

Viral GI Infections

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Mumps

- Mumps is a **common childhood disease** mainly characterized by **swelling** of the **parotid glands**
- Also called **epidemic parotitis**
- Caused by **mumps virus**; which is an **enveloped (-) sense ssRNA virus** from **Paramyxoviridae family**
- **Humans** are the **only host**

Mumps

- Mumps is **highly contagious** (especially among crowded populations) and it is mainly **transmitted through salivary and respiratory secretions**, but also by direct contact and contaminated objects.
- Patients are **contagious from 1 week before to 1 week after** the onset of symptoms
- Mostly occurs in **children under 15 years old** during **late winter and early spring**
- **Incubation period: 2-3 weeks**
- **~40% of cases are subclinical**

Mumps

- **Initial symptoms** include fever, headache, nasal discharge, muscle pain, and malaise
- Followed by **painful swelling** of the **parotid salivary glands (parotitis)**
- Usually **self-limited** disease with complete recovery in **7-10 days**
- Natural infection usually results in **lifelong immunity**
- **Complications may rarely occur** especially in **adults** which include:
 - **Orchitis** and **epididymitis** (in **adult males**) which may **rarely cause infertility**
 - **Pancreatitis**
 - **Viral meningitis**
 - Infection of the **inner ear** that can lead to **deafness**



Mumps

- Diagnosis:
 - Usually based on **clinical manifestation**
 - Infected cells get viral **fusion proteins** into their plasma membrane causing them to **fuse with neighboring cells** forming multinucleated giant cells called **syncytia**; a diagnostically useful cytopathic effect
 - **Antigen test** (ELISA or direct fluorescent test)
 - **PCR**

Mumps

- Prevention:
 - **Live attenuated vaccine** is available (usually part of **MMR vaccine**)
 - Highly protective vaccine that can induce **lifelong immunity**
- Treatment:
 - No specific antiviral therapy is available
 - Usually **symptomatic treatment** (to relieve fever, dehydration and pain)

Viral Gastroenteritis

- Also known as the **stomach flu**
- Viruses are responsible for **~75% of all infective diarrheas**
- Viral gastroenteritis is **the second most common viral illness** after upper respiratory tract infections
- In **developing countries**, viral gastroenteritis is a **major killer of infants** who are undernourished.
- Many types of viruses are found in the gut but only some are associated with gastroenteritis, such as:
 - Rotavirus
 - Norovirus (Norwalk virus)
 - Adenoviruses (40 & 41)
 - Astroviruses

Rotavirus

- Rotavirus is a **non-enveloped dsRNA** virus from the family **Reoviridae**
- There are **eight species** of this virus, referred to as rotavirus A, B, C, D, E, F, G and H
- **Rotavirus A**, the **most common** species, causes more than 90% of rotavirus infections in humans
 - Rotavirus **B** and Rotavirus **C** can also cause human infections but to a lesser extent
- Rotavirus has a **segmented genome** (11 segments) and **reassortment** of gene segments can occur and thus create **hybrid viruses**
- Rotavirus is **Very stable** and may remain viable for **weeks or months** if not properly disinfected
 - Stable to treatment with detergents, pH extremes of 3.5 to 10 or even repeated freezing and thawing
- In addition to humans, rotaviruses are found in **many other mammals and birds**

Rotavirus

- **The most common** cause of acute diarrhea (gastroenteritis) in **infants and young children**
 - **Outbreaks** are common in **preschool children**, among **daycare centers** and **hospitalized infants**
 - **Less common in adults** due to acquired immunity
- Nearly universal infection **by 5 years** of age
- **Transmitted** mainly by the **fecal-oral route**
- Most prevalent in **fall and winter**
- Communicable **2 days before to 10 days** after onset of symptoms

Rotavirus

- Mainly infects and replicates in the **enterocytes of the small intestine** leading to their destruction in addition to other **functional changes** including:
 - Prevents water reabsorption from the gut causing a net **secretion of water and loss of electrolytes** which together result in a **watery diarrhea**.
 - The loss of fluids and electrolytes can lead to **severe dehydration** and even death
 - Reduction in **disaccharidases** (i.e. lactase) activity leading to **transient lactose intolerance**

Rotavirus

- **Incubation** period: **1-3 days**
- May be **asymptomatic** or result in **severe dehydrating diarrhea with fever and vomiting**
- Clinical manifestations depend on whether it is the **first infection or reinfection**
 - First infection is generally the most severe
- Generally **self-limited** with symptoms resolving in **3 to 7 days**
- **Complications** may occur including **electrolyte imbalance and metabolic acidosis** which can be **fatal** especially to **infants** and young children

Rotavirus

- First infection usually **does not lead** to permanent **immunity**
- **Reinfection** can occur at any age, however subsequent infections generally **less severe**
- Groups with **increased exposure** to the virus:
 - Children in **daycare centers**
 - **Hospitalized** children (nosocomial rotavirus)
 - **Care-takers and parents** of these children
 - Children and adults with **immunodeficiency** diseases (e.g. SCID, HIV, bone marrow transplant)

Rotavirus

- Diagnosis:
 - Clinical manifestations
 - **Virus isolation** from **stool** which can be detected by **ELISA, EM or PCR**
- Prevention:
 - **Two** attenuated live virus vaccines are available:
 - **RotaTeq:** contains **five rotavirus strains** produced by reassortment. Administered orally in **3 doses** (at 2, 4 and 6 months of age)
 - **Rotarix:** contains **one rotavirus strain**. Administered orally in **2 doses** (at 2 and 4 months of age)
- Treatment:
 - Symptomatic treatment mainly focused on **fluid and electrolyte replacement** therapy
 - Oral rehydration solutions are usually used unless severe cases where IV fluids will be necessary

