



Rotavirus infection in iraqi children: a review

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Abstract

The rotavirus remains the most common cause of diarrhea in children. The World Health Organization has indicated that more than half a million children under the age of five years died because of contracting rotavirus, and most of them are from poor countries. Adults appear to be less susceptible to rotavirus infections, which is likely due to partial immunity resulting from previous infections. Rotavirus infection often begins within two days of virus introduction. Fever and vomiting are the first signs, followed by three to seven days of watery diarrhea. The infection might result in stomach pain, as well as minor or no signs and symptoms. The diagnosis is done by using immunological techniques such as latex agglutination test, immune chromatography (Rapid test), and enzyme-linked immunosorbent assay or molecular methods such as polymerase chain reaction and real-time polymerase chain reaction and the rates vary between 18-57% in different Iraqi cities depend on sociodemographic and clinical characteristics. Rotavirus infection contentious a major public health problem in the Iraqi population and the rates diverge from one area to another according to many factors.

Keywords: Rotavirus, Diarrhea, Gastroenteritis, Agglutination test, Immune chromatography

Introduction

About 500,000 children under the age of five die each year as a result of diarrhea, with rotavirus being the most common cause. About 200,000 individuals are predicted to die each year as a result of rotavirus infection. Death from rotavirus infections is caused by severe dehydration (Carvalho & Gill, 2019). Males are two times more than females to be admitted to hospitals (Intusoma et al., 2008). Gastroenteritis affects 3-5 million children each year, according to the World Health Organization, with roughly 12% of those under the age of 5 years old (Cieza et al., 2019), and is responsible for 17% of all deaths among children under the age of five in the world (Mathers et al., 2009).

Rotavirus infections are more common in the winter in temperate areas, although they are more common all year in the tropics, owing to seasonal fluctuations in temperature and humidity (Schael et al., 2009).

In our country, rotavirus infection has been seen to follow a seasonal pattern, with cooler temperatures and a drier atmosphere being related to it. For temperate countries, the seasonal spread of this virus during the cooler months has previously been observed. Rotavirus infection peaked in the autumn when temperatures were cooler and declined in the summer when temperatures were warmer (Abood, 2013). The study reported that the infection increased in the colder months of the year after performing a study on children with acute gastroenteritis under five years old admitted to Basrah General Hospital during the study period 2008-2013 (Hassan et al., 2016).

Features of the virus

The rotavirus belongs to the Reoviridae family and has a genome made up of 11 double-stranded RNA (dsRNA) segments encased in a triple-layered capsid with no envelope (Carroll et al., 2015). Rotaviruses' outer layer is made up of two proteins, VP7 and VP4, which are encoded by RNA

segments 9 and 4, respectively. These proteins elicit neutralizing antibody responses and are used to divide group A rotaviruses into G (VP7) and P (VP4) kinds, with G denoting glycoprotein and P denoting protease-sensitive protein (Estes & Cohen, 1989). This virus is divided into seven groups, referred to as A-G. Rotavirus A, which causes more than 90% of rotavirus gastroenteritis in humans, is found all over the world (Van et al., 2006).

Transmission

During rotavirus-associated diarrhea, substantial amounts of rotavirus are excreted in the stool. The virus is spread mostly by feces-oral contact, which is frequently close to person-to-person (Knipe et al., 2013). Rotavirus transmission is encouraged by contaminated fomites, which are common in out-of-home care and hospitals (Butz et al., 1993). The much higher infection incidence among patients who drink and swim in river water compared to other sources of water supply is a warning, as most prior research has confirmed the relevance of polluted water in virus transmission (Prevost et al., 2016).

Pathophysiology

Rotavirus is transmitted by the fecal-oral route. It infects cells lining the small intestine and the rotavirus non-structural protein 4 (NSP4) was proposed to function as an exotoxin, which causes gastroenteritis, which can result in severe diarrhea and even death due to dehydration (Tanaka et al., 2007). Outbreaks of rotavirus A diarrhea are common among hospitalized infants, young children, and elderly people in nursing homes (Moreira et al., 2009). However, with each infection, immunity develops, and subsequent infection is less severe (Malik et al., 2008). Rotavirus replication and assembly take place in cytoplasmic viroplasm following cellular absorption, and newly generated rotaviruses are discharged from the cells via cell lysis or Golgi-independent non-classical vesicular transport (Pham et al., 2017).

