Short Communication

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Small ruminant abortions in The Netherlands during lambing season 2012–2013

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ABORTION in small ruminants can be caused by various non-infectious and infectious agents (Givens and Marley 2008, Holler 2012). Several infectious agents can cause serious disease in human beings. As a consequence, abortion results in reproductive loss and also can have severe zoonotic implications, as became apparent in 2007–2010 when *Coxiella burnetii*, originating from dairy goat farms with abortion storms, caused one of the largest recorded community outbreaks of Q fever (Roest and others 2011). This outbreak stimulated the development of the so-called one-health concept, and also increased awareness towards the zoonotic potential of infectious causes of abortion in small ruminants (van den Brom and others 2012). Monitoring causes of abortion is of economic interest for farmers, and is also important for the benefit and health of the animal keeper himself, farm visitors, citizens living in the surroundings and of other animal species. Reports of incidences and causes of abortion from different countries vary (Plagemann 1989, Kirkbride 1993, Moeller 2001, Buxton and others 2002, Chanton-Greutmann and others 2002, Szeredi and others 2006, Masala and others 2007, van den Brom and others 2012), and may change over time due to changes in climate, housing and breeding systems, introduction of new infectious agents, or control measures, like vaccination (Vellema and Van den Brom 2013). Therefore, we describe our observations on causes and incidences of abortion in small ruminants in The Netherlands during the lambing season 2012–2013, and compare these findings with data from the 2006–2011 lambing seasons and those of other countries.

The results of laboratory investigations on ovine and caprine cases of abortion were analysed using the pathology records of submissions to the GD Animal Health during the 2012–2013 lambing season. A submission was defined as the presentation of one or more foetuses with or without placenta from one farm at the same time. Submissions were considered complete if foetus and foetal membranes were available. Postmortem examination was performed according to standard procedures as described previously (van den Brom and others 2012), with the modification that bacteria were identified using a Matrix-Assisted Laser Desorption Ionization–Time of Flight Mass Spectrometry system Biotyper (MALDI-TOF, Brüker, Germany) (Clark and others 2013). From each submission, completeness of submission, animal species, history and results of laboratory investigation were noted. Data were statistically analysed using STATA V.12 (StataCorp, Texas, USA). Pearson's χ^2 test was used to test the significance of differences in percentages.

During the lambing season 2012–2013, 24 caprine and 57 ovine submissions were examined. These submissions included 43 caprine and 98 ovine foetuses from 20 goat and 51 sheep farms. A diagnosis was made on 16 (67 per cent) out of 24 caprine submissions, and on 42 (74 per cent) out of 57 ovine submissions. A total of 42 (74 per cent) ovine submissions were complete. A diagnosis was made in 34 (81 per cent) of 42 complete, and in 8 (53 per cent) of 15 incomplete ovine submissions ($P<0.05$). For caprine submissions, complete submissions also resulted in a higher percentage of diagnoses, however, this was not statistically significant. In ovine abortions, as shown in Table 1, the most commonly detected infectious agents were *Campylobacter* species (19 per cent), *Toxoplasma gondii* (14 per cent), *Chlamydia* species (12 per cent), *Escherichia coli* (5 per cent), *Yersinia* species (4 per cent), *Arcanobacterium pluranimalium* (2 per cent) and *Listeria ivanovii* and *Listeria monocytogenes* (both 2 per cent). In 11 per cent of the ovine cases placentitis was recorded but no infectious agent was found, and in 9 per cent of the cases foetal malformation was recorded from which two were Schmallenberg virus ELISA or PCR positive in the foetus. In caprine abortions, the most commonly detected infectious agents appeared to be *L monocytogenes* (21 per cent), *T gondii* (17 per cent), *Chlamydia* species (17 per cent), *Salmonella typhimurium* (4 per cent) and *Yersinia pseudotuberculosis* (4 per cent). In 4 per cent of the caprine cases, placentitis was recorded but no infectious cause was found.

