International Journal of Pharmaceutical Research and Applications
Volume 9, Issue 2 Mar-Apr 2024, pp: 911-918 www.ijprajournal.com ISSN: 2249-7781

Nipah Virus: An Overview

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Submitted: 01-04-2024 Accepted: 08-04-2024

ABSTRACT

Nipah Virus (NiV) is an emerging zoonosis with the potential to cause significant morbidity and mortality in humans and major economic and public health impact. Nipah virus is an bat born pathogen. After being discovered for the first time in Malaysia twenty years ago, outbreaks have since occurred throughout southeast and south-central Asia. Due to its high mortality in humans, its zoonotic nature, the possibility of human-to-human transmission and lack of an available vaccine, the World Health Organization (WHO) has recognized it as a global health problem. Disease progression may be fatal and extremely dangerous. The infection transmitted from bats to pigs and subsequently from pigs to humans. Consumption of contaminated food, contact with animals and human to human, direct contact were identified as Nipah virus transmission routes. Severe encephalitis was reported in Nipah virus infection often associated with neurological and respiratory disease, fatal encephalitis. First nipah virus outbreak in India occurred in Siliguri district of West Bengal in 2001. There are currently know effective therapeutics and supportive care and prevention are the mainstays of management. Educating people about the risk factors and self-protective measures is the only way to lessen or prevent infection in humans. The primary goals of case management should be to give patients intensive support for severe respiratory and neurological complications as well as supportive care measures. State and national authorities activated a multisectoral coordination and response mechanism to contain the spread of the outbreak including enhanced the spread of the outbreak including enhanced surveillance and contact tracing, laboratory testing of suspected cases and high risk contacts, hospital preparedness for case management, infection prevention and control (IPC), risk communication and community engagement.

Keywords: Nipah virus, Hendra virus, Zoonotic, Encephalitis,

I. INTRODUCTION

Nipah (Nee-pa) viral disease is a zoonotic infection and an emerging disease caused by Nipah virus (NiV), an RNA virus of the genus Henipavirus, family Paramyxoviridae, which is spread by particular kinds of fruit bats, primarily Pteropus species [1-2]. The primary hosts of the virus are fruit bats, and human infection is caused by contact with infected fruit bats or intermediate hosts like pigs. Recall that the Nipah virus retains several physiological and genetic traits from other paramyxoviruses [3]. Nipah virus has single stranded RNA of negative polarity. In spite of the fact that RNA viruses are already thought to be the primary causative agents of 25–44% of newly discovered infectious diseases, their incredibly short production time and rapid development increase the likelihood that they may infect novel host species [4,5,6]. NiV causes great spectrum of disease from mild to life threatening encephalitis or fatal respiratory illness in humans and animals [7]. The first cases began in late September 1998 in villages near the city of Ipoh in the state of Perak, West Malaysia, where pig farming was a major industry. Cases Continued to occur in this region until early February 1999. The second cluster occurred Near Sikamat, a small town in a different state, Negri Sembilan, in December 1998 and January 1999. The third and largest cluster began near the city of Bukit Pelandok in the Same state in December 1998[8]. NiV is highly pathogenic to a broad range of mammals and is considered to have pandemic potential due to its zoonotic as well as person to person transmission [9]. Deforestation, agricultural expansion, global travel, trade in wildlife, and other anthropogenic factors can lead to increased interaction among humans, domestic animals, and wildlife, increasing the opportunities for pathogens to be exchanged among these groups [10]. In turn, the Centers for Disease Control and prevention (CDC) and the National Institute of allergy and infectious Diseases (NIAID) classified NiV as category C in the classification of pathogens that pose a terrorist threat [11].