The damage of absorptive enterocytes (causes malabsorption), intestinal secretion induced by rotavirus nonstructural protein 4, and activation of the enteric nervous system are all mechanisms used by rotavirus to cause diarrhea (Crawford et al., 2017). Furthermore, the release of 5-hydroxytryptamine (also known as serotonin) by rotavirus infection can activate signaling pathways that cause diarrhea and vomiting (Hagbom et al., 2011).

Clinical Manifestations

The incubation period for rotavirus is 1 to 3 days, after which symptoms arise suddenly and in a variety of ways. The most common presenting symptoms are fever, diarrhea, and vomiting. Symptoms of infection are nearly identical to those of other gastrointestinal illnesses. Rotavirus infections are more serious (Bernstein, 2009).

Diarrhea, the most prevalent symptom of acute gastroenteritis, continues to be the third most common cause of morbidity and infant mortality (Nirwati et al., 2016). In temperate places, which is known as "winter diarrhea," there is marked seasonality, whereas, in the tropics, the effect of season on rotavirus infection is not as strong (Levy et al., 2009).

Rotavirus infection can cause vomiting, lethargy, and fever in addition to diarrhea. Vomiting is a common symptom of rotavirus infection (Hagbom et al., 2011). Fever is a typical symptom of rotavirus infection, as is malaise (Brodal, 2004). Fever is induced by the release of the pro-inflammatory cytokines IL-1, tumor necrosis factor (TNF), and IL-6, and IL-1's role in fever induction is dependent on IL-6 expression (Eskilsson et al., 2014).

Diagnosis

Laboratory-confirmed diagnosis is desired, rotavirus antigen can be detected in stool specimens using an ELISA or immunochromatography. The window for detecting viral shedding with ELISA normally closes within a week of the beginning of sickness, although more sensitive tests can detect the virus for longer periods., such as real-time polymerase chain reaction assays are more accurate and allows genotyping of viral isolates; as a result, epidemiological investigations may benefit from it (Pham et al., 2017). Electron microscopy, polyacrylamide gel electrophoresis, antigen detection assays, and virus isolation are some of the other methods of detection. Confirmation testing is usually recommended only if it has the potential to save money by reducing hospital stays or avoiding unnecessary operations (Anderson & Weber, 2004).

Complication

Rotavirus is a major cause of morbidity and mortality in otherwise healthy newborns. The lack of rotavirus vaccination in our national immunization program may have a role in the difficulties that result. Rotavirus gastroenteritis, which can lead to serious consequences such as sepsis, is still a common cause of morbidity in children (Aldemir et al., 2016).

Electrolyte imbalance is the most prevalent complication of the infection, which is thought to be caused by a viral enterotoxin that induces malabsorption and disaccharidase depression due to mucosal damage. The degree of mucosal injury is related to the severity of diarrhea (Hotez et al., 2014). The second most common consequence was septicemia. Although the exact process is uncertain, it is suspected that rotavirus-induced intestinal epithelial dysfunction makes infected enterocytes more vulnerable to bacterial invasion (Çiftçi et al., 2009).

Treatment and Prevention

The treatment for rotavirus infection emphasizes symptom management as well as the treatment and prevention of dehydration. Salt solutions for oral rehydration should be tried first. To help with symptom alleviation and diarrhea volume

management, codeine, loperamide, and diphenoxylate can be administered (Anderson & Weber, 2004).

Drinking plenty of drinks is the greatest method to avoid dehydration. Oral rehydration treatments are available over the counter in U.S. grocery and drug stores and are most effective for mild dehydration. Severe dehydration may necessitate hospitalization for intravenous (IV) fluid therapy, in which patients receive fluids directly via their veins (CDC, 2017).

