Schmallenberg Virus Infections in Ruminants

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Susceptible Species

- SBV-infections detected only in ruminants so far
  - Cattle
  - Sheep
  - Goats
  - Bison
  - Roe deer (antibody detection)
  - Red deer (antibody detection)

Clinical picture

Clinical signs in adult cattle (DE)

- 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 fromSchmallenberg**

Map of first cattle cases in Germany

- 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

[7] 2 Lamm Pa 1170_2011 Arthrogryposis IMG_4942.JPG

[2] 10 Lamm Pa 10_2012 Kleinhirnhypoplasie IMG_5027.JPG

[12] 7_1 Lamm Arthrogryposis und Brachygnathia inferior Pa 9_2012 IMG_4997.JPG

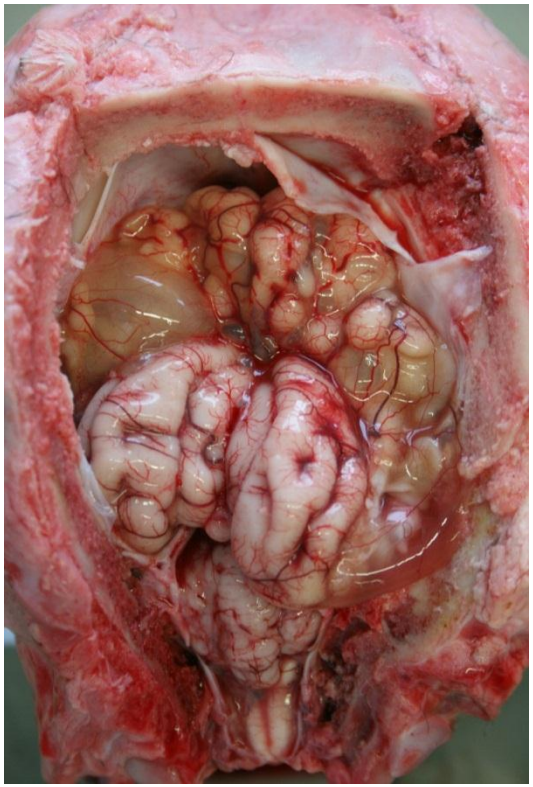
[9] 4 Pa 1146_2011 Schaflamm Arthrogryposis und Torticollis 004.jpg

Arthrogryposis, torticollis, brain hypoplasia, brachygnathia inferior, skoliosis

Pictures: Courtesy of Dr. Brügmann, LVI Oldenburg

Clinical picture in calves

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

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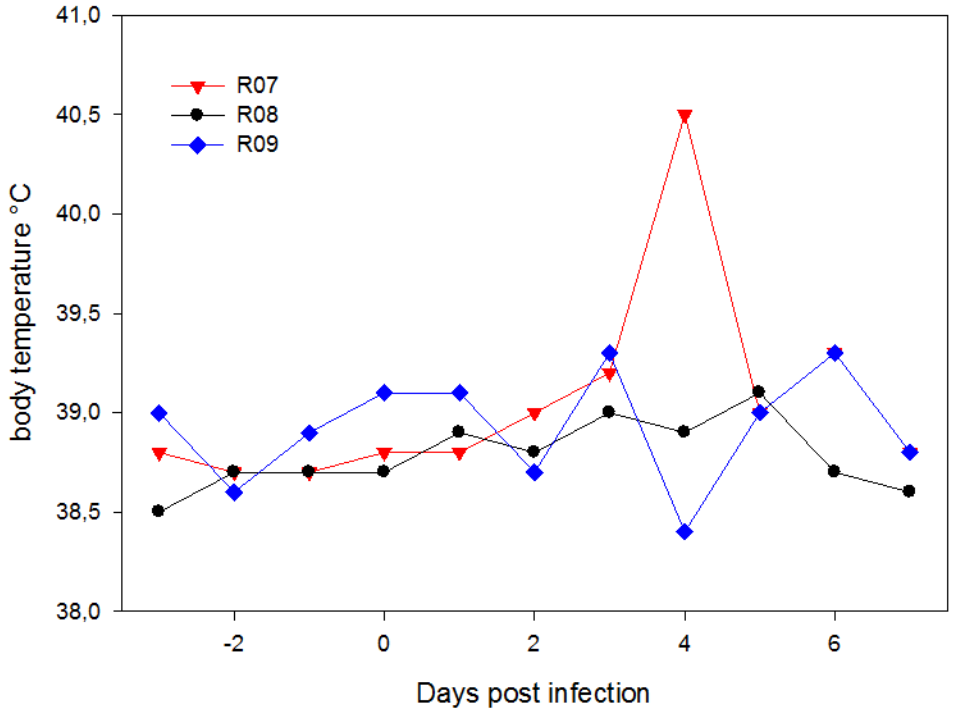
Experimental infection of cattle

