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Lameness in dairy heifers; impacts of hoof lesions present around first calving on future lameness, milk yield and culling risk

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ABSTRACT

The importance of lameness in primiparous dairy heifers is increasingly recognised. Although it is accepted that clinical lameness in any lactation increases the risk of future lameness, the impact of foot lesions during the first lactation on long-term lameness risk is less clear. This retrospective cohort study aimed to investigate the impacts of foot lesions occurring around the time of first calving in heifers on future lameness risk, daily milk yield and survival within a dairy herd. Records were obtained for 158 heifers from one UK dairy herd. Heifers were examined in 2 month blocks from 2 months pre-calving through to 4 months post-calving. Sole lesions and white line lesions were scored on a zero to 10 scale and digital dermatitis on a zero to 3 scale. Outcomes investigated were; lameness risk based on weekly locomotion scores, average daily milk yield and culling risk. Mixed effect models were used to investigate associations between maximum lesion scores and outcomes. Lesion scores in the highest score categories for claw horn lesions (sole lesions and white line lesions) in the 2 to 4 month post-calving period were associated with an increased risk of future lameness; heifers with white line lesion scores ≥3 compared with scores zero to 1 and heifers with sole lesion scores ≥4 compared with score 2, at this time point, had a predicted increased risk of future lameness of 1.6 and 2.6 respectively. Sole lesions ≥4 were also associated with a reduction in average daily milk yield of 2.68 kg. Managing heifers to reduce claw horn lesions during this time period post-calving may provide health, welfare and production benefits for the long-term future of those animals. A novel finding from the study was that mild lesion scores compared with scores zero to 1, were associated with a reduced risk of future lameness for white line lesions and sole lesions occurring in the pre-calving or 2 to 4 months post-calving periods respectively. Mild sole lesions in the pre-calving period were also associated with a reduced risk of premature culling. One hypothesis for this result is that a mild insult may result in adaptive changes to the foot leading to greater biomechanical resilience and so increased longevity.

1. Introduction

Lameness is one of the most significant diseases currently impacting on dairy cow health, welfare and productivity (Huxley, 2013). Since a first occurrence of lameness increases the future risk of lameness (Hirst et al., 2002; Green et al., 2014; Randall et al., 2015), lameness in dairy heifers has the potential to have a severe impact on their overall lifetime performance within the herd. The significance of this is most pronounced when considering the high prevalence of lesions in heifers (Manske et al., 2002; Capion et al., 2009; Maxwell et al., 2015). Capion et al. (2009) found the prevalence of moderate to severe sole haemorrhage and white line lesions in 147 Danish Holstein heifers was 55% and 72% at 1–100 days in milk (DIM) respectively and the prevalence of digital dermatitis (DD) peaked at 39% at 0–100 DIM. Similarly, Maxwell et al. (2015) reported that 95% of a cohort of 139 Holstein dairy heifers being trimmed at between 50 and 80 days post-partum had some pathology on at least one claw. Lameness in the first lactation has been associated with a doubling of the hazard for lameness in the second lactation (Hirst et al., 2002). Consequently, Bell et al. (2009) suggested that a critical control point for lameness in dairy

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cattle should aim to prevent claw horn lesions and digital dermatitis in heifers. The transition period, around the time of calving, has been identified as an important risk period, with increased stress related to physiological changes, social factors and changes in housing that impact on the risk of lameness occurring in heifers (Tarlton et al., 2002; Bergsten et al., 2015). Webster (2002) reported that heifers housed in straw yards for eight weeks after calving before being moved to cubicle housing resulted in less severe sole haemorrhages compared to heifers introduced to cubicle housing four weeks before calving. This finding demonstrated that housing practices around the time of calving affect the development of foot lesions in dairy heifers. The impact of lesions in heifers on long-term lameness is not yet known and could have major implications for the future health and welfare of the dairy herd.

Lameness in dairy cows has also been demonstrated to be associated with significant impacts on performance, such as reduced milk yield and increased culling risk (Booth et al., 2004; Amory et al., 2008). For other diseases, such as mastitis, it has been shown that disease occurring in heifers affects lifetime performance, for example an increase in somatic cell count in heifers in early lactation negatively impacts on lifetime milk yield (Archer et al., 2013). This relationship may also be true for lameness, but has not yet been fully explored.

This study aimed to investigate the long-term impacts of hoof lesions that occur around the time of first calving in heifers, on lameness, daily milk yield and culling risk. A retrospective cohort study using mixed effect logistic regression and linear regression models was conducted to test the null hypothesis that hoof lesions occurring around the time of first calving in heifers have no impact on future lameness risk, average daily milk yield and culling risk in one UK dairy herd.

