Information of the Friedrich-Loeffler-Institut on

Schmallenberg virus (SBV)
(European Shamonda-like orthobunyavirus)

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Causative agent
Schmallenberg virus (SBV) is an orthobunyavirus strongly related to viruses of the Simbu serogroup, which also comprises the Akabane virus. So far, the strongest genetic similarity has been detected to the Sathuperi and Douglas viruses within this group. The genome of these viruses consists of three segments (S, M, and L) which encode at least 5 proteins.

Distribution
Infections with Schmallenberg virus have so far been detected in Germany, the Netherlands, Belgium, Great Britain, France, Italy, Luxembourg, Spain, Denmark, Estonia, Ireland, Finland, Norway, Sweden, Poland, Austria, and Switzerland. According to unconfirmed reports infections in further European countries are possible.

Affected animals
So far, Schmallenberg virus has been detected in cattle, sheep, and goats. Antibodies against the virus have been found in alpaca, bison, roe deer, red deer, fallow deer, and mouflon.

Transmission
Like other viruses of the Simbu serogroup, Schmallenberg virus is transmitted by insects (biting midges, possibly also mosquitoes or other arthropods). SBV genome has been detected in biting midges caught in Belgium, Denmark, and Germany (Brandenburg) in 2011. Vertical transmission from females to their offspring is of particular importance (see clinical picture). Late in 2012, the FLI first detected genetic material of the virus in the semen of bulls with a history of SBV infection. In some bulls with SBV-genome-positive semen samples, also first SBV-antibodies could be detected.

A first animal study showed that semen samples with a high and with a low viral load are potentially infectious. In cattle subcutaneously inoculated with SBV-genome-positive semen samples, infection was safely detected by PCR and antibody test in 2 of 6 animals. Therefore, a high sensitivity of tests for detection of SBV in semen samples is required. The FLI has supplied regional laboratories with methods for detection of SBV genome from a large variety of sample materials, including semen, for investigation in a national ring trial.

In order to exclude transmission of SBV safely, semen of bulls with an SBV positive antibody status should be investigated by means of appropriate methods according to the recommendations of the FLI.

Human health risk
Schmallenberg virus is no zoonotic pathogen. Investigations of the Robert Koch-Institute in persons with close contact to infected animals revealed no signs of an infection (also see risk assessment of the European Center for Disease Prevention and control:

Clinical picture
Cattle with acute infection show mild symptoms such as fever and a drop in milk yield. These symptoms have mainly been observed during the vector-active season (April to November) of 2011. The viraemic stage is very short (1 to 6 days) and the clinical symptoms usually subside within a few days. So far, there are no reliable reports on symptoms of acute infection in small ruminants (sheep, goats). As a rule, infection in these animals seems to be clinically inapparent.

Fetal infection plays a special role. If infection occurs during a vulnerable stage of pregnancy (analogously to Akabane virus in sheep probably between weeks 4 and 8 and in cattle probably between weeks 8 and 14), the virus may infect the fetus and cause severe damages. Birth of malformed lambs and calves is typical. Most malformed lambs and calves are stillborn or non-viable. Furthermore, a return to estrus (presumably after death of the embryo and resorption), abortions, mummified fetuses, premature birth or stillbirth may occur. The most common malformations are severe arthrogryposes (ankylosis, tendon shortening), torticollis, hydranencephaly, and hydrocephalus (Fig. 1 and 2). The central nervous system may show extreme deformations. Altogether, the clinical picture is very similar to that of infections with the Akabane virus. The malformations induced by viruses of the Simbu serogroup are designated “arthrogryposis hydranencephaly syndrome” (AHS).

In some cases, various degrees of encephalitis in both, acute infections and newborns, are observed for viruses of the Simbu serogroup.

Fig. 1: Malformed lamb with arthrogryposis of individual joints

Fig. 2: Malformed lamb with arthrogryposes, torticollis and hydrocephalus

Fig. 3: Cerebellar hypoplasia

Fig. 4: hydranencephaly

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Laboratory diagnostic detection

Pathogen detection: Pathogen detection is done by real-time RT-PCR or virus cultivation.

For pathogen detection during acute infection, serum and EDTA blood samples can be used which must be collected during the clinical stage (fever, drop in milk yield, diarrhea).

Pathogen detection in fetuses, abortions, stillbirths, and in malformed lambs and calves (AHS) is mainly done from brain samples (cerebrum as well as cerebellum samples); supplementary investigation of spleen and blood samples is recommended.

After the first comparative tests, amniotic fluid (e.g. in swab samples from the skin of malformed animals) is also suitable as diagnostic material. Detection of SBV-RNA in the meconium is also possible, although the detection rate in this material is lower.

Indirect detection: Antibody detection can be done by indirect immunofluorescence and neutralization test. In addition, licensed ELISA kits for detection of antibodies in milk as well as in plasma and serum are available.

The sample materials of choice are serum samples; EDTA blood samples are less suitable for neutralization test. If possible, serum samples from newborn lambs or calves should be collected precolostrally.

Epidemiology
The origin of Schmallenberg virus is still unclear. Data available so far indicate that it has been present in Central Europe for a relatively short time only or that is has been introduced just recently. There is no evidence that SBV was present in Europe prior to 2011.

SBV has spread rapidly across large parts of Europe, particularly the western part of the continent. In Germany, 2000 cases have been reported so far, over 1000 in cattle, over 900 in sheep and nearly 50 in goats. Nationwide, infections have on average been reported from 0.8 % of cattle holdings, 4.2 % of sheep holdings, and 0.4 % of goat holdings in the frame of mandatory reporting pursuant to the regulation on reportable animal diseases. However, there are considerable regional differences particularly with regard to sheep holdings, in North Rhine-Westphalia e.g. as many as 11.8 % of sheep holdings were affected. A seroprevalence study in cattle carried out in winter 2012 revealed that the estimated prevalence of antibody carriers in the western and northwestern federal states ranged from 60 to 98%, whereas in the northeast and south the percentage of seropositive cattle was significantly lower (2.3 to 32%). However, as numerous new cases of SBV occurred in 2012, the seroprevalence will certainly also have increased significantly in regions with a lower incidence rate in the winter of 2012.

Control
Classical control measures do not provide reliable protection from SBV infections. However, protection of susceptible animals from biting midges/mosquitoes is a possibility to reduce the risk of infection, particularly during the vector-active season. Furthermore, the time point of insemination of female animals can be chosen, so that the vulnerable stage of pregnancy (analogously to Akabane virus in sheep presumably from weeks 4 to 8, in cattle approximately from weeks 8 to 14) does not lie within the vector-active season. Vaccines are not available, but are under development.

Recommendations for animal holders and veterinarians
Upon occurrence of the described symptoms of acute infection (drop in milk yield, fever, and diarrhea) in cattle during the time of insect activity, suitable samples should be sent to the responsible diagnostic agencies of the federal states for detection of a possible infection with Schmallenberg virus. The same applies to clinically suspicious newborns (AHS, see above).