

**Human Pathogens:**

**The Rotavirus**

Madison Quattlebaum

Clinical Microbiology

Junior Class, Winston Salem State University

601 S Martin Luther King Jr. Drive

Winston-Salem, NC 27110

**Introduction:** The rotavirus is a viral pathogen that was first discovered in 1973 by Ruth Bishop and some of her associates [1]. Bishop examined the virus with an electron microscope and noted that the pathogen resembled a wheel, so it was dubbed rotavirus because *rota* means wheel in Latin. Rotavirus is the primary viral cause of severe gastroenteritis within both babies and children worldwide, and while infections occur most commonly in children, the virus can also infect adults. The rotavirus is extremely infectious as well as communicable, yet most people have never heard of this viral pathogen that infects millions of children each year [2].

**Appearance:** The rotavirus belongs to a small and unique viral family, and its peculiar appearance makes it stand out among other viral pathogens. The Rotavirus is one of the few human viral pathogens to be a part of the double-stranded RNA genome [3]. It is classified as a naked virus, meaning that it is not encapsulated within an envelope; however, the virus's eleven RNA segments are enclosed within a capsid consisting of three shells. The RNA components housed within the shells translate into twelve proteins, which aid in the multiplication and continuation of the virus within the body. The structure of the virus granted it its name. It appears wheel-like because it consists of an even, round shell surrounded by small rods, so it was named Rotavirus after a derivative of the Latin word for wheel.

**Communicability:** The rotavirus spreads swiftly from the unhealthy to healthy. The virus transmits via a fecal-oral life cycle [4]. The virus is held in the feces as it exits the body, and it is contracted through exposure and contact with a sick individual [3]. The virus then enters the body through the oral passageway, and this can occur several ways [4]. Since children are more likely to be infected by the rotavirus, they usually contract it by putting their hands in their mouth, after their hands have been polluted with fecal matter containing the virus. The virus can also live on inanimate items, so if an object becomes contaminated, the virus can be passed to

others if the object is placed in their mouth. The rotavirus may pollute food if it comes in contact with feces containing virions, so if one ingests the polluted food, they could become infected with the virus. Disinfecting inanimate objects and high touch surfaces can help diminish the rapid spread because without disinfectants, the rotavirus can remain potentially viable for weeks on various materials [5]. Since the virus is contagious, an individual has to ingest or intake very little of the rotavirus in order to generate the infection within the body [3]. Upon intake through the mouth, the rotavirus virions travel to the small intestine and penetrate intestinal epithelial cells [enterocytes] in order to multiply throughout the body [1].

**Life Cycle:** Like all viruses, the rotavirus cannot multiply and duplicate on its own, so the virus must infect healthy cells in order to synthesize within the body. The rotavirus infects the intestine, more specifically the fully developed enterocytes that line the interior layer of the small intestine [3]. Once inside the upper portion of the small intestine, the virions enter the cells by connecting one of its surface proteins to the receptor on the outer cell wall of the enterocyte. Upon entering the enterocyte, the rotavirus unleashes its viral RNA into the nucleus of the enterocyte, which causes the intestinal cell to begin producing viral copies [6]. When multiplication is completed within the enterocyte, the newly duplicated viral copies of the rotavirus are expelled from the host cell, and they travel into the cavity of the intestine. Within the intestinal cavity, the new viruses go through another replication cycle, and from this secondary replication, the virus spreads throughout the rest of the small intestine. The rotavirus usually does not spread to other organs. It remains within the inner lining of the small intestine, and it is in this lining that the viral infection generates the commonly associated gastrointestinal reaction as well as other immune system reactions. Based on immunity, the body's reaction will vary from person to person; however, the body will stop at nothing until it rids itself of the

infection [3]. The body achieves healing by eliciting various responses, which are exhibited as the symptoms commonly associated with rotavirus [6].

**Symptoms:** Like most infections, the rotavirus causes mild to severe symptoms, and the age of the person diagnosed plays a major role in what symptoms and complications can cause the most harm. The symptoms begin roughly two days after the virus has been introduced to the body [5]. The primary indicators of the rotavirus include an elevated fever as well as throwing up, which are not specific to just the rotavirus. However, beginning on the third day of the infection cycle, runny diarrhea persists for a week.

If a child is infected with rotavirus, a parent or guardian should reach out to a physician if the child experiences diarrhea for longer than a day or has violent spells of vomiting. Infants and children may have a fever higher than 104 °F and may pass dark brown to black feces, which can include blood or pus [5]. The most severe symptom for children is dehydration, which causes oliguria, peculiar exhaustion, and even unconsciousness. For adults suffering from rotavirus, the symptoms are usually less severe than that of a child; however, adults that show symptoms still experience diarrhea and a fever of 103 °F or higher. A doctor should be contacted if diarrhea persists for two days, if blood is passed through stools or vomit, and if any indicators of dehydration occur. Even though rotavirus infections produce similar symptoms in both children and adults, the virus has many more severe implications for infants and children [7].

