Nipah: An interesting stance

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Introduction

Nipah instead was one of the most fatal outbreaks of diseases in the mankind which was initially erroneously assumed as Japanese encephalitis. A multidisciplinary exploration was done at several levels of microbiology, histopathology and genetics which led to the discovery of a new paramyxovirus named Nipah virus (NiV). The disease was primarily identified in Malaysia in 1998 and named after a village, Sungai Nipah. It subsequently extended to the wider belts of Asia and Africa with mortality as high as 70%. The main mode of transmission in the Malaysian outbreaks was thought to be the consumption of bat’s dropping, urine and fruit partially eaten by pigs in the intensive pig farms in peninsular Malaysia, where fruit trees were planted in pig farms to yield extra income for the farmers. In Bangladesh and northeast India virus was directly transmitted from bats to human through consumption of raw date palm juice. To curb the epidemic, a meticulous and coordinated effort by health care providers and veterinary doctors has become mandatory. This article gives a note about the NiV, its infection and on-going researches on its management strategies. Data was collected using electronic media consisting of articles, books and websites.

Virus

NiV belongs to the subfamily Paramyxovirinae covering the five genera Respiro-, Morbilli-, Rubula-, Avula-, and Henipavirus, and a group of uncategorized viruses so far. The genome is made up of six genes (N, P, M, F, G and L) of nucleoprotein, phosphoprotein, matrix, fusion, glycoprotein and large RNA polymerase and three non-structural proteins which riles on the host innate immune response in vitro.

Natural host

Pteropid fruit bats, i.e. Pteropus vampyrus (large flying fox), and Pteropus hypomelanus (small flying fox) are the prime pool for the virus which routinely spreads to pigs making it the second most common habitat. Bat being the airborne and outgoing creature can easily transmit the virus with its distribution as wide as in 10 genera and 23 species of bats and other genus.

Emergence

Nipah is an emerging infectious disease with a natural spread from animals to humans due to their enhanced interface. This exchange of virus could be attributed to forest clearing done to promote agricultural growth, international voyage, trade in wildlife, and other anthropogenic factors. Fire for deforestation produces sulphate and organic carbon particles in haze, leading to reduction in 73%-92% of total light, altering the rain forest and rest of ecosystem. Tang et al. in 1996 accounted that diminished activity of photosynthesis by forest trees could be attributed to 1994 haze event in Malaysia. The smog
considerably condensed flowering and fruiting among
orchard fruit trees in southern peninsular Malaysia.

The menace to tropical rainforests of Amazon, Africa
and Southeast Asia was caused by agricultural ranching
in these areas.2 Industrialization and dearth of natural
resources have lead bats to migrate and make a permanent
abode in other farms.13 Even the pigs are often transported
to the southern parts of Malaysia and Singapore for trade,
creating a front for infection in these regions. This loss of
foraging habituation for fruit bats, coupled with increasing
deforestation, propagated their migration into cultivated
orchards and human terrain.12

Chief dissimilarities between the outbreaks in
Bangladesh and those in Malaysia and Singapore were
proposed in epidemiological survey: (1) In all the five
independent outbreaks, the NiV has tipped on humans;
(2) The outbreaks are seasonal; (3) Virus tipping occurred
without domestic animals; (4) Data suggests spread
between humans. Genetic mapping of virus between
human samples from Bangladesh and Malaysia were
distinct.13

Transmission14

From bat to human: Generally, the dissemination occurs
by consumption of fresh date palm sap, spoiled with bat
secretions. Other routes include NiV infected domestic
animals which drop the virus to humans during contact.
Human-to-human transmission: Human-to-human
transmission was only documented in the Bangladeshi
and Indian outbreaks. There was no definite human-to-
human transmission in the Malaysian outbreaks; though
studies showed serological scars in health care workers.

The innate immune response to NiV

Very less data is available about the effect of NiV on the
innate immune system. However, many in vitro studies
have established, that the infected endothelial cells secrete
IFN-β, chemokines and cytokines.15

The adaptive immune response to NiV

Research in this subject is still requisite, yet some
evidences do show recruitment of immune cell IgG and
IgM in the infected patients. Whether the disease is due to
incompetent immunity or hyper responsive system is still
questionable.13

Clinical features

Signs and symptoms include fever, unsettled stomach,
light-headedness and headache. Encephalitis of aggressive
nature is frequent and has been associated with elevated
mortality index.16

Diagnosis

Investigations for NiV include serum neutralization,
enzyme-linked immunosorbent assay (ELISA), polymerase
chain reaction (PCR) assays, immunofluorescence assay
and virus isolation by cell culture.17

Prevention14

Care of domestic animals: Maintaining the sanitary
conditions by regularly bathing them, removing excreta,
saliva and secretions, cleaning of the pig farms with sodium
hypochlorite solution and limiting the migration of the
animals from an infected neighbourhood can go a long
way in minimizing the zoonotic culprit. Animal health
surveillance system should be proactive in identifying the
development of new cases and timely notifying preventive
and community department.

Public health awareness programs should consider
following points:

1. Alleviate the risk of bat-to-human transmission:
   Keep the fruit farms of date palm sap safe from
   bats. Maintain a check on the quality with a habit
   of washing and boiling before consuming juice and
   fruits.

2. Alleviate the risk of human-to-human transmission:
   Prevent any physical contact with NiV infected
   individuals, if at all use personal protective barriers
   as a shield.

3. Alleviate the risk of animal-to-human transmission:
   Personal protective barriers should be used while
   managing sick animals.

