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DIARAGEN VIRUSES CLASSIFICATION, PATHOGENESIS, AND LABORATORY DIAGNOSIS

Scientific Supervisor: Head of the Department of Medical Preventive Sciences
Xolmurodov Inoyatullo Ismatullayevich
inoyatulloxolmurodov@gmail.com
Termiz Economy and Service University, Faculty of Medicine
Medical Studies Department
Student:
Eshboboyeva Farzona Kamoliddin qizi
farzonaeshboboyeva022@gmail.com

ABSTRACT

Diarrheagenic viruses are among the major etiological factors of acute gastroenteritis and diarrheal diseases in humans. These viruses are especially widespread among children and can lead to disturbances in water-electrolyte balance and dehydration of the body. Diarrheagenic viruses include rotaviruses, noroviruses, adenoviruses, astroviruses, and sapoviruses. They differ from each other in terms of genetic structure, morphological characteristics, and epidemiological distribution.

This article provides detailed information on the classification of diarrheagenic viruses, the pathogenesis processes after their entry into the human body, and modern laboratory diagnostic methods used for their detection. These viruses mainly infect intestinal epithelial cells, disrupt the absorption of nutrients, and increase the secretion of water and electrolytes in the intestine, resulting in the development of diarrhea.

Laboratory diagnosis plays an important role in identifying the disease, and methods such as antigen detection tests, polymerase chain reaction (PCR), serological examinations, and electron microscopy are widely used. These methods are essential for accurate virus identification, strengthening epidemiological surveillance, and developing preventive measures against the disease.

Keywords: Diarrheagenic viruses, rotavirus, norovirus, adenovirus, astrovirus, sapovirus, pathogenesis, laboratory diagnosis, gastroenteritis

INTRODUCTION

Diaragen Viruses: Major Pathogens of Gastroenteritis and Acute Diarrhea

Diaragen viruses are the main pathogens responsible for gastroenteritis and acute diarrhea, and they belong to several virus families. Each of these families differs in terms of genetic structure, morphology, clinical manifestations, distribution characteristics, and infectious potential. Among the most common and clinically significant viruses are rotaviruses, noroviruses, adenoviruses, astroviruses, and sapoviruses.

Rotaviruses belong to the Reoviridae family and have a segmented double-stranded RNA genome. They damage the epithelial cells of the intestinal villi, resulting in a significant reduction in the absorption of nutrients, water, and electrolytes. Rotaviruses are classified into types A, B, and C, with type A being the most widespread and causing severe gastroenteritis, often leading to dehydration. The morphology of rotavirus is round, with a double-layered capsid. The VP4 and VP7 proteins on the outer capsid play a key role in cell attachment and immune response detection. Rotavirus infection primarily occurs in children aged 6 months to 2 years, but it can also cause mild diarrhea in adults with weakened immunity. The transmission is usually via the fecal-oral route, through contaminated water and food, and the high infectivity of the virus contributes to the rapid spread of epidemics.

Noroviruses belong to the Caliciviridae family and have an RNA genome. They are highly infectious and cause rapid outbreaks, especially in adults, in settings such as public places, schools,