**Statistical Information:** Out of the all the illnesses in the world, diarrhea is in the top three death causing sicknesses for children [7]. A 2017 study indicated that over half a million young people have died from a diarrhea related illness. Since rotavirus is the main pathogenic cause for diarrhea worldwide, it is estimated that a quarter to a third of all diarrhea caused childhood deaths are attributed to rotavirus diseases. While rotavirus infections occur around the world,

they are more common among malnourished children in underdeveloped countries that lack access to an adequate food supply, clean drinking water, and proper sanitation. Sub-Saharan African countries, like Nigeria, Angola, and the Democratic Republic of Congo, have the highest rotavirus child mortality rates; however, for both adult and children, India has the most rotavirus related deaths each year. Dehydration and loss of nutrients are the main cause of death from the rotavirus, so if treatment and vaccines could be more widespread in developing countries, the cases and death rate would begin to decrease.

**Diagnosis and Treatment:** While the rotavirus causes severe symptoms and even death, there is no antiviral that aids in removing the infection from the body [4]. In order for a doctor to diagnose rotavirus in an individual, a clinical examination must be performed, and this examination studies the symptoms to assess the severity of the case [5]. Stool samples can also be sent to the laboratory where the rotavirus antigen test is used in order to verify the presence of rotavirus within the specimen. Since no medication exists to rid the body of rotavirus, a patient must allow the body's immune system to eliminate the virus. However, there are some doctor advised techniques that can help a person recover.

Overcoming dehydration is the key to survive a rotavirus infection, so physicians prescribe rehydration fluids, like Pedialyte and Gatorade, in addition to water and juices because these fluids help replenish electrolytes lost from vomiting and diarrhea [2]. Other at home remedies include eating toast, crackers, and broth, while avoiding foods high in sugar and fat content as these foods can affect the severity of diarrhea within a person. Severe and deadly cases must be monitored by medical personnel, and the patient must be given IV fluids in order to replenish the nutrients that the body has lost [5]. These supportive care treatments as well as newly innovated technologies were used to save the life of a four-month-old infant [8].

**Case Study:** In March of 2012, a female infant, who was only four months old, was taken to the hospital after suffering from liquid-like diarrhea for forty-eight hours [8]. In the course of one day, the baby defecated diarrhea-like stool ten times, which caused her great discomfort. Due to the pain, she was experiencing, she was only able to drink half of her needed milk/fluid intake. When she was finally admitted to the hospital's emergency room, she had a fever of 103.8 °F, an elevated heart rate of 170-190 beats/min, but a normal respiratory rate of 40 to 80 breaths/min. Two weeks prior to her hospital visit, she weighed 9.68 pounds; however, on the night of her ER visit she weighed only 8.80 pounds, which meant she had lost ten percent of her body weight in just a few days. Due to dehydration and decreased liquid consumption, her daily urine volume was reduced, and since her scans did not reveal abnormalities within her heart and lungs, the physicians decided to perform fecal tests.

The results of these tests confirmed that the patient's fecal sample contained antigens for rotavirus. She was admitted to the pediatric care unit and was given IV fluids and drinkable rehydration fluids in order to combat the dehydration as well as restore a healthy mineral equilibrium that was lost due to the excessive diarrhea. However, after four days in the hospital, her diarrhea had not lessened, so the medical personnel began a new treatment that involved a machine called gelatin tannate, which helps lessen diarrhea within people of all ages. After just twelve hours, her diarrhea began to subside and progress towards normal stool, and three days later, her diarrhea dissipated completely. The findings from this case revealed that new technology like gelatin tannate may aid in healing a person suffering from gastroenteritis caused by the rotavirus.

**A Vaccine that may Lead to a Cure:** As this case shows, the rotavirus is a terrible pathogen, and it is far from eradication [2]. However, with the advent of the rotavirus vaccine, both the

cases and deaths worldwide have begun to decrease. In 2006, the United States adopted the first successful rotavirus vaccine into infant vaccine regimens, and since then, the World Health Organization (WHO) has endorsed four vaccines combating this disease: Rotarix, RotaTEq, RotaSiil, and Rotavac [7]. The rotavirus vaccines RotaSiil and Rotavac, which are used outside the USA, must be administered orally between fifteen- and thirty-two-weeks after birth. It is crucial that the specific time frame of each vaccine is followed because there is not a child/adult version of the vaccine [2].

In the United States, only RotaTEq and Rotarix can be legally administered to infants before fifteen weeks of age [4]. RotaTEq requires a triple dosage at two, four, and six months of age, while Rotaix requires a double dosage at two and four months of age. According to the CDC, the initial dosage of either vaccine must be administered prior to fifteen weeks after birth, and the last dosage must be administered prior to thirty-two weeks (eight months) after birth. In spite of the vaccine's success in decreasing both deaths and severe cases of the rotavirus, only 101 nations worldwide regularly administer the vaccine to infants. If the vaccine could become more commonplace, it is assumed that the vaccine could prevent over 82,000 childhood deaths each year, especially in developing nations [7]. With the afore mentioned vaccines, the rotavirus is posing less of a threat to the lives of children around the world.

**Conclusion:** The rotavirus is a leading cause of death around the world among children under the age of five years old [4]. It causes gastroenteritis, which in turn causes severe dehydration; however, with the advent of a vaccine in 2006, the cases worldwide have begun to diminish [1,4]. If the administration of the vaccine could become a more commonplace practice around the world, the rotavirus' massive impact on children, especially those in third world countries, world begin to diminish, adding to the success list of world health [7].

## References

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