

CASE REPORT

Use of photodynamic antimicrobial therapy and laser therapy in the treatment of ovine infectious dermatitis

Utilização da terapia fotodinâmica antimicrobiana e fototerapia a laser no tratamento da dermatite interdigital infecciosa ovina

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Abstract

Ovine infectious dermatitis or foot rot is a cosmopolitan disease and causes losses in animal husbandry. The objective of this study was to report the clinical features of a case of foot rot in a sheep from Itabuna, Bahia and treatment of this case using the diode laser. Physical examination revealed that the patient exhibited claudication, did not place the hoof on the floor, had nails with irregular growth on the hoof, and showed displacement of the sole and wall with the corium exposed. The treatment consisted of daily cleaning of the lesions, foot trimming, and photodynamic antimicrobial therapy and laser therapy with a red laser in the foot lesions. The dosimetric parameters, energy (J) and fluence (J/cm²), varied according to characteristics and extent of the claw lesions. At the end of the treatment, a complete resolution of the foot lesions and absence of claudication were noted. Therefore, it can be concluded that the combination of photodynamic therapy and laser

therapy with the red laser might be an effective treatment for foot rot, and serves as a promising alternative to conventional treatments.

Keywords: *Dichelobacter nodosus*. Foot rot. Laser therapy. Photodynamic therapy.

Resumo

A dermatite interdigital infecciosa ovina é uma doença cosmopolita e ocasiona perdas econômicas na produção animal. O presente trabalho teve como objetivo relatar as alterações clínicas e o uso de fototerapias com laser em um caso de dermatite interdigital infecciosa em um ovino, proveniente de Itabuna, Bahia. No exame físico, o paciente apresentou claudicação, não apoio do casco no solo, unhas com crescimento irregular e deslocamento da sola

e muralha, com exposição do cório subjacente. Instituiu-se tratamento baseado em limpeza diária das lesões, para terapêutica, e associação da terapia fotodinâmica antimicrobiana e laserterapia de baixa potência com laser vermelho nas lesões podais. Os parâmetros dosimétricos, energia (J) e fluência (J/cm²) variaram de acordo com as características e extensão das lesões dos dígitos. Ao término do tratamento, houve cicatrização completa das lesões podais e ausência de claudicação. Conclui-se que a associação da terapia fotodinâmica antimicrobiana e da laserterapia com laser vermelho foi eficiente no tratamento, sendo uma alternativa promissora ao tratamento convencional.

Palavras-chave: *Dichelobacter nodosus*. Foot rot. Fotobiomodulação. Terapia fotodinâmica.

Introduction

Ovine infectious dermatitis or foot rot is a cosmopolitan disease that causes significant economic losses in ovine breeding, due to complications such as reduced productivity, reproductive problems, treatment expenditures, and involuntary discarding (Strobel et al., 2014; Silveira et al., 2016). The causative agent is *Dichelobacter nodosus* in association with *Fusobacterium necrophorum*, and possibly with spirochetes, which causes lesions in the epidermal tissues of the interdigital and corneal space of the hoof (Clifton and Green, 2016). The clinical presentation begins with an interdigital skin dermatitis and progress to separation of the sole and wall of the hoof, with exposure of the underlying corium (Winter, 2008; Silveira et al., 2016). The treatment consists of isolation, trimming, topical and systemic antibiotic therapy, as well as the use of footbaths (Winter, 2008; Strobel et al., 2014).

Antimicrobial photodynamic therapy (APDT) is an alternative therapeutic option to conventional treatments for localized infected lesions, which allows for the avoidance of the use of antibiotics and prevention of the development of bacterial resistance (Bagnato et al., 2017). This therapy involves the use of a photosensitizer, specific wavelength light, and molecular oxygen, which will initiate a chemical

reaction for the formation of reactive oxygen species and production of singlet oxygen, which in turn will destroy microorganisms by altering structures that are essential for their survival (Chavantes, 2009; Bagnato et al., 2017). Low-power laser therapy (LPLT) can be used alone or in combination with other therapies, and it brings about the following effects on injured tissue: analgesia, inflammation reduction, edema reduction, tissue restoration, and local microcirculation stimulation (Chavantes, 2009; Andrade et al., 2014).

