



TEAM443
MICROBIOLOGY

Viral Gastroenteritis

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Objectives



Definition of GE



Viral Etiology of GE (Structures)



Epidemiology



Clinical Features



Lab Diagnosis



Treatment & Prevention (Vaccine)

Any future corrections will be in the editing file, so please check it frequently

Color Index:

Main text

Important

Doctor Notes

Males slide

Females slide

Extra



Gastroenteritis

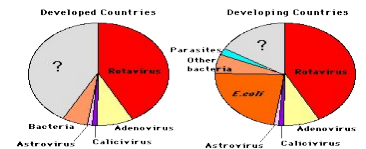
Male Slides

Gastroenteritis (1)

It is an **irritation & inflammation** of the **lining** gastrointestinal tract which involves both stomach and small / **all** intestine, leading to acute diarrhea and vomiting. **Causes can be either infectious or non-infectious.**(2)

Viral Etiology (3, 4)

⊙ Etiologic agents in severe diarrheal illnesses requiring hygiene **and rehydration** of infants & young children include:



- ✦ Rotavirus
- ✦ Adenovirus **serotype 40 & 41**
- ✦ Caliciviruses (**Norovirus**)
- ✦ Astrovirus
- ✦ Coronaviruses
- ✦ Enteroviruses
- ✦ **Toroviruses**

Epidemiology

A Distribution: Worldwide, ↑ in poor hygiene, overcrowding, and poverty.

B Age: can affect all age group but more common in Infants & young children especially from 6m - 2y of age > Older children.(rarely)

C Transmission: Faecal-oral route. (5)

D Season: Winter months.

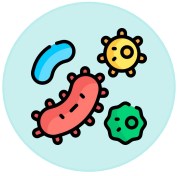
- ▶ **Endemic infection:** Group A Rotavirus & Adenovirus serotype 40 & 41.
- ▶ **Epidemic infection:** Norovirus.

(6)



Gastroenteritis

Clinical Features



Incubation Period:

Short

also, it has sudden, short onset



Symptoms:

- Diarrhea
- Vomiting & nausea
- Fever
- Abdominal cramps



Winter Vomiting Disease:

Vomiting is more frequent than diarrhea (associated with Calicivirus)



Dehydration most common complications:

Dehydration with ↓ Na⁺ → life threatening, especially in children

Lab Diagnosis

Cell Culture (7)

- **Fastidious** → growing poorly → not used.

Electron Microscopy (8)

- **Catch all techniques.**
- Many disadvantages → not used.

Specific (Routine) Test

- **Multiplex / RT PCR (9)**
- **Immunoassay** “the most common metode” such as: **ELISA** and **Immunochromatography** for detection of viral Ag in stool samples (rota - adeno - astro - caliciviruses).

Management

Treatment: (10)

- **Self-limiting.**
- Rehydration and supportive.

Prevention:

- **improving** sanitation & hygiene measures
- No vaccines **except for rotavirus.**



Gastroenteritis

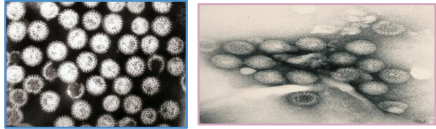
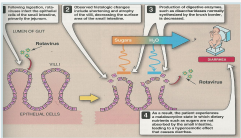
Rotavirus

Enteric Adenovirus

Caliciviruses

Astroviruses

Rotavirus

Family	<ul style="list-style-type: none"> ◦ Reoviridae (Respiratory & Enteric Orphan).
Description / Morphology	<ul style="list-style-type: none"> ◦ 11 segments ds-RNA. (11) ◦ Double-layered (Double-shelled) icosahedral -spherical- capsid with wheel-like structure. ◦ Non-enveloped. (12) ◦ ~ 70 nm. ◦ RNA – dependent RNA polymerase. (13) 
Classification	<ul style="list-style-type: none"> ◦ 7 groups (A-G): Group A is the most common. (14)
Epidemiology	<ul style="list-style-type: none"> ◦ Spread (Mode of Transmission): Faecal-oral route. ◦ Age: All age groups, but mostly in infant between 6 - 24 months, in which they present with symptomatic infection. (15) ◦ Peak: Winter months. ◦ Type of infection: Endemic. However, outbreak have been reported.
Pathogenesis	<ol style="list-style-type: none"> 1. Following ingestion, rotaviruses infect the epithelial cells of the small intestine, primarily the jejunum. 2. Observed histologic changes, including shortening and atrophy of the villi and decreasing the surface area of the small intestine. 3. Production of digestive enzymes, such as disaccharidases that are normally synthesized by the brush border “tip of the villi”, is decreased. 4. As a result, the patient experiences a malabsorptive state in which dietary nutrients such as sugars are not absorbed by the small intestine, leading to a hyperosmotic effect that causes watery/ non-bloody diarrhea. ★so, in the case scenario if i found bloody diarrhea, i will exclude rotavirus immediately 

