Review Article

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Nipah virus outbreak in India: is it a bat-man conflict?

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ABSTRACT

Nipah virus infection is a newly emerging zoonotic disease that spreads from animal to human. The fruit bats are the one of the carriers of Nipah virus which gets transmitted from bats to other animals mainly through body fluids. Nipah can cause asymptomatic infection to the acute respiratory syndrome and fatal encephalitis in human beings with a dreadful mortality rate of 70 per cent. This review article focused on role of bats in ecosystem and preventive measure to contain the virus by improving public health. In 2018 the outbreak of Nipah in Kerala state of India claimed 17 lives. It has indeed opened Pandora's box exposing the role of general public, health department and social media and so on. The early detection and the well-oiled medical infrastructure in the state did wonders. Though social media have been accused of spreading misinformation leading to culling of bats, the people of Kerala responded with positive frame of mind. Prompt and synchronized efforts of all stakeholders like health workers, state government, scientists, researchers and central government led to timely and successful control of Nipah virus cases in Kerala.

Keywords: Nipah virus, Fruit bats, Kerala, Ecosystem

INTRODUCTION

virus (NiV) is a member of the family *Paramyxoviridae*, genus henipavirus. In 1998 the pig farmers from Sungai Nipah, a village in the Malaysian Peninsula became ill with encephalitis detected with presence of some virus in their body fluid, which was later rechristened as "NiV". In Bangladesh too the outbreak was reported around same time.² This virus was identified and isolated for the study in the following year too during the outbreak of encephalitis among the pig breeders and people with close contact with virus infected pigs. But shockingly this outbreak caused a relatively mild disease in pigs, but almost 300 people were infected with NiV and over 100 deaths were reported for the first time. Since this outbreak, no subsequent cases (in neither swine nor human) have been reported in either Malaysia or Singapore.³ Given the relatedness of NiV to Hendra virus, bat species were rapidly handpicked for investigation and flying foxes of the genus *Pteropus* were subsequently identified as the reservoir for NiV.⁴

In India NiV outbreak reported in 2001 and 2007 in West Bengal with symptoms of acute respiratory distress associated with febrile illness and/or neurological manifestations causing 50 deaths out of 71 cases (70% mortality rate). All fatal cases were found to be positive for NiV. In 2007 outbreak, a cluster of bats were seen hanging from the trees around a patient's residence. The 2018 again there was an outbreak of the NiV in the Kerala pointed out its origin to fruit bats in that area specifically localized in Kozhikode and Malappuram districts of the state which claimed 17 lives. This is the third outbreak reported in India. Over 2,000 people in these two districts were quarantined and kept under observation during the period of the outbreak.

The epidemicity of NiV is distinct in different countries. In the 1998 outbreak in Malaysia, first the pigs were infected by the virus perhaps after consuming fruit contaminated with bat saliva. After spreading widely on pig farms, the virus began advancing to humans who came in contact with the animals. As a result around 300 people fell ill but no person-to-person transmission seems to have occurred in Malaysia, unlike in Kerala.

METHODS

Most of the information about NiV was gathered from articles between 2000 to 2018 except for two articles from 1995 and 1999 from PubMed confirming Nipah as an emerging infectious disease. Some more details were compiled from various newspaper reports, editorials of recent times which I have acknowledged in the later part of the article.

The clinical presentation of NiV infection in humans has a range of clinical presentations from asymptomatic infection to acute respiratory syndrome and fatal encephalitis. It is an airborne transmission infection and can affect those who come in direct contact with infected bodies. It is usually associated with inflammation of the brain due to which several days of fever can often lead to a state of confusion, disorientation and even consistent drowsiness. If not taken care of these symptoms it may even cause a coma in a span of few days.

There are no specific drugs or vaccines for this infection. Only intensive supportive care is the recommended treatment. Since there is no effective treatment for the disease, prevention is the only mode of action to safeguard ourselves. The infection can be prevented by avoiding exposure to bats in endemic areas and sick pigs. Bats are infamous for drinking toddy from open containers and sometimes urinate in it, which makes it contaminated with the virus. So drinking such raw palm sap or toddy contaminated by bat excreta, eating of fruits partially consumed by bats and domestic use of water from wells infested by bats should be avoided. Since the recommendation of the reco

