide	Dysentery	Cytotoxin, enterotoxin	-	+	-	+	-	-
<i>Clostridium perfringens</i>	Worldwide	Watery diarrhea	Enterotoxin	-	+	-	-	-	-
<i>Bacillus cereus</i>	Worldwide	Watery diarrhea	Enterotoxin	-	+	-	-	-	-
Rotavirus	Worldwide	Watery diarrhea	Mucosal destruction	Electron microscopy ^f	-	NAA	-	-	+
Caliciviruses	Worldwide	Watery diarrhea	Mucosal destruction	Electron microscopy ^f	-	NAA	-	-	-
<i>Giardia lamblia</i>	Worldwide	Watery diarrhea	Mucosal irritation	Flagellates, cysts	-	-	-	-	-
<i>Entamoeba histolytica</i>	Worldwide ^d	Dysentery	Mucosal invasion	Amebas, PMNs	-	-	-	+	-
<i>Cryptosporidium</i>	Worldwide	Watery diarrhea	?toxin	Acid-fast oocysts	-	-	-	-	-



Introduction

- Viral gastroenteritis is an acute diarrheal disease that is caused by viruses, usually of rapid evolution (within hours), that lasts less than 3 weeks.
- Viral gastroenteritis is the second most common viral illness after upper respiratory tract infection.
- In addition to the bacterial and protozoal agents responsible for approximately 20 to 25% of these cases, **viruses** are a significant cause of acute diarrhoea. It is thought that viruses are responsible for up to $\frac{3}{4}$ of all infective diarrheas.



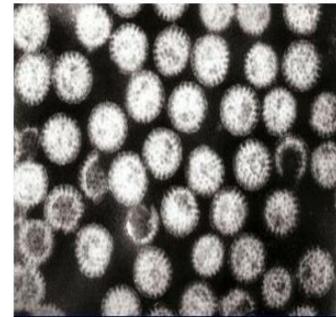
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- Viral gastroenteritis causes major morbidity and mortality worldwide, most significantly in **young children** in developing nations.
 - Many viruses can be shed in stool but not all of them are responsible for gastroenteritis. For example, Poliovirus and Hepatitis viruses can be found in stool however they cause different kinds of diseases.
 - Viral gastroenteritis treatment is manily **supportive**.



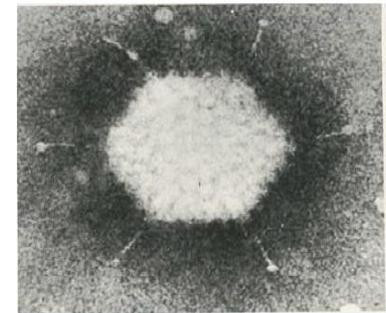
Causes of Viral Diarrhea

- Four groups of viruses have been clearly established as important causes of gastrointestinal disease:

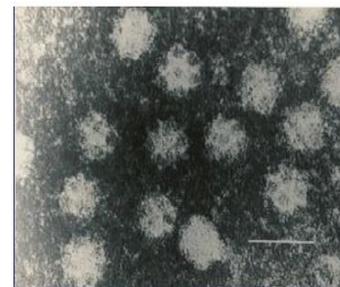
1. Rotaviruses
2. Caliciviruses
3. Astroviruses
4. Adenoviruses (serotypes 40 and 41).