© Always remember, rotavirus have 2 exceptions:

1. have **ds-RNA**
2. have **vaccine**



Gastroenteritis

Rotavirus

Enteric Adenovirus

Caliciviruses

Astroviruses

Rotavirus

<p>Clinical Features</p>	<p>© Rotavirus usually leads to intestinal infection:</p> <ul style="list-style-type: none"> ▸ In infant & young children → gastroenteritis or infantile GE (Features below) ▸ In older children & adults → mild or asymptomatic. ▸ In low immune hosts → chronic diarrhea, persist for months <p>© In case it causes Extra-intestinal infection:</p> <ul style="list-style-type: none"> ▸ Encephalitis can be noted in small number of cases. mostly in immunocompromised Pt <p>◦ Features of infant & young children gastroenteritis or infantile GE</p> <ul style="list-style-type: none"> • Incubation Period is between 1-2 days. • Watery osmotic, non-bloody diarrhea, vomiting, and fever. • Dehydration. • Outcomes Vary depending on the country: <ul style="list-style-type: none"> → ~ 1/2 of all GE cases → Admission. → In <u>developed</u> countries → Mortality is low due to the present of vaccine. → In <u>developing</u> countries → Mortality is high because of lacking for medical staff → Death is sometimes reported. (16)
<p>Lab Diagnosis (18)</p>	<p>Sample: Stool (17)</p> <ul style="list-style-type: none"> ◦ Immunoassay is mostly used for diagnosis, which include: <ul style="list-style-type: none"> ▸ ELISA (most use), Immunochromatography & latex agglutination. (23) ◦ EM ◦ Gel Electrophoresis ◦ RT-PCR ◦ Cell Culture -grow poorly- <div data-bbox="1300 1556 1516 1680" style="text-align: right;"> <p>Immunochromatography</p> </div>
<p>Management</p>	<ul style="list-style-type: none"> ◦ Treatment: <ul style="list-style-type: none"> ▸ Self-limiting. ▸ Rehydration. ◦ Prevention: <ul style="list-style-type: none"> ▸ improving sanitation & hygiene measures. ▸ Vaccine: Live attenuated vaccine, oral, 3 doses (2m → 4m → 6m): <ul style="list-style-type: none"> • Rotarix (use in ksu) • RotaTeq • Rotashield (withdrawn) <div data-bbox="1300 1724 1508 1960" style="text-align: right;"> </div>



Gastroenteritis

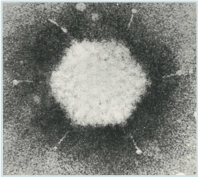
Rotavirus

Enteric Adenovirus

Caliciviruses

Astroviruses

Enteric Adenoviruses

Family	<ul style="list-style-type: none"> ◦ Adenoviridae.
Description / Morphology	<ul style="list-style-type: none"> ◦ ds-DNA. ◦ Classical icosahedral -spherical- capsid with fibers. ◦ Non-enveloped. ◦ It is the ONLY virus with a fiber protruding from each of the vertices of the capsid. ◦ Function of the fibers: <ul style="list-style-type: none"> ▸ Attachment on a specific receptor on the host cells ▸ The fiber protein are the type-specific Ag. ▸ Hemagglutinin. 
Classification (19)	<ul style="list-style-type: none"> ◦ Adenovirus in general has: <ul style="list-style-type: none"> ▸ 6 subgenera (A-F) / 7 subgenera (A-G). actually there is > 60 subtypes ▸ 51 / 50 serotypes. ▸ Most of them grow in routine cell culture. ◦ Enteric Adenovirus specifically: <ul style="list-style-type: none"> ▸ Belongs to subgenus F. ▸ 40 & 41 serotypes. ▸ They are fastidious, which makes them difficult to grow in cell culture.
Clinical Features	<p>Is similar to rotavirus but have some different. So, in comparison to Rotavirus:</p> <ul style="list-style-type: none"> ◦ Longer incubation period. ◦ Mild / Less severe & less complications ◦ Prolonged illness. -long diarrhea-
Lab Diagnosis	<ul style="list-style-type: none"> ◦ Immunoassay / Routine Test: Viral Ag detection in stool samples by: <ul style="list-style-type: none"> ▸ ELISA ▸ Immunochromatography Tech ◦ PCR (20)