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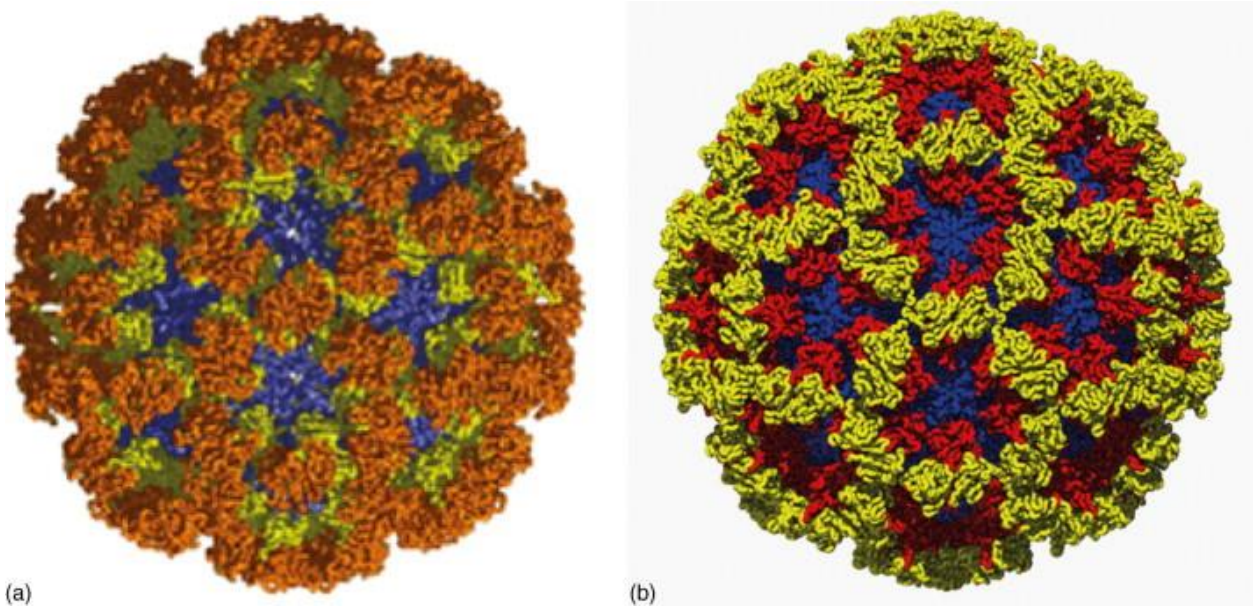
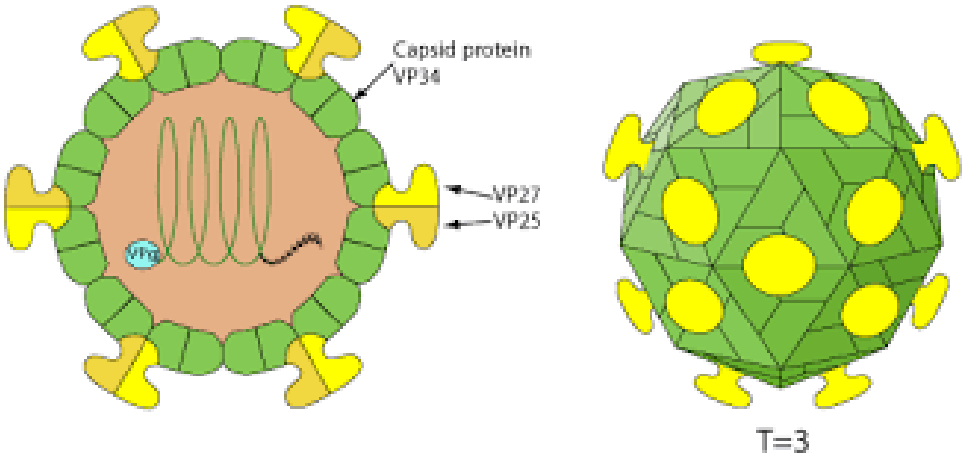
cruise ships, and healthcare facilities. The morphology of norovirus is round, and the outer protein capsid helps the virus evade the immune system. Clinically, norovirus infection starts suddenly and is characterized by vomiting, watery diarrhea, stomach pain, headache, and fever. The virus's high transmission rate, short incubation period (12–48 hours), and environmental resistance increase its epidemic potential.



Adenoviruses belong to the Adenoviridae family and are DNA viruses. They are not only limited to gastroenteritis but can also cause respiratory infections, conjunctivitis, and other diseases in individuals with weakened immunity. The serotypes associated with gastroenteritis are 40 and 41, which primarily manifest in children with acute diarrhea, vomiting, and moderate to high fever. Adenoviruses enter the cells of the intestinal mucosa and replicate inside the cells, leading to cell damage and an increased risk of dehydration. The virus has a round morphology and a double-layered capsid, which contributes to its resistance to the immune system.

Astroviruses belong to the Astroviridae family and have an RNA genome. Morphologically, they have a star-like shape. They primarily affect children under the age of 6 and cause mild to moderate gastroenteritis. Astrovirus infection typically presents with acute diarrhea, mild vomiting, stomach pain, and less frequent fever. Transmission occurs via the fecal-oral route, and the virus has an incubation period of 3-4 days.



Sapoviruses belong to the Caliciviridae family and are closely related to noroviruses, affecting primarily children and adolescents. Sapovirus infection generally presents with mild