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Nipah virus

The Nipah virus is closely related to Hendra virus (HeV) and Cedar virus [12,13]. They are the three recognized species members of the genus Henipavirus, a new class of virus in the Paramyxoviridae family. Among Paramyxoviruses, henipaviruses are characterized by a wider host range and a larger genome [12]. Considering that all Paramyxovirinae members share an almost identical genome size and typically have a limited host range, these viruses pale in comparison to other members of the family like the measles and canine distemper viruses [14].Nematically, NiV is similar to other paramyxoviruses: it is an enclosed virus that is pleomorphic, spherical, or thread-like, measuring between 40 and 1900 nm in diameter and having a single layer of surface protrusions that are around 17 nm long on average [15,16]. Nipah is an envelope, negative-sense, single-stranded RNA virus, with a genome sequence size of about 18,000 nucleotides. The six key genes that make up the NiV genome organization include envelope membrane protein genes (F and G), matrix protein (M), RNA polymerase and nucleocapsid genes (N, P, and L), and all other paramyxoviruses. The attachment (G) glycoprotein which binds the viral receptor, and the fusion (F) glycoprotein which drives virus-host cell membrane fusion, are the two membrane-anchored envelope glycoproteins responsible for host cell infection by NiV[14]. The virus is rendered inactive at 60°C for 60 minutes, just like other animal paramyxoviruses Therefore. Between pH 4.0 and 10.0, it is stable. Under favorable circumstances, it can last for extended periods of time, even for days, in fruit bat urine and tainted fruit juice. It is susceptible to common soaps and disinfectants. Lipid solvents, such as alcohol and ether, and sodium hypochlorite solutions were used effectively in outbreaks for disinfection [17].

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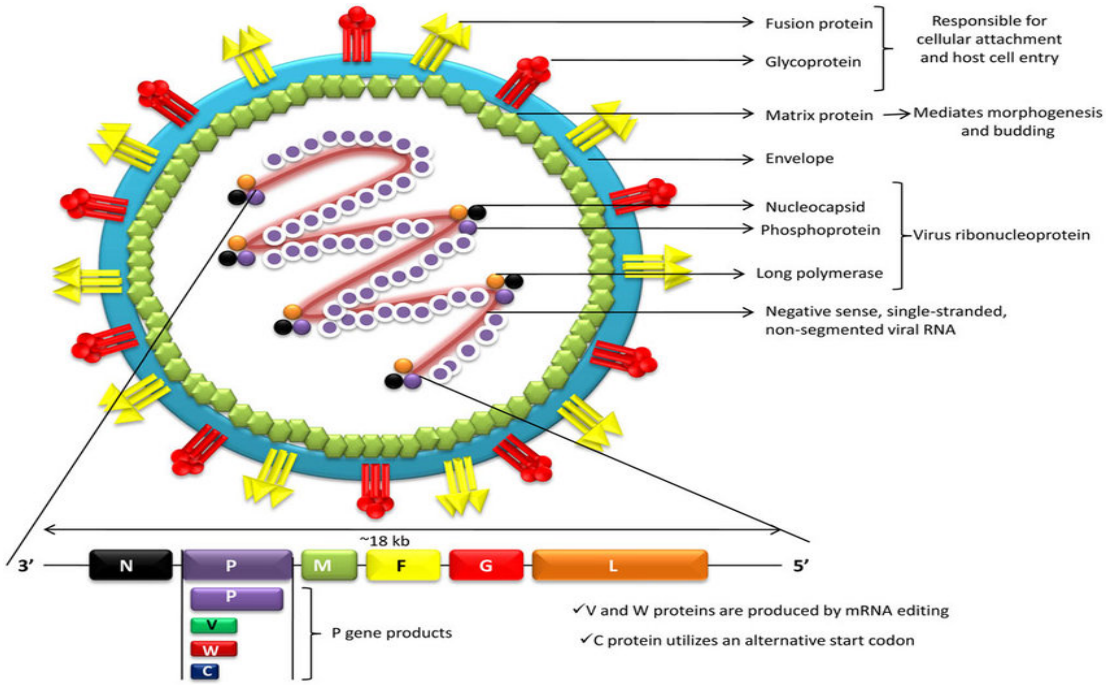