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.

Animal trial SBV: body temperatures

Body temperatures

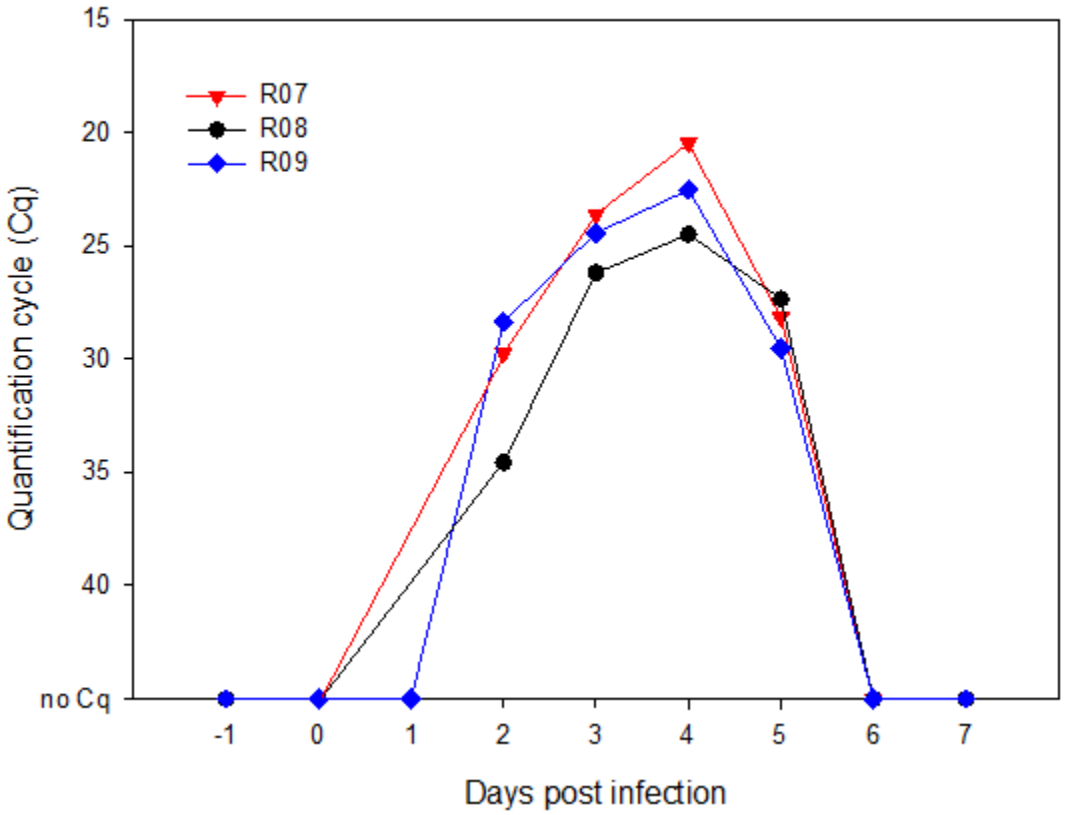
	-3	-2	-1	0	1	2	3	4	5	6	7
R07	38,8	38,7	38,7	38,8	38,8	39,0	39,2	**40,5**	39,0	39,3	38,8
R08	38,5	38,7	38,7	38,7	38,9	38,8	39,0	38,9	39,1	38,7	38,6
R09	39,0	38,6	38,9	39,1	39,1	38,7	39,3	38,4	39,0	39,3	38,8