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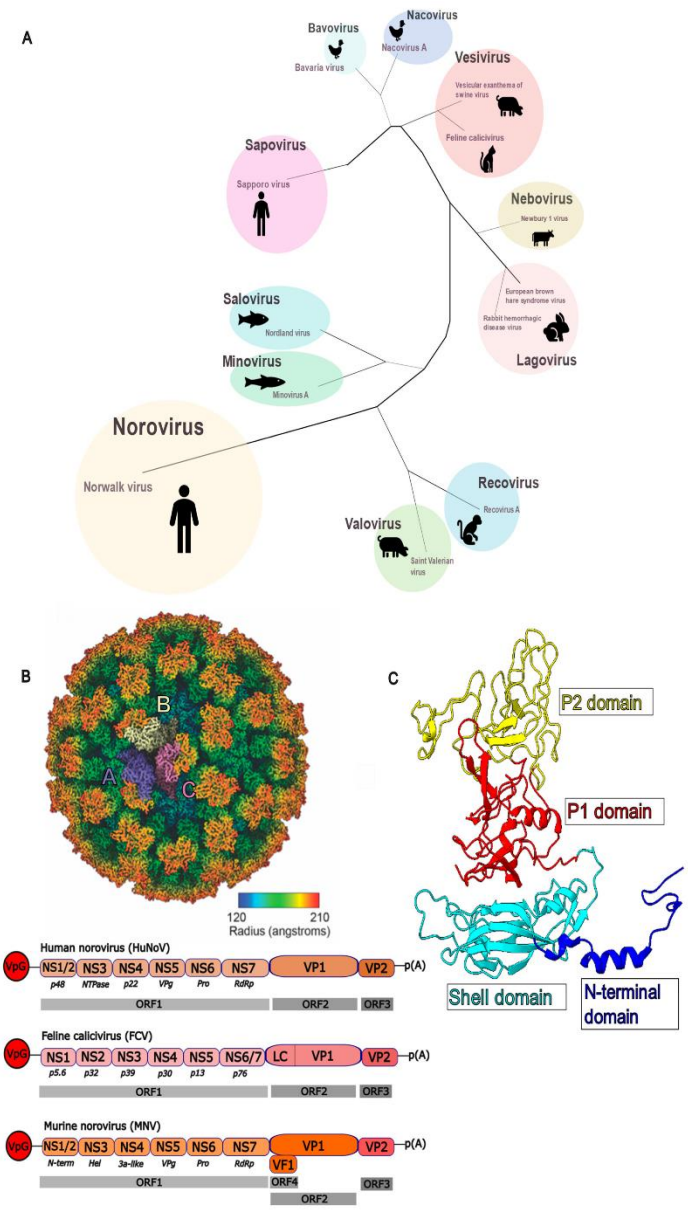
diarrhea, stomach pain, and vomiting. The virus's high infectious potential, its ability to cause small outbreaks, and its resistance to environmental factors increase its epidemiological significance.

Thus, the detailed classification of diaragen viruses is crucial for their identification, diagnosis, and the establishment of measures to prevent epidemics.



Pathogenesis Upon entering the organism, the primary target cells for diaragen viruses are the enterocytes in the intestinal mucosa. The viruses adsorb specifically to these cells and enter the epithelial cells in the upper villus portion of the intestine, where they begin to replicate their genetic material. In rotavirus infections, the VP4 and VP7 proteins of the virus play a crucial role in cell attachment, which ensures the virus's high specificity and infectious potential. Once the viruses replicate in the enterocytes, the cells are damaged and ultimately undergo apoptosis or lysis, which leads to a shortening of the intestinal villi, reduction in surface area, and a significant decrease in nutrient absorption. As a result, the assimilation of carbohydrates, electrolytes, and water is impaired, leading to the development of watery diarrhea.

Noroviruses, in addition to replicating in enterocytes, also affect the neuroendocrine cells and the intestinal nerve network, which explains the rapid onset of gastrointestinal symptoms. Norovirus infections are often characterized by the sudden onset of vomiting and diarrhea, as the virus increases water and electrolyte secretion in the intestines and enhances motility.

Adenoviruses enter intestinal cells and alter their replication cycle, leading to long-term damage to enterocytes. This explains the prolonged nature of diarrhea with less noticeable vomiting. Astroviruses damage the upper villus layer of the enterocytes and cause mild damage to the intestinal mucosa, which is why they typically present with mild diarrhea and less vomiting.

Sapoviruses also damage mucosal cells, but clinical symptoms are usually mild to moderate, and outbreaks occur in small groups. During a viral infection, there is an increase in water and electrolyte secretion in the intestines, leading to dehydration. Additionally, the viruses trigger a local immune response: interferons and other cytokines are released, which intensify inflammation but do not fully stop viral replication. Children and individuals with weakened immunity are more susceptible to the effects of the virus, and their diarrhea tends to be more severe.

