

Popular Article

Nipah Virus: A Major Zoonotic Threat

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Abstract

Nipah virus (NiV) is an emerging zoonotic pathogen, responsible for serious illness in humans. Fruit bats naturally harbour the virus, and infections have also been reported in animals like pigs, horses, domestic and feral dogs and cats. The virus transmission occurs by both intra-species (pig-to-pig, human-to-human) and inter-species levels (bat-to-human, horse-to-human, pig-to-human). Severe cases often present with respiratory and neurological forms in both humans and pigs with higher rates of mortality. Diagnostic methods for Nipah virus include conventional, serological, molecular, and immunohistochemical techniques. Effective control and prevention strategies involve managing reservoir and intermediate hosts, implementing stringent biosecurity measures, raising public awareness and developing effective vaccines.

Introduction

Nipah virus belongs to the genus *Henipavirus*, of the *Paramyxoviridae* family, closely related to the Hendra virus. These viruses are enveloped with large glycoprotein spikes (8-14 nm in length), containing a "herringbone-shaped" helically symmetrical nucleocapsid. The genome is linear negative-sense, single-stranded non-segmented RNA of 13-19 kb size encoding six structural proteins. G and F help in viral attachment and fusion respectively, by attaching with epiphrinB2/B3 receptors.

The disease was named Nipah virus infection according to the village Sungai Nipah in the State of Negeri Sembilan, where the first outbreak was noticed in 1998-99 when the pig handlers suffered from acute encephalitis with a higher mortality rate.

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Epidemiology

The prevalence and geographical distribution of disease depend upon the presence of reservoir hosts and their breeding status, climatic conditions and human feeding habits. Bats, which are widespread in the southern hemisphere, have been identified as carriers of the virus, with seropositive cases found in West Africa, Madagascar, and Southeast Asia. The first Nipah outbreak was reported in Malaysia and Singapore with subsequent outbreaks in Bangladesh, India and the Philippines. Human infection often results from close contact with pigs, which act as reservoir hosts. In Bangladesh, NiV-carrying *Pteropus* are prevalent mostly in the country's northwestern and central regions, leading to the bat to human transmission. Mortality rates were higher in India and Bangladesh (70%) when compared to Malaysia (40%).





In India, the first Nipah outbreaks in humans were recorded in 2001 and 2007 in West Bengal, with severe mortality rates. The most recent outbreak in India occurred in September 2023 in Kerala, marking the sixth such incident in the country, characterized by human-to-human transmission.

Transmission

Transmission of the virus occurs from bats to pigs, pigs to humans and from date palm sap to humans. NiV infections are associated with the consumption of virus-contaminated foods and direct contact with the infected materials. Aerosol transmission also plays an important role in disseminating the virus.







(Source: Singh et al., 2019)

The transmission cycle involves the following steps as depicted in the above picture 1) NiVcarrying fruit bat feeds on the date palm sap, in which the virus survives 2) The virus is transmitted to humans through the consumption of palm sap 3) The bats can also contaminate other farm soil and fruits 4) virus-contaminated fruits are consumed by animals like pigs, that act as both intermediate and amplifying host 5) Pigs are infected with NiV. 6) Human gets infected by consumption of contaminated pork. 7) Human-to-human transmission occurs due to close contact with the infected person.

Clinical Manifestation

Nipah virus infection is characterized by fever with fatal encephalitis and respiratory involvement. Headache, dizziness, myalgia, vomition and diarrhoea have been observed as non-specific prodromal symptoms. Brain dysfunction and neurological signs include abnormal eye reflexes, vasomotor changes, myoclonic jerks and seizures. Cerebellar dysfunction was also reported in some outbreaks. Post-recovery, patients may experience relapse of encephalitis with psychiatric and neurological issues. In pigs, the disease is characterized by febrile respiratory illness, with epistaxis, dyspnoea and coughing, mostly in young pigs. In Malaysia, the infection was known as "barking pig syndrome" due to its characteristic coughing in the affected pigs. Adult pigs usually show neurological signs such as ataxia, paresis, seizures, and muscle tremors.

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Diagnosis

Laboratory diagnosis includes haematological examination, cerebrospinal fluid analysis, imaging, molecular and serological detection of the virus. For isolation and propagation of NiV, a biosafety level-4 laboratory is essential, whereas primary virus isolation can be carried out in biosafety level-3 laboratory.

Test	Interpretation
Haematological test	Thrombocytopenia
	• Leucopenia
	• Elevated liver enzymes
Cerebrospinal fluid analysis	Lymphocytic pleocytosis
	• Raised protein levels
	• Normal glucose levels
Imaging	2-7mm multifocal discrete lesions in the
	subcortical and deep white matter
Virus specific test	• ELISA for detection of antibodies
	• PCR, RT-PCR, qPCR
	Virus isolation

Differential diagnosis

Nipah virus can be differentially diagnosed from Japanese encephalitis (JE), Measles, Rabies, Dengue encephalitis, Cerebral malaria, Scrub typhus, Leptospirosis, Herpes encephalitis and Bacterial meningitis

Treatment, Control and Prevention

Currently, there is no approved treatment protocol for Nipah virus infection, only symptomatic treatment is administered. Antiviral drugs like Ribavirin and Favipiravir have been used along with m102.4 monoclonal antibodies. As control and preventive majors, exposure to sick animals can be avoided and fruits and date palm plants should be protected from bats by using a greenhouse, artificial infrared ultrasound frequency may be used to divert the bats. Though vaccines are not fully effective in combatting the disease, they induce hope for successfully implementing prevention strategies. Various types of vaccines viz. DNA vaccines, virus-like particles, and virus vector (live and recombinant) based vaccines have been developed.

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Conclusion

In the current scenario, a proper curative regimen and a preventive major are two utmost requirements for tackling this future pandemic. Hence, effective treatment protocols and extensive research focusing on the mechanisms of virus transmission and pathogenesis are essential. One health approach must be executed to prevent and establish an effective control major of the deadly disease. Further studies on viral pathogenesis, virus-host interaction and host immune response will help to combat these emerging zoonotic diseases.

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