Small Ruminant Research 144 (2016) 17–22

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Docked tail length is a risk factor for bacterial arthritis in lambs

Joan Lloyd[a,*], Allan Kessell[b], Idris Barchia[c], Johann Schröder[d], David Rutley[e,f]

[a] Joan Lloyd Consulting Pty Ltd., P.O. Box 496, West Ryde, NSW 1685, Australia
[b] Gribbles Veterinary Pathology, Glenside, SA 5065, Australia[1]
[c] Elizabeth Macarthur Agricultural Institute, NSW Industry, Private Bag 4008, Narellan, NSW 2567, Australia
[d] Meat & Livestock Australia, P.O. Box 1961, North Sydney, NSW 2059, Australia
[e] Thomas Foods International, Lagoon Road, Murray Bridge, SA 5253, Australia
[f] School of Animal and Veterinary Science, The University of Adelaide, Roseworthy, SA 5371, Australia

ARTICLE INFO

Article history:
Received 9 June 2016
Received in revised form 24 July 2016
Accepted 25 July 2016
Available online 26 July 2016

Keywords:
Sheep
Arthritis
Tail docking
Erysipelothrix rhusiopathiae
Streptococcus suis

ABSTRACT

Arthritis is commonly observed in lambs at slaughter, resulting in losses due to carcase downgrading, trimming or condemnation. The condition arises on-farm and is thought to be influenced by a number of predisposing factors, which vary in their ability to be addressed by sheep producers. The aim of this study was to investigate whether there is a link between tail length and arthritis in lambs. If there is, leaving a longer tail stump when docking may be a cost-effective way of reducing the prevalence of joint infections in lambs. The study was conducted at an abattoir in South Australia and included 63,287 carcases. This study found a correlation between short-docked tails (fewer than three coccygeal vertebrae remaining) and bacterial arthritis in lambs. Other risk factors for arthritis included breed and the regional source of the lambs, but not age. The constraints of data collection within the abattoir did not allow the effects of tail docking method, sex or whether male lambs had been castrated on the prevalence of bacterial arthritis to be determined. The bacterium most commonly isolated from abnormal joints was *Erysipelothrix rhusiopathiae*, followed by *Streptococcus* spp., including *Streptococcus suis*.

1. Introduction

The docking of lambs' tails is a long-standing practice used to reduce the life-long susceptibility of sheep to breech fly strike. The length of the docked tail has life-long consequences for animal welfare if it is done incorrectly (mostly, too short). In Australia, the current recommendation for ewe lambs is to dock the tail immediately below the third palpable joint or through the third joint space, a recommendation that was first published in 1943 (Anon, 1943) based on research conducted with both mulesed and unmulesed sheep (Gill and Graham, 1938, 1939; Graham et al., 1941; Riches, 1941, 1942; Johnstone, 1944). It is recommended that male lambs have their tails docked to the same length as ewe lambs. This will result in the healed tail protecting the anal region and extending to around the tip of the vulva in ewes. Short tails predispose lambs to rectal prolapse (Thomas et al., 2003) and, later in life, to squamous cell carcinoma of the perineal region (Swan et al., 1984). A short tail takes longer to heal after docking than a longer tail, and is more prone to infection and flystrike (Johnstone, 1944; Watts et al., 1979).

Bacterial arthritis/polyarthritis is a significant cost to the Australian sheep industry, estimated at A$39m annually (Lane et al., 2015). Globally, *Erysipelothrix rhusiopathiae* is considered to be the most common cause of bacterial polyarthritis in lambs (Thompson, 2007). In lambs, infection with *E. rhusiopathiae* usually develops first at a site on the skin, most commonly infected docking and castration wounds. Infection can be limited to the skin or spread via the circulation to the joints.

The aim of this study was to investigate whether there is a link between tail length and arthritis in lambs. If there is, leaving a longer tail stump when docking may be a cost-effective way of reducing the prevalence of joint infections in lambs. The hypothesis was that short docking leads to infected tailing wounds that take longer to heal, with subsequent haematogenous spread of bacteria to the joints, resulting in arthritis.

2. Materials and methods

2.1. Survey of tail length and arthritis

The survey of tail length and arthritis was conducted at the Thomas Foods International abattoir at Murray Bridge in

* Corresponding author.
E-mail address: joan@joanlloydconsulting.com.au (J. Lloyd).
[1] Current address: College of Public Health, Medical and Veterinary Sciences, James Cook University, Townsville, QLD 4814, Australia.

http://dx.doi.org/10.1016/j.smallrumres.2016.07.018
0921-4488/

South Australia. The abattoir data collection was conducted in three phases, December 2014–January 2015, March 2015 and September–October 2015.

Carcases with arthritis were identified by Australian government Department of Agriculture and Water Resources (DAWR) (formerly AQIS)-accredited meat inspectors by visual inspection in accordance with the Australian Standard for the Hygienic Production and Transportation of Meat and Meat Products for Human Consumption (Anon, 2002). The arthritic joints were not opened during the inspection process, although some joints had been damaged during processing prior to the point of inspection.

The tail length of the carcases was determined by palpating the number of coccygeal vertebrae present in tail of the carcase after skinning and inspection, but prior to tail removal. Only tails that had not been damaged during processing were assessed. Within a consignment of lambs, the tail lengths of all carcases with arthritis were recorded. In addition, the tail lengths of as many carcases as possible without arthritis were also determined, with the aim of collecting tail length data on every third non-arthritic carcase or a minimum of 25 non-arthritic carcases per line, within the constraints of the chain speed (approximately 10–11 carcases per minute). Tail lengths were recorded manually using a data capture sheet and then transcribed to a Microsoft Excel spreadsheet.

