Viral Gastroenteritis

Microbiology

Editing File

Summary

MED439
KING SAUD UNIVERSITY

MICROBIOLOGY
TEAM 439

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- Girls' slides
- Main content
- Important
- Boys' slides
- Extra
- Drs' notes

Objectives:

- Definition of GE

- Epidemiology

- Clinical features

- Lab diagnosis

- Treatment & Prevention (Vaccine)

- Rotavirus, Adenovirus, Calicivirus & Astrovirus

Gastroenteritis
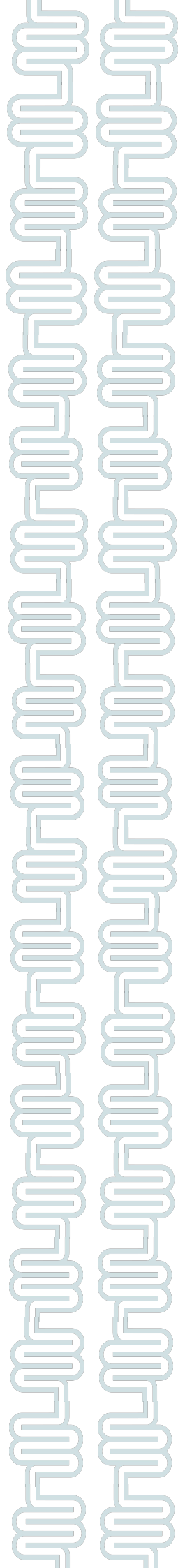
Definition
- It is an inflammation of the gastrointestinal tract which involves both stomach and small intestine leading to acute diarrhea and vomiting.
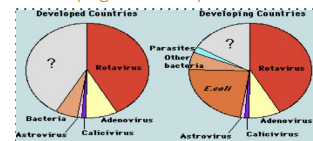
Causes
- Infectious. (More common than non-affections)
- Non-infectious. (such as chemical toxins, allergies and antibiotics)

Epidemiology[1]
- Worldwide:↑in poor hygiene, overcrowding, and poverty.
- Mainly infants & young children > older children.
- Transmit by fecal-oral route.
- Peaks in winter months
- Endemic[2] infection:
  group A Rotavirus & Adenovirus 40 & 41 in children.
- Epidemic[3] infection: Norovirus (from Caliciviruses)

You can see that viruses (especially Rotavirus) are the main etiology in developing and developed countries

Etiologic agents in severe diarrheal illnesses requiring hygiene, hospitalization and rehydration of infants & young children.

Etiology   all the viruses in one page? Click here
- **Rotavirus**. (Most common & can cause severe infection in children)
- **Adenovirus** serotype 40 & 41
- **Astrovirus**
- **Caliciviruses** (Norovirus/ norwalk virus)
- Others: Coronavirus, Torovirus, and Enterovirus.

Clinical features

incubation period
Short (few days or a week) (1-2 days in Rotavirus)

Symptoms
- Sudden onset, non-bloody (watery) Diarrhea
- Vomiting
- Fever
- Abdominal cramps

Winter vomiting diseases
- A form of gastroenteritis in which **Vomiting is more prominent than diarrhea** (caused by Calicivirus)

Dehydration
- Dehydration with decreased Na+ is a life threatening condition especially in young children caused by diarrhea and vomiting

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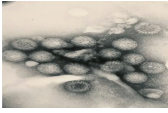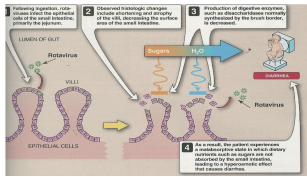1: The classification of countries is based on the economic status:
Developed Countries refers to the (independent) nation/state whose economy has highly progressed and possesses great technological infrastructure, as compared to other nations.
Developing countries refers to the countries with low industrialization and low human development index.
2: An endemic is disease that belongs to a specific population or country
3: An epidemic is known as an outbreak, meaning it affects multiple countries and populations