Norovirus

- Norovirus (**Norwalk virus**) is a **non-enveloped (+) sense ssRNA** virus from the family **Caliciviridae**
- Norovirus **affects all ages** and is the **most common cause** of gastroenteritis (especially in adults).
- Norovirus was recently approved as the official genus name for the group of viruses provisionally described as "**Norwalk-like viruses**" (NLV).
- Currently, there are at least **five norovirus genogroups** (GI, GII, GIII, GIV and GV), which in turn are divided into at least **31 genetic clusters**

Norovirus

- Causes **numerous outbreaks**
- Norovirus is **transmitted** primarily through the **fecal-oral route**, either by consumption of fecally contaminated **food or water** or by direct **person-to-person** spread. Also by **contaminated objects** and **aerosolization of vomits**.
- Norovirus is **highly contagious** and as few as **10 viral particles** may be sufficient to infect an individual
- Communicable from **onset of symptoms to 2 weeks** after recovery

Norovirus

- **Incubation period: 12-48 hours**
- **Asymptomatic in about 30% of infections**
- Usually presents as **acute-onset vomiting, watery diarrhea with abdominal cramps and nausea.** **Low-grade fever** also occasionally occurs
- **Dehydration** is the **most common complication**, especially among the **young and elderly**
- **Symptoms** usually last **24 to 60 hours.**
- **Recovery is usually complete** with no serious long-term sequelae

Norovirus

- Infection doesn't induce long lasting **immunity**; it lasts only a **few months**
- Individuals are likely to be **repeatedly infected** throughout their lifetimes
- This may explain the **high attack rates** in all age groups reported in **outbreaks** (especially foodborne and waterborne outbreaks).
- **Susceptibility** to infection may be **genetically determined**, with people of **blood group O** being at **greatest risk** for severe infection

Norovirus

- Diagnosis:
 - Clinical manifestations
 - **Virus isolation** from **stool** which can be detected by **ELISA, EM or PCR**
 - Kaplan's criteria:
 - To determine whether an **outbreak** of gastroenteritis is of **viral origin**
 - Viral etiology is suspected if:
 - A mean incubation period of 24 to 48 hours
 - A mean illness duration of 12 to 60 hours
 - More than 50% of people with **vomiting**
 - **No bacterial** agent previously found

Norovirus

- Prevention:
 - No vaccines available (2 vaccines under clinical trials)
 - Strict **hand washing** after using the bathroom and before handling food items
 - Proper handling of food
 - Sick leave
 - Cohort isolation in hospitals
 - Proper disinfection
- Treatment:
 - **Symptomatic treatment** mainly focused on fluid and electrolyte replacement therapy

Adenoviruses

- Adenoviruses are **nonenveloped dsDNA viruses** from the family **Adenoviridae**
- **57 serotypes** (1, 2, 3...) can infect humans, which are classified into **6 subgroups** (A, B, C...)
- Only ~**45%** of adenovirus infections result in **clinical disease** (the rest are asymptomatic)
- Infections **mainly in children**
- Infections occur **anytime** in the year but **most frequently** during **late winter or early spring**
- Adenoviruses are mainly **spread by respiratory droplets** but also by **fecal–oral route**

Adenoviruses

- The virus replicates in **epithelial cells**, producing **cell necrosis** and **inflammation**
- **Viremia** sometimes occurs, and can result in **spread to distant sites**, such as kidney, bladder, liver, lymphoid tissue and CNS
- After the acute phase of illness, the **viruses** may **remain latent in lymphoid tissues** (e.g. tonsils, adenoids and Peyer's patches)
 - It may become reactivated and **shed** without producing illness for **6 to 18 months** thereafter
- **Immunity** to adenoviruses is usually **long-lasting** after infection but it is **serotype-specific**

Adenoviruses

Site of infection	Manifestation	Common serotypes	Remarks
URT	Fever, cough, rhinitis, pharyngitis and conjunctivitis	1,2,3,5,7	Mainly in young children
LRT	Laryngitis, croup, bronchiolitis, and pneumonia	1,2,3,4,5,7,14	Common in military recruits
Eyes	Conjunctivitis Keratoconjunctivitis	2,5,7,8,19,21 3,8,9,19	Usually with URT Can cause corneal scarring
GIT	Gastroenteritis (diarrhea and vomiting)	40,41	2 nd most common cause of viral gastroenteritis
Multi-system	Hepatitis, cystitis....		In immunocompromised patients

Adenoviruses

- Adenoviruses **40 and 41** are associated with **endemic gastroenteritis**, usually in **young children and neonates**
- Can cause **occasional outbreaks**
- Possibly the **second most common** viral cause of gastroenteritis (after norovirus).
- Similar disease to rotavirus, except:
 - Incubation period: ~1 week
 - Symptoms last for ~8-12 days

Adenoviruses

- Diagnosis:
 - **Cell culture**: can be used with most serotypes (other than 40,41)
 - **Antigen tests**: for all serotypes (including 40 and 41)
 - **Electron microscopy**: for 40 and 41
- Treatment:
 - No specific antiviral agents
 - Mainly **symptomatic treatment**
 - **Cidofovir** and **ribavirin** have been suggested by some studies to be potentially effective

Astroviruses

- Astroviruses are **non-enveloped (+) sense ssRNA viruses** from the family **Astroviridae**
- Spread is by the fecal-oral route
- They typically cause outbreaks of gastroenteritis as a result of **common source contamination** (water, shellfish and food).
- **Outbreaks occur year-round** in schools, resorts, hospitals, nursing homes, restaurants and cruise ships
- They are similar clinically to rotavirus disease