Because rotavirus infects approximately all children in both developed and developing countries at a young age, proper cleanliness and sanitation are insufficient to avoid the disease. In observational studies, breastfeeding appears to protect against rotavirus gastroenteritis, while one case-control study suggested that it may just postpone the start of rotavirus gastroenteritis till after weaning (Clemens et al., 1993; Parashar et al., 2013). The best protection against rotavirus comes from orally delivered live attenuated vaccines that resemble natural illnesses. Since 2006, two approved rotavirus vaccinations have been available and are being used in various countries (Parashar et al., 2013). Two rotavirus vaccines, RotaTeq and Rotarix, are licensed for global use; (RotaTeq) is administered at 2, 4, and 6 months of age, and the monovalent vaccine (Rotarix) is administered at 2 and 4 months of age (Rosettie et al., 2018).

Review of Iraqi Studies

Several studies reported different infection rates with Rotaviruses among children in Iraqi cities, such as Hussein et al., (2018) who identified 20% (30 out of 160) of children with gastroenteritis admitted to Al-Batool Teaching Hospital for Maternity and Children in Baqubah city using Cer Test one step (Hussein et al., 2018). A high percentage of 75% was recently reported among children in Diyala 75% (Nasser et al., 2021).

Three studies conducted in Baghdad such as the study of Abdul Sattar (2012) who reported 11 cases (18.03%) had positive Rotavirus infection among 61 children admitted to Children Welfare Teaching Hospital (Abdul Al-Janabi, et al., 2019) who found 21.4% (21 out of 98) among children with acute gastroenteritis in two hospitals which are Children's Protection Teaching Hospital and Al-Alawiya Children's Hospital from October 2018 till the end of January 2019 using multiplex RT-PCR (Al-Janabi et al., 2020). Recently Abdulridha (2019) reported 30.3% among all collected samples (Abdulridha, 2019).

Muneam (2020) found 32% in Ramadi (Muneam, 2020) and Abd-al Fattah et al. (2020) reported 32.6% of rotavirus group A among 150 children with diarrhea admitted to Hospital of Maternity and Children in Ramadi city at Al-Anbar governorate using a rapid test (Abd-Al-Fattah et al., 2020; Abood et al., 2013) who found that 42.45% were positive for rotavirus among 384 infants with gastroenteritis were admitted to the Teaching Hospital of Maternity and Child in three cities (Al-diwaniya, A-Najaf, and Babylon) and two hundred fourteen infants from the outpatient departments of the hospitals, (some of them from primary health care centers and

others from private clinics using latex agglutination test (Abood et al., 2013). Al-Nasrawy and Al-Yasseen (2020) found that 34% of fecal specimens were from children with acute gastroenteritis in Al-Najaf Al-Ashraf governorate (Al-Nasrawy et al., 2020) and Mutlak et al., (2018) reported 48% in Babylon City (Mutlak et al., 2018). Recently in Karbala was 56.3% (Ldawmy et al., 2021).

Several Iraqi studies conducted in northern Iraq, such as Jaff et al., (2016) who detected 22% (22 out of 100) children with gastroenteritis under 5 years old attended Sulaimani Pediatric Hospital using the VIKIA test (Jaff et al., 2016), Salih (2009) the incidence of RV infection in was 28.7% among 150 children hospitalized with acute diarrhea referred to Ibn-Al-Atheer pediatric Hospital in Mosul city using Latex agglutination test (Salih, 2009), Zaman et al., (2012) reported 33.3% Rotavirus using immunochromatographic in Kirkuk city-Iraq (Zaman et al., 2012) and Herish et al., (2006) who reported 37% of rotavirus gastroenteritis were showed in another study in Iraqi Kurdistan (Ahmed et al., 2006).

Numerous Iraqi studies conducted in the South of Iraq, such as Habash and Sawsan (2018) found that 32.5% of 120 children with acute gastroenteritis aged under 5 years old were admitted to the pediatric hospitals in Basra (Habash & Sawsan, 2018). Thwiny and Hasoni (2015) reported 40% among children with acute diarrhea in Basrah City (Thwiny & Hasoni, 2015), and Jarullah and Mohammed (2019) revealed that 45% among 100 infants and children less than five years of age in Thi-Qar Province in the south of Iraq for five Months (From November 2017 to March 2018) using RT-qPCR (Jarullah & Mohammed, 2019).

