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Effect of Footrot on embryo losses in Polwarth sheep

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Abstract

Footrot is caused by the association of *Dichelobacter nodosus* and *Fusobacterium necrophorum*. The disease is characterised by severe lameness associated with initial inflammation at the coronary band, followed by progressive separation of the hoof capsule from the underlying tissue. This determines uneasiness in the animal and loss of body condition. Embryo losses are affected by several factors that interact with each other. Among them, the body condition of the sheep is an important factor. Therefore, this study aimed to evaluate the embryo losses associated with footrot in Polwarth sheep. In autumn, 130 ewes were synchronized with intravaginal sponges for 14 days. According to the footrot score diagnosed, three groups were made: Score 0) Healthy ;1) with minor injuries and 3) with more significant injuries without becoming serious (Scores 4 and 5). Embryo loss (EM) was measured from 18 days post-service to day 50, followed up every 5 days, by transrectal ultrasonography. Subsequently, the presence, number, and size of embryos or foetuses were recorded, as well as the presence of dead embryos or foetuses. The loss of body condition status was determined to have higher embryonic losses in group 3 (72,0%) than in the others (< 25,0).

Keywords: Sheep; Footrot; Embryo losses; Body condition

1. Introduction

Footrot is caused by the coexistence of two gram-negative, anaerobic bacteria, *Fusobacterium necrophorum* and *Dichelobacter nodosus* (also referred to as *Bacteroides nodosus*). Several different strains of *Dichelobacter* affect sheep and goats, and can also be carried by cattle, camelids, deer, and horses [1,2]. The bacteria *F. necrophorum* causes a common disease known as foot scald. *Fusobacterium necrophorum* is a natural inhabitant of the large intestine of small ruminants and is found normally in the soil and manure of pastures or feedlots. *Fusobacterium necrophorum* readily infects the soft, irritated area. Alone this bacterium is not capable of causing footrot. *Dichelobacter nodosus*, the second bacteria, is only capable of living in the soil for 10 to 14 days, yet can survive in the hoof for extended periods given the right anaerobic environment. These bacteria require irritation of the interdigital area, possibly due to moisture or trauma, to gain entry for infection. *Dichelobacter nodosus* was detected more frequently on feet with interdigital dermatitis, whereas *Fusobacterium necrophorum* was detected more frequently on feet with severe footrot [3]. *Fusobacterium necrophorum* has been considered a secondary pathogen in ovine footrot [4,5,6].

In sheep, one of the most efficient strategies to increase the ovulation rate, increasing the number of sheep lambing and litter size is the improvement of the nutritional plane before service [7,8,9]. However, some factors have a direct impact on reproductive outcomes, highlighting among them, reproductive losses. The main causes of losses during pregnancy are embryonic deaths (15-30% of oocytes released), with deaths during the fetal stage generally lower (5-7%) [10,11,12]. Unlike neonatal deaths, embryo loss, as it cannot be directly observed, is ignored or minimized by the sheep breeder.

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In the present experiment, embryo losses associated with mixed bacterial infection caused by *Dichelobacter nodosus* and *Fusobacterium necrophorum* were quantified.

2. Material and methods

2.1. Location

The work was carried out at the Experimental Station of the Faculty of Agronomy of Salto (latitude 31.23° South).

2.2. Animals

130 adult sheep of the Polwarth breed, in good body condition (BC) (3.0±0.35; scale from 0 to 5, [13], dewormed; they grazed with animals with footrot a month before the service. BC was determined at the end of the experiment (day 50) In autumn (April; 15.3-19.5 C°), the sheep were synchronized with intravaginal sponges (medroxyprogesterone, 60mg, Syntex®, Argentina) for 14 days.

2.3. Treatments

15 days after mating (pen mating: 7% of rams), a clinical examination of the hooves was performed on all the ewes, based on the scale described by Egerton et al. [4,14] (Figure 1). The severity of a footrot infection is scored on a scale of 1 to 5. Benign footrot, or inflammation between the claws, receives a score of 1 or 2. Under warm, moist conditions this can progress to virulent footrot, with a score of 3, 4, or 5. According to the score diagnosed, and after pregnancy was determined, three groups were made: Score 0) Healthy (n=33);1) with minor injuries (n=28) and 3) with more significant injuries (n=28) without becoming serious (Scores 4 and 5). Score 2 animals, due to their small numbers, were not considered.