Animal trial SBV: PCR

RT-qPCR (Aka-like L1)

dpi	R07	R08	R09
-7	no Cq	no Cq	no Cq
0			no Cq
1			no Cq
2	**29,75**	**34,57**	**28,36**
3, 9 Uhr	**23,61**	**26,20**	**24,43**
3, 17 Uhr	**22,17**	**24,38**	
4, 9 Uhr	**20,47**	**24,50**	**22,53**
4, 16 Uhr	**24,99**	**25,60**	
5	**28,17**	**27,34**	**29,52**
6	no Cq	no Cq	no Cq
7	no Cq	no Cq	no Cq



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Serum neutralisation assay

	1/ND50 (L164)	1/ND50 (L228)
Animal 07, 18dpi	**15**	**15**
Animal 08, 18dpi	**20**	**20**
Animal 07; 21dpi	**15**	**15**
Animal 08; 21dpi	**15**	**15**

After day 40 post inoculation: appr. 1:160

NC ref1 <5	<5	
NC ref2 <5	<5	
RT (KID50)	80	80

SBV TV 02/12 – 2nd cattle experiment

R10 bis 14: s.c. infection

2 animal 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

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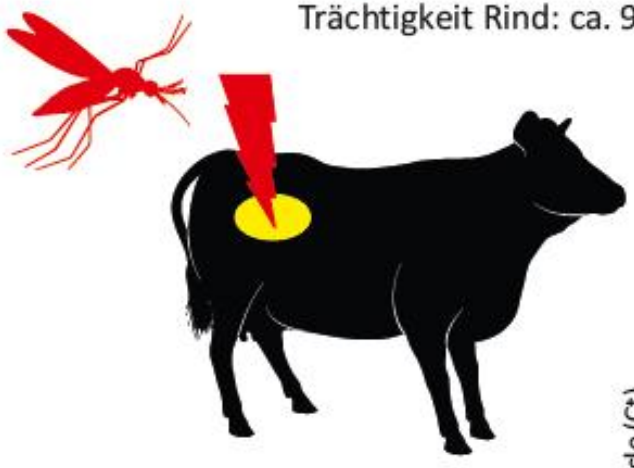
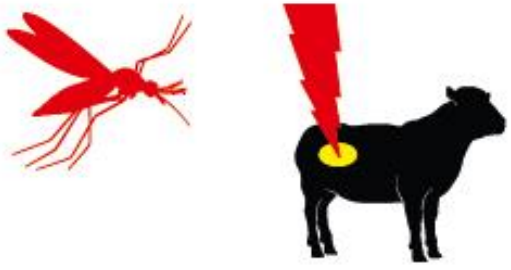
Pathogenesis

Transplacental infection

Trächtigkeit Rind: ca. 9 Monate



Höchste Empfänglichkeit im 1. Drittel



Nachweis viraler RNA im Blut akut infizierter Alttiere

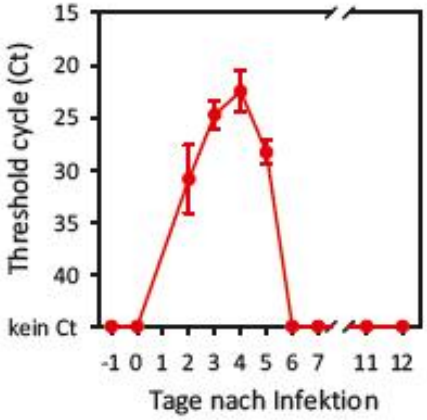
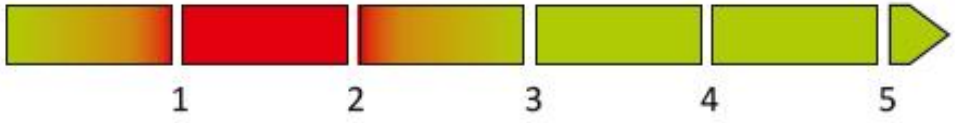


