Schmallenberg Virus

An Emerging New Challenge to Farm Animals

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Schmallenberg virus causes stillbirths in animal populations like cattle, goats, sheep, bison and Alpaca. The first case was reported in Germany in November 2011 in a town called Schmallenberg. Consequently, many more cases were reported all over Europe, in The Netherlands, Belgium, the United Kingdom and France. Here, we elaborate on the recently identified Schmallenberg virus and its pathological outbreak in animals.

Advances in diagnostic and therapeutic strategies have helped combat many infectious-disease-causing agents over the years. However, evolution is a continuous process and we are constantly challenged with emerging and re-emerging infections that pose a constant threat to human and animal health. Indeed, researchers around the globe are still fighting deadly diseases like malaria, trypanosomosis and AIDS. In this article, we focus on a recently identified virus, namely, Schmallenberg virus as an example of a newly emerging virus infection that poses threat to the livestock industries. In addition to describing the life cycle, epidemiology and the disease caused by this newly discovered virus, we also explore the potential of this infection crossing the species barrier and thereby posing a direct challenge to human health.

1. Introduction

The 'Schmallenberg virus' (SBV) is an enveloped, negative-sense, segmented, single-stranded RNA virus which belongs to

*I spent some time in the summer at Smiths Dairy farm, which brought me in contact with cows and the numerous illnesses they may contract. As one can expect, I spent most my time milking the cows and doing chores like, bringing them in, brushing their beds, and caring for the calves. Of course, the birth of a calf was the highlight of my time there. It is a great moment to see a new life born, big or small. Witnessing a cow abort unfortunately also marked my experience. According to the farmer, lots of cows had aborted lately due to a pandemic of the Schmallenberg virus. The virus was unknown to me and so I wanted to have a better understanding of this case.

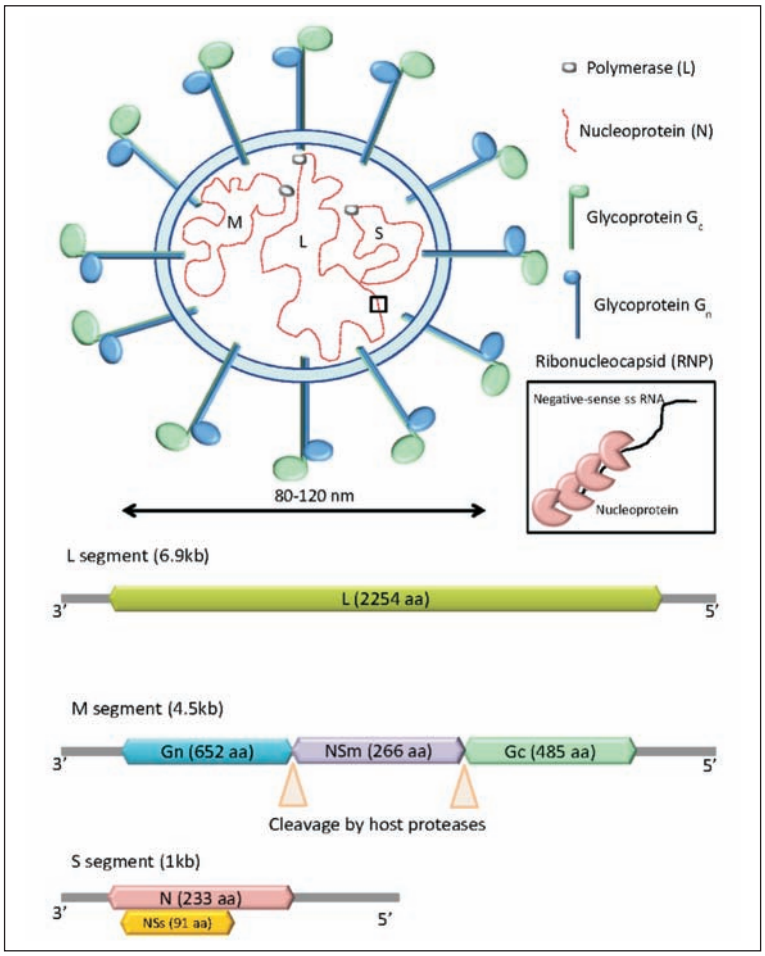

Figure 1. Schematic representation of a generic bunyavirus virus particle (A) and SBV antigenomes (B). (Adapted from [2])

the Bunyaviridae family of virus as shown in *Figure* 1 [1]. The classification of the virus has not yet been acknowledged by International Committee of Taxonomy of Viruses. It has a diameter of 80–120 nm. The available information on the structure of these proteins is limited because of its recent discovery.

