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Relationship between postmilking standing duration and risk of intramammary infection in freestall-housed dairy cows milked 3 times per day

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ABSTRACT

Recent evidence exists to suggest that the risk of subclinical mastitis, particularly those infections caused by environmental pathogens, in dairy cows is related to standing and lying patterns. The objective of this study was to determine the association between postmilking standing duration (PMSD) of dairy cows milked 3×/d and risk of intramammary infection (IMI). Four commercial freestall dairy herds in Eastern Ontario, milking 3×/d, were enrolled in a longitudinal study. Forty Holstein-Friesian cows per herd were randomly selected as focal animals from those cows in each herd that met our selection criteria of days in milk (<200 d) and somatic cell count (<100,000 cells/mL). The study consisted of three 28-d periods. The study began following a regularly scheduled Dairy Herd Improvement test with the collection of quarter-level milk samples from all focal animals. Bacteriology was used to confirm infection status at the start of the study and for determination of incidence of IMI throughout the study. A new IMI was defined as having a culture-positive quarter-level sample when the previous sample (28 d prior) had been culture negative for the pathogen of interest. Four sets of quarter-level milk samples were obtained for each focal animal. Lying behavior was recorded for 5 d after each milk sampling using data loggers. For these 5 d, individual milking times, production, and feeding times were also recorded. Postmilking standing duration was analyzed by milking event, with increased PMSD being positively associated with provision of fresh feed or freshly pushed-up feed around the time of milking, greater feed bunk space per cow, and lower freestall stocking density. Over the study period, 456 new IMI were detected, resulting in a mean herd incidence rate of 3.22 IMI per quarter year. Coagulase-negative staphylococci (CNS) and *Corynebacterium* spp. IMI were statistically analyzed to determine relationship with PMSD; they were the 2 predominant pathogens representing 45 and 31% of IMI, respectively. Only CNS IMI was associated with PMSD. A nonlinear relationship between PMSD and incidence of CNS IMI was found; cows with a PMSD of 90 to 120 min were at a reduced risk for CNS IMI. The risk of experiencing CNS IMI was also reduced with increased frequency of feed push-ups and provision of fresh feed 60 min before to 90 min after milking and >540 min after milking. These results indicate that management practices that promote PMSD of 90 to 120 min, such as the provision of fresh feed or freshly pushed-up feed around the time of milking, providing ample feed bunk space per cow, and keeping freestall stocking density low, should be encouraged to reduce the risk of CNS IMI in freestall-housed cows milked 3×/d.

Key words: mastitis, behavior, dairy cow

INTRODUCTION

Encouraging cows to remain on their feet after milking has been a long-accepted practice surmised to decrease the incidence of IMI in lactating dairy cows. This practice is thought to increase the likelihood that the teat canals will have closed before the udder contacts the stall substrate when the cow lies down, thus decreasing the odds of bacterial penetration of the teat, and by association resulting in a decreased risk of IMI (Tyler et al., 1997; Johansson et al., 1999). Recent research on the effects of farm management on standing and lying behavior and the incidence of IMI provides some evidence of a relationship between incidence of IMI and postmilking standing duration (**PMSD**; DeVries et al., 2010, 2011), as described below.

In a recent longitudinal study, decreased odds of environmental IMI in tie-stall-housed cows was observed with PMSD of 40 to 60 min as compared with those animals lying down within 40 min of milking, whereas the incidence of new environmental IMI increased as PMSD increased past 60 min (DeVries et al., 2010).

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A similar type of study but undertaken with freestall, robotic-milked cows noted that the only IMI pathogens associated with PMSD were CNS (DeVries et al., 2011). In that study, the incidence of new CNS IMI was similar in cows with PMSD of up to 2.5 h, after which the risk tended to increase (DeVries et al., 2011). Interestingly, few of the robotic-milked cows laid down soon after milking, which DeVries et al. (2011) hypothesized may have contributed to a lack of an increased risk observed in the time period immediately following milking when risk has traditionally thought to be greatest.