Foto: Dr. Holsteg, Rinder-gesundheitsdienst NRW

Foto: Dr. Brügmann, LVI Oldenburg

Trächtigkeit Schaf: ca. 5 Monate



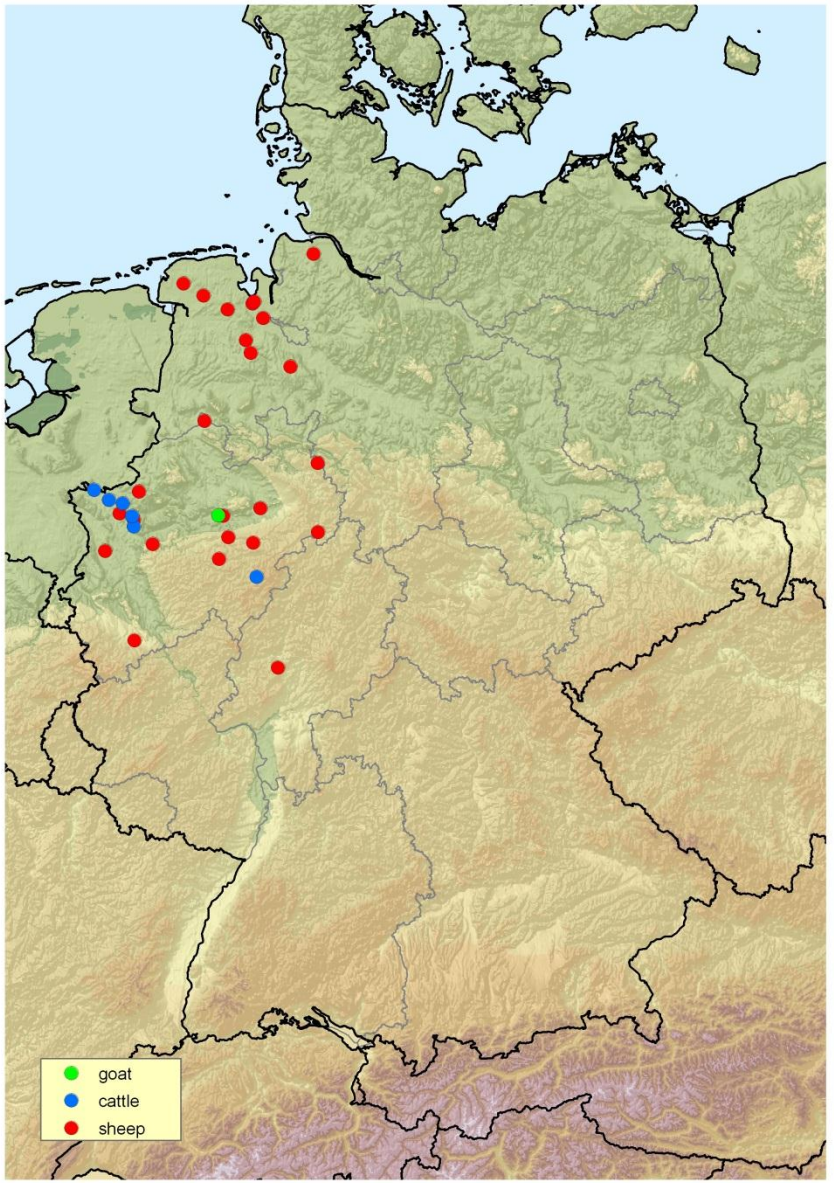
Fehl-, Früh- oder Schwergeburten, missgebildete Kälber und Lämmer Monate nach der akuten Infektion der Muttertiere!

