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Rotavirus Infection in Children below 5 Years of Age

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Abstract

Rotavirus, the most prevalent diarrheal infection in children globally, is responsible for almost a third of hospitalizations for diarrhoea and 800,000 fatalities each year. The incidence and severity of subsequent bouts of rotavirus diarrhoea are reduced by natural infection, therefore the condition might be managed with vaccine. Immunity that is unique to a certain serotype may aid in disease prevention. The virus genome can be detected immediately by polyacrylamide gel electrophoresis or after reverse transcription of the viral RNA and amplification by PCR. Rotaviruses are simple to identify, and methods have been devised to visualise their distinctive appearance. Rotaviruses were quickly identified as a leading cause of potentially fatal diarrhoea in young children and infants worldwide, as well as in the young of many mammalian and bird species. A thorough discussion of Rotaviruses and their associated clinical syndromes is provided in this review chapter, including information on their viral structure, genome structure, classification, viral replication, pathogenesis, pertinent immune response, clinical symptomatology, epidemiology, and laboratory diagnosis.

Keywords: Childhood diarrhoea, Enteropathogenesis predominance, Antigen, Host, epidemiology, gastroenteritis.

Introduction

Rotavirus is one of the most etiological agents of acute gastroenteritis in infants and children less than 5 year of age. In infants, it shows asymptomatic effects due to antibodies which neutralize the effect. It is found in humans and animals having different type of rotavirus types and strains. Rotavirus group A is most common cause of diarrhoea in human beings it belongs to genus Rotavirus and family Reoviridae. Rotavirus is one of the deadly diseases in the developing countries. It is the main problem of acute gastroenteritis worldwide in children up to age 5 years; some of them are suffering from more than this period of age. In developing

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countries, about 80% of children having age ranging from 6-9 months are suffering mostly from this disease. In developed countries, the median age of infection ranging from 9-15 months of ages (65% occurs in >1 year of age). According to researchers, about 20% of all diarrhoea associated hospitalizations in children and they conducted this data locally and nationally. It is second most leading cause of death in children with 10% of death each year.

Genome Structure, Morphology

- Rotavirus is a 70nm non-enveloped, double stranded RNA genome having 11segments and each segment is a gene with code for one protein. Rotavirus has distinct morphology when seen under the electron microscope; resemble the wheel with short spokes.
- In Latin the word 'Rota' means 'wheel'. Three-dimension cryo-electron microscopy showed that the particle has isohedral symmetry. The rotavirus has estimated 10-1000 viral particles.
- There are six structural proteins and six on-structural proteins which helps the virus to infect the host cell. Then on-structural proteins help in viral replication and antagonistic to innate immune response (RoleofNSP1) and include viral enterotoxinVP4.
- Group A rotavirus is a main leading problem of diarrhoea which is further divided into based on presence or absence of antigens; subgroup I and II, subgroup I, subgroup II, sub group non-I and II. There are six structural proteins (VP1, VP2, VP3, VP4, VP6,and VP7) and 6 non-structural proteins (NSP1, NSP2, NSP3, NSP4, NSP5,and NSP6). The functions of these proteins involved in RNA synthesis and packaging inthevirion, mRNA transport to site of replication of genome, mRNA translation and regulation of gene expression.
- Genotypes: G types has 6 types (G1, G2, G3, G4, G9, and G12) and P has 3 types (P4, P6, P8). Different species of rotavirus A species has G1P (8), G2P (4), G3P (8), G9P (8), and G12P. One non-structural protein NSP4 is widely studied because of its role in virus morphogenesis and its enterotoxin property.

History

- In 1943, Jacob Light and Horace Hodes proved that a filterable agent in the faeces of children with severe infectious diarrhoea also caused livestock diarrhoea in cattle. After 3 years, the samples which are preserved were shown to have rotavirus.

- In1973, Ruth Bishop and colleagues described related viruses found in children with severe gastroenteritis.
- In 1974,Thomas Henry Flewett suggested the name rotavirus after observing under

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the electron microscope, a rotavirus particle looks like a wheel (*Rota* in Latin). Four years later, the name rotavirus was officially recognized by the International Committee on Taxonomy of Viruses.

- In 1976, related viruses were described in several other species of animals. In 1980, rotavirus serotypes were first discovered.
- In 1981, Rotavirus from humans is derived from monkey kidney cells, they were first grown in cell culture by adding trypsin to culture medium.
- In 2013, vaccines were provided to children in UK and it reduces the mortality rate and hospitalized rate of rotavirus infection by severe diarrhoea by 70% (UK Department of Health 2012).
- In 2016 Indonesia has 38-67% of children were admitted in hospital due to rotavirus.
- In 2019, only a few vaccines like rotavirus - can be given orally. Most must be delivered by injection.

Molecular Mechanism

- Trypsin protease present in the lumen intestine cleaves the VP4 viral protein. It produces N- TerminalVP8 and C-Terminal VP5 peptides.
- Outer viral spike of VP4 is essential for infection. It is leading to stable, spike like structure, displaying VP8 domain for attachment and binding to mucosal epithelium.
- VP8 on epithelium identified as oligosaccrides of histo-blood group antigens, present on red blood cells, epithelial intestinal. In a mice model, RV infection suggested that extra intestinal spreads occur via lymphatic vessels, determined bynon-structural NSP3, which is modified by VP6 protein.
- Viral spreads occur through VP6 and NSP3, other components are also related to genetic host. Glyphorin mechanism involves in viral read inhibition. Glyphorin are cell membrane gly-proteins rich in sialic acid, a monosaccride associated with RV infection.

Transmission

- Rotavirus is shed in large quantity during episodes of rapid diarrhea. Transmission of rotavirus is basically via fecal oral route through several factors i.e., person to person contact, contact with contaminated objects, contaminated hands and unhygienic conditions.