Given the tremendous variation in management of freestall-housed dairy cows observed on commercial farms (von Keyserlingk et al., 2012), it follows that IMI risk and PMSD may be affected by differences in management that in turn affect lying behavior. DeVries et al. (2010) reported a mean PMSD of 79 min for tie-stall-housed cows. This value was comparable to subsequent studies observing cows under freestall housing conditions milked by an automatic milking system (**AMS**; 78 min, DeVries et al., 2011; 77 min, DeVries et al., 2012). However, a shorter PMSD was reported by Tyler et al. (1997) when observing the effects of feed provision following milking on freestall-housed cows milked 2×/d in a parlor: 48 min for cows with access to feed versus 21 min for cows without access to feed. This reduced latency to lie down after milking in 2×/d-milked freestall cows as a response to fresh feed access was also found by DeVries and von Keyserlingk (2005); cows provided with fresh feed had an average PMSD of 66 min versus 45 min for cows without access to fresh feed. Also under freestall housing and 2×/d milking, Fregonesi et al. (2007) observed an average PMSD of 39 min under 100% stocking conditions.

It is plausible that the reduced latency to lie observed in freestall 2×/d parlor milking conditions is a result of the forced period of standing inherent to parlor milking practices. Thus, this period of forced standing may be expected to affect PMSD in herds milked 3×/d, as well. A study of 16 freestall herds, milking either 2 or 3×/d, revealed that mean daily milking time was 2.7 h/d with a range of 0.5 to 6 h/d on the 2×/d milking farms and a range of 1.2 to 5.7 h/d on the 3×/d milking farms (Gomez and Cook, 2010). In a study of North American freestall herds, mean time away from pen was reported as almost 4 h/d in Western herds and almost 5 h/d in Eastern herds, indicating that regardless of milking frequency, parlor-milked cows experience long periods of time outside of their pens (von Keyserlingk et al., 2012). Although long group milking times have been reported, individual variability in milking time exists; Cook and Nordlund (2009) noted that although parlor design and group sizes generally target a milking time of 45 to 60 min per group, individual cow daily milking times may be quite variable ranging from 1.5 h/d to more than 3 h/d in 3×/d-milked cows. Thus, reduced PMSD may be anticipated in cows milked 3×/d given the increased potential for standing demands associated with this management practice and the expectation that cows will choose to lie down more quickly following milking if not provided with an incentive to remain standing, such as fresh feed.

The objectives of this study were, for freestall cows milked 3×/d, to determine (1) which factors are associated with PMSD and (2) whether an association of PMSD with incidence of IMI exists. It was hypothesized that cows that had shorter PMSD would be at an increased risk to experience an IMI and that PMSD would be longer when feed delivery and feed push-up occurred close to the time of milking.

MATERIALS AND METHODS

Farm Selection

Four commercial dairy farms in Eastern Ontario, Canada, were recruited for participation in this longitudinal study. Herds were selected as a convenience sample for their proximity to the University of Guelph, Kemptville Campus (Kemptville, ON, Canada). Selection criteria were as follows: freestall housing, parlor milking, milked 3×/d, participated in a DHI program, predominantly Holstein-Friesian (>90%), >120 lactating cows in the herd, and no sand bedding. Farms had a mean herd size of 326 cows (range: 133 to 566 cows), mean adjusted 305-d milk yield of 11,670 kg (range: 10,801 to 13,012 kg), and a geometric mean annual bulk milk SCC of 240,000 cells/mL (range: 161,000 to 330,000 cells/mL). The study was conducted between April and August 2012. Initiation of the study on each farm was based on a rolling start date corresponding to the DHI test dates of each farm. The study was composed of three 28-d periods beginning on the initial on-farm milk-sample date. Use of animals for this study was approved by the University of Guelph's Animal Care Committee (Animal Use Protocol #1665).

Animal Selection

Forty cows per herd were randomly selected as focal animals from those cows on each farm that met our selection criteria of <200 DIM and SCC <100,000 cells/mL at the most recent DHI test. Less than 200 DIM was targeted to ensure that focal cows would remain in the milking herd for at least 2 periods of the study. An SCC of <100,000 cells/mL was targeted as a prescreening method for IMI, and these cows were assumed to be infection free (Dohoo and Leslie, 1991; Schepers et