2. Materials and methods

2.1. Study herd

Records for 158 Holstein Friesian heifers that calved for the first time between August 2003 and March 2006 were obtained from the Scotland's Rural College (SRUC) Dairy Research and Innovation Centre in Dumfries, Scotland. Lifetime data for these animals were collected from September 2003 to August 2011. The SRUC centre has two pedigree research herds which are based at the same site; the 'Langhill' systems herd and 'Acrehead' herd. Cows remained within the Langhill herd for typically 3 lactations, after which they were moved to Acrehead, however if no replacement heifers were due to calve within 2 months, the cow remained at Langhill for one or more additional lactations (Roberts and March, 2013).

The Langhill herd was managed on a long-term 2×2 factorial genetic and feed management system that comprised two contrasting dairy management systems; low forage, continuously housed (LF) and high-forage, grazed (HF) groups. Cows belonging to one of two genetic lines, Control (C) and Select (S), were divided equally between the management systems (Pryce et al., 1999). These management systems are described in further detail below. The Acrehead herd was managed as a separate research and experimental herd with no long-running feed or management groups.

2.1.1. Young-stock management prior to first calving

At the Langhill site, heifers calved all year round. Young-stock were reared in stable groups of approximately 25 animals from weaning to the start of their first transition period at approximately eight weeks before calving. As calves, they remained with the dam until at least 24 h of age, and were fed 2 l of colostrum by stomach tube. Following removal from the dam, calves were housed individually indoors in straw-bedded pens and received 2 l of pooled colostrum twice daily for up to 7 days, followed by 6 l per day of calf milk replacer. After ten days, calves were housed in group pens with deep straw bedding; the UK minimum recommended space allowance (Defra, 2003) was exceeded at all times. Fresh water was available from drinking bowls fitted to the wall of the building and calf milk replacer was fed via automatic feeders. Calves were weaned at approximately 50 to 60 days and managed as one group of dairy replacement young-stock; they were reared indoors until their second summer. Heifers were grazed during their second summer and then fed a young-stock ration when housed during winter. Table 1 presents a summary of the typical formulation for the young-stock ration. Housing was straw bedded pens until 12 to 15 months of age, at which time all heifers were moved to cubicle housing with mattress and sawdust until the transition period. Passageways were grooved concrete. Target age at first calving was 24 months; first service was scheduled at approximately 350 kg of BW and 15 months of age. All inseminations were artificial. No routine foot trimming was performed prior to first calving. Footbathing was carried out monthly for young-stock using 5% copper sulphate solution. Live weight was recorded monthly using walk-in weigh scales. Prior to the start of the transition period before first calving, heifers were separated according to the feeding system to which they had been allocated (described below) and were fully housed in straw bedded pens until calving. The same management protocols were applied by the same stock persons and technicians throughout the study period.

Table 1
Example young-stock ration fed to dairy heifers calving during the time period August 2003 to March 2006 at the Scotland's Rural College (SRUC) Dairy Research and Innovation Centre.

Description	DM (%)	Actual Weight (kg/animal)	
Young-stock ration	54.66	16.10	
		Actual kg/animal	% Load
Straw	80.00	6.00	37.27
Distillery co-product	30.00	8.00	49.69
General purpose minerals	100.00	0.10	0.62
Molasses	75.00	2.00	12.42

2.1.2. Lesion scoring around first calving

During the period 1st September 2003 to 31st January 2006, all four feet of heifers were lifted and lesions were recorded on standardised hoof maps (Greenough and Vermunt, 1991). Examinations were carried out by the same veterinary surgeon at regular intervals, approximately two months apart, with an average of 37 heifers being examined each time over the three year period 2003 to 2006. Lesions were severity scored on a 1 to 10 scale for sole or white line lesions (1 to 5 for haemorrhage and 6 to 10 for sole ulcers or white line separation) and a 1 to 3 scale for digital dermatitis (1 for mild or 3 for severe) as described by Offer et al. (2000) and Leach et al. (2005) (Table 2).

2.1.3. Management subsequent to first calving

As heifers calved they were introduced into the Langhill milking herd, remaining within the feeding system to which they had been allocated prior to calving. The detailed diet and management systems for the herd have been described by Chagunda et al. (2009). Briefly, low forage (LF) cows were housed continuously throughout the year whilst high forage (HF) cows were housed during winter months (typically November to March) and grazed during summer months provided sufficient herbage was available. When housed, cows were fed a complete diet that was between 45% and 50% forage in the dry matter (DM) for those in the continuously housed, low forage group, and 70% to 75% forage in the DM