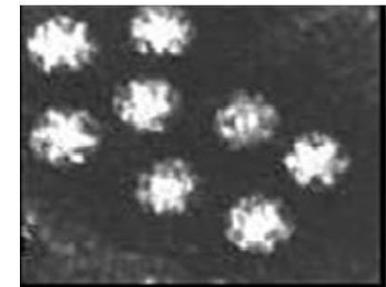
Rotavirus



Adenovirus



Calicivirus

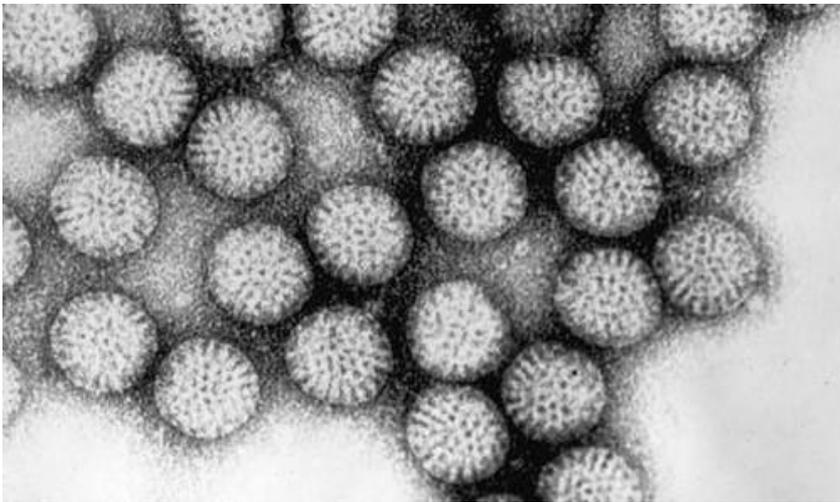


Astrovirus

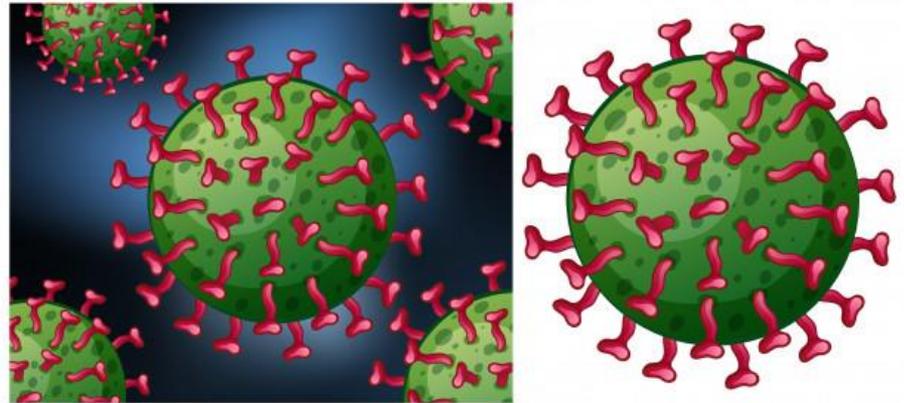


Rotavirus

- The human intestinal rotaviruses were first found in 1973 by electron microscopic examination of duodenal biopsy specimens from infants with diarrhea.
- **Electron-microscopic appearance:** a wheel with radiating spikes.

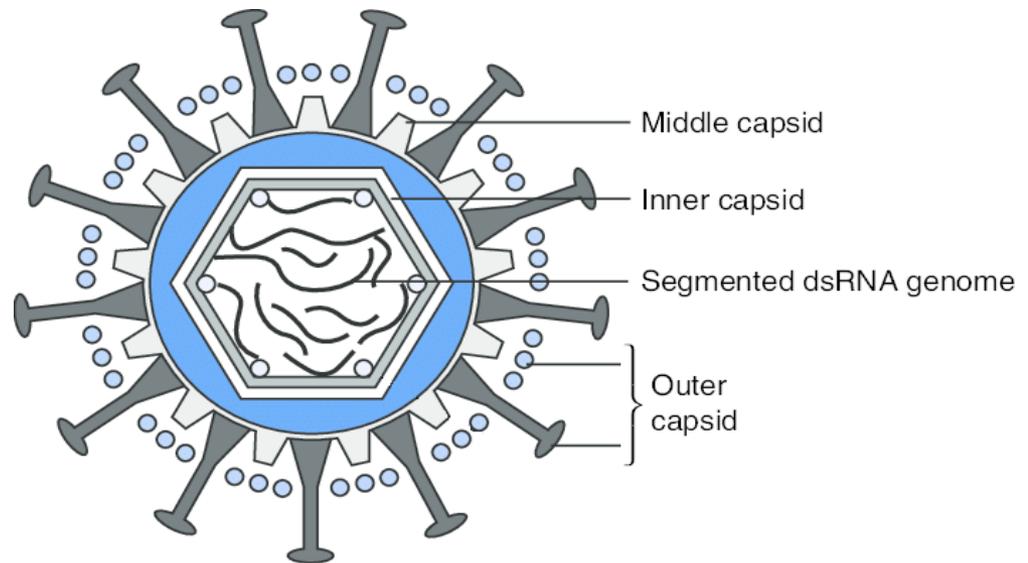


Rotavirus



Structure

- Family: Reoviridea
- Icosahedral
- Three capsid layers (inner, middle and outer capsids).
- Non-enveloped virus
- Genome:
 - segmented
 - **double stranded**
 - **RNA**



Epidemiology

- Rotaviruses account for **40 to 60% of cases** of acute gastroenteritis occurring during the cold weather in infants and children less than 2 years of age.
- Older children and adults can also be affected, but attack rates are usually much lower; it usually occurs in elderly adults in nursing homes.
- Rotavirus is highly infectious and transmission is **feco-oral**.
- By the age of 4 years, more than 90% of individuals have **humoral antibodies**, suggesting a high rate of virus infection early in life.