Fig :Structure of Nipah virus

Epidemiology

Malaysia

It has been postulated that initial transmission of NiV from bats to pigs in Malaysia occurred in late 1997/early 1998 through contamination of pig swill by bat excretions, as a result of migration of these forest fruit bats to cultivated orchards and pig farms in Malaysia from Indonesia, which experienced El Nino-related drought and fires in 1997 to 1998[18]. Studies using satellite telemetry have shown that Malaysian flying foxes are highly mobile, traveling hundreds of kilometers between roosting sites within a year and occupying home ranges that extend beyond Malaysia to include Indonesia and Thailand [19]. In March 1999, a cluster of 11 cases of respiratory illnesses and encephalitis was noted in Singapore among abattoir workers who handled pigs that had come from the outbreak areas in Malaysia [20]. The outbreak in Singapore ended when importation of pigs from Malaysia was prohibited, and the outbreak in Malaysia ceased when 11 million pigs were culled from the outbreak area and immediately surrounding areas [21,22]. A total of 265 cases of encephalitis, from which 105 deaths resulted, were associated with the outbreak in Malaysia.

India

While not as regularly as in Bangladesh, NiV epidemics have happened multiple times in India.

2001 saw the first NiV case outbreak in West Bengal, which is located in a different part of Bangladesh than the NiV belt [23]. At the time, the highest numbers of confirmed infections and deaths were 45 and 66, respectively.The same area saw the second NiV outbreak in 2007 [24]. In April of 2007, the second outbreak of NiV was discovered in the West Bengali district of Nadia, in the village of Belechuapara, close to the Bangladeshi border. Even though there were only five cases in this outbreak, every infected person passed away within a week of illness, meaning that the case fatality rate was 100% [25,26]. In May 2018, an outbreak of NiV was declared in Kozhikode and Malappuram districts of Kerala, a southern state in the west coast, which is geographically disconnected from previously affected areas. There were 18 confirmed cases and 17 deaths as of 1 June 2018 [27]. Between 12 and 15 September 2023, a total of six laboratory confirmed cases of Nipah virus infection including two deaths were reported by the State Government of Kerala. All confirmed cases were males within the age range of 9 to 45 years old and were reported within the Kozhikode district of Kerala [28].

Philippines

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An outbreak of NiV infection occurred in the Philippines in 2014.Seventeen cases were confirmed, the case fatality rate was 82%. Ten patients had a history of close contact with horses or of horse meat consumption. Deaths of 10 horses were reported in the same time period, of which nine showed neurological symptoms. However, samples from horses were not tested for NiV. Five patients, including two healthcare personnel, acquired the disease through person-to-person transmission. This strain was closely related to the Malaysian strain where definite person to person spread had not been previously identified [29].

Transmission

The epidemiological studies of NiV outbreaks in Malaysia, Singapore, Bangladesh, Philippines, and India suggested that a number of factors play a crucial role in NiV transmission to human. Close contact with NiV infected animals, reservoir animals, and consumption of contaminated food are important factors responsible for NiV transmission [30,31]. The highest degree of sequence similarity of NiV genes from infected bats and Indian patients compared to Malaysia, Cambodia, and Bangladesh clearly suggests that bats were the most likely source of human infection during this epidemic. It could have occurred by eating fruit contaminated with bat saliva or by inhaling an aerosol containing droplets of contaminated urine or saliva [32]. Raw date palm juice may also be an important source of the virus, which confirms that the dates of the NiV epidemics in Bangladesh coincide with the palm fruit harvesting and juice production periods (December–May) [23]. A 2003 study found the presence of the virus within shared households, which could indicate human-to-human transmission (by the respiratory route), but at the same time did not rule out the possibility of external infection [33].