2. Origin of the Virus

The Orthobunyaviruses[1] are prevalent in the tropical countries of the world. Seroprevalences[2] of Orthobunyaviruses is provided in *Table* 1. However, so far, the SBV infections have been reported only in European unions and not in tropical countries till date. Although, the identification of Schmallenberg virus is from the

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Animal virus, veterinary infection, vaccine, emerging infection.

[1] Orthobunyavirus is a genus of the Bunyaviridae family.

[2] Seroprevalence is fractions of subject in a population who test positive for a specific disease based on serology (blood serum) samples.

Table 1. Seroprevalence of orthobunyaviruses.

Virus Type	Region	Year
Akabana	Australasia & Japan	1961 & 2007
	Korea	2007 & 2010
	Southeast Asia	1975
	Australia	1976 & 1988
	Middle east	1994
	Israel	1980 & 2004
	Saudi Arabia	1998
	Kenya	1985
	Sudan	1996
	Turkey	1985
Alino	Japan	1995
	Australia	1978
	South Korea	2007
	Israel	2004
Shamonda	Nigeria	1972
	Japan	2005
	Korea	2007
Schmallenberg	Netherlands	2012
	Germany	2012
	Belgium	2012
	France	2012
	UK	2012

Netherlands, it is possible that occurrence of this infection may be common in tropical countries, as shown by the presence of other viruses of the same family. There is a lack of systematic data on the worldwide geographical distribution of Schmallenberg virus. It would be helpful for organizations like WHO to issue an advisory to monitor this infection in other parts of the world.

3. How Does SBV Replicate?

Researchers assume that the life cycle of the SBV will be similar to that of other bunyaviruses. Intracellular lifecycle of virus is depicted in *Figure* 2 [2]. As shown, the viruses are ingested by the cell by endocytosis. The envelope of the virus fuses with the vesicle wall, thus releasing the RNA into the cytoplasm of the host

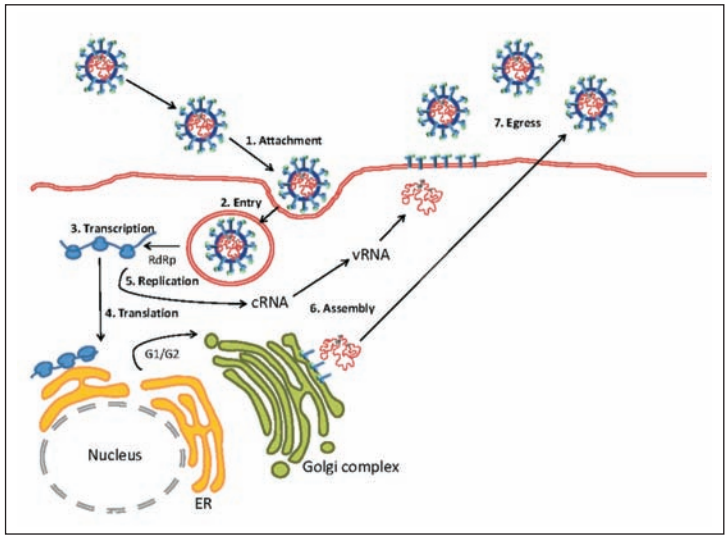

Figure 2. Life cycle of SBV. (Adapted from [6]).

cell. The RNA is transcribed to form mRNA, which is used to produce viral proteins that are matured in Golgi apparatus.

4. What are the Symptoms of Infection by SBV

The first clinical signs in adult animals are acute diarrhoea, a dip in milk production, loss of appetite, fever (> 40°C) and abortions as shown in *Figure* 3 [3]. Other signs of infection are visible in the offspring. The European Food and Safety Authority observed various clinical signs across Europe with congenital malformations and stillbirths as the most common. The musculoskeletal alterations in the aborted, stillborn or neonatal SBV-positive calves consisted of vertebral and limb deformities, also called Arthrogryposis [4]. Their joints fuse, and when calving or lambing normally, they

Figure 3. Abortion of SBV-infected Heifer.
Credit: Anosha Meyers.

must be cut out or an electro caesarean must be performed.

