Schmallenberg Virus Infection

Pankaj Dutta[1], AV Harikumar, GK Sharma
Animal Health Group,
National Dairy Development Board, Anand 388001

1. Aetiology:

The Schmallenberg Virus (SBV) was discovered in November 2011 in Germany. It is an enveloped, negative-sense, segmented, single-stranded RNA virus, that belongs to Bunyaviridae Family and Orthobunyavirus Genus [1]. Genomic studies have shown that SBV closely resembles to the viruses belonging to Simbu serogroup i.e. Shamonda, Aino and Akabane viruses [2]. Recent full-genome study and serologic investigations have revealed that SBV belongs to the species *Sathuperi virus* and may be an ancestor of the reassortant Shamonda virus [3].

2. Epidemiology:

SBV mainly affects ruminants and is transmitted by insects or by vertical intra-uterine transmission [1]. As Simbu serogroup viruses do not cause disease in humans, therefore the risk to human is seems to be negligible for SBV also. Further, there is no report of any clinical signs in human till now. But the risk for human cannot be entirely excluded [2, 4].

2.1. Hosts:

Confirmed by PCR or virus isolation: Cattle, Sheep, Goat, Bison,

Confirmed by serology only: Red deer, Rope deer, Alpaca and Mouflons.

No evidence of Zoonotic risk [1].

2.2. Transmission:

Epidemiological studies indicate that SBV is transmitted mainly by insect vectors whereas evidence of vertical transmission across the placenta is also exists [1]. The

[1]For communication please contact pdutta@nddb.coop

transmission of SBV most likely occurs by vectors like biting midges similar to bluetongue virus [5]. The transmission and spread of SBV by biting midges was confirmed with the detection of SBV in two species of *Culicoides* in Belgium [6]. However, there is a need of further research in this aspect to understand the possible role of other insect vectors.

3. Geographical Distribution

During 2011 summer in Germany, a significantly higher number of cattle were affected with a disease of unknown etiology where the affected animals had high fever, drop in milk production up to 50%, general depression, diarrhoea and loss of appetite. Within a few months, abortions, still- births and congenital malformations also surfaced in ovine as well as in bovine herds. During laboratory investigation, the Friedrich Loeffler Institut (FLI), Germany detected an unknown microbial genetic material in samples of affected animals by means of metagenomic analysis [7].

Comparative genetic analysis revealed that the new virus is very similar to certain members of the *Orthobunyavirus* genus [7]. The virus was provisionally named as "Schmallenberg virus" after the name of the town from which the first positive samples originated [8]. Soon in December 2011, the Netherlands also reported identification of SBV with presence of similar clinical signs in animals. Congenital malformations in newborn lambs were also recorded [1]. Experimental studies in calves revealed that the virus cause fever, viraemia and diarrhea [2]. The SBV could be cultivated in insect cells and hamster cell line [7].

By February 2012, the Netherlands, Germany, Belgium, the United Kingdom and France had reported OIE about the outbreak of Schmallenberg virus [5]. While SBV is not a reportable disease to OIE, the OIE working pro-actively promptly established an *ad-hoc* group to monitor the developments and provide technical facts and guidelines on SBV to member countries. Presently, nine European countries confirmed SBV as presented in *Table-1* [9].

