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Systemic prepartum treatment of end-term dairy heifers with penethamate hydriodide: Effect on udder health, milk yield, and culling until 120 days in milk

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ABSTRACT

Prepartum intramammary treatment with antimicrobials of end-term dairy heifers has frequently been proposed as a practice to reduce the prevalence of intramammary infections (IMI) at calving. From a safety standpoint for both animal and administrator, systemic treatment is preferred. A clinical trial was conducted on heifers from 10 well-managed, commercial dairy farms with a low prevalence of heifer mastitis. The aim was to assess both the short- and long-term effects of a systemic prepartum therapy with penethamate hydriodide on udder health and milk production. Because it was hypothesized that some herds would benefit more from this treatment than others, specific herd-level information was collected before the start of the actual trial to screen for and explain potential herd-specific treatment effects. Further, the effect of treatment on antimicrobial susceptibility of staphylococcal isolates was monitored. End-term heifers were either treated systemically (over 3 consecutive days) 2 wk before expected calving date with penethamate hydriodide (n = 76) or remained untreated (n = 73). Systemic prepartum treatment of end-term heifers with penethamate hydriodide resulted in fewer IMI in early lactation. However, all 6 cases of clinical mastitis in early lactation occurred in the treatment group [*Streptococcus uberis* (n = 1), *Corynebacterium bovis* (n = 1), *Staphylococcus aureus* (n = 1); 1 sample was contaminated; 2 samples remained culture negative]. No long-term treatment effects (from 4 to 120 d in milk) on milk production, udder health, or culling hazard during later lactation were detected, although treated heifers belonging to herds classified as having low-yielding heifers out-produced the control heifers. Moreover, penicillin susceptibility of staphylococci isolated from milk samples of treated or control heifers did not differ. Herds with a low prevalence of heifer mastitis are not likely to benefit from prepartum systemic antimicrobial treatment of the end-term heifers.

Key words: clinical trial, heifer mastitis, penethamate hydriodide, prepartum treatment

INTRODUCTION

Generally, bred heifers are assumed to have no issues with udder health and for that reason their mammary glands and secretions are often not checked until calving (Nickerson, 2009). However, a large proportion of dairy heifers calve with infected quarters (Fox, 2009). Studies have shown a wide variation in prevalence, from 29.0 to 74.6% (Oliver and Mitchell, 1983; Trinidad et al., 1990a) and from 12.3 to 55.0% (Roberson et al., 1994; Parker et al., 2007) of quarters being reported as culture positive before and at calving, respectively. Several different pathogens have been isolated but studies have shown that infections are predominantly caused by gram-positive bacteria, specifically CNS, *Staphylococcus aureus*, and environmental streptococci (Fox, 2009). Heifer mastitis can have a negative effect on future productive life (De Vliegher et al., 2004, 2005a,b), the effect depending on factors such as virulence of the pathogens involved and time of onset of the IMI during gestation (Piepers et al., 2009). The cost of subclinical heifer mastitis in early lactation alone on an average Dutch or Flemish dairy farm has been estimated to vary from €4 to €82 per heifer with an average of €31 (Huijps et al., 2009).

The use of prepartum antimicrobial treatment of end-term heifers in the control of heifer mastitis has been studied using short-acting intramammary preparations, administered between 6 and 21 d before calving. (Oliver et al., 1992, 2004; Middleton et al., 2005; Borm et al., 2006; Roy et al., 2007) and long-acting intramammary preparations, administered between 0 and 270 d before calving (Trinidad et al., 1990b; Owens et al., 1991, 1994, 2001; Sampimon et al., 2009). The majority of those studies showed positive effects in the short term,