FRUIT BATS AS HOST AND CARRIERS OF VIRUS

NiV infection is one of the newly emerging zoonosis that causes severe disease in both animals and humans. The natural host of the virus are fruit bats of the Pteropodidae family, *Pteropus genus*. ¹⁴ Several instances blemished fruit bats as carrier and hosts of many viruses. In the world's first Nipah outbreak virologists isolated the virus from the urine of the Island flying fox, a fruit bat species. One such outbreak in Bangladesh researchers found antibodies to Nipah in the Indian flying fox. Though all bats can carry viruses some of them are lethal enough to kill humans. The Marburg virus, a relative of Ebola, was isolated in 2009 from the Egyptian Rousette, a fruit bat, in Uganda's Kitaka cave. After the 2003 outbreak of severe acute respiratory syndrome (SARS) in China,

researchers found antibodies to the SARS Corona virus in cave-dwelling insectivorous bats. Likewise, Ebola antibodies were found in species like the hammer-headed fruit bat. As a matter of fact SARS and Ebola virus was never isolated from the mammals suggesting other animals may also play a critical role in the outbreaks of disease. ¹⁵ Around 1200 species of bats presently exists in the world which comprise 20% of the earth's mammalian diversity. Not to be surprising that they host many viruses but not all of these viruses are threats to humans. The mystery element is how bats stay healthy despite carrying this pathogens. ¹⁶

WHY ARE SO MANY EMERGING DISEASES LINKED TO BATS?

Since the outbreak of NiV in Kerala, fruit bats have attracted attention as the wildlife reservoir for the virus. The virus survives in the bat's body without causing disease at the same time allowing it to transmit to susceptible mammals like humans or pigs, when bats come in contact with them. Such contact is becoming increasingly frequent as agriculture and urbanisation destroy bat habitats, forcing them into human dwellings.¹⁸

It is reported that The Indian flying fox could hosts over 50 viruses. Based on "flight as fever" hypothesis many researchers suggested that long periods of flying raises the temperatures of bats, boosting their immune responses. Thereby helping them survive pathogenic effects from microbes. The Pteropus fruit bats are the ones seen to be the most common carriers of the virus, which are the big fruit bats. What could be considered as a suspected carrier in Kerala is the great Indian fruit bat, also known as the Indian flying fox, Pteropus giganteus. 17 Interestingly, when a bat colony was spotted in a well at the home of Kozhikode's first Nipah victim, virologists zeroed in on these mammals as a possible source of infection. However, things have not been as straightforward as expected. When animal husbandry officials collected bats from the well, they only found the insect-eating kind, which belong to a different family. There was some evidence that insectivorous bats can host Nipah, but they have not been connected with human infections so far. 19.

DISCUSSION

Bats and ecosystem

Bats are one of the most important and under rated group of animals. Across the world they play a pivotal role in the balancing act of eco systems. They are key predators of night-flying insects that burn a big hole in the farmers pocket annually. India is renowned for its majestic wildlife but the bats of India are hardly ever mentioned and very little is known about them. With at least 109 species, India has an incredible diversity of bats. India has an incredible diversity of bats.

The habits of India's bats are as diverse as the habitats they live in. Extending from Himalayas, to the deserts of the Northwest, to the tropical forests of the East and South, there are bats that feed on fruit, nectar, insects, frogs, and even other bats.22 According to an Indian survey about the feeding habits of fruit bats indicated that three common fruit bats alone aid in the pollination and seed dispersal of more than 114 species of plants. Many of these trees are great economic, ecological, medicinal, and even religious importance. Many wild varieties of fruits like banana, guava and other fruits dependent on bats to maintain natural populations. We could often see a carpet of chewed fruits favourites of fruit bats on the ground near the fig trees. Such ecologically important trees are considered keystone species because numerous animals utilize them as a resource.²³ Another survey conducted on flying fox bat suggests that there is dramatic decline in the number of species almost half at present. Historically, flying foxes lived in large colonies, often in the thousands; now the average size is 500 or fewer. Over 70 per cent of the species faced some kind of threat due to tree cutting and other human nuisances. The dwindling number is reduced to 10 for smaller fruit bats where as the largest flying foxes, however, roost in large colonies in trees and are therefore vulnerable to destruction by humans.24

Despite their importance, bats are often oppressed either intentionally or unintentionally, and their shirking number from habitat loss, environmental toxins and other reasons. Many studies on past few decades on Indian bats have been restricted to studying either their distribution or their physiology. On such study centered on understanding the role of fruit bats as seed-dispersal agents in Indian forests and how such dispersal aids in forest growth and regeneration patterns.²⁵ Regardless of the importance of India's bats to diverse ecosystems, they receive no official protection. All 12 fruit bats have been classified as vermin or pests under India's wildlife protection act and thus can be actively persecuted. There is no proper surveillance system on the population levels of bat species in the past so very little information available on their present status.

The presence of the NiV in patients of Kerala outbreak was confirmed from RT-PCR tests conducted at the Manipal Institute of Virology and the National Virology Institute, Pune. The virus can be even detected by enzyme linked immunosorbent assay (ELISA) test. Days after the Kerala government declared Kozhikode and Malappuram districts as NiV free identifying the source of the infection will help to prevent future spread. The health department did a tremendous job by containing the outbreak and ensuring there is more causality.

