

Abortions in sheep associated with *Arcobacter skirrowii* infection

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The history, circumstances, clinical signs, *post mortem* lesions, morbidity, mortality and laboratory findings are described in an abortion storm in sheep that occurred in Mpumalanga, South Africa, associated with infection with *Arcobacter skirrowii*. Altogether, about 200 Suffolk Down ewes lost 60 lambs in late pregnancy or at term. Although only three fetuses were submitted for investigation, two had signs consistent with a diagnosis of *A. skirrowii* infection and the organism was isolated from the placentas of both specimens. No abortions had occurred in previous years, or have subsequently. There were no animal introductions prior to the outbreak that could have indicated a source of infection. One stillborn lamb submitted subsequently had lesions consistent with dystocia, and the history and circumstantial evidence indicated that dystocia had been a factor in several more losses. No ewes or rams had shown signs of diarrhoea or other diseases associated with *A. skirrowii* infection. Twenty-two faecal, preputial and vaginal swab specimens taken from six rams and 13 ewes after the abortion event were all negative for *A. skirrowii*. This is the first report of abortions in sheep associated with *A. skirrowii* in South Africa. Because the genus *Arcobacter* is similar to *Campylobacter*, it is possible that infection has gone unrecognised in the past. Veterinarians and laboratories should take note and include this genus in the list of potential abortifacient organisms. The possible role of *Arcobacter* species in other diseases like enteritis and mastitis, as well as the potential role as a zoonosis, must be borne in mind.

Introduction

Perinatal mortality in lambs is widely regarded as a leading cause of preventable lamb losses (Aitken 2007; Bath & De Wet 2000; Haughey 1991; West, Bruère & Ridler 2002) and thus a very important factor in determining profitability on sheep farms in many countries. The majority of losses are usually attributed to non-infectious causes in most large surveys, where the starvation, mismothering and exposure complex is held to be the leading cause of death (Aitken 2007; Bath & De Wet 2000; Dennis 1970; Haughey 1991; West *et al.* 2002). However, on individual farms, infections causing abortion, stillbirths and weak lambs may become significant. In various countries, bacterial organisms like *Brucella melitensis*, *Campylobacter fetus*, *Salmonella* spp., *Listeria monocytogenes*, *Leptospira* spp. and others have been shown to cause ovine abortions (Bath & De Wet 2000; Coetzer & Tustin 2004; Fielden 1986). In addition, a range of viral infections have also been implicated (Bath & De Wet 2000; Coetzer & Tustin 2004; Fielden 1986; West *et al.* 2002). Because the preventive and control measures vary so much and are usually specific to the organism responsible, accurate identification of the causative agent is necessary for the correct advice to be given. Thus, in the case of bacterial causes, isolation of organisms known to cause abortion is part of a good diagnostic procedure.

Arcobacter is a genus that was separated from *Campylobacter* (formerly *Vibrio*) in the early 1990s (Altekruse & Perez-Perez 2006; Coetzer & Tustin 2004; Milesi 2010; Vandamme *et al.* 1991) and is a member of the Epsilonbacteria group. It has the same morphology as *Campylobacter*, *viz.* curved, s-shaped, or helical motile rods, and thus may have been confused with that organism in the past. The distinguishing features of *Arcobacter* are that all species are aerotolerant and can grow at lower temperatures than *Campylobacter* (Altekruse & Perez-Perez 2006; Coetzer & Tustin 2004; De Smet, De Zutter & Houf 2011; Lehner, Tasara & Stephan 2005; Milesi 2010; Vandamme *et al.* 1992). Twelve species have been identified, of which six have been found in humans or animals (Aydin *et al.* 2007; De Smet *et al.* 2011; Vandamme *et al.* 1992; Van Driessche *et al.* 2003), and four (*Arcobacter butzleri*, *Arcobacter cryaerophilus*, *Arcobacter skirrowii* and *Arcobacter thereius*) have been associated with reproductive disorders, enteritis or mastitis in domestic livestock (De Smet *et al.* 2011). Apart from the indications that these species can cause disease in domestic livestock, there is growing evidence that human infections can be related to occurrence in livestock (Houf & Stephan 2007; Lehner *et al.* 2005; Milesi 2010; Montvill & Matthews 2008; Vandenberg, Dediste & Houf 2004) and thus the genus is regarded as an emerging zoonosis (Collado & Figueras 2011; Houf & Stephan 2007; Milesi 2010; Vandenberg *et al.* 2004).