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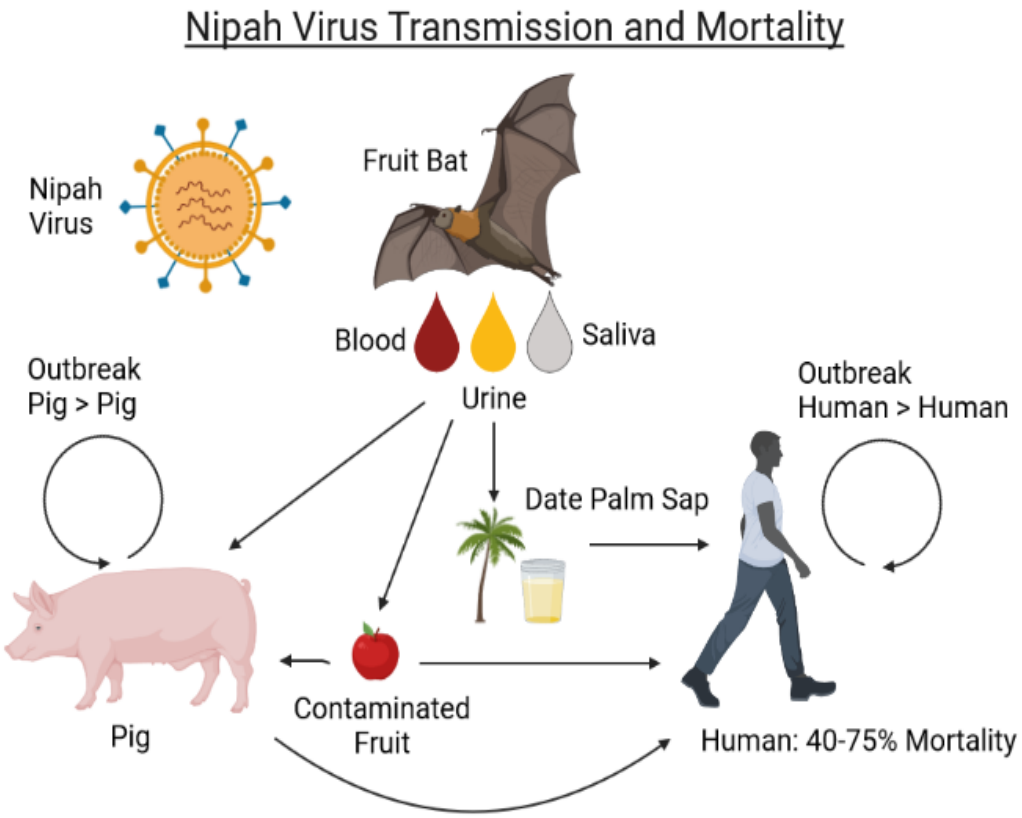

Fig: Transmission of Nipah virus

Signs and symptoms

In Human

Clinical symptoms of NiV infection are broad, ranging from the asymptomatic to very severe [34]. The virus is the cause of severe and quickly spreading illnesses in humans, mostly affecting the central nervous system (CNS) and respiratory system [35]. The brain, lungs, heart, kidneys, and spleen are just a few of the major organs that can be impacted by a Nipah virus infection. Initial NiV symptoms, such as fever, headache, dizziness, and vomiting, are comparable to those of flu infections [36]. But these symptoms can soon develop into an encephalitic syndrome, which is marked by severe neurological symptoms along with fever and headache.Patients experienced tachycardia, convulsions, and obvious cerebellar signs in addition to a decline in awareness [16].

In Animal

The illness is also referred to as one-mile cough, barking pig syndrome (BPS) in peninsular Malaysia, and porcine respiratory and encephalitis syndrome (PRES) in pigs. Pigs under six months of age have been documented to have an acute febrile sickness, characterized by the development of a respiratory illness ranging from rapid laborious breathing to a harsh nonproductive cough. The mortality rate is comparatively low, with the exception of young piglets [37,38,39].