Gastroenteritis

Rotavirus

Enteric Adenovirus

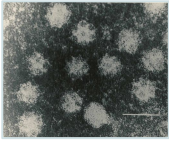
Caliciviruses

Astroviruses

Caliciviruses

Norovirus (Norwalk Virus)

Sapovirus

Family	◦ Caliciviridae (Calyx = cup).	
Description / Morphology	<ul style="list-style-type: none"> ◦ ss-RNA with +ve polarity. (21) ◦ Icosahedral capsid with cup-like depression on its surface. looks like معمول ◦ Small, Non-enveloped. 	
Morphology	Small Round Structured Viruses with smooth outline	Typical caliciviruses
Epidemiology	<ul style="list-style-type: none"> ◦ Spread through faecal-oral route (water, shellfish). ◦ Outbreaks “Epidemic” of GE in schools, camps, and cruises. ◦ Affects all age groups. 	can affect all age groups, usually cause mild illness
Clinical Features	<ul style="list-style-type: none"> ◦ Children → Vomiting (Projectile). ◦ Adults → Diarrhea. 	
Lab Diagnosis	<ul style="list-style-type: none"> ◦ Immunoassay / Routine Test: Viral Ag detection in stool samples by: ELISA ◦ RT-PCR 	-

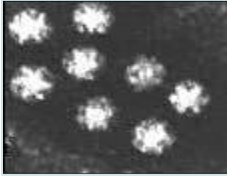
Rotavirus

Enteric Adenovirus

Caliciviruses

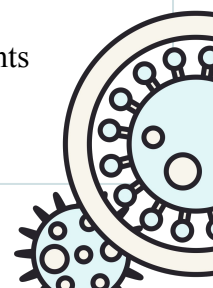
Astroviruses

Astrovirus

Family	◦ Astroviridae (astro = a star).	
Description / Morphology	<ul style="list-style-type: none"> ◦ ss-RNA with +ve polarity. ◦ Icosahedral capsid with 5 or 6 pointed star on its surface. ◦ Small, Non-enveloped. ◦ It has 8 serotypes. 	
Clinical Features	<ul style="list-style-type: none"> ◦ Milder GE than rotavirus (22) ◦ Outbreak of diarrhea in children < 5 years. 	
Lab Diagnosis	<ul style="list-style-type: none"> ◦ Immunoassay / Routine Test: Viral Ag detection in stool samples by: ELISA ◦ RT-PCR 	