Clinical Manifestations

- Incubation period of 1 to 3 days
- Abrupt onset of vomiting, followed within hours by frequent, copious, watery, brown stools. In severe cases, the stools may become clear.
- Fever, usually low grade, is often present.
- Vomiting may persist for 1 to 3 days, and diarrhea for 4 to 8 days.
- The major complications result from **severe dehydration**, which could lead to death.



Diagnosis

- Diagnosis of acute rotavirus infection is usually by detection of virus particles or antigen **in the stools** during the acute phase of illness.
- This can be accomplished by:
 1. Direct examination of the specimen by electron microscopy.
 2. Immunologic detection of antigen with enzyme immunoassays (EIA); which is the most convenient method of detection



Treatment and Prevention

- There is no specific treatment.
- Vigorous **replacement of fluids and electrolytes** is required in severe cases and can be life-saving.
- Control consists of strict hygienic measures, including careful hand washing and adequate disposal of enteric excretions.
- Vaccine:
 - Live attenuated vaccines have been developed
 - CDC recommends routine vaccination of all infants.



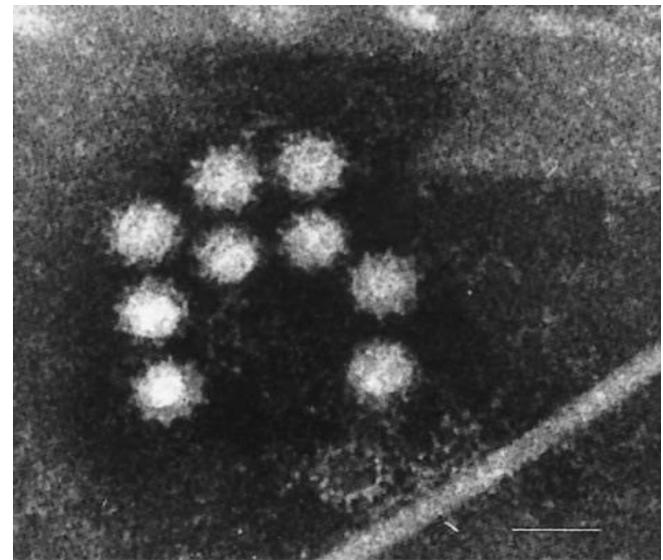
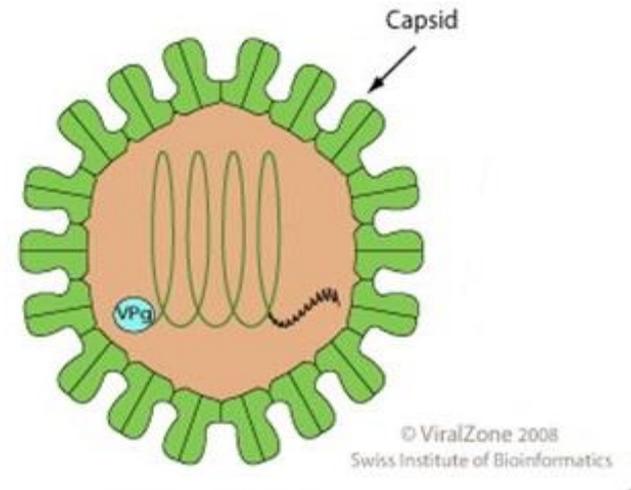
Caliciviruses

- Example: Noroviruses
- The caliciviruses were the first to be clearly associated with outbreaks of gastroenteritis.
- They were first associated with an outbreak in Norwalk, Ohio, in 1968, and their role was confirmed by production of disease in volunteers fed fecal filtrates. The original virus was thus called the Norwalk virus “Norovirus”.



Structure

- Structure:
 - Icosahedral
 - Nonenveloped
 - Single stranded RNA viruses
 - Characteristic morphology is cup-shaped depressions or hollows on the capsid surface.



Epidemiology

- Family and community outbreaks (nursing homes or cruise ships) are common and can occur in **any season**.
- Caliciviruses cause 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 is primarily **fecal–oral**; outbreaks have been associated with consumption of contaminated water, uncooked shellfish, and other foods.