The objective of this study was to report the clinical features of ovine infectious dermatitis and effects of the use of APDT and LPLT as an alternative treatment of lesions caused by ovine infectious dermatitis.

Case report

We present a case of infectious ovine interdigital dermatitis in a six-month-old, mixed-breed, sheep from the municipality of Itabuna-BA, which was treated at the Veterinary Hospital of the State University of Santa Cruz for foot injuries in the thoracic limbs. The patient presented severe claudication and did not support the right thoracic limb (RTL) in the soil. Digits with excessive growth of the corneal case, dermatitis in the interdigital space, separation of the abaxial wall and the sole with exposure of the corium, and presence of grayish exudate of putrid odor were observed; the hoof of RTL recorded a score of 4 and the hoof of the left thoracic limb (LTL) recorded a score of 3, according to the scoring system for clinical classification of infectious interdigital dermatitis (Ware and Kluver, 2014). The diagnosis of foot injury was made on the basis of anamnesis, clinical sign observation, and bacteriological testing involving the observation of *D. nodosus* via Gram staining.

The initial treatment consisted of the therapeutic trimming of the hooves and cleaning of lesions with 0.9% physiological solution (Figure 1). The lesion areas of the lateral digit and median digit of the RTL were 4.5 cm² and 4.0 cm² and those of the LTL were 14 cm² and 2.5 cm², respectively. A single APDT treatment session was initiated in which the foot lesions were irradiated with a continuously

emitting diode laser with 0.1 W of power, spot area of 0.028 cm², and irradiance of 3.5 W/cm². Initially, a gauze soaked with 5 mL of aqueous methylene blue solution (300 µM), with a pre-irradiation duration of five minutes and irradiated with a red laser ($\lambda = 660$ nm), with energy of 9 J per application point, fluency/point of 321 J/cm², and exposure time of 90 seconds. The number of points with a 1-cm interval between them, used to irradiate the lesions were two for the lateral and medial RTL digits and

four and one for the LTL lateral and medial digits, respectively. Two sessions of LPLT with 660-nm wavelength, energy of 1 J per point, fluency/point of 35.7 J/cm², exposure time/point of 10 seconds, were performed 24 and 96 hours after APDT. The numbers of points to irradiate the foot lesions were three for the RTL and four for the LTL. The hooves were protected by bandaging. Furthermore, the lesions were clinically evaluated daily until complete healing.

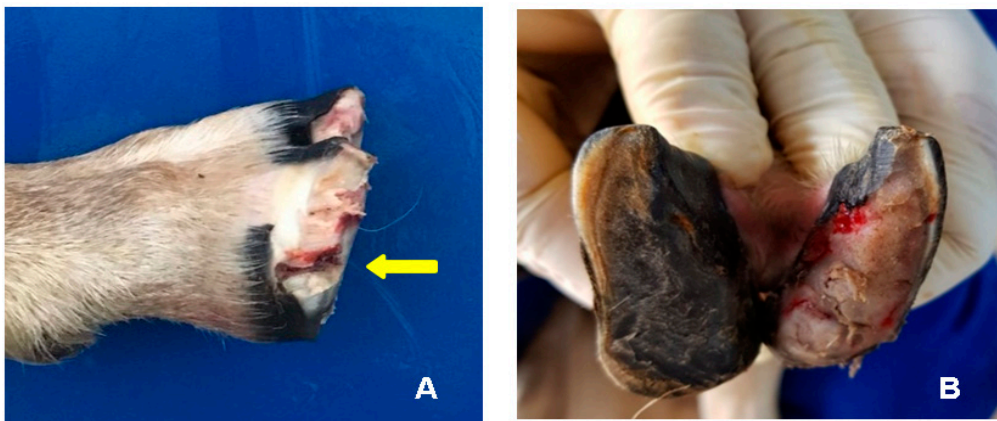


Figure 1 - Therapeutic trimming of the hooves. A: Removal of the abaxial wall and vertical fissure (arrow) in the lateral nail of the right thoracic limb. B: Removal of the sole necrotic structures in the medial nail of the left thoracic limb.