Viral Gastroenteritis

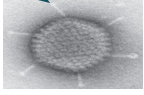| Virus	Rotavirus ▶
Family	○ <u>Re</u>oviridae (<u>R</u>espiratory & <u>E</u>nteric <u>O</u>rphan) 　○ when it was firstly discovered it was isolated from respiratory and enteric tract but it was not associated with gastroenteritis
Description	○ Non-enveloped.　★ 11 segments double stranded-**RNA.** ○ RNA-dependent RNA polymerase[1]　○ 70 nm. ○ Double shelled with wheel like structure (Double-layered icosahedral capsid)
Morphology	○ **Double-shelled with wheel-like structure.**
Epidemiology	★ **Spread by fecal-oral route** ○ Most common cause of gastroenteritis in infants and young children ○ Affect all age groups but mainly infants 6-24 months. (Symptomatic infection) ○ Endemic ○ Peak at winter months
Classification	○ Has 7 groups (A-G), Most common: group A. (Represents 95% of identified rotavirus in human, group A is the most common cause of infantile gastroenteritis)
Special informations	Outcome vary: ○ 1⁄2 of all GE cases requires admission. ○ Developed countries have low mortality. ○ Developing countries have significant mortality. (poor healthcare access) ○ Deaths are reported
Clinical features	★ **Most common cause of gastroenteritis in infants (Infantile GE)** & young children (GE) ○ IP= 1-2 days. (short) ○ **Sudden onset of watery, non-bloody diarrhea** with vomiting & fever. ○ Dehydration in infants **Intestinal infection:** - GE in infants & young children. - Asymptomatic in older children & adults - Chronic diarrhea in low immune hosts. **Extra-intestinal infection:** Encephalitis in small number of cases. (immunocompromised)
Diagnosis	○ Sample: Stool (should be collected in first days of illness because there will be a higher conc. of the virus) ★ **Immunoassay: (Most used):** Viral Ag in stool samples by **ELISA** & Immunochromatography[2] & latex agglutination. ○ Others: EM, Gel electrophoresis, RT-PCR & Cell culture[3]
Pathogenesis	Rotavirus infects villus cells of the proximal small Intestine, The virus replicates intracellularly and eventually causes lysis in host cell,Cell destruction results in a significant decrease in intestinal surface area and consequently absorption from the intestinal lumen, thus causing **Watery diarrhea.**
Vaccine	★ **(Rotavirus is the only virus that has a vaccine in this lecture):** **Live attenuated vaccine, given orally;** Rotarix, RotaTeq (the one available in KKUH), Rotashield (withdrawn)

1: All RNA viruses with negative polarity have RNA-dependent RNA polymerase, But the positive polarity RNA viruses can translates directly into protein without the RNA-dependent RNA polymerase
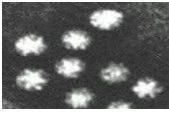
2 :Immunochromatography is coated with antibodies so when exposed with the sample it will bind to the virus and you'll see a band, Control band (C) is always there. if it is not then the test is faulty.

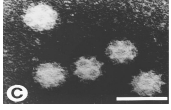3: Cell cultures are not prefered because they can be contaminated with bacteria from the stool

Viral Gastroenteritis

Virus	Enteric Adenoviruses (Serotypes 40&41)
Family	○ Adenoviridae
Description	○ Non-enveloped. ○ **Double stranded -DNA** ○ Icosahedral capsid Fibers
Morphology	★ Classical icosahedral capsid with **fibers**. (The only virus that has fibers emerging from its capsid)
Epidemiology	○ The 2nd most common cause of gastroenteritis

Classification	○ Adenovirus has 6 subgenera (A-F) (7 subgenera (A-g)) which is composed of 51 (>50) serotypes, but only adenoviruses causes gastroenteritis.
	 ○ Grow in cell culture.
	 ○ Enteric Adenoviruses:
	    - Subgenus F, 40 & 41 serotype.
	    - Fastidious (difficult to grow in cell culture)

Special informations	○ The only virus with fiber protruding from each of the vertices of the capsid.
	 ○ Fibers for:
	    1. Attachment,
	    2. Hemagglutinin
	    3. Type-specific Ag.

Clinical features	○ In comparison to Rotavirus:
	    - Longer IP.
	    - Less severe.
	    - Prolonged illness.