To our knowledge, the identification of *A. skirrowii* as a cause of disease in animals in South Africa has not been recorded in a scientific journal before, although there are unpublished records (M. Henton, pers. com., 2012). The presence of *A. skirrowii* in water sources in South Africa has, however, been officially reported (Diergaardt *et al.* 2004). In the major Southern African reference book *Infectious diseases of livestock* (Coetzer & Tustin 2004) the genus is mentioned but not recorded as a cause of abortion in sheep, although *Campylobacter foetus* and *Campylobacter jejuni* are listed (Irons *et al.* 2004). Abortion outbreaks attributed to *A. skirrowii* infection in sheep worldwide are not common (De Smet *et al.* 2011; Milesi 2010) and therefore a formal, brief report of its occurrence in South Africa is deemed to be of interest and use.

Case history

The abortion outbreak occurred near Delmas in Mpumalanga province, on a small farm running about 200 Suffolk ewes under semi-intensive conditions and irrigated pastures. Ewes were grazing pastures of kikuyu, rye grass and *Eragrostis* previously and from the start of April, winter oats that had been fertilised and irrigated. The ewes had been scanned ultrasonically and were fed extra supplements according to parity. In past years, the new born lambs had weighed 2.5 kg – 8 kg, with an average of 4.5 kg. During the abortion outbreak, the lambs were on average much lighter, with healthy new born lambs averaging only 3.5 kg. In normal years, the lambing was 120%, with very few losses to weaning, probably thanks to the standard use of lambing pens.

There were no records of similar outbreaks in previous seasons and no records of recent introductions of sheep or other livestock. The ewes were due to lamb from 15 May 2011 onwards and the first lamb loss was recorded on 28 April 2011. By 09 May 2011 there had been 11 abortions or stillborn lambs, which was much higher than in previous years. By the end of the lambing season, the farmer had lost 60 lambs out of 250 recorded (24%), although not all of these could necessarily be attributed to *A. skirrowii* or other infection.

Ewes had been vaccinated for enzootic abortion (Cevac[®], Ceva), Rift Valley fever (Onderstepoort Biological Products [OBP]) and bluetongue (OBP) 6 weeks before mating. The farmer had seen no signs of disease in them, including diarrhoea or mastitis, either prior to or during the outbreak.

The farmer reported that the neighbouring farm had goats and he had been told that some of the does had aborted. However, there was no follow-up or investigation of these losses. In the previous year (November 2010), the farmer had sold some 30 non-pregnant ewes and a ram to another farmer in the Koster district, where they were mated in January 2011. This second farmer said he had lost eight sets of twins but this case had not been investigated either.

Two aborted lambs and placentas were submitted to a private veterinary laboratory (Idexx Laboratories) for examination on 03 May 2011. Gross macroscopic findings for the first

lamb comprised a flattened cranium, brachygnathia inferior, brain congestion, unexpanded lungs, mild splenomegaly, cotyledons pale yellow-pink, joint laxity and mild renal congestion. The second lamb did not show signs of congenital defects but the cotyledons were also dull yellow, with possible petechiae. The internal organs were homogeneously pink and dry, suggesting early mummification, whilst the brain was autolytic.

Histopathological examination confirmed autolytic changes in the brain specimens but leukostasis was visible in some blood vessels, whilst some meningeal areas were hypercellular due to perivascular and interstitial accumulations of mononuclear cells, mainly lymphocytes, with some neutrophils. The placentas were characterised by a moderate neutrophilic inflammation in the cotyledon villi, with notable congestion of blood vessels. Some areas revealed necrotic cells, calcification and neutrophilic infiltration. In the liver specimens, autolytic changes hampered meaningful evaluation. The lung samples confirmed the atelectasis seen macroscopically and in addition the high cellularity of the alveolar walls indicated immaturity.