Course of the epidemic in ruminants

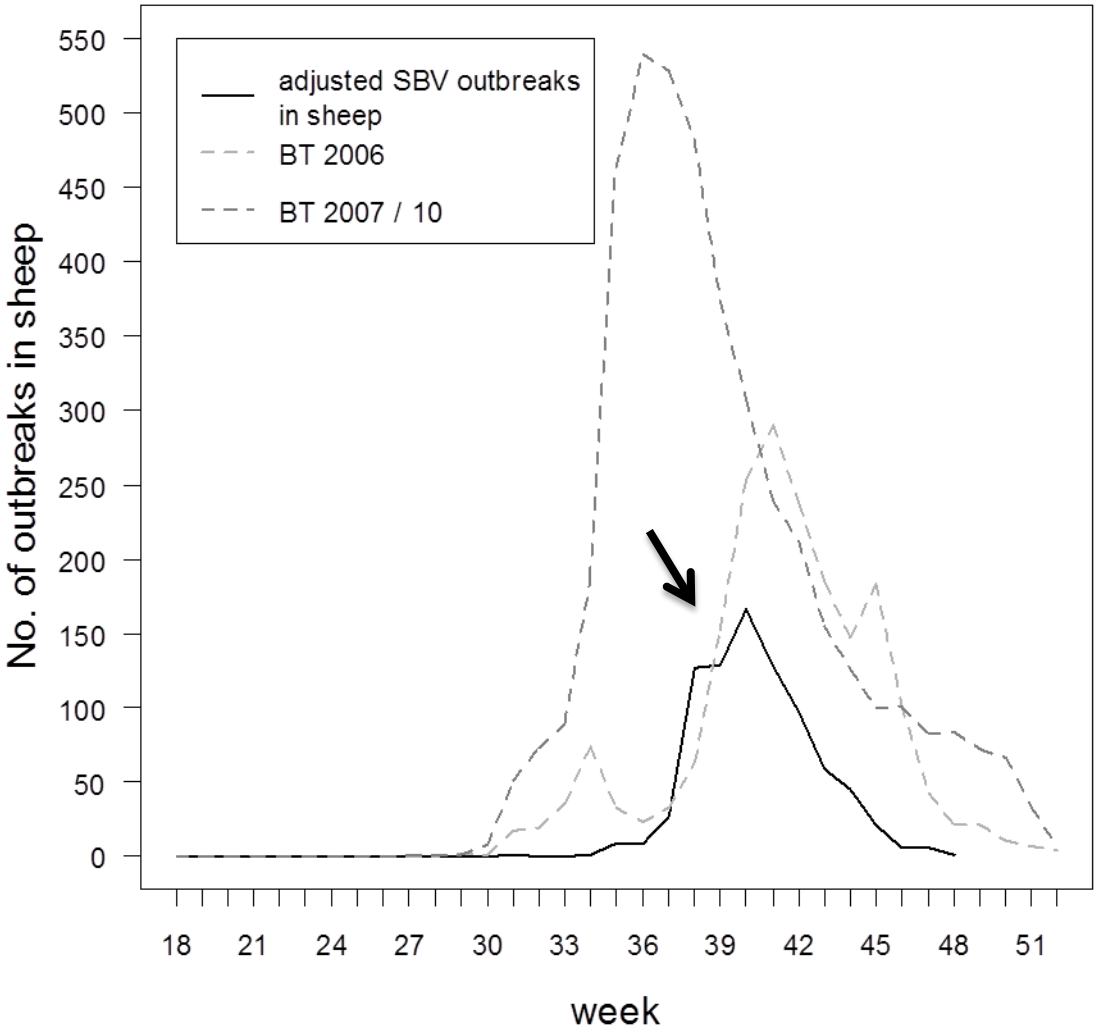
Epidemiological situation

First cases in Germany

Species	First cases
Cattle	(Conception in January 2011)
Sheep	December 2011
Goats	January 2012



SBV transplacental infections peaked at the same time of the year as BTV8



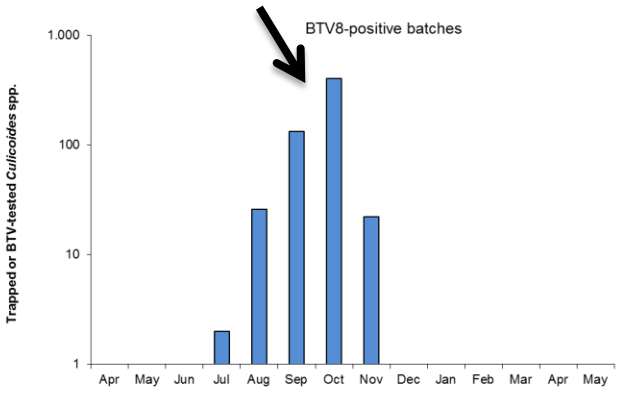
Spearman's rank correlation:

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

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



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

- Acknowlegdements

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Thank you