Antiviral treatment

In vitro and animal studies have partly proved the
effectiveness of ribavirin in delaying the progression of
the disease pathogenesis.18 Nevertheless; some historically
controlled trials do support the use of ribavirin as the
main stay of treatment.19

Vaccination

Several animal studies have confirmed that both the HeV-
sG vaccine and the m102.4 human antibody can be used
against Niv. The HeV-sG subunit immunogen has been
adopted as an effectual vaccine in horses.20 Nonetheless,
its use in developing countries of Southeast Asia is
questionable considering its expenditure.

Conclusion

Nipah is a deadly virus which has taken a toll over
the mankind. The infection control team should have
thorough perception and conception of the disease.
Additional researches need to be diverted towards
preventive and management strategies consisting chiefly
of vaccines to curb the epidemic.

Ethical approval

Not Applicable.

Competing interests

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Authors’ contributions

RDR: Concept and design, definition of intellectual content,
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References

1. Paton NI, Leo YS, Zaki SR, Auchus AP, Lee KE, Ling AE, et al. Outbreak of Nipah-virus infection among abattoir workers in Singapore. Lancet. 1999;354(9186):1253-6. doi: 10.1016/s0140-6736(99)04379-2.

2. Middleton DJ, Westbury HA, Morrissy CJ, van der Heide BM, Russell GM, Braun MA, et al. Experimental Nipah virus infection in pigs and cats. J Comp Pathol. 2002;126(2-3):124-36. doi: 10.1053/jcpa.2001.0532.

3. Khan M, Nahar N, Sultanan R, Hossain M, Gurley ES, Luby S. Understanding bats access to date palm sap: identifying preventative techniques for Nipah virus transmission. New Orleans: American Society of Tropical Medicine and Hygiene, 2008. p. 331.

4. King AMQ, Adams MJ, Carstens EB, Lefkowitz EJ. Virus Taxonomy: Classification and Nomenclature of Viruses -- Ninth Report of the International Committee on Taxonomy of Viruses. Amsterdam: Academic Press; 2011. P. 1261-91

5. Chong HT, Abdullah S, Tan CT. Nipah virus and bats. Neurol Asia. 2009;14(1):73-6.

6. Field H, Young P, Yob JM, Mills J, Hall L, Mackenzie J. The natural history of Hendra and Nipah viruses. Microbes Infect. 2001;3(4):307-14. doi: 10.1016/s1286-4579(01)01384-3.

7. Malingreau JP, Stephens G, Fellows L. Remote sensing of forest fires: Kalimantan and North Borneo in 1982-83. Ambio. 1985;14(6):314-21.

8. Schwedhelm J. The fire this time. An overview of Indonesia’s forest fire 1997-1998. World Wide Fund for Nature Discussion paper. WWF Indonesia programme; 1998.

9. Barrie LA, Hoff RM, Dagguatpy SM. The influence of mid-latitude pollution sources on haze in the Canadian arctic. Atmos Environ. 1981;15(8):1407-19. doi: 10.1016/0004-6981(81)90347-4.

10. Yanhong T, Naoki K, Akio F, Awang M. Light reduction by regional haze and its effect on simulated leaf photosynthesis in a tropical forest of Malaysia. For Ecol Manage. 1996;89(1-3):205-11. doi: 10.1016/S0378-1127(96)03849-2.

11. Aziz J, Olson J, Lee OB, Daniels P, Adzhar AB, Bunning M, et al. NIV of animals in Malaysia. In: Abstracts of the XI International Congress of Virology; August 9-13, 1999, Sydney, Australia.

12. Epstein JH, Field HE, Luby S, Pulliam JR, Daszak P. Nipah virus: impact, origins, and causes of emergence. Curr Infect Dis Rep. 2006;8(1):59-65. doi: 10.1007/s11908-006-0036-2.

13. Chong HT, Kamarulzaman A, Tan CT, Goh KJ, Thayaparan T, Kunjapan SR, et al. Treatment of acute Nipah encephalitis with ribavirin. Ann Neurol. 2001;49(6):810-3. doi: 10.1002/ana.1062.

14. World Health Organization (WHO). The Weekly Epidemiological Record (WER). Available from: http://www.who.int/wer/en/. Accessed October 24, 2018.

15. Lo MK, Miller D, Aljofan M, Mungall BA, Rollin PE, Bellini WJ, et al. Characterization of the antiviral and inflammatory responses against Nipah virus in endothelial cells and neurons. Virology. 2010;404(1):78-88. doi: 10.1016/j.virol.2010.05.005.

16. Goh KJ, Tan CT, Chew NK, Tan PS, Kamarulzaman A, Sarji SA, et al. Clinical features of Nipah virus encephalitis among pig farmers in Malaysia. N Engl J Med. 2000;342(17):1229-35. doi: 10.1056/nejm200004273421701.

17. Daniels P, Ksiazek T, Eaton BT. Laboratory diagnosis of Nipah and Hendra virus infections. Microbes Infect. 2001;3(4):289-95. doi: 10.1016/s1286-4579(01)01382-x.

18. Freiberg AN, Worthy MN, Lee B, Holbrook MR. Combined chloroquine and ribavirin treatment does not prevent death in a hamster model of Nipah and Hendra virus infection. J Gen Virol. 2010;91(Pt 3):765-72. doi: 10.1099/vir.0.017269-0.

19. Chong HT, Kamarulzaman A, Tan CT, Goh KJ, Thayaparan T, Kunjapan SR, et al. Treatment of acute Nipah encephalitis with ribavirin. Ann Neurol. 2001;49(6):810-3. doi: 10.1002/ana.1062.

20. Bossart KN, Rockx B, Feldmann F, Brining D, Scott D, LaCasse R, et al. A Hendra virus G glycoprotein subunit vaccine protects African green monkeys from Nipah virus challenge. Sci Transl Med. 2012;4(146):146ra107. doi: 10.1126/scitranslmed.3004241.