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## Tick-borne “Bourbon” Virus: Current situation and future implications

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### Abstract

Ticks transmit wide range of virus to human and animals all over the globe. Bourbon virus is new tick transmitted virus from bourbon county of United States of America. This is first reported case from western hemisphere. The objective of this review is to share information regarding present situation of this newly emerged virus and future challenges.

**Keywords:** Global scenario, tick, bourbon virus

### Introduction

Ticks (Arthropoda: Acari), an obligate blood imbibing ecto-parasite of vertebrates <sup>[1]</sup> spreads mass of pathogens to humans and animals globally <sup>[2]</sup>. Ticks have been divided into two broad families on the base of their anatomical structure i.e. Ixodidae and Argasidae commonly called as hard and soft ticks respectively <sup>[3]</sup>. Approximately 900 species of ticks are on the record <sup>[4-6]</sup> and 10% of these known tick species <sup>[7]</sup>, communicate several types of pathogens to human and animals of both domestic and wild types. Ticks ranked next to mosquitos as vectors of human <sup>[8]</sup>, and animal diseases. During the past few decades, it has been noticed that the number of reports on eco-epidemiology of tick-borne diseases increased <sup>[2]</sup>. Ticks transmit a number of species of viruses <sup>[7]</sup>, bacteria <sup>[9]</sup>, protozoa <sup>[10, 11]</sup>, rickettsia <sup>[11-13]</sup>, and fungi <sup>[14]</sup>. Ticks have been reported to transmit at least 38 types of viruses belonging to different six virus families (Asfarviridae, Reoviridae, Rhabdoviridae, Orthomyxoviridae, Bunyaviridae and Flaviviridae <sup>[7]</sup>. All the tick-borne viruses are RNA viruses <sup>[7]</sup>. Some of the ticks communicate viral diseases which are very much harmful for both humans and livestock species. Tick-borne viruses (TBV) are a group of viruses with significant world-wide importance in public health perspective. Most common tick transmitted viral diseases of human and animals are: Crimean-Congo hemorrhagic fever virus (CCHF) transmitted by Hyalomma ticks <sup>[15]</sup>, Tick-borne encephalitis virus (TBEV) transmitted by Ixodes ricinus <sup>[16]</sup>, Louping-ill virus (LIV) <sup>[17]</sup>, and Colorado tick fever virus (CTFV) <sup>[18]</sup>, transmitted by Dermacentor andersoni <sup>[19, 20]</sup>. Viruses vectored by ticks are found mainly in the genera; Ixodes, Haemaphysalis, Hyalomma, Amblyomma, Dermacentor, Rhipicephalus (Boophilus) <sup>[7]</sup>. The aim of this article is to focus on recently, new identified virus in Kansas, USA.

### Bourbon Virus

Bourbon virus ‘Bourbon’ is the type of Thogotovirus (THOV) genus of family Orthomyxoviridae which is RNA virus and has resemblances with Dhori and Batken virus <sup>[21]</sup>, which has been isolated from Hylomma tick species <sup>[22-25]</sup>. The name of bourbon virus is proposed in 2014 after the name of county (Bourbon) of Kansas USA where it was an outbreak causing death of patient <sup>[26]</sup>.

### Discovery

Bourbon Virus is discovered by Kosoy and his colleagues of centre of disease control (CDC) and prevention in 2014 in Fort Collins, Colorado, when they are processing the blood sample of the patient <sup>[21, 27a]</sup>. <sup>[21]</sup> Used next generation sequencing (NGS) technology to identify this novel virus. In addition to this technology they also use real-time (RT) reverse transcription polymerase chain reaction (PCR) to confirm presence in the blood sample of patient.

### Morphology

Bourbon virus is found in different form but filamentous and roughly spherical forms are more common. The diameter of Bourbon virus ranges from 100–130 nanometre.