1. Gastroenteritis, as you know, still or continue to be a major cause of morbidity & mortality especially in children, and it's one of the most common causes of death.
2. ◦ Infectious: Viruses, bacteria. Viruses are the most common
◦ non-infectious: Food intolerance. chemical. side effect of allergy, autoimmune disease, celiac disease, and inflammatory bowel disease, etc.
3. For graphical representation picture, it represent the common causes of gastroenteritis in children requiring the admission to the hospital. and as you see the most common etiology are viruses, mainly rotavirus, adenovirus serotype 40 & 41, calicivirus, and astrovirus.
4. The last three viruses (Coronaviruses, Enteroviruses & Toroviruses) causing GE have been identified & detected in the stools of the patient with GE. But their role in causing human disease is not well established.
5. Through the contaminated food or water, from person to person or through contaminated surface.
6. ◦ **Endemic:** when the disease is always present but limited to particular region, it's seen more in children & infant
◦ **Epidemic or outbreak:** are unexpected high number of patients occurs at the same time, it's seen in adults & associated with norovirus which is the most important cause of non-bacterial GE
7. Fastidious mean it's require special nutrient / medium to grow, so it's grow poorly in the routine cell culture, so NOT used routinely.
8. It's the original diagnostic method, diagnose the viruses based on their morphology & size. and the viruses that we will take in this lecture have specific morphological features so easily detected. also, it catch all techniques because **it has the ability to catch all viruses present in the sample by ONE test**, but have many disadvantages such as expensive maintenance & need expert technology
9. Available but expensive and need specialized equipment. So available mainly in big hospitals. it highly sensitive & specific but the interpretation of the results still a little bit complicated
10. **There is no specific antiviral for the viral causing GE but the therapy based mainly on rehydration which is either oral or I.V based on the severity & degree of the dehydration**
11. ds-RNA is an **IMPORTANT exception** in virology. because as you know RNA ALWAYS have single strand of the genome but here is double strand.
12. Viruses that are transmitted by faecal-oral route are mostly **non-envelopes** "which is common feature between ALL the viruses in this lecture". **WHY?** because non-enveloped viruses are more resistant to the harsh environmental conditions and resistant to the acid pH of the stomach.
13. Because we have 11 segments and ds-RNA it mean the virus have specific enzymes that present inside it **for the translation of the genome to mRNA** to continue the replication.
14. Group A, B, and C infect the humans. But group A is the most common type infected the human worldwide and it represent > 90% of the identified strains.
15. **Why infant before 6 months are rarely infected or rarely symptomatic?** because of the present of passive transmitted maternal antibodies (immunity) through placenta.
16. Due to complication of inspired vomit, underlying disease or severe dehydration.
17. Should be collected in the first few days of the illness (it will have the highest concentration)
18. ◦ ELISA is more sensitive & specific than others, but the other immunoassay are rapid test.
◦ Gel Electrophoresis used to detect different type of the virus. because as we know rotavirus have ds-RNA with 11 segment. So this test is used to assessment the migration of these segments in the gel by electrophoresis and it useful to **identify the different types**
◦ We use RT-PCR because it is RNA (RT = Reverse transcription)

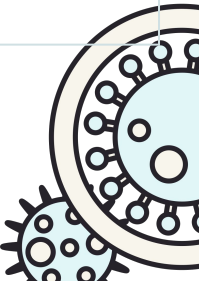


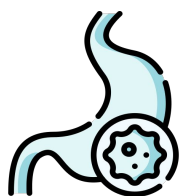


19. Adenoviruses are classified into 7 (A-G) genera *based of DNA homology* → then classified into > 60 serotypes *based on serological test*. So, **enteric** adenovirus refers to the subtype 40 & 41 which are included within the genus F.
20. We didn't say RT-PCR because it's genome is DNA so just PCR
21. Positive polarity mean it act directly by it self as mRNA without the need of other enzymes to transmission
22. We always compare to rotavirus because it is the most common & associated disease with GE.
23. **What is the difference between the immunoassay methods?**
 - **ELISA:** Detection of the Ag by the use of Ab labeled with *enzymes*
 - **Immunochromatography:** Detection of the Ag by the use of Ab labeled with *color particles* (chromo=color)
 - **Latex agglutination:** *latex coated* with Ab against rotavirus so it will bind with the rotavirus Ag

Extra Summary

Virus	R otavirus	Enteric A denoviruses	Caliciviruses (N orovirus)	A strovirus
Genome	11 segments ds-RNA	ds-DNA.	ss-RNA with +ve polarity	
Morphology	<ul style="list-style-type: none"> ◦ Double-layered icosahedral capsid with wheel-like structure. ◦ Non-enveloped. ◦ RNA-dependent RNA polymerase 	<ul style="list-style-type: none"> ◦ Classical icosahedral capsid with fibers (the ONLY virus with a fiber) ◦ Non-enveloped. ◦ Fibers function: <ul style="list-style-type: none"> ▸ Attachment ▸ type-specific Ag. ▸ Hemagglutinin 	<ul style="list-style-type: none"> ◦ Icosahedral capsid with cup-like depression on its surface ◦ Small Round ◦ Non-enveloped 	<ul style="list-style-type: none"> ◦ Icosahedral capsid with star on its surface. ◦ Non-enveloped.
Lab diagnosis	The most Specific (Routine) Test: <ul style="list-style-type: none"> ▸ Multiplex / RT PCR (RT-PCR → for RNA only) ★ Immunoassay: ELISA, Immunochromatography, and latex agglutination ▸ EM (many disadvantages) ▸ Gel Electrophoresis ▸ Cell culture (Fastidious so not used) 			
Treatment & prevention	★ It's the ONLY virus here that have vaccine	<ul style="list-style-type: none"> ◦ Treatment: No antiviral, just self-limiting, rehydration & supportive. ◦ Prevention: Improving sanitation & hygiene measures 		
Notes	<ul style="list-style-type: none"> ◦ It cause Endemic ◦ Clinical features: Watery, non-bloody diarrhea, vomiting, fever & Dehydration. 	<ul style="list-style-type: none"> ◦ It cause Endemic ◦ In comparison to Rotavirus: <ul style="list-style-type: none"> - Longer IP. - Less severe - Prolonged illness 	<ul style="list-style-type: none"> ◦ It cause Epidemic (outbreak) ◦ Spread through water, shellfish. 	<ul style="list-style-type: none"> ◦ It cause Epidemic (outbreak)