Clinical Manifestations

- The incubation period is 1 to 2 days but maybe as short as 10 hours. This is followed by abrupt onset of vomiting and diarrhea.
- **Vomiting** is the prominent feature of disease.
- The duration of illness is relatively brief (usually 1–2 days).



Diagnosis and Treatment

- Diagnosis:

- 1) These viruses can be detected by electron microscopy or immunoelectron microscopy in stools during the acute phase of illness.
- 2) EIA and PCR methods have been developed.

- Treatment:

- 1) There is no specific treatment other than fluid and electrolyte replacement.
- 2) Prevention requires good hygienic measures.



Adenoviruses

- Associated with cases of gastroenteritis, usually in **young children and neonates**.
- Adenoviruses are considered second to Rotavirus in terms of its significance as a cause of gastroenteritis.
- Has a long incubation period 7-8 days
- Disease is similar to rotavirus.
- Most people have antibodies against enteric adenoviruses by the age of three.

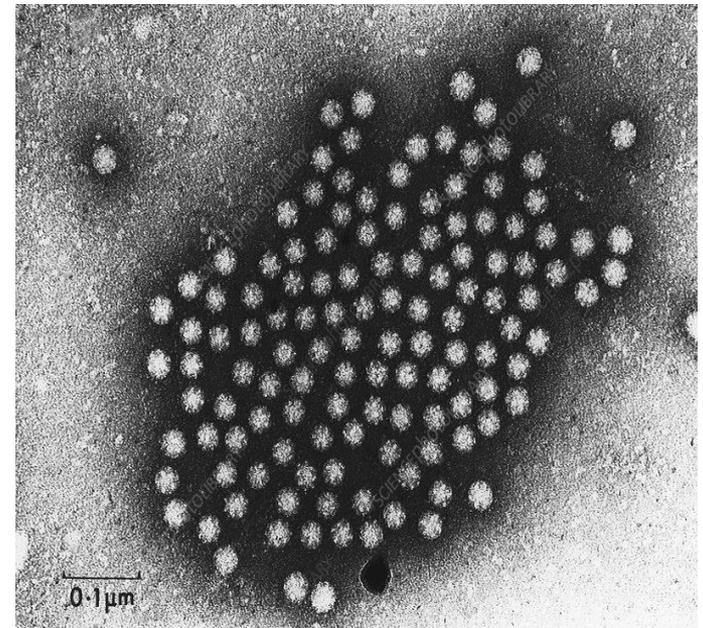


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- Serotypes **40** and **41** - “enteric” adenoviruses: the major serotypes causing gastroenteritis.
 - **Structure:**
 - Nonenveloped
 - Double stranded DNA virus
 - **Diagnosis:** by
 - Electron microscopy
 - Detection of adenovirus antigens in stool by EIA.



Astroviruses

- Small non-enveloped single-stranded RNA viruses, named because of **star-shaped surface** morphology.
- In recent years astroviruses have been acknowledged as causes of often mild gastroenteritis outbreaks, primarily among toddlers and school children.
- Similar disease to rotaviruses and adenoviruses.
- Most people have antibodies by the age of three.
- Diagnosed by **electron microscopy**.



Summary

Biological and Epidemiologic Characteristics of Viruses that Cause Diarrhea				
SPECIAL FEATURES	ROTAVIRUS	CALICIVIRUS	ASTROVIRUS	ADENOVIRUS
BIOLOGICAL				
Nucleic acid	Double-stranded RNA	Single-stranded RNA	Single-stranded RNA	Double-stranded DNA
Diameter, shape	65–75 nm, naked, double-shelled capsid	27–38 nm, naked, cup shaped depressions	28–38 nm, naked, star-shaped	70–90 nm, naked, icosahedral
Replication in cell culture	Usually incomplete	None	None	None or incomplete
PATHOGENIC				
Site of infection	Duodenum, jejunum	Jejunum	Small intestine	Small intestine
EPIDEMIOLOGIC				
Epidemicity	Epidemic or sporadic	Family and community outbreaks	Sporadic	Sporadic
Seasonality	Usually winter	None known	None known	None known
Ages primarily affected	Infants, children <2 y old	Older children and adults	Infants, children	Infants, children
Method of transmission	Fecal–oral	Fecal–oral; contaminated water and shellfish	Fecal–oral	Fecal–oral
Incubation period (days)	1–3	0.5–2	?1–2	8–10
Major diagnostic tests	EIA, EM ^a	EM, IEM, PCR	EM, PCR	EIA, EM



Thank you 😊

GOOD LUCK