Furthermore, neurological disorders such as Ataxia[3] have been recognized to show up in the offspring. They may also be born with Amaurosis, when the animal looses sight in one eye, due to a lack of blood flow to the eye without an apparent lesion. A behavioral abnormality often found to be occurring in SBV calves is the 'Dummy syndrome' with the following symptoms: walking continuously, avoiding food or drink, pressing head against solid objects, inability to back out of narrow enclosures and lack of response to normal stimuli.

[3] Ataxia: neurological condition referring to lack of voluntary co-ordination of muscle movements.

The virus targets mainly the brain of the unborn animal resulting in neurological damage. Necropsy studies performed on calves have proved that there has been a lack in the brain cerebral hemispheres. Hydrocephaly[4] is another common sight in neonates with an excessively large formation of a head due to excess cerebral fluid. Porencephaly[5] is another symptom where cysts form in the cerebral hemispheres. Cerebral and cerebellar hypoplasia is another embryonic developmental disorder – it is where the cerebrum is smaller than usual, or has not been formed entirely [4].

[4] Hydrocephaly: condition referring to abnormal accumulation of cerebrospinal fluid (CSF) in the ventricles, or cavities, of the brain.

[5] Porencephaly: presence of cysts or cavities within the cerebral hemisphere.

5. How to Detect SBV?

The virus is located in the blood of the adult infected animal or in the central nervous system of its offspring. The virus can be diagnosed in extracted samples from adult animals using cell culture techniques and serological tests on serum samples. There are commercial kits available for these serological tests [2, 5]. From stillborns and malformed calves or lambs, virus can be detected in tissue samples of the brain, amniotic fluid and placenta. Virus infection can also be diagnosed by scoring for antibodies made against the virus during infection or from histopathology in the CNS and spinal chord. A real time quantitative reverse transcriptase PCR (RT–qPCR) test which has been developed recently in the Friedrich-Loeffler Institut in Germany can also be used.

6. Transmission and Sources of SRV

Orthobunya viruses are primarily transmitted from animal to animal through blood-feeding insects like culicoides, ticks and mosquitoes [6]. Therefore, in the warmer months of the year, farm animals are more prone to the Schmallenberg virus. It is suspected that the spread of the virus is due to insect migrations. Exports and imports can also be to blame for the spread, for obvious reasons. However, direct transmission between animals is unlikely, unless through reproduction. The virus can be transmitted from parent to offspring as it can inhabit itself in fetal tissue. If infection occurs prior to pregnancy, SBV contamination might not occur in the offspring.

7. Currently Available Preventative Treatments

***Treatment*:** Vaccination against AKAV and Aino virus, members of Simbu sero group, are available. Hence successful vaccination against SBV should be possible. Wernike *et al.* report the animal trial for five prototype vaccines [7]. The trial showed that 4 out of 5 candidates showed complete prevention of RNAemia after challenge infection. That is, vaccinated animals when challenged by re-introduction/inoculation of the virulent virus resulted in destruction of the virus evident from the loss or absence of the viral genome (RNA) for these animals. For future treatments for the Schmallenberg viral infection, the use of inactivated viral candidate vaccines may provide a possible solution. However, prolonged testing will provide conclusive evidence of its effectiveness.

***Preventative Measures*:** Prevention is better than cure. Some simple precautionary measures such as a) control of potential vectors during the vector active season could help reduce contamination cases and b) rescheduling of breeding outside the vector season in order to reduce fetal malformations [7]. In order to have control on this virus pathology, one must have knowledge about SBV. Country-wide initiatives to research SBV cases and sharing the findings internationally will aid in its eradication or

treatment development. SBV surveillence centre in France was set up on the 4th of January 2012. Veterinarians around Europe have been asked to send in spleen and brain samples from newborns or aborted offspring that are suspected to have the SBV. qRT-PCR is performed to detect the Schmallenberg's RNA. In March 2012, 66 laboratories were set up around France which has enabled us to extensively explore SBV.

8. Possibility of Human Exposure?

It has been confirmed from Human Animal Infection and Risk Surveillance group (HAIRS) that until now, no SBV infection was found in people (n = 360) having occupational exposure. Currently, the SBV infection is not considered as zoonotic[6] [8]; however there is always a possibility of the virus crossing species barrier as exemplified by recent episodes of swine flu, and health officials must be educated in order to exhibit alertness in monitoring potential spread of this virus to humans.

[6] Transmission of the disease either directly form infected animals to humans or via intermediate vectors (insects like mosquitoes).

Suggested Reading

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