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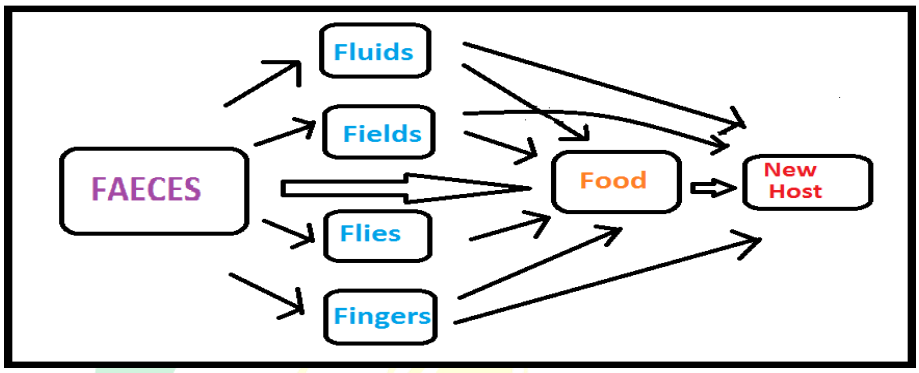
- The virus can also spread through ingestion of the faecal contaminated food and water and also through the respiratory droplets.
- Contaminated fomites (the objects that allow the transmission of pathogens) also play a role in transmission of infection especially, in out of homecare facilities and hospitals.



Treatments

- It includes antiviral medications, anti- diarrheal drugs and antibiotics. Themain aimed of treatment is replacement of fluid and electrolytes lose. Intravenous fluid should be preferred if children is suffering from severe diarrhea.
- The morbidity and mortality rate can also be reduced by nutritional therapy. There are no anti-viral agents available for the treatment of rotavirus infection. In high income countries, 80-90% vaccines are effective against rotavirus infection.
- Six Types of rotavirus vaccines: Rotarix, Rota Teq, Rotavac, Rotavin-M1, Rotavin-M1, Rotasiil. Among these two vaccines Rota Teq and Rotarixare licensed since 2006.

Symptoms

- Rotavirus infection induces fever and is associated with malaise. Fever is the acute phase of infection that is regulated by the hypothalamus and showed symptoms like sleepiness, depression and reduce intake of water and food.
- In the serum of the infected children viral antigens (that is, anti-genaemia) and infectious viruses (that is, viraemia) has been reported.

Preventions and Controls

- Proper hygiene and sanitation to reduce the risk of the disease occurrence.
- Two other live oral vaccines: Pentavalent (Rota Teq) and monovalent (Rotarix). These two vaccines were each tested in clinical trials around 60,000-70,000 children

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without licensed. The efficiency of these two vaccines is 54-60% in Africa and USA.

- Chlorhexidine gluconate and quaternary ammonium compounds should be used in preparations that contain a high proportion of alcohol.
- Lysol Brand Disinfectant spray (79 % ethyl alcohol l, 0.1%*o*-phenylphenol) successfully blocked transmission of rotavirus infection to humans when sprayed on inanimate surfaces.
- Oral rehydration solutions contribute to decrease this verity of infection. Children are rehydrated via liquids delivered via tube or intravenously.
- Rotarixisa live-attenuated human rota virus vaccine prepared from a single human strain(P1A8G1) that replicates in the gut, two doses are recommended at age of 2 and 4 months of age.

Epidemiology

- During 18th century, children died from cholera in 1-2 years of age. In 1900, the death rate of children aged 6-18 months in New York City was 5603 out of 100,000 populations. An outbreak of Rotavirus is caused by contaminated municipal water occurred in Colorado in 1981.
- During2005, the largest recorded epidemic of diarrhea occurred in Nicaragua.
- In 1942-1943, in London, 109/216, children admitted and died due to severe diarrhea, without identification of the enteric pathogen.
- In 1946-1947, death from enteritis in young children >15 months admitted in hospitals average 40/70 perweekinUK.After1973, rotavirus was discovered.
- In 1979, WHO estimated that one episode of illness was caused by gastroenteritis infection per person per year. Inearly1900s, some developed countries can be recognized a winter peak of vomiting illness. In 1985, in Mexico summer disease is dominant but after few days winter disease is on peak after the country improved water and sewage proper handling.
- Between 1968 and 1991, US had an 80% decrease in mortality rate of children having gastroenteritis.
- In 2006 study estimated that 1.6 million deaths were caused by diarrhoea. According to 2003 data, 20,000rotavirus related deaths in Brazil and 12,000 in Mexico. Death rate in poor countries is 82% (6, 11,000deaths/year). Rotavirus causes about 70,000

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hospitalizations in US, individually India accounts with highest death rates i.e.,>100,000deathsannually. Outbreaks of Rotavirus A diarrhoea are common among hospitalized infants, young children attending day-care centres, and elderly people in nursing homes. Rotavirus B**,** also called as adult diarrhoea rotavirus, infected peoples of all aged groups in China. Rotavirus B infections also occurredinIndiain1998.Itwas due to unsafe drinking water. Rotavirus C has been associated with rare and sporadic cases of diarrhoea in children, and small outbreaks have occurred in families.

Conclusion:

Due to diverse nature of rotavirus, the phenotypic and genotypic studies are essential. There are different serotypes circulating in the environment at a given time and types of the strains changes with time. The emergence of new strains has been reported worldwide and cause serious threat. The global disease burden can only be removed by availability of vaccines at poorest rate, so it should be affordable to the developing countries of world. A national rotavirus vaccination program is cost effective for reducing the deadly disease of diarrhoea and economic burden of Rotavirus in the country.

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