The viruses also have environmental resistance, which contributes to their rapid spread via the fecal-oral route and facilitates the emergence of epidemics. Thus, the pathogenesis process involves

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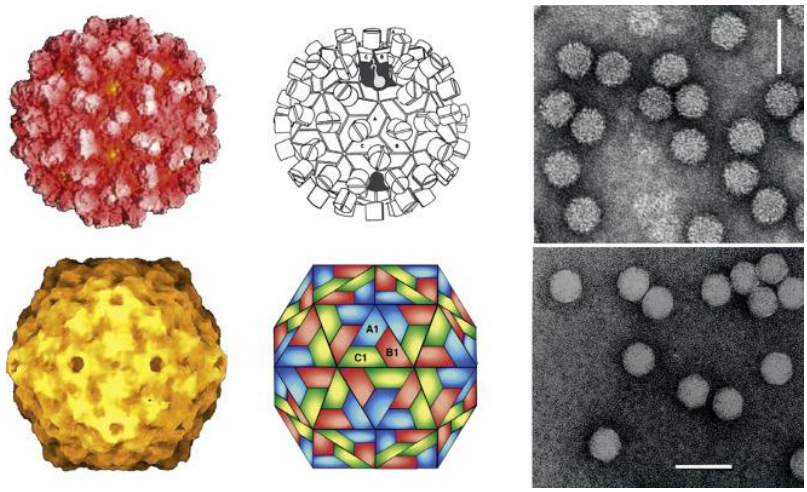
the virus entering the cell, replicating, disrupting cell functions, increasing water and electrolyte secretion in the intestines, and triggering a local immune response, leading to the manifestation of diarrhea and gastroenteritis symptoms.

Laboratory Diagnosis The role of laboratory diagnosis is crucial in identifying gastroenteritis caused by diaragen viruses and determining the causative agent of the disease. Since it is difficult to diagnose viral infections solely based on clinical symptoms, modern laboratory methods focus on detecting the virus's antigens, genetic material, or the patient's immune response. One of the most commonly used and rapid methods is antigen detection tests, among which ELISA (Enzyme-Linked Immunosorbent Assay) is widely used. ELISA helps detect rotavirus, adenovirus, and astrovirus antigens in stool samples from patients. These tests have high sensitivity and specificity, and the results can be obtained within a few hours. Additionally, ELISA is effective in epidemiological monitoring, enabling the tracking of disease spread, identification of infection sources, and quick implementation of preventive measures. The advantage of antigen detection tests is that they allow rapid identification of the virus during the acute diarrhea phase of the patient; however, if the virus concentration is very low, the sensitivity may decrease slightly.



Another important diagnostic method is molecular diagnostics, particularly PCR (Polymerase Chain Reaction). PCR enables the high-sensitivity detection of the virus's genetic material, such as RNA or DNA. This method is used for the rapid and accurate confirmation of viruses like rotavirus, norovirus, sapovirus, and adenovirus. PCR allows the detection of even small amounts of the virus, making it essential for monitoring epidemic chronic cases and small infection outbreaks. PCR also helps identify genetic types and study the evolutionary relationships of the virus, which assists in monitoring the emergence of new virus strains and developing vaccine strategies. However, despite its high accuracy and speed, PCR's main limitation is its high cost and the requirement for specialized laboratory equipment.

Serological tests allow for the assessment of infection by detecting the presence of antibodies against the virus in the patient’s blood. This method can determine whether the patient is currently infected, has had a previous infection, or is in a state of immune response. For example, detecting antibodies against rotavirus or norovirus indicates whether the patient has been vaccinated or previously exposed to the virus. Serological tests play an important role in epidemiological studies, determining the immunity level in the population, and evaluating vaccination effectiveness. However, serological tests are only effective after antibodies have developed, so they are not sufficient for detecting acute infections in the early stages.

Electron microscopy (EM) allows direct visualization of viral particles. Through EM, the virus's morphology, size, and the structure of its outer capsid can be determined. This method is used

to identify and classify new virus strains and distinguish them from other gastroenteritis-causing pathogens. However, EM is expensive and technically complex, so it is not widely used in practice, though it is of great importance in scientific research and epidemic studies.

In laboratory diagnosis, it is often recommended to combine several methods. For example, after antigen detection using ELISA, confirming the genetic material with PCR and assessing the immune response with serological tests maximizes the sensitivity and accuracy of infection detection. This comprehensive approach allows for rapid and reliable virus identification, epidemic monitoring, the implementation of preventive measures, and the reduction of disease complications. Thus, laboratory diagnosis plays a central role in identifying viruses and understanding their epidemiological and clinical characteristics.

CONCLUSION

Studying diseases associated with diaragen viruses is crucial not only for clinical diagnosis and treatment but also for controlling epidemics in the healthcare system, ensuring water and food safety, and developing immunization strategies. Furthermore, the genetic diversity and high transmission potential of these viruses require regular monitoring and strengthening of laboratory surveillance. Overall, when correctly applied, the classification of diaragen viruses, pathogenesis mechanisms, and laboratory diagnostic methods improve the quality of gastroenteritis diagnosis, control epidemics, and significantly reduce disease complications.

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