Diagnosis

Nipah virus infection can be diagnosed by a number of different tests. Nipah is categorized as a biosafety level 4 (BSL4) agent, so when gathering, submitting, and processing samples, extra care must be used [40]. Viral antigen capture ELISAs offer a high-through put and inexpensive method for screening suspect samples. An antigen-capture method using monoclonal antibodies It has been claimed that ELISA can both detect NiV and distinguish it from HeV [41]. Polymerase Chain Reaction (PCR) assay and real-time PCR can be applied with the advantage of not propagating live infectious virus. Immunohistochemistry can be applied on formalin-fixed tissues or formalin-fixed cells of vascular endothelium from brain, lung, mediastinal lymph nodes, spleen, kidney, uterus, placenta and foetus, using antisera to NiV, rabbit antisera to plaque-purified NiV or biotin

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streptavidin peroxidase-linked detection system [40]. Serum Neutralisation (SN) test is designated as the reference standard for anti-henipa virus antibody detection [40]. Cultures are read at 3 days, and those sera that completely block development of CPE are designated as positive. Immune plaque assay is an option in case of cytotoxicity. Indirect or capture enzyme-linked immunosorbent assay (ELISA) can be applied on for detection of IgG and IgM, respectively. Due to false-positives related to specificity of ELISA, positive reactions have to be confirmed by SN [40].

Treatment

After an infectious illness outbreak, the importance of treatment techniques and potent medications is recognized. In order to manage patients during NiV epidemics and reduce mortality, medicines must be administered. To yet, no particular medication has been approved for the treatment of this significant illness. Little focus has been placed on the creation of therapies to fight NiV infection.Monoclonal antibodies have been employed as therapeutic agents in preclinical research he discovery of broad range antivirals and an emphasis on small interfering RNAs (siRNAs) are crucial due to the high cost of antibody-based medications [42]. In a ferret model of NiV illness, a monoclonal antibody that targets the viral G glycoprotein has been demonstrated to be helpful [43]. A promising outcome of an in vivo study in a nonhuman monkey model utilizing an experimental therapeutic—fully humanized monoclonal antibody m102.4 against NiV—highlights the availability of a possible medication for NiV treatment in the future [44].

Prevention

Since there are few treatment options, prevention should be the main focus of NiV care.

Interventions to stop farm animals from ingesting fruit tainted by bats are examples of preventive methods. Farms should not be located next to fruit trees that draw bats and should be planned to minimize overcrowding in order to prevent the fast spread of disease among animals [45].

Avoiding consuming tainted sap is advised. However, because they defy social and cultural norms, efforts to decrease the intake of fresh sap generally would not be well received.More acceptable approaches would be to use physical barriers to keep bats out of sap and away from it [45].

A crucial preventive step that can significantly lessen the scope of the NiV outbreak is to stop the virus from spreading through direct human-to-human contact. The conventional guidelines for caring for an individual who is infected or suspected of having NiV infection include washing hands, cleaning with 70% ethanol, donning gloves and other protective gear, and avoiding direct contact with bodily fluids [16].

Execution of measures an further element that may reduce the likelihood of a fresh outbreak is increasing public knowledge of the dangers connected to the viral outbreak and the need of taking preventive action. For instance, local societies were educated by printed, radio, and television media about the risks of consuming tainted date palm juice and were advised to reduce their intake [23].

II. CONCLUSION

Flying foxes are the primary vectors of the highly contagious Nipah virus, which affects both humans and other animals. NiV causes encephalitis and respiratory infections in humans. NiV is becoming more widespread around the world and could lead to serious epidemics.Early detection is the first line of defense against NiV epidemics and reducing their effects.As a result, communities and animal reservoirs that are at high risk of contracting NiV should be continuously monitored. Through various awareness campaigns, people should be made aware of food and personal hygiene. NiV does not yet have a specific antiviral or vaccine, attempts to produce one do not yield the desired results, and sufferers can only get supportive care.To prevent further epidemics, new treatment and vaccination approaches against Nipah and related viruses are required. In the near future, vaccination techniques that are effective against infectious pathogens such as NiV must be developed.

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