Schmallenberg Virus Infections in Ruminants

Susceptible Species

- SBV-infections detected only in ruminants so far
  - Cattle
  - Sheep
  - Goats
  - Bison
  - Roe deer (antibody detection)
  - Red deer (antibody detection)
Clinical picture
Since August 2011 increased number of requests to BTV reference laboratory to analyse samples; new BTV cases?

In North Rhine-Westphalia cases of drastic milk drop and fever reported; similar symptoms in the Netherlands (?)

In September first samples sent to FLI/Institute of Diagnostic Virology for further investigations (M. Holsteg, LWK NRW und R. Jungblut, VUA Arnsberg)

All tests for „classical“ diseases negative:

- BTV, EHDV, FMDV, BHV-1, MKFV, BVDV, RVFV, BEFV

Virus isolation on bovine cells negative (no CPE)

Metagenomic analysis of 3 pooled blood samples from diseased dairy cows from Schmallenberg
- 12 positive samples
- 6 cattle farms
- 11 adult cattle
- 1 stillborn twin calf
- All in North Rhine-Westphalia
- Close to Dutch border
Clinical signs in adult sheep

- No reports at the time of acute infection (DE)

- Unspecific, mild symptoms occasionally reported after detection of malformations in lambs
  - Diarrhoea
    - Causal relationship to SBV unclear
    - Recall bias?

- Diarrhoea in Frisian Milksheep (NL)
  - 4/5 holdings with SBV-affected lambs had reported diarrhoea in August/September
Clinical signs in lambs

• **Ovine Congenital Malformation**
  
  – History
  
  • 25.11.2011 first case (Maastricht)
  • 5/40 dairy sheep holdings in NL affected

• **Clinical picture**
  
  – Arthrogryposis, torticollis, brain hypoplasia, brachygnathia inferior, „silly lambs“ (unable to suckle), skoliosis, little wool, hardly any muscles
  
  – Lambs born live or dead

• Piet Vellema, GD

Picture: Dr. Brügmann, LVI Oldenburg
Clinical picture in lambs

Arthrogryposis, torticollis, brain hypoplasia, brachygnathia inferior, skoliosis

Pictures: Courtesy of Dr. Brügmann, LVI Oldenburg
Deformation of the vertebral column, torticollis, brachygnathia inferior in a calf

Hydranencephaly and cerebellar hypoplasia

Pictures: Courtesy of Dr. Martin Peters, SVUA Arnsberg, Germany
Case description

• Dairy sheep farm (53 ewes)
  – No purchase of ewes for 2 years
  – Ram purchased on 04.09.2010
  – well managed
  – organic farming (Demeter)
  – Heavy problems with insects until 11/2011 on pastures
  – SBV suspicion since 18.01.2012
    • 16/33 (48.5%) lambings produced at least one SBV-suspect lamb (AHS)
    • 24 lambs affected (AHS, stillborn or too weak to survive)
    • One stillbirth without AHS in 13.01.2012
    • One AHS-affected lamb survived
  – (More information collected using standard questionnaire)
Experimental infections
Experimental infection of cattle

Animal

R07  4ml blood from 4 different blood samples s.c.
R08  4ml blood from 4 different blood samples i.v.
R09  KC-cell supernatant s.c. and i.v.
<table>
<thead>
<tr>
<th></th>
<th>-3</th>
<th>-2</th>
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<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td>38,8</td>
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<tr>
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<td>38,7</td>
<td>38,7</td>
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<td>38,7</td>
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<tr>
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Body temperatures over days post infection for R07, R08, and R09.
RT-qPCR (Aka-like L1)

<table>
<thead>
<tr>
<th>dpi</th>
<th>R07</th>
<th>R08</th>
<th>R09</th>
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<td>2</td>
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<td>34,57</td>
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<td>3, 9 Uhr</td>
<td>23,61</td>
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<td>22,17</td>
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</tr>
<tr>
<td>4, 9 Uhr</td>
<td>20,47</td>
<td>24,50</td>
<td>22,53</td>
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<tr>
<td>4, 16 Uhr</td>
<td>24,99</td>
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<td>28,17</td>
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<td>no Cq</td>
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Serum neutralisation assay

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<th>1/ND50 (L228)</th>
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<tr>
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<tr>
<td>Animal 08, 18dpi</td>
<td>20</td>
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<tr>
<td>Animal 07; 21dpi</td>
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<tr>
<td>Animal 08; 21dpi</td>
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After day 40 post inoculation: appr. 1:160

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</tr>
<tr>
<td>NC ref2</td>
<td>&lt;5</td>
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<tr>
<td>RT (KID50)</td>
<td>80</td>
<td>80</td>
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</table>
R10 bis 14: s.c. infection
2 animals orally inoculated
2 animals re-infected
3 Contact animals

Inoculation material:
KC/1P. BHK Material

Short viremia of less than 6 days in naive cattle
No viremia in re-infected or oronasally inoculated or contact cattle
No infection in contact animals detected
Experimental Infections in Sheep

- Hyperimmunisation in seropositive sheep

- Experimental infection of lambs to start within a few weeks

- No clinical signs in adult sheep infected with virus derived from cell culture (Vero)

- Wim van der Poel
Pathogenesis
Transplacental infection

Trächtigkeit Rind: ca. 9 Monate

Nachweis viraler RNA im Blut akut infizierter Alttiere

Höchste Empfänglichkeit im 1. Drittel

Trächtigkeit Schaf: ca. 5 Monate

Fehl-, Früh- oder Schwergeburten, missgebildete Kälber und Lämmer Monate nach der akuten Infektion der Muttertiere!
Course of the epidemic in ruminants
### Epidemiological situation

#### First cases in Germany

<table>
<thead>
<tr>
<th>Species</th>
<th>First cases</th>
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<tbody>
<tr>
<td>Cattle</td>
<td>(Conception in January 2011)</td>
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<tr>
<td>Sheep</td>
<td>December 2011</td>
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<tr>
<td>Goats</td>
<td>January 2012</td>
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SBV transplacental infections peaked at the same time of the year as BTV8

Assumptions:
Duration of pregnancy in sheep 150 d [145-155] days
Risk period for SBV infection day 32 [25-38] of pregnancy.

=> Shift: 17 weeks

Spearman's rank correlation:

Adjusted SBV outbreaks in sheep - BT 2006:
rho = 0.894, p-value = 1.264e-11

Adjusted SBV outbreaks in sheep - BT 2007:
rho = 0.857, p-value = 7.484e-10
Summary

• SBV has so far affected primarily sheep, but also cattle, goats and bison. Roe deer and red deer seem to be susceptible and naturally infected.
  – Mild disease in adult cattle (diarrhoea, milk drop, fever) for a few days
  – Severe congenital malformations in SBV-positive lambs, calves and kids
    • Evidence for vertical (transplacental) transmission from dam to progeny

• Experimental infections in cattle
  – short viraemia (< 6 days)
  – No viremia in re-infected or oronasally inoculated or contact cattle
  – No infection in contact animals
    • No evidence for direct horizontal transmission

• SBV transplacental infections peaked at the same time of the year as BTV8
  – Seasonal transmission pattern
  – High correlation with BTV8 in 2006
    • Indirect evidence for vector transmission
Acknowledgements

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