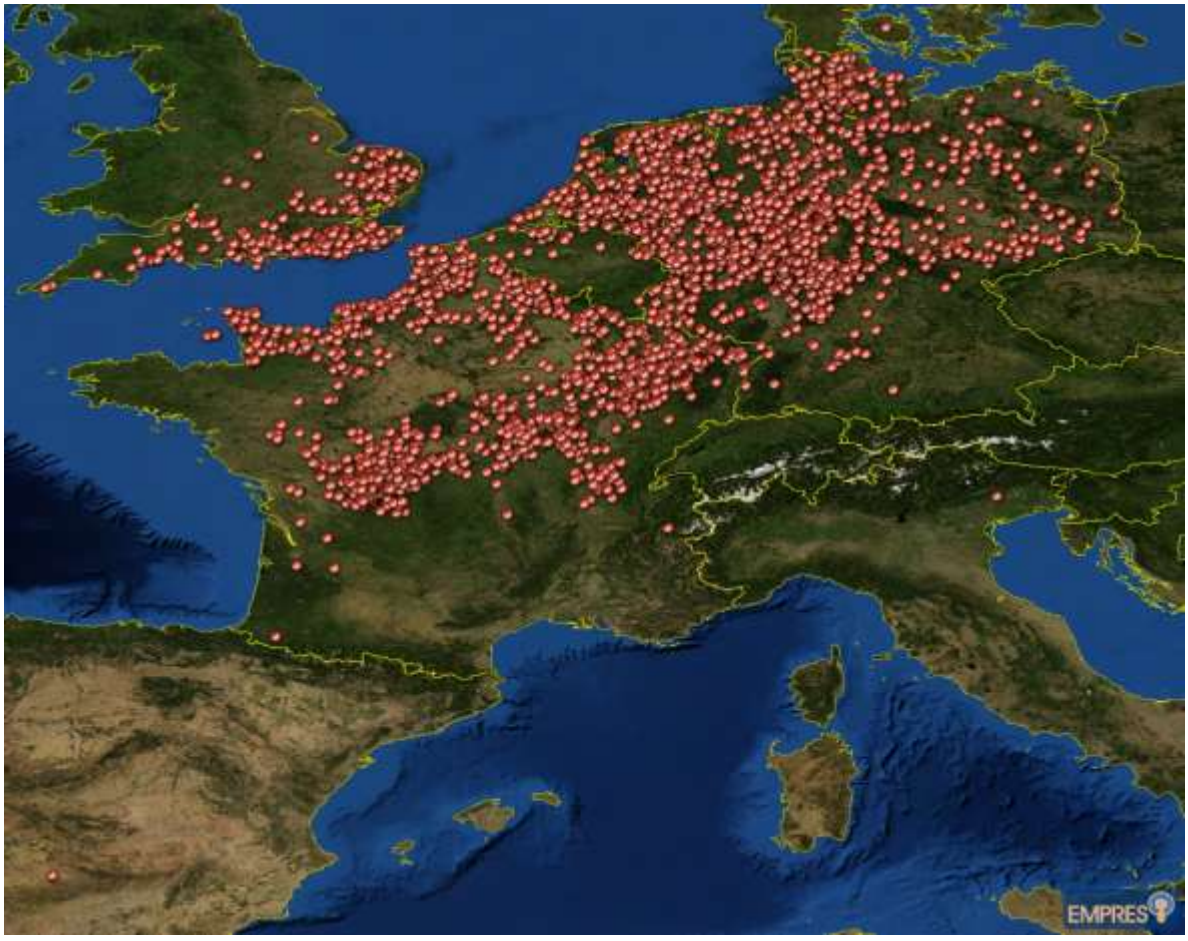
Table 1: Schmalllenberg virus confirmed in Europe (Updated: July 25, 2012)

Country	Cattle holdings	Sheep holdings	Goat holdings	Total
France	1505	1,128	17	2650

Germany	866	865	48	1779
Belgium	407	167	2	576
Netherlands	237	107	6	350
United Kingdom	53	220	3	276
Italy	2		1	3
Luxembourg	11	6	1	18
Spain		5		5
Denmark	2 (*)			2
Switzerland	2			2

(*) = Presence of SBV detected in *Culicoides sp*.

Source: Update No.10 on Schmallenberg Virus in Northern Europe, Department for Environment, Food and Rural Affairs, Veterinary & Science Policy Advice, International Disease Monitoring, UK



Map of Western Europe which shows the location of the foci compatible with SBV that have been notified to the OIE Updated: (July 20, 2012). [9]

Source : flutrackers.com

4. Incubation period:

In experimental trials, blood from PCR positive (for SBV) animal was inoculated intravenously or subcutaneously in three calves that became infected and gave positive PCR results 2-5 days post-inoculation. After 6 days of post inoculation virus could not be detectable in blood, indicated a short period of viraemia. The clinical signs also subsided within few days [2].

5. Risk assessment and the potential spread of the disease through different sources/trading:

Blood from SBV infected adults and brain from infected fetus has been found to positive by virus isolation. Similarly, organs and blood from infected fetus, placenta, amniotic fluid and meconium has been found positive by PCR. [1]

The OIE technical factsheet provides the following information for risk assessment.

Meat	*Relevant information*	Only clinically healthy animals should be slaughtered. The viraemic period is very short. Transmission of the virus is most likely by vectors.
	Risk of transmission	Negligible
Milk	*Relevant information*	Milk should only be collected from clinically healthy animals. The viraemic period is very short. Transmission of the virus is most likely by vectors.
	Risk of transmission	Negligible
Semen	*Relevant information*	The viraemic period is very short. Semen should be collected from clinically healthy animals. From 8 bulls experimentally infected with Akabane virus, virus was not found in semen even during the viraemic period (*Experimental infection of bulls with Akabane virus*, Parsonson IM, Della-Porta AJ, Snowdon WA, O'Halloran ML, Res Vet Sci. 1981 Sep; 31(2):157-60.).
	Risk of transmission	Negligible for sero-positive bulls; negligible for sero-negative and PCR negative bulls.