Previously, decreasing annual numbers of submissions were recorded from 2006 to 2011 (van den Brom and others 2012), and compared to these years, in the season 2012–2013, the numbers of submission have declined further. In general, in cases of abortions, the proportion of undiagnosed causes used to be substantial, probably due to the presence of non-infectious causes, which are difficult to detect. However, in the present study, percentages of diagnoses were higher compared to the previous period. This may be due to the facts that the percentage of complete submissions increased from 57 per cent in the previous study to 74 per cent in this study, and that complete submissions have a significantly higher success rate than incomplete submissions. Inclusion of the placenta in a submission is essential for detecting *Chlamydia* species and *C burnetii* (Wouda and Dercksen 2007). The main abortifacient agents *Campylobacter* species, *Chlamydia* species, *Listeria* species and *T gondii* made up two-thirds of the diagnoses in this study. Comparable results were described in our previous study (van den Brom and others 2012). In sheep, *Campylobacter* species were found more frequently compared to goats, while for *Listeria* species, the opposite was found. This relatively high incidence is consistent with our previous findings and studies from the USA (Kirkbride 1993), but is in contrast with studies from other countries where *Campylobacter* species are found less frequently (Chanton-Greutmann and others 2002, Szeredi and others 2006, Masala and others 2007). Compared with our previous study, *Chlamydia* species are found more frequently, and these findings are similar to those other countries like Germany (Plagemann 1989), Switzerland (Chanton-Greutmann and others 2002), UK and Hungary (Szeredi and others 2006).

It is noteworthy that in The Netherlands no abortion caused by *C burnetii* was diagnosed in small ruminants since 2010. This contrasts with our previous study in which *C burnetii* was the main cause of abortion in goats (11 per cent) and the incidence in sheep was 2 per cent. That absence is likely the beneficial result of the current compulsory vaccination of all breeding animals on dairy goat and dairy sheep farms (Arricau-Bouvery and others 2005, van der Hoek and others 2010).

In the examined period, *A pluranimalium* and *Yersinia enterocolitica* were found for the first time in ovine cases of abortion. *A pluranimalium* was isolated from liver tissue and abomasal contents of two lambs from

Veterinary Record (2014) doi: 10.1136/vr.102244

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Provenance: not commissioned; externally peer reviewed
Accepted March 20, 2014

TABLE 1: Incidence of causes of ovine and caprine abortion based on submissions in The Netherlands in the lambing season 2012–2013

	Goat			Sheep		
	Incidence in submissions (%)	Incidence in submissions (#)	Submissions with placenta	Incidence in submissions (%)	Incidence in submissions (#)	Submissions with placenta
Arcanobacterium pluranimalium				1.8	1	1
Campylobacter spp.				19.3	11	11
Chlamydia spp	16.7	4	4	12.3	7	7
Escherichia coli				5.3	3	2
Listeria ivanovii				1.8	1	1
Listeria monocytogenes	20.8	5	3	1.8	1	0
Salmonella Typhimurium	4.2	1	0			
Toxoplasma gondii	16.7	4	2	14.0	8	6
Yersinia enterocolitica				3.5	2	1
Yersinia pseudotuberculosis	4.2	1	1			
Fetal malformation				8.8	5	2
Placentitis	4.2	1	1	10.5	6	6
No diagnosis	33.3	8	4	26.3	15	8
Autolysis	37.5	3	0	66.7	10	8
Mummification	12.5	1	0	6.7	1	0
Total*	100.0	24	14	105.0*	57	42

*Total incidence per submission can be above 100 per cent because in some cases, in the same submission, more than one possible cause of abortion was found

one submission in which liver tissue showed inflammatory signs, and no other pathogens were found. Thus, *A pluranimalium* may be regarded as the causal agent of this case of abortion. This is also described by Foster *et al* for ovine submissions in the UK previously (Foster and Hunt 2011). In two submissions, *Y enterocolitica* was cultured in relatively high numbers from the abomasal content and one of these submissions comprised of two aborted lambs. Since no inflammatory changes were found, it is questionable if this bacterium was the causal agent for this abortion. However, no other bacteria were cultured in these cases, and *Y enterocolitica* has been reported to cause abortion in sheep previously (Corbel and others 1990). Nonetheless, in view of its zoonotic potential and taking the precautionary principle into account, it is advisable to be aware of the possible presence of this bacterium in sheep or goat abortion material. In the case of placentitis whithout diagnosed pathogen, an infectious cause of the abortion is likely, however, it could be that the bacterium is already dead at the time of entrance in the laboratory, does not grow under standard conditions, or the culture is contaminated with a mixture of non-pathogenic bacteria. This study shows the relative abundance of the classic abortifacient agents and other infectious causes of abortion in small ruminants. Additionally, it emphasises the importance of continuous monitoring to reveal the presence 'new' pathogens in the field.

Acknowledgements

Monitoring of Small Ruminant Health is financially supported by the Dutch Ministry of Economic Affairs (EZ) and the Product Board for Livestock and Meat (PVV).

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