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What if you share a drink with a bat?

Authors:
Mohammed Saiful Islam, Hossain M.S. Sazzad, Syed Moinuddin Satter, Sharmin Sultana, M. Jahangir Hossain, Murshid Hasan, Mahmudur Rahman, Shelley Campbell, Deborah L. Cannon, Ute Ströher, Peter Daszak, Stephen P. Luby, and Emily S. Gurley
Associate Editor:
Elitsa Panayotova

Abstract

Bats transmit several different viruses, including the Nipah virus, which scientists discovered recently. (S*ee the fascinating story of its discovery in References!*) We studied 14 cases of people in Bangladesh who got sick with the virus between 2011 and 2014. The source of their infection was unknown. We found that eight of them drank fermented palm sap - the local palm wine. We believe that drinking this liquor is a potential way to get infected with Nipah virus. Palm wine producers should probably take measures to prevent contact between bats and the sap.

Introduction

Bats have a really bad reputation - undeserved one. Maybe you have heard some horrifying stories yourself like blood-sucking and hair tangling. They are not true, by the way! Bats are in fact important for our environment (Fig. 1) – they keep insect populations in check and some of them are important pollinators (like bees).

One thing, though, that makes bats look bad is that sometimes, not often, they spread diseases. Unfortunately, pretty deadly ones. These include the scary Ebola and Marburg diseases, SARS (Severe Acute Respiratory Syndrome) and Nipah virus infections which cause *encephalitis* - an inflammation of the brain.

Scientists discovered the Nipah virus recently (in 1999) in Malaysia, in a farming village called Nipah (this is how the virus got its name). It turned out that people built their pig farms too close to bat-inhabited forests. The virus jumped from the bats, which are its natural reservoir, to the pigs, then from pigs to humans. Many people got sick and more than half of them died. (Read more in *How one man saved his country from a nightmare virus called Nipah*.)

A few years later, in Bangladesh scientists found that people also could get sick from drinking raw date *palm sap*. It's because bats like to drink it too. They contaminate it with their saliva in which a lot of viruses reside. Worse still, the virus started to pass from human to human and relatively small Nipah outbreaks occur every year somewhere in Asia.

In the past few years, there were some new Nipah cases in Bangladesh which had an unknown source. Had the virus found yet another way to infect people?

Figure 1:
Indian Flying Fox bat (*Pteropus giganteus*)

Methods

Our *epidemiological* study took place in two districts in Bangladesh from 2011 to 2014. We took a few steps and some detective work to find a possible route of infection.

1) We identified possible cases of Nipah virus infections. Sometimes, diagnosis is not that easy. So we categorized the possible cases as:

- Suspected = no lab diagnosis but the symptoms were present (fever, altered mental status, seizures);
- Probable = the patient had exhibited the described symptoms and had lived near a patient with confirmed Nipah virus infection but had died before we could take samples;
- Confirmed = the symptoms were present and we found *antibodies* against the virus.

We also noted if the patient has had contact with another Nipah-infected patient. In this case we are talking about a *secondary infection*. When there has been no such contact we talk about *primary infection*.

2) We identified *clusters* of Nipah virus infection - at least two people with brain inflammation living near each other.

3) We identified probable route of infection. We talked to the surviving patients or the friends of the deceased ones. Had they been drinking raw palm sap? Had they had contact with sick pigs or other animals? We limited this study to clusters where these answers were no. It turned out that some of them had drunk wine, called *tari*, prepared from fermented palm sap, so we investigated its production as well.

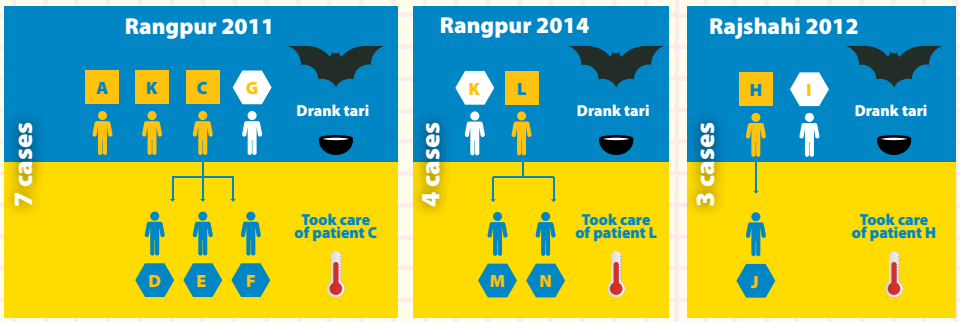
Results

We focused on three clusters where the virus source was unknown. Within them, there were 14 cases of sick people described in figure 2.

Eight of the patients had drunk *tari* before their illness began. Another six had close contact with them (for example, they took care of the sick) and then got sick themselves.