Embryos	*Relevant information*	The viraemic period is very short. Embryos should be collected from clinically healthy animals. Akabane virus is classified under the category 4 (diseases or pathogenic agents for which studies have been done or are in progress that indicate that either no conclusions are yet possible with regard to the level of transmission risk; or the risk of transmission via embryo transfer might not be negligible even if the embryos are properly handled between collection and transfer).
	Recommendation	Safety measures applicable to Akabane virus should be followed.
	Risk of transmission	According to the current knowledge, the risk from sero-negative donor animals is negligible. Sero-positive and PCR-negative donor animals at the day of insemination should be also considered with negligible risk.
Live non-pregnant animals	*Relevant information*	The viraemic period is very short. Mild clinical signs might occur. Transmission is most likely by vectors.
	Risk of transmission	Negligible for the following animals: • PCR-negative after 7 days in a vector-free environment or, • Sero-positive and PCR-negative.
Live pregnant animals	*Relevant information*	The virus can persist in the fetus; this may result in the birth of virus positive calves, lambs and kids. The relevant pregnancy time to induce viraemic newborns is not exactly known.
	Risk of transmission	• Negligible for the offspring of sero-negative animals tested twice in a vector-free environment (within 28 days), • Negligible for the offspring of animals sero-positive before insemination, • Undetermined for the offspring of all animals not covered by the previous bullets

Study conducted on antibodies against SBV in adult cows and proportionate transmission to fetuses shows that risk for infection to the fetus in a newly exposed herd is ≈28%. If the fetus immune system is mature enough to control viral spread, uterine infections persist with no sequelae visible at birth [10]. The natural immunity of the cow plays an important role in case of Akabane virus to prevent subsequent infections of the fetus [11]. In case of SBV also, It seems likely and the resulting economic effects on farms concerned might disappear in 2012 [10].

Russia, Ukraine, Kazakhstan, Egypt, Mexico suspended import of live cattle and sheep, along with embryos and semen from SBV infected countries. USA has banned the import of germplasm collected from EU countries after June 1, 2011.

6. Diagnosis:

6.1. Clinical signs and symptoms:

The clinical manifestation varies from species to species.

In adult cattle,

- Fever (>40°C)
- Anorexia
- Reduced milk yield
- Diarrhoea
- Impaired general condition etc [1]

Malformed animals and stillbirths (calves, lambs, kids)

- Arthrogryposis/ Hydranencephaly
- Brachygnathia inferior
- Ankylosis
- Torticollis
- Scoliosis [1]

Lesions

In malformed newborn the symptoms are hydranencephaly, Hypoplasia of the central nervous system, Porencephaly and Subcutaneous oedema (calves)

6.2. Laboratory diagnosis:

Samples taken from live animals for the detection of acute infection may be EDTA-preserved whole blood and Serum. At least 2 ml of sample should be collected and transported cooled or frozen [1].

Samples to be taken from stillborns and malformed calves, lambs and kids:

I. For Virus detection:
   a. Tissue samples of brain (cerebrum and brainstem)
   b. Amniotic fluid
   c. From live newborn:
      i. Amniotic fluid and placenta
      ii. Meconium

II. Antibody detection:
   a. Pericardial fluid
   b. Blood (preferably pre-colostral)

III. Histopathology:
   a. Fixed central nervous system, including spinal cord [1].

Laboratory tests

Identification of the agent:

a. Real-time RT-PCR
b. Cell culture isolation of the virus: insect cells (KC), hamster cells (BHK), monkey kidney cells (VERO)

Serological tests on serum samples

i. ELISA
ii. Indirect Immunofluorescence
iii. Neutralization test

A real-time reverse transcriptase PCR (rRT-PCR) test has been developed by the FLI for detection of SBV. Same PCR protocol has been used by other countries i.e. Germany, Netherlands, Belgium, France, United Kingdom, Italy, Denmark, and the United States. [13]. Netherlands & Germany and France have developed an antibody-based test for SBV (viral neutralization) for mass testing [14, 15, 16].

Commercial kits for diagnosis of SBV by reverse transcriptase PCR as well ELISA are available.

6.3. Differential diagnosis:

The clinical signs of SBV are similar to some other diseases / agents (viral, bacterial, genetic, toxic or nutritional) causing abortion, congenital malformations, and transient systemic problems in cattle, sheep, and goats. Therefore SBV has to be differentiated from bovine viral diarrhea (BVD) and other pestiviruses, bovine herpesvirus type 1, bovine ephemeral fever virus, bluetongue virus, foot-and-mouth disease virus, epizootic hemorrhagic disease virus, rift Valley fever virus, toxicities (e.g. *Veratrum californicum*, *Lupinus* spp.), genetic abnormalities (e.g. spider lamb syndrome) and nutritional deficiencies (e.g. gestational protein deficiency, manganese) etc [17].

7. Prevention and control:

Presently there is no vaccine available control of SBV. Likewise, there is no treatment available. The control of *Culicoides* may be useful with synthetic pyrethroid insecticide applied to the animal, animal housing and by reduction of local breeding sites [18]. However, where the challenge is high, control of midges with pour-on insecticides may be fruitless in bringing a noticeable reduction in biting midges population [19].

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