2.4. Embryo losses determination

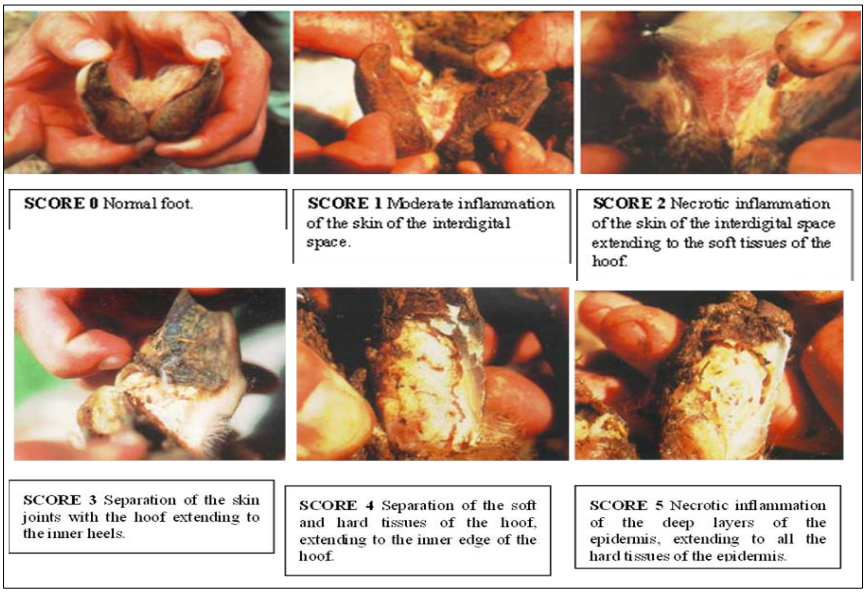

Figure 1 Scores of footrot according to Egerton et al. [14]

One week after mating, the ovulatory rate was determined by laparoscopy, using a 5 mm, 0° Storz endoscope. Embryo loss (EM) was measured from 18 days post-service to day 50, followed up every 5 days, by transrectal ultrasonography (ALOKA 550) (7.5 Mhz probe) and from 40 days using a transcutaneous probe (5.0 Mhz). Pregnancy was confirmed on the first ultrasound by observation of one or more live embryos. Subsequently, the presence, number, and size of embryos or foetuses were recorded, as well as the presence of dead embryos or foetuses. A pyrethroid-based spray product (Permethrin 10, PBI Gordon Corporation. USA) was applied every 5 days to prevent myiasis.

2.5. Data analysis

The differences in the analyzed reproductive parameters were evaluated through non-parametric tests (chi-square, Kruskal & Wallis) using the SYSTAT-7 statistical package (SPSS Inc., France, 1997).

3. Results and discussion

The results show a high increase in EM in animals with Score 3 (P<0.05; Table 1). BC is more related to the nutritional status of sheep than live weight. It determines reproductive performance. BC determines changes in the ovulation rate and fertility of sheep. Fertility, a result of the rate of fertilization and embryo survival, is lower in sheep of condition 2.25. According to Fernandez Abella and Formoso [15] fertility of sheep of regular body condition (2.25 to 2.75) is closely related to embryo losses. The discomfort of the footrot lesions affects the voluntary intake of forage, determining a reduction in the body condition [4-5].

Table 1 Effect of the score of footrot on the reproductive parameters

Footrot Score	Ovulation rate	Conception rate	Embryo losses (%)
0	1.20 a	94.0 a	22.1 a
1	1.15 ab	89.3 a	24.7 a
3	1.08 a	85.7 a	72.0 b
P<0.05			

Table 2 Variation of body condition score

Footrot Score	Day 0	Day 50	Embryo losses (%)
0	3.05 ± 0.34 a	3.10 ± 0.37 a	22.1 a
1	3.05 ± 0.35 a	3.15 ± 0.40 a	24.7 a
3	3.05 ± 0.45 a	2.60 ± 0.39 b	72.0 b
P<0,05			

Indeed, in this experiment, the disease progressed with the loss of body condition (3.05 *versus* 2.60; scores 0-1 *versus* 3). This loss of body status was determined to have higher embryonic losses than those observed in other works, in which the effects of diet and gastrointestinal parasites on EM were evaluated [11,15,16,17,18]. No associations between footrot and embryo loss have been reported in the literature. Therefore, this work would be the first to evaluate the effect of footrot on embryo losses in sheep.

4. Conclusion

It is concluded that significant lesions of the footrot (Score 3) can cause embryonic deaths of more than 70%, conditioned by a loss of body condition.

Compliance with ethical standards

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Disclosure of conflict of interest

None of the authors has any financial or personal relationships that could inappropriately influence or bias the content of the paper.

Statement of ethical approval

This work was approved by the Commission for Animal Experimentation of University of the Republic of Uruguay (CEUA).