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Unlike other member of the family Bourbon virus genome is single stranded negative sense RNA virus with approximately six segments and is closely resembled to Dhori and Batken virus which is also member of Thogotovirus genus and reported from Eastern hemisphere<sup>[21]</sup>. This was the first case reported from all over the world and the patient was farmer<sup>[21, 28]</sup>. After the outbreak of this virus, CDC and Kansas health and environment Department planned to screen Kansas county population which have shown similar symptoms<sup>[26]</sup>. Endocytosis of bourbon virus took place at 100 nm and sialic acid in vertebrate host cell is receptor for virus which is bound by the viral glycoprotein. Entry is by endocytosis, with fusion of the viral and cell membranes occurring once the vesicle are acidified. Viral transcription and replication occurs in nucleus unlike other orthomyxoviruses<sup>[29]</sup>.

### Transmission of Bourbon Virus

Yet it is not clear that the virus is completely transmitted through ticks. However, the patient passed away has history of multiple tick bites before sickness. Therefore, it is hypothesized that the virus belong Thogotovirus genus which was first time isolated from the pool of tick from cattle in Kenya in 1960<sup>[30]</sup>. Furthermore, it is not clear that which ticks species bite the patient. There are many genera of hard and soft ticks which have been reported as vector of different viruses to human and animals. THOV has been isolated from the following genera of ticks: Hylomma, Boophilus, Amblyomma, and Rhipicephalus and also from humans and animals<sup>[31, 32]</sup>. On the other hand, only single report is available that directed that Batken virus is mosquito borne<sup>[33]</sup>.

### Epidemiology

This is the eighth human case associated with THOV globally and first due to Bourbon virus. It is also first case reported from western hemisphere<sup>[21]</sup>. Thogotovirus rarely causes infection in humans, early to this case two people have been found infected with Thogotovirus from Nigeria and 5 laboratory workers were found infected with Dhori virus from Russia<sup>[34, 35]</sup>, and another virus namely Aransas Bay virus reported from seabirds associated with ticks from USA<sup>[21, 29]</sup>. This is the first reported case of human infection apparently associated with a THO virus in the Western hemisphere<sup>[36]</sup>.

### Future Implications

Discovery of this new virus raises many questions in the scientific community as it is not clear yet from where bourbon virus raised, either it is already existing virus, sub specie, strain or a novel species of virus though it has some relation with already existing viruses like Dhori and Batken but these are from Eastern hemisphere. Another lacuna is that health professional does not propose the name of disease as they proposed name of virus. Therefore, it is responsibility of all experts of the following fields (ecologist, epidemiologist, pharmacist, microbiologist, and parasitologist) that they sit under one umbrella and utilize their expertise in their fields to explore more information about the Bourbon virus. Epidemiologist in collaboration with ecologist may design surveillance studies to understand the eco-epidemiology of virus. Parasitologist and microbiologist may collect ticks specimens from field and screen them for isolation of this virus. In addition to ticks, insect particularly (mosquitoes) can also be screened for the existence of virus. Further, certain domestic and wildlife animals including birds should also be investigated for the presence of virus. Another point linked to this viral infection is unclear either it is contagious or not.

Countries where ticks have already been reported for other viral transmission must be screened for the occurrence of this virus. During screening for other viruses of public health importance, medical professionals must screen samples for this virus too. Viral infection also have worse impact on the tourism of country because chances of transmission of infection is associated with movement of tourists as it has been observed in Ebola, SARS, and Swine Flu epidemics earlier. Pharmaceutical experts must start development of effective anti-viral medicine and vaccine against bourbon virus. Now it is the noble duty of funding agencies across the globe to allocate their budgets particularly for this emerging issue. Centre of disease control and other organization already working on this emerging issue should train the trainers of other countries through collaborative research projects. Experts must provide directions about routine diagnostic and culture test for this virus. There is need of development of primers and establishment of cell lines of Bourbon virus for diagnostic purpose in future. After the first case reported from USA, it is possible that the similar cases may be reported from other countries. Therefore, information about this viral infection must share with countries having poor hygienic and heavy tick infestation on animals. Further, studies on virus to explore complete genome structure, its glycoprotein synthesis, types and expression will be required. Study on pathological complication regarding to this viral infection is still investigable. Professionals during handling such type of cases and public specifically livestock owner and farmers during daily life activity must adapt preventive measure regarding ticks.

### Conclusion

Tickborne viral diseases are constant threat for human and animals demanding a comprehensive novel control measure of both vector (tick) and viruses at global scale.

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