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as seen by higher cure rates of IMI detected before calving and a lower prevalence of IMI at calving in treated heifers compared with untreated controls (Nickerson, 2009). One could argue that it makes more sense from an economical point of view to study the treatment effects in the longer term rather than in the short term. Trinidad et al. (1990b) studied milk production during the first 2 mo of lactation and showed that *Staph. aureus*-infected heifers that had received prepartum dry cow therapy (penicillin and dihydrostreptomycin) produced an average of 2.5 kg more milk per day than *Staph. aureus*-infected herdmates that did not receive treatment. Oliver et al. (2004) showed that prepartum intramammary treatment using short-acting preparations (penicillin-novobiocin and pirlimycin hydrochloride) was effective in reducing the percentage of infected heifers and quarters during the first 30 DIM, whereas Sampimon et al. (2009) reported positive long-term effects of dry cow antimicrobial (cloxacillin) treatment 8 to 10 wk before the expected calving date on the incidence of clinical mastitis (**CM**), test-day SCC, and test-day milk yield (**MY**) in first lactation. The study of Oliver et al. (2004) is contrasted with the findings of Middleton et al. (2005), who observed that intramammary treatment using short-acting preparations (pirlimycin hydrochloride) did not necessarily reduce SCC or result in higher milk production during the first lactation, although a higher overall cure rate at calving was noted.

Borm et al. (2006) concluded, based on the results of milk production, that prepartum treatment of end-term heifers with short-acting intramammary preparations (cephapirin) was not uniformly efficacious across herds, but potential herd-level factors explaining the findings were not studied further. Bryan and Taylor (2009) also reported a strong herd effect in their study, demonstrating that systemic treatment with a single large dose of intramuscular penicillin within 12 h after calving was successful in significantly reducing the incidence of CM in heifers within the first 7 DIM. Given these results, use of prepartum antimicrobial therapy in end-term heifers, as a universal and economical viable strategy to increase milk production and improve udder health in heifers, is not warranted. However, because some herds seem to benefit from treatment and others do not, it would be useful to understand why this is and what kind of factors are associated with that finding, specifically in the light of prudent and substantiated use of antimicrobials.

Systemic antimicrobial treatment of end-term heifers has several advantages over intramammary treatment: a lower risk of teat contamination, a higher convenience and safety to administer, and 4 quarters being treated with a single administration. Systemic use of penethamate hydriodide before calving was associated with penicillin G levels in mammary tissue and secretion substantially higher than the MIC_{90} (the concentration required to inhibit growth of 90% of the organisms) of pathogens associated with heifer mastitis (Passchyn et al., 2010). However, the limited number of studies that have looked at systemic treatment showed either no effect (Parker et al., 2008; using tylosin) or a positive effect and were only conducted on problem herds (Kreiger et al., 2007; using penethamate hydriodide).

Antimicrobial agents are necessary for decreasing the prevalence and incidence of bacterial diseases in animals. Their use in veterinary medicine can have a positive effect on animal health, animal well-being, and productivity when used with sound clinical judgment combined with sound management practices (Johnston, 1998). Excessive or injudicious use of antimicrobials should, however, be avoided at all time. Given the recent concerns related to the emergence of antimicrobial resistance in human and animal pathogens and the possible link with the use of antimicrobials in livestock, monitoring the development of antimicrobial resistance, even in the short term, in treatment trials obviously reflects good practice. Antimicrobial resistance of udder pathogens in Belgium (Annual Report 2011, Milk Control Centre Flanders, Lier, Belgium) is low and in line with that in other countries (Erskine, 2006).

A clinical trial was conducted on heifers from 10 well-managed, commercial dairy farms with a low prevalence of heifer mastitis. The aim was to assess both the short-term and long-term effects of a systemic prepartum therapy with penethamate hydriodide 2 wk before the expected date of calving on udder health and milk production. Because it was hypothesized that some herds would benefit more from this treatment than others, herd-level information was collected before the start of the actual trial to screen for and explain any herd-specific treatment effect. Further, the effect of treatment on susceptibility of staphylococcal isolates from milk was monitored.

MATERIALS AND METHODS

Herds, Heifers, and Study Design

The study was conducted between September 2008 and June 2010 and included 229 heifers from 10 commercial dairy herds, located in a radius of 20 km around Torhout, in the province of West Flanders, Belgium (Table 1). In total, 80 heifers served as monitoring heifers, 76 heifers were treated, and 73 were untreated control heifers. Herd owners were approached by the first author and asked whether they were willing to participate. All herds had a good animal identification