Though it has been confirmed that fruit bats were the source of the deadly virus they need to find the actual origin of the virus. While they had a strong suspicion that

fruit bats carried the virus that infected the first victims of Kerala outbreak but their search has hit a wall as the test samples of these bats have turned negative. The officials later reported that it is not because fruit bats are not carriers but it only means the samples were not collected soon enough. In the Kozhikode epidemic, the virus seems to have moved from bats to humans in one splash over event followed by spreading from one human to another. Officials are trying to single out specific bat species behind the outbreak. Even if the outbreak is eventually linked to these mammals, the transfer of bat viruses to humans is a rare event.

NIPAH OUTBREAK; DON'T BLAME THE BATS ALONE, IMPROVE PUBLIC HEALTH

Ironically, bats have been scapegoated as the cause for Nipah as they are the natural host of the virus. Knowing the critical role of bats to the ecosystems, the Kerala government did a tremendous job by taking a firm stand against culling bats in response to the outbreak. It is due to this reason that the government had to strictly warn public not to indulge in any activities that can harm the animal. Substantially, every animal species that has been studied has some virus of potential risk to other species. In the past few decades, so-called 'emerging diseases' have killed fewer than 20,000 people worldwide, and there is no more than unsubstantiated speculation for blaming even half of those deaths on bats.

It is the well-known fact that some of the most valued crops depends heavily on flying foxes and their closest relatives for pollination. Flying foxes are also Southeast Asia's most important long-distance seed dispersers, essential to reforestation. Surprisingly, in reality the bats have one of the world's finest safety records when it comes to living with people. Hundreds of bat biologists, millions of people who eat bats and the millions more who share cities with huge bat colonies are no less healthy than others.²⁸

It is highly regrettable that an unnecessary panic has spread among the people against bats. Bats have been living in close proximity to communities for ages. Most of the older open wells in the Kerala, especially those that have been dug through laterite rock beds, commonly have bats hanging on the walls. It is neither possible, nor necessary to clean all these wells and remove bats. In a crisis situation we need to be careful and take precautionary measures like using boiled water for drinking and cooking.

While the health authorities in Kerala are pulling out all stops to contain the virus and investigate its source, there is a sigh of relief among people that the infection did not spread into an outbreak and it was fully under control. However, from where did the infection start is the question that continues to be a mystery. Bat specialists were fairly sure that the bats hanging on the laterite walls

of the dug well in the households of first victim were not the culprits. They were insect-eating ones, and insectivorous bats have not been seen to be the carriers of NiV in the past. The other reason for disease spread mainly by drinking palm sap that has been infected with the NiV by the greater Indian fruit bat Pteropus giganteus. Preventing bats access to the sap collection pots has reduced the infection rate in other parts of the world.²⁹ This may be a possible route of infection and experts advised to avoid palm toddy for a brief period. This is better way to prevent the infection from spreading than harming the fruit bats. Culling of bat species is not the way to deal the problem even if tests show some of the fruit bats in the affected region are carrying NiV. This has to be totally avoided. By experience from Malaysian outbreak proved that the virus will get more virulent if the animal is stressed mostly out of human-induced factors and this could cause more infections.³⁰ According to the WHO report on NiV infection states that there is strong evidence that emerged from bat-related viral infections communicable to humans and animals had been ascribed to the loss of natural habitats of bats. The flying fox bats get stressed and hungry, accompanied by weak immune system due to habitat loss caused by human activity or lack of food, climate change or deforestation. This would lead to shoot up in their viral load a lot of virus spills out in their urine and saliva.³¹

CONCLUSION

In recent years, man and animal conflict when in contact with each other is also causing outbreak of diseases such as Nipah. It is highly appreciable that the public health system in Kerala is among the best in the country. Even though the Kerala government extraordinary response to virus outbreak is no solace for the family who lost lives, the way people and government authorities has handled the NiV outbreak holds crucial lessons for the rest of India. Though there was false propaganda through social media for culling of bats most of the intellectual and educated general public turned a blind eye to the call. Rapid urbanization, coupled with changing climate in recent years, has played a key role in triggering the reemergence of NiV in India. We oblige to educate and emphasize the need for better public health awareness and preparedness. Mortality rate due to NiV is a small number considering the world statistics for other diseases. This virus can be tackled with precautions and concerned authorities should give more importance to public health than focusing more on curative medicines. Some simple measures like staying away from eating bat bitten fruits, take proper precautions while contacting infected persons and drink only boiled water can do away with virus infection.

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