Results and discussion

Infectious ovine dermatitis is a common cause of claudication in sheep and the recommended treatment consists of trimming, footbath, and antibiotic therapy (Strobel et al., 2014; Silveira et al., 2016). For the present case, therapeutic trimming was performed in conjunction with APDT, as it allowed for the selective killing of several microorganisms without the use of antibiotics (Chavantes 2009; Gomes et al., 2016), and LPLT, as it allowed for biomodulation and biostimulation, which in turn cause cellular homeostasis (Chavantes, 2009; Andrade et al., 2014). The patient, after the end of APDT, presented a reduction in pain intensity, partially supporting the RTL hoof in the soil. Twenty-four hours after treatment, the interdigital dermatitis observed in the hooves of the RTL and

LTL presented reduction of inflammation and absence of secretion. The lesions in the hoof capsules presented a thin layer of keratinized epidermal tissue. After the first LPLT session, an increase in food intake and absence of inflammation in the hooves were observed. At the 2nd LPLT session, on the fifth day of hospitalization, re-epithelialization of the interdigital space, wall, and sole (Figure 2A) and analgesic effect on the foot lesions were evident, based on the absence of claudication and the hoof clamping test result. These results are caused by the photochemical effect associated with laser therapy, which restores cell energetic homeostasis, inhibits inflammatory mediators, as well as cause analgesia, endothelial and keratinocyte cell proliferation, increased synthesis and deposition of collagen, and neo-angiogenesis (Chavantes, 2009; Andrade et al., 2014). Corroborating with the results of the present

study, Sellera et al. (2017) treated ten lesions of digital dermatitis in dairy cows with two sessions of APDT and observed complete healing of the lesions

on day 28 and Gomes et al. (2016) reported that APDT was efficient in reducing claudication in cattle with digital lesions.

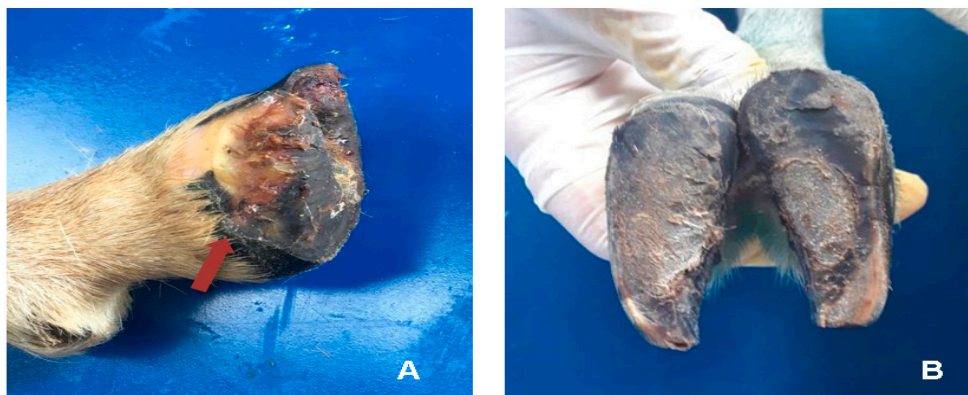


Figure 2 - A: Presence of keratinized epidermal tissues and reduction of fissure (arrow) in the right thoracic limb on day 5. B: Clinical recovery of foot injuries in the left thoracic limb on day 11.

Strobel et al. (2014) compared the efficacy of gamithromycin 6 mg/kg with that of oxytetracycline 20 mg/kg in the treatment of ovine pododermatitis. The study reported a reduction in claudication in both treatments on the ten farms participating in the study, with a 21-day cure rate of 79.3% for oxytetracycline and 93.7% for gamithromycin. In the present study, absence of claudication was observed on the fifth day, and increased dry matter intake and complete healing of foot lesions were observed on the eleventh day of hospitalization (Figure 2B).

Conclusion

Treatment with antimicrobial photodynamic therapy and laser therapy seems to be efficient in the recovery of foot lesions in sheep, even without the use of antibiotics, and results in an improvement in the patient's clinical condition, and in turn promotes animal welfare. In the present case, the ovine presented reduction of claudication and of foot injuries in a short period of time; thus, it seems to be a promising complementary

therapy. As it is the first report on the use of laser phototherapy in infectious ovine dermatitis, further studies are needed to establish consensus regarding dosimetry parameters and session frequency, and confirm the effects observed in the present case.

References

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