The variation in the Rota infection rates among Iraqi cities may be related to the fact that they occurred before the introduction of the Rota vaccine into Iraq's national immunization schedule in 2012. This fact is supported in the study done by Sadeq et al., (2019) showed that the rotavirus vaccine is effective in reducing the severity and duration of infection in 715 patients with gastroenteritis admitted to Al-Kadhimiya Pediatrics Hospital in Baghdad using commercial Kits (Biotec-UK) (Sadeq et al., 2019). The reason for the increased rotavirus prevalence in some vaccinated cities despite the use of the vaccine is the emergence of new genotypes and new strains not included in the vaccine, and this is due to the nature of the genome virus of re-assortment or due to missed Rota vaccine doses particularly those who did not take any dose in some families.

The significantly higher infection rate among patients consuming river water for drinking and swimming compared to other sources of water supply is a notice with most previous studies affirming the importance of contaminated water for transmitting the virus (Prevost et al., 2016). Several studies have documented the detection of rotavirus from rivers and surface waters using molecular techniques. Contamination of water undoubtedly comes through human and probably animal excreta, and in this regard, it has been documented that one gram of the feces of the infected person contains more than 10 trillion viral particles and that only 10-100 viral particles are

needed to transmit the infection. Some studies reported bottle-feeding carries a risk of diarrhea for several reasons, including incorrect feeding practice, inadequate sterilizing technique, and infection risk, and allergy to cow's milk, a higher prevalence of rotavirus infection is seen among bottle-fed children, such as a study done by [Mohamed et al., \(2013\)](#) who found a high frequency of rotavirus in children with acute gastroenteritis under one year with a high incidence of Bottle-Feed 22 cases (52.37%) in the Al-Salam hospital and Al-Madana Clinical Laboratory in Mosul City ([Mohamed et al., 2016](#); [Al-Saidy, 2019](#)) reported that 136 patients (56.67%) were artificially fed among children who suffered from diarrhea in Al-Diwaniyah ([Al-Saidy, 2019](#)). [Fenjan and Basim \(2019\)](#) found that 22 children (48.9%) are fed bottle feeding in children under five years old in Thi-Qar Province ([Fenjan & Basim, 2019](#)). Another study was done by [Al-khafagi et al., \(2011\)](#) who reported that the statistical analysis was highly significant $P < 0.05$ in mixed feeding in comparing with breastfeeding in acute infantile diarrhea using rapid chromatography immunoassay for the qualitative detection of rotavirus in human feces specimens ([Al-khafagi et al., 2011](#)). Infants whose moms had high antirotavirus-IgA titers in their breast milk were less susceptible to rotavirus than those whose mothers had low titers. Lactoferrin, lactadherin, secretory IgA, lymphocytes, oligosaccharides, and human milk glycans are bioactive components found in breast milk that aid in the development of innate immunity ([Sushmita et al., 2016](#)).

In our country, rotavirus infection has been seen to follow a seasonal pattern, with cooler temperatures and a drier atmosphere being related to it. For temperate countries, the seasonal spread of this virus during the cooler months has previously been observed. Rotavirus infection peaked in the autumn, when temperatures were cooler, and then declined in the summer ([Nirwati et al., 2016](#)). [Hassan et al., \(2016\)](#) reported that the infection elevated in the cold months of the year after performing a study on children with acute gastroenteritis under five years old admitted to Basrah General Hospital during the study period 2008-2013 ([Hassan & Rasha, 2016](#)).

A significantly higher infection rate was reported among parents' patients with low education and low health education, [Ibraheem \(2012\)](#) found most of the mothers of the patients were illiterate 78 cases (38.6%) among 202 patients suffering from diarrhea over 6 months period in Children Welfare Teaching hospital in Baghdad ([Ibraheem, 2012](#)).

In conclusion. Rotavirus infection is still a major public health problem in our population and the rates diverge from one area to another according to many factors.

Recommendations

The prevalence of infection rotavirus in Iraqi children was high in some of the studies. The bottle-feeding and low education of the mothers were found to increase the incidence of infection. Health education should be recommended to mothers at primary health centers about the benefit of breast

milk and of the rotavirus vaccine in preventing the disease. The concerned authorities should provide sterilized water for children as a right of theirs and to reduce the transmission of infection. Mothers should also be made aware of the need to sterilize the water before drinking it, especially for children from one month to 5 years old.

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Conflict of interest

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