It seemed quite possible that the *tari* was somehow infected so we asked around how it was made. The process resembles the process of collecting raw palm sap: the harvesters cut the old leaves at the top of the palm tree and insert a bamboo spigot (tap). (See Fig. 3 and the **video**.) Then they hang a pot under the spigot and wait. The collected sap ferments for several days in the pot. This is a mistake – the longer the pots stay there exposed, the more opportunities for bats to contaminate them. Indeed, the harvesters had found bat excreta in and on the sap pots.

Figure 2:
Nipah virus transmission in 3 clusters in Rangpur and Rajshahi districts, Bangladesh from 2011, 2012 and 2014.



probable case
confirmed case
Instead of using the patients' names, we call them by the first 14 letters of the alphabet.

The top level = primary infections (directly from the wine)
Bottom level = secondary infections (transmitted from another person)

Figure 3:
This is how palm sap is harvested to make tari.

Discussion

Is drinking *tari* one more way for Nipah virus to get you? We believe so. All of the primary case-patients had been drinking *tari* regularly. They hadn't been drinking raw palm sap and they hadn't been in contact with any sick pigs.

Maybe there had still been some raw palm sap inside the *tari*? No, we checked that the harvesters collect tari in the morning and all the patients had been drinking it in the evening – enough time for the sap to ferment at least partially.

Unfortunately, raw palm sap is tasty for bats. They often lick it and sometimes pee inside the collection pots. Both bats' urine and saliva are rich in viruses (when the bat is infected).

We also know that alcohol tends to kill some viruses. So is it possible for the Nipah virus to survive inside the *tari*? If we want to sterilize a surface or an object we use 60-70% alcohol solution. Palm wine contains only 5-8% alcohol, so yes, the virus can survive.

Conclusion

Using an epidemiological approach we were able to link clusters of Nipah virus infection with drinking *tari*. There is the possibility that other bat viruses can infect people the same way. So what can we do?

First, palm sap harvesters can use bamboo to cover the tree cuts so that bats have less contact.

What about the bats? Shouldn't we kill them all? No! Don't hate bats. It's not their fault. They don't even know they are sick when they carry the virus passively. Killing bat populations would lead to an ecological disaster as they are really important pollinators. Plus, one single bat can eat 2000 insects per night, including mosquitoes.

However, you shouldn't touch bats! If you find a bat on the ground, don't pick it up! It may be sick. Instead, call a local wildlife rehabilitation center. If you absolutely have to touch it always use thick leather gloves.

Glossary of Key Terms

Encephalitis – inflammation and swelling in the brain. Most often viruses and bacteria are to blame. It can lead to fever, confusion, changes in behavior, seizures and even death.

Natural reservoir – the host in which the virus lives and reproduces for a long time. Usually the natural reservoir doesn't get sick but it spreads the virus. For example – the natural reservoir for plague bacteria are wild rodents such as rats.

Palm sap vs *tari* – just as we have a blood stream, plants also have vascular system. The fluid there is called sap and a lot of people (and bats) drink it. *Tari*, also called palm wine, is fermented palm sap and it's alcoholic.

Epidemiology – part of medicine which studies the spread of a disease – how does someone get infected, how many people are at risk, where people are at risk and so on. For example, there is no risk for you to get Ebola unless you have been to Africa or you had contact with someone who had it.

Antibodies – scientists use the presence of specific antibodies - molecules in the blood - as an indirect indicator for the presence of an infection. For example, if you had chickenpox as a baby you developed specific anti-chickenpox antibodies, so if scientists detect these antibodies they will know you have had chickenpox in the past. They can also distinguish if you had it in the past or if you are having it right now.

Cluster – a group of people with a disease in a relatively small area in a short period of time. For example, a cluster of Ebola virus is when five people have the disease in a small village in the same week.

Primary vs. Secondary infection – patients with a secondary infection had exposure to a patient who was already sick. In those cases, the illness occurs several days after the contact. Primary infection patients got the virus infection in some other way.

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National Public Radio reports:

- **The fascinating story of how Nipah was first discovered: How one man saved his country from a nightmare virus called Nipah**
http://www.npr.org/sections/goatsandsoda/2017/02/25/515258818/a-taste-for-pork-helped-a-deadly-virus-jump-to-humans

- **Disease detectives find a really good reason not to drink date palm wine**
http://www.npr.org/sections/goatsandsoda/2016/03/22/470803523/disease-detectives-find-a-really-good-reason-not-to-drink-date-palm-wine

Check your understanding

1. Nipah virus is related to measles, mumps and parainfluenza viruses. There is something really alerting about that. So alerting that a lot of governments donated a total of 460 million dollars for the fast development of a vaccine against Nipah virus. What is it?

2. Bats are mammals like us. Do you have any ideas why they don't get sick from the deadly viruses they carry?

3. Are bats and the viruses they carry in a mutualistic relationship?

4. Why are bats an important part of our environment?

5. What should you do if you discover a bat in your house or fallen on the ground?