MCQs

Q1 - What is the most common cause of infantile gastroenteritis with watery non-bloody diarrhea?			
A. Rotavirus	B. Enteric Adenovirus	C. Norovirus	D. Astrovirus
Q2 - Which of the following Rotavirus groups is the most common to cause GE?			
A. Group A	B. Group B	C. Group C	D. Group D
Q3 - In a rural community, there is a sudden increase in cases of gastroenteritis, particularly among adults. Investigation shows that the virus causing the outbreak is transmitted through contaminated water sources. Which virus is the likely cause?			
A. Rotavirus	B. Enteric Adenovirus	C. Norovirus	D. Astrovirus
Q4 - Which virus can be contracted from eating shellfish?			
A. Rotavirus	B. Enteric Adenovirus	C. Norovirus	D. Astrovirus
Q5 - Which of the following viral gastroenteritis can be prevented by vaccine?			
A. Rotavirus	B. Enteric Adenovirus	C. Calicivirus	D. Astrovirus
Q6 - Viral gastroenteritis is routinely detected by which laboratory test?			
A. DNA in stool	B. RNA in stool	C. Antibody in stool	D. Antigen in stool
Q7 - What is the routine test to diagnose viral gastroenteritis?			
A. Cell Culture	B. Immunoassay	C. Electron Microscopy	D. RT-PCR
Q8 - Which of the following tests have the highest sensitivity & specificity among the immunoassay?			
A. Latex agglutination	B. PCR	C. Immunochromatography	D. ELISA
Q9 - What is the most sensitive and specific test in general?			
A. Latex agglutination	B. PCR	C. Immunochromatography	D. ELISA
Q10 - Which of the following methods can detect rotavirus and adenovirus 40, 41 at a single test?			
A. ELISA	B. RT-PCR	C. Immunochromatography	D. PCR



SAQ

1

A 10-month-old infant presents with sudden-onset watery diarrhea, vomiting, and fever. The parents mention that the symptoms started a day after the infant attended a playgroup. Stool examination reveals non-bloody diarrhea.

- Q1. What is your diagnosis?
- Q2. What is the most likely etiology of this episode?
- Q3. How would you confirm the diagnosis?
- Q4. If you take a the sample under the microscope, how do you expect to see the etiology look like?

2

An outbreak of gastroenteritis occurs in a summer camp, affecting both children and adults. The affected individuals present with sudden-onset vomiting and diarrhea. The camp authorities suspect a viral etiology.

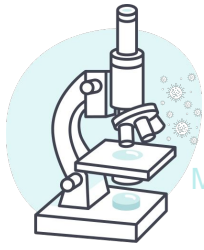
- Q1. What is your diagnosis?
- Q2. Which group of viruses should be considered as the possible cause?
- Q3. How would you confirm the diagnosis in this outbreak setting?
- Q4. If you take a the sample under the microscope, how do you expect to see the etiology look like?

© Case 1 Answers:

- A1. Viral gastroenteritis
- A2. Rotavirus
- A3. a stool sample can be tested using immunoassay techniques such as ELISA or immunochromatography to detect viral antigens specific to Rotavirus.
- A4. Non-enveloped, Double-layered icosahedral capsid with wheel-like structure.

© Case 2 Answers:

- A1. Viral gastroenteritis
- A2. Caliciviruses, specifically Norovirus
- A3. laboratory testing can be done using techniques such as immunoassays (ELISA or immunochromatography) to detect viral antigens in stool samples.
- A4. Small, non-enveloped, Icosahedral capsid with cup-like depression on its surface



TEAM 443
MICROBIOLOGY

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