The clear presence of purulent placentitis in both cases and autolytic changes together with alveolar immaturity were supportive of an infectious abortion due primarily to placental damage and therefore tests were performed for known bacterial abortifacient organisms. The results were that chlamydiosis, brucellosis and Q fever could be ruled out. The initial smears and bacteriology were indicative of *Campylobacter* or *Arcobacter* infection, and subsequently *A. skirrowii* was isolated in heavy culture from both placental specimens. A presumptive diagnosis of *A. skirrowii* infection was thus justified.

Another lamb was presented to the Faculty of Veterinary Science on 10 June 2011, since lamb losses continued. This lamb revealed severe cerebral and cerebellar congestion and haemorrhage, but no other significant changes. Histopathology also revealed no significant changes except congestion and haemorrhages that confirmed the macroscopic observations. No pathogenic organisms, including *A. skirrowii*, were isolated. These findings support a diagnosis of dystocia (Aitken 2007; Bath & De Wet 2000; West *et al.* 2002).

A visit to the farm was arranged on 09 May 2011. Since the presence of *A. skirrowii* in sheath washings had been previously reported (Allen 2007), all six rams that had been mated with the ewes were subjected to vigorous swabbing of the sheath. The swabs were then placed in transport medium and kept on ice for transport to the laboratory. Eleven of the ewes that were identified as having recently aborted were swabbed vaginally and the specimens prepared for transport in the same way. Five ewes, three that had aborted and two that had not aborted but showed some soiling indicating

previous diarrhoea, were chosen for faecal sampling. All of these specimens were submitted on ice with minimal delay with a specific request to examine for the presence of *A. skirrowii*, but all 22 specimens were reported negative for this organism.

Discussion

A diagnosis of abortions due to *A. skirrowii* infection is justified for many but not all the losses experienced in this outbreak. From the farmer's records and one necropsy, dystocia was another important cause. However, the pattern of the outbreak, the macroscopic and microscopic lesions and other findings, including bacteriology, do support this diagnosis of infection by *A. skirrowii*. It is known (Allen 2007) that many sheep remain asymptomatic carriers of these organisms and that infection appears to be transient (De Smet *et al.* 2011; Van Driessche *et al.* 2005). The failure to detect any organisms in eleven vaginal swabs, six preputial swabbings and five faecal samples lends support to these previous findings. Bacterial placentitis explains the other lesions observed and was the proximate cause of the abortions. Based on knowledge of *Campylobacter* infections in cattle (Irons *et al.* 2004), a single sampling for the related *Arcobacter* is not enough to be confident that the sheep were necessarily all free of the infection, but subsequent enquiry revealed that the next lambing was normal, with just a few losses probably due to a variety of non-infectious causes (Aitken 2007; Bath & De Wet 2000; West *et al.* 2002). An intriguing aspect of the abortion storm was the light body weights of most lambs. It cannot be determined whether this was in some way connected with the infection, either as cause or effect, or if it was incidental. Also, the congenital lesions reported in just one lamb have not been reported before as part of the *Arcobacter* infection picture, nor are they usually associated with bacterial infections as a group.

Conclusion

This report confirms the presence of *A. skirrowii* in sheep in South Africa and its association with abortion. This organism should be added to the list of bacterial pathogens that have to be considered in the differential diagnosis of infectious abortions in sheep in the future.

Since the genus *Arcobacter*, including *A. skirrowii* was separated from the closely related *Campylobacter* (formerly *Vibrio*) genus only in 1991, and has not been reported in a scientific journal as a cause of animal disease in South Africa prior to this report, it is a reasonable likelihood that the responsible organisms in previous abortion events were wrongly identified, and ascribed to either *C. foetus* or *C. jejuni*. The true importance of the genus *Arcobacter* as a pathogen for animals and humans, and as a zoonosis, is yet to be determined in South Africa and should be investigated. Sources of infection and immunity after exposure to the organisms also require the attention of researchers.

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Competing interests

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

Authors' contributions

G.F.B. (University of Pretoria) obtained the history, took specimens, led the investigation and wrote the manuscript, R.L. (University of Pretoria) sourced references, took specimens and helped with the manuscript, K.P.P. (University of Pretoria) contributed to the investigation and article drafts, and D.J.C. (University of Pretoria) assisted with referencing and formatting the article, and presented the investigation at the 8th International Sheep Veterinary Congress, 22–26 February 2013 in New Zealand.

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