References

[1] Ardüser F, Moore-Jones G, Gobeli Brawand S, Dürr S, Steiner A, Ryser-Degiorgis MC, Zanolar P. *Dichelobacter nodosus* in sheep, cattle, goats and South American camelids in Switzerland—Assessing prevalence in potential hosts in order to design targeted disease control measures Preventive Veterinary Medicine. 2020 May;178:104688. DOI:10.1016/ j.prevetmed.2019.05.001

[2] Knappe-Poindecker M, Gilhuus M, Jensen TK, Vatn S, Jørgensen HJ, Fjeldaas,T. Cross-infection of virulent *Dichelobacter nodosus* between sheep and co-grazing cattle. Veterinary Microbiology. 2014 June;170 (3–4):375-382.

[3] Witcomb LA, Green LA, Kaler J, Ul-Hassan A, Calvo-Bado L, Medley GF, Grogono-Thomas R, Wellington LMH. A longitudinal study of the role of *Dichelobacter nodosus* and *Fusobacterium necrophorum* load in initiation and severity of foot-rot in sheep. Preventive Veterinary Medicine 2014 March;115(1-2):248-255.

[4] Egerton JR, Roberts DS, Parsonson IM. The aetiology and pathogenesis of ovine foorot. A histological study of the bacterial invasion. Journal of Comparative Pathology 1969; 79: 207-216.

[5] Bennett G, Hickford J, Sedcole R, Zhou H. *Dichelobacter nodosus*, *Fusobacterium necrophorum* and the epidemiology of footrot. Anaerobe 2009 Aug;15(4):173-176. DOI: 10.1016/j.anaerobe.2009.02.002

[6] Clifton R, Giebel K, Liu N, Purdy KJ, Green L, Clifton, R Sites of persistence of *Fusobacterium necrophorum* and *Dichelobacter nodosus*: a paradigm shiftin understanding the epidemiology of foot-rot in sheep. 2019 Oct; 9: Scientific Reports 14429. DOI: 10.1038/s41598-019-50822-9

[7] Rattray P, Jagusch K, Smith J, Winn G, MacLean K. 1981. Effects of genotype, liveweight, pasture type, and feeding level on ovulation responses in ewes. Proceedings of the New Zeeland Society of Animal Production 41:174-182.

[8] Azzarini M. Non-genetic pathways to modify sheep prolificacy. In. 2nd Technical Seminar on Sheep Production.1985 pp. 111-132. SUL. Salto. Uruguay.

[9] Banchero G, Quintans G. Pre-incarnate management to increase the percentage of twins in Corriedale ewes. In: Annual Conference on Animal Production. Experimental Results. Experimental Unit Palo a Pique. INIA Treinta y Tres. Uruguay, October 2004. pp 6-8.

[10] A B Dixon AB, Knights M, Winkler JL, Marsh DJ, Pate JL, Wilson ME, Dailey, Seidel G, Inskeep EK. Patterns of late embryonic and fetal mortality and association with several factors in sheep. Journal of Animal Science 2007 May;85(5):1274-84. DOI: 10.2527/jas.2006-129.

[11] Fernández Abella D. Reproductive Technologies Bovine and Ovine. Hemisferio Sur SRL. Ed. 2015. pp. 200. Montevideo.

[12] Fernández Abella D. Embryo Losses in Sheep. International Journal of Zoology and Animal Biology 2023; 6(2): 000465. DOI: 10.23880/izab-16000465

[13] Jefferies B. Body condition scoring and its use in management. Tasmanian Journal of Agriculture 1961; 32:19-21.

[14] Egerton J.R , Ribeiro LA, Kieran P J, Thorley C M. Onset and remission of ovine Foot-rot. Australian Veterinary Journal 1983; 60:334-336.

[15] Fernandez Abella D, Formoso D. Embryo and foetal mortality in sheep II. Effect of body condition and stocking rate on embryo and foetal losses. Producción Ovina (SUL) 2007; 19: 5-13.

[16] Fernandez Abella D, Castells D, Piaggio L, Deleón N. Embryo and foetal mortality in sheep. I. Effect of different parasitic levels and their interaction with feeding on embryo losses and fertility. Producción Ovina (SUL) 2006 18: 25-31.

[17] Fernandez Abella D, Formoso D, Goicoechea I, Locatelli A, Scarlato S, Ibañez W, Irabuena O. Embryo and foetal mortality in sheep. III. Effect of forage allocation and artificial rainfall stress on ovulatory rate and reproductive losses in Corriedale sheep. Producción Ovina (SUL) 2007; 19:15 -23.

[18] Fernandez Abella D, Folena G, Formoso D, Irabuena O. Embryo and foetal mortality in sheep. IV. Effect of artificial and natural rainfall stress on ovarian activity and reproductive losses. Producción Ovina, (SUL) 2008; 20: 21-29