Diagnosis	★ **Viral Ag in stool samples by immunoassay** (ELISA, Immunochromatography), and RT-PCR

Virus	Astroviruses
Family	○ Astroviridae (astro=a star).
Description	○ Non-enveloped ○ Single stranded RNA with +ve polarity. ○ Icosahedral capsid
Morphology	★ **5 or 6-pointed star on its surface.**
Classification	○ 8 serotypes.
Clinical features	○ **Mild GE** (rarely require admission) ○ Outbreak of diarrhea in children <5 yr.
Diagnosis	○ **Viral Ag in stool samples** by ELISA, Immunochromatography and RT-PCR

Viral Gastroenteritis

Virus	Caliciviruses (Subtype: Norovirus) ▶
Family	○ Caliciviridae (Calyx=cup).
Description	○ Non-enveloped. ○ ss-RNA with +ve polarity[1] ○ Icosahedral capsid.
Classification	**Has two morphologic types:** ○ Typical Caliciviruses **(Sapovirus).** ○ Small round structured viruses **(Norovirus).** Norovirus is more common than sapovirus
Morphology	★ Caliciviruses (including sapoviruses): **Cup-like depression on its surface.** ★ Noroviruses: Small round structured (no cup like appearance) To illustrate: caliciviruses in general (including sapoviruses) have a cup like appearance. However, subtype **norovirus** lacks it.
Epidemiology	★ **Faecal-oral** (contaminated water, **shellfish**). ○ All age groups. ○ Outbreaks of GE in **schools**, **camps** & **cruises**. (most important cause of non-bacterial epidemics and outbreaks)
Clinical features	○ Children: vomiting (projectile) → winter vomiting disease ○ Adults: diarrhea.
Diagnosis	○ Viral Ag in stool samples by ELISA, Immunochromatography and RT-PCR

Lab diagnosis

○ Specific test:
-ELISA/Immunochromatography[2]: for detection of viral antigens in stool samples. (Rota, adeno, Astro, caliciviruses)
-Multiplex PCR[4]

○ **Electron microscopy:**
Catch all tech[3]
Many disadvantages - not used

○ **Cell culture**:
Fastidious → Growing poorly → not used
in routine cell culture

Management [5]

Prevention	🏥 Sanitation & hygiene measures. 💉 No vaccines except for **Rotavirus**: live attenuated vaccine, **oral**; Rotarix, RotaTeq & Rotashield (withdrawn)
Treatment	Self-limiting, treated by rehydration (especially important for infants) and supportive treatment.

[1] acts directly as a viral mRNA upon entering the cell, because it has a base sequence similar to mRNA.
[2] Aka. Immunoassay (most commonly used method to diagnose viral gastroenteritis)
[3] It can detect all viruses in a sample only by one test. However, it has many disadvantages (cost/expensive, difficult maintenance, poor sensitivity) so it is not used.
[4] Multiplex PCR is used for detection of multiple viruses, and it works on the DNA so we have to convert RNA to DNA to use it as a second step after RT
[5] No specific antiviral therapy to treat viral gastroenteritis. usually treatment is supportive (re-hydration).

Drs' notes

Dr. Malak

- Viruses are the most common cause of viral gastroenteritis in both developed and developing countries.

- **All viruses in this lecture are non-enveloped (that makes them more resistant to stomach acidity).**

- Norovirus is the most common cause of non-bacterial epidemics of gastroenteritis. **(schools, camps, cruises)**

- **Rotavirus is the <u>most common</u> cause of viral gastroenteritis:**
  - It is an important exception in virology because it has a **double stranded RNA genome**. (RNA is usually single stranded but rotavirus is an exception). In order for it to act in the cell, its genome needs to be converted to mRNA (By a special enzyme called **RNA-dependent RNA polymerase**).
  - Group A rotavirus is the most common rotavirus that infects human, and it is the most common cause of **infantile gastroenteritis.**
  - Infection with one serotype of rotavirus will produce immunity to that specific type. (The second infection might be mild and asymptomatic).
  - Rotavirus affects all groups. However, symptomatic infections only start after 6 months of age. Why? because the passive acquiring of maternal antibodies in babies give them protection against the virus (if an infant less than 6 months got the infection he will be asymptomatic)
  - Watery diarrhea in rotavirus is due to (1) destruction of epithelial cells from the tip of villi which led to decrease in surface area and reduction in production of digestive enzymes. (2) Enterotoxin.

