Biological Times

Volume No. 3 | Issue No. 6 | Pages 9-10

NOROVIRUS (NoV): An Overview

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ABSTRACT

Norovirus (NoV) is an enteric non-enveloped virus causing gastroenteritis across all age groups. Forty percent (40%) of all NoV outbreaks occur in long-term and acute-care facilities. Nosocomial settings set ideal environments for the transmission of NoV. It is transmitted by fecal-oral route by consumption of raw oysters and clams. Infection consequences in asymptomatic cases or gastrointestinal (GIT) sickness. Due to rapid modification, NoV divides into ten (10) genotypes and forty-nine (49) genotypes depending upon the complete amino acid sequencing of VP1 (viral protein) capsid protein and incomplete sequencing of RdRp (RNA-dependent RNA Polymerase), respectively. The most important genotypes that lead to gastroenteritis in humans comprise GI-1 (infectious genotype 1) and GII-4 (infectious genotype 4). There are no fixed preventive measures and vaccines averse to NoV. Some regular implementations are utilized against it such as hand sanitization.

1. Introduction:

Viral diseases are of great concern for public health significance as no specific treatment is present due to the rapid variations in the viral genome. Norovirus (NoV), formerly known as Norwalk virus is also one of them that has no treatment. NoV is an endemic virus that has resulted in roughly 200,000 mortalities yearly. Being a primary source of gastroenteritis, it has circulated in the human community for nearly 50 years [1,2]. NoV belongs to the *Caliciviridae* family, genus *Norovirus*. It is an enteric non-enveloped virus that's 27-35nm in diameter [1,3].

NoV is of great zoonotic importance being the main cause of gastroenteritis in humans [2,3]. This virus was identified as the cause of gastroenteritis outbreaks in Norwalk, Ohio, in 1968 [4]. Once infected, a small latency period of 10-15 hr will result in primary symptoms comprising of stomach pain, vomiting, and diarrhea, which usually last around 2-3 days [5]. NoV primarily targets the gastrointestinal system after entering the body via the nose, mouth, or sometimes eyes through contaminated surfaces, food, and water. Consumption of raw oysters and clams results in NoV infection. NoV has no intermediate host [6]. It still remains a great public health concern due to the unavailability of treatment.

2. Lifecycle and Modes of Transmission

NoV infection is a multi-step process involving viral attachment, receptor engagement, entry by endocytosis, uncoating, and release of the viral genome [7]. Information on how human NoV (HuNoV) invades and assists the illness is little to undisclosed, but there have been many suggested patterns depending on the applications of virus-like particles (VLPs), as they are structurally and antigenically alike to the actual virus, additionally the MNoV (murine *norovirus*) and other calicivirus, such as feline calicivirus (FCV) application [8].

The lifecycle of NoV involves many stages, from ingestion to the release of newly replicated viral particles. Here is a brief overview:

Intake

The virus is commonly uptake through polluted or dirty water, food, and surfaces.

Entry

Penetrate the body after binding to receptors at the entry site by the process of endocytosis and attack the cell covering the small intestine.

Replication

After penetration, the virus utilizes the machinery of the host cell to synthesize new viruses.

Release

Newly formed viruses get released and result in damage to the cells.

Shedding

Infected living organisms shed viral particles in their feces, which results in contamination of the environment.

NoV is highly contagious and can be transmitted through several ways like person-to-person contact, contaminated food (raw oysters and clams), water, surfaces, and aerosolized particles.

The structure of NoV is shown in (Fig. 1).

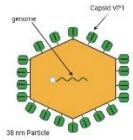

Fig. 1: Structure of Norovirus (Retrieved from Biorender)

3. Pathophysiology(pathogenesis) and immune response

The incubation period has not been discovered accurately for a long time, yet it is currently estimated between 10-51 h [5,9]. Individuals can be split into symptomatic and asymptomatic clinical features of HuNoV (human *norovirus*) [4]. Cases of asymptomatic types are frequent, especially in children where fecal excretion is a common finding. While symptomatic problems affect all age groups having a range of signs. These include diarrhea, vomiting, nausea, stomach cramps, headache, and body aches [10]. The knowledge about NoV is less regarding the acute immune response of infected individuals.

A lot of achievements have been made in recent ten years regarding GI-1 (infectious genotype 1) and GII-4 (infectious genotype 4) evoked immune reactions relating to T-helper type-1 (Th1)-skewed Y cell reaction with few Th-2 activation in human [11,12]. Initiation of Th-1 is pro-inflammatory and over-activation can lead to tissue injury of gut epithelia during sickness. Th-2 activation reduces the regulation of Th-1 cytokines through the increased response of IL-10 (interleukins) and elicits an adaptive protective reaction [13]. The dis-regulation of Th-1 and Th-2 T-cell activation results in a pro-inflammatory environment, which assists in prolonging infection [13].

4. Epidemiology

NoV outbreaks have resulted in approximately 400,000 infectious problems and 56 death incidents in the UK yearly [14]. Regarding Public Health England (PHE), the levels of NoV outbursts for the 2021-2022 season were accessed to be much higher than the last five seasons [15]. There are about 685 M (million) problems of NoV universally, and about 200 M of them are observed in children under 5 years of age. It has been guessed that one case in every 5 cases of gastroenteritis is of NoV [16]. The same methods of increased outbursts have been observed in the US, with 103 cases noticed across 13 states. Oysters are common in all these states [17]. Other bivalve Mollusca like clams, mussels, and scallops can also be sources of NoV infection. Infection occurs on consumption of raw clams, oysters, and another bivalve Mollusca.

Around 40% of all NoV outbursts happen in acute care and long-term protective facilities. Problems of NoV are very commonly found in developed countries (20%), in contrast to the low death percentage (19%) in developing countries [18]. Spatial proximity is a major risk factor for NoV nosocomial outbursts because the hospital environment has a high level of contamination resulting in easy transmission of the virus [19].

5. Current methodologies for combating NoV transmission (control and treatment)

NoV is a global health issue as it lacks specialized treatment and control. Still, there is no vaccine against NoV infection. Advices recommended by governmental bodies, such as the Health Care Infection Control Practices Advisory Committee (HICPAC), provides defense against NoV. Reducing the transmission rate by controlling the oyster population also decreases the risk of infection [15]. The protective measures include contact precaution, clean up, and hand hygiene, alongside the ward shutting down being very disputed as it results in a high economic burden [21,22]. Although the preceding work has concluded that alcohol-based sanitizer and hand wash products are found to be relatively useless. Thus, research still needs to proceed on finding more efficient solutions or liquids for neutralizing NoV and reducing its transmission.

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To cite this article: Raza A, A Quddus, A Hussain, A Raheem & MZ Khalil. NOROVIRUS (NoV): An Overview. Biological Times. 2024 June 3(6): 9-10

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