Lamb age, breed and property identification code (PIC) were obtained from abattoir records. It was not possible to determine the sex of the animals because the majority of the lambs and young lambs in Australia are marketed as mixed sex consignments and sex is not determined pre-slaughter or recorded by abattoirs. By the time a carcase reaches the point of inspection within an abattoir, the sex of the lamb from which is originated can no longer be determined. Lamb age was determined by abattoir personnel who checked the dentition of the animals at the time of slaughter. A lamb is defined as female, castrate or entire male ovine that has zero permanent incisor teeth and a young lamb as a female, castrate or entire male ovine that has zero permanent incisor teeth and no evidence of eruption of permanent upper molar teeth (AUS-MEAT Limited, 2010). The PIC code was assigned to a region within South Australia using a key provided by Primary Industries and Research South Australia. For lambs sourced from outside South Australia, region was at the level of the State.

2.2. Collection of arthritic joint samples

Following trimming of affected joints by the meat inspectors, the joints were placed in plastic bags (one bag per carcase) and stored in buckets on the slaughter floor until the next break, when they were placed on ice. This ensured that all the sampled joints were chilled within two hours of collection. The joints sampled were from the legs and included the carpus, elbow, tarsus and stifle. Metacarpal and metatarsal joints could not be sampled because these had been removed from the carcases prior to the point of inspection. At the end of each five hour shift, all the collected joints and associated trim were re-examined grossly and damaged joints discarded because of the possibility of cross-contamination on the slaughter floor.

During December 2014 and in January and March 2015 joints that had not been damaged during processing were placed back on ice for up to 18 h prior to collection of samples for bacterial culture. A sterile set of instruments was used to remove subcutaneous and *peri*-synovial tissue from around the joint and then a second set of sterile instruments was used to open the joint. A sterile swab of joint fluid was collected, as well as samples for histopathology (synovial tissue in 4% buffered neutral saline). In September and October 2015 samples for bacterial culture and for histopathology were collected at the end of each shift. The exterior surfaces of the joints that had not been damaged during processing were sprayed with 70% alcohol and a 0.9 by 40 mm needle attached to a 10 mL sterile syringe used to aseptically aspirate joint fluid. The joint fluid was transferred to a sterile blood collection tube and to a swab in transport media. Each joint was then opened and synovial tissue samples taken for histopathology.

During December 2014 and in January 2015 only the most swollen, undamaged joint per carcase was sampled for bacterial culture. In March, September and October 2015, in an effort to improve the positive-culture rate, all the undamaged abnormal joints from each carcase were sampled for bacterial culture. No joints classified as negative by the inspectors were sampled because these joints were not trimmed from the carcases. In the abattoir in which the study was conducted, farmers were paid 'over-the hooks' based on final carcase weight and to trim normal joints would have resulted in an unnecessary financial penalty.

2.3. Bacterial culture

Joint fluid and swabs were plated on Horse Blood Agar/MacConkey Agar (ThermoFisher Scientific), Columbia Naladixic Acid Agar (ThermoFisher Scientific) and Chocolate Agar (ThermoFisher Scientific) and cultured aerobically for 48 h, as well as being plated on NEO Agar (ThermoFisher Scientific) and cultured anaerobically for 48 h. The joint fluid and swabs were also inoculated into CSF broth (ThermoFisher Scientific), incubated aerobically for 24 h and then sub-cultured onto Chocolate Agar and NEO Agar and the plates incubated for a further 48 h.

Bacterial isolates were identified by a combination of gram stain, catalase, oxidase, kit identification, Matrix Assisted Laser Desorption Ionization—Time of Flight (MALDI-TOF) and/or 16S rRNA sequencing.

2.4. Histopathology

Tissue was fixed in 4% phosphate buffered formalin and trimmed as required after fixation. Following routine processing, 4 μm sections were stained with Mayer's haematoxylin and Young's eosin, and examined microscopically.

Synovial proliferation and inflammatory infiltrate results were allocated to seven categories, from nil, minimal, mild, mild to moderate, moderate, moderate to marked or marked, with the cell type or types comprising the inflammatory infiltrate described. Other changes (i.e. haemorrhage, fibrosis) were also noted.

2.5. Statistical analysis

A subset of the arthritis data with reliable tail length data (i.e. tail length data on all carcases in a consignment with arthritis and at least 25 or all carcases within a consignment without arthritis) was selected for analysis of the potential link between arthritis and tail length. The distribution of carcase samples examined in total and selected for the analysis is presented in Table 1. The majority of the selected samples were crossbred lambs. Fat accumulated within the tails of Dorper lambs and young lambs made reliable palpation of coccygeal vertebrae extremely difficult.

If a joint was trimmed for arthritis by the inspectors but found to be normal on histopathological examination and negative on bacterial culture or on PCR for *Chlamydia pecorum* (Lloyd, 2016) data from that carcase was excluded from the analysis. The rationale for this was that the animal did not have arthritis. Trimmed joints that were abnormal on histopathological examination, but negative on bacterial culture or on PCR for *C. pecorum*, were included in the analysis because it was assumed that these animals did have arthritis.

All of the binary data (0 = arthritis absence; 1 = arthritis presence) were used to investigate the relationship between arthritis