- Adenovirus is the only virus that has fibers emerging from its capsid.

- Astroviruses have a pointed stars appearance on their surfaces.

- Caliciviruses (norovirus) is mostly transmitted through faecal-oral (contaminated water, shellfish).

- Caliciviruses in general (including sapoviruses) have a cup like appearance. However, subtype norovirus lacks it.

- <u>Why astrovirus and calicivirus lack **RNA-dependent RNA polymerase**</u>? because their RNA has **+ve polarity** already (meaning it can act as mRNA by itself without the help of another enzyme).

- Cell culture is not used as a routine test in viral gastroenteritis (it was used in the past only).

- Most cases of viral gastroenteritis are not diagnosed. This is either because they are mostly self limiting, or because medical laboratories and facilities are not available.

- **Best diagnostic method for all viruses in this lecture is immunoassay (looking for viral antigens in stool)**

- All viruses in this lecture have no specific treatment (mostly supportive by rehydration), and the only virus with available vaccine in this lecture is rotavirus.

Dr. Alhetheel

- Adenovirus is the he second most common cause of gastroenteritis

- Positive polarity of the virus means that the virus acts directly as a viral mRNA when it enters the cell, because it has a base sequence similar to mRNA.

- PCR only works on DNA so RNA viruses need reverse transcription mechanism (RT-PCR). However, it is not routinely used.

- Multiplex PCR is used for detection of multiple viruses. However, it is not widely used.

- Cell cultures are not prefered because they can be contaminated with bacteria from the stool.

Quiz

MCQ

Q1: transmission is by ?

A- close contact
B- Mucus
C- fecal-oral route
D- Touch

Q2: which of the following is The only virus with fiber protruding from each of the vertices of the capsid ?

A- Rotavirus
B- Enteric Adenoviruses
C- Caliciviruses
D- Astroviruses

Q3: which of the following is the most common cause of gastroenteritis?

A- Rotavirus
B- Astrovirus
C- Caliciviruses
D- Adenovirus

Q4: When suspecting viral gastroenteritis in children, what type of sample is used for immunoassay, and for the detection of what?

A- Stool sample, viral antibodies
B- Blood sample, viral antibodies
C- Stool sample, viral antigen
D- Blood sample, viral antigen

Q5: Which of the following can come from shellfishes?

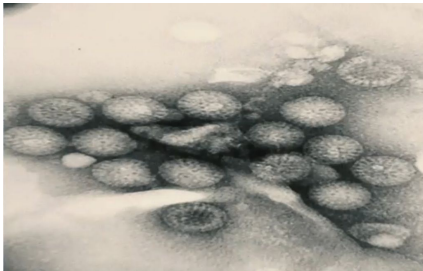A- Rotavirus
B- Enteric Adenovirus
C- Norovirus
D- Astrovirus

Q6: 26y/o man with history AIDS , if infected with Rotavirus what would be the most prominent symptom (main complain) ?

A- Asymptomatic
B- Gastroenteritis
C- Chronic diarrhea
D- headache

Answers: Q1:C | Q2:B | Q3:A | Q4:C | Q5:C| Q6:C
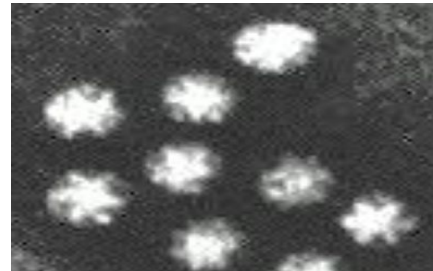
SAQ

Qs by Dr. Malak

SAQ1:

Q1: Describe the virus in the picture?

A: 1- double shell/layer
2- wheel structure
3- non-enveloped 3-icosahedral

Q2: What is the most likely virus?

A: Rotavirus

SAQ2:

Q1: Describe the virus in the picture?

A: 1- non-enveloped
2-icosahedral capsid
3- stars on the surface

Q2: What is the most likely virus?

A: Astrovirus

Members Board

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