

Maternity Pen Design and Management From the Cow's Perspective

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Abstract

The calving period is a critical time for dairy cows, as they are at high risk of disease soon after calving. Ensuring that these cows receive proper care is paramount to their welfare and to the overall profitability of the herd. Although we have clearly made progress in our understanding of production diseases, we are just now gaining an understanding of maternal behaviors before and after the calf is born. Here, we review the literature to date about behavioral changes during the peri-parturient period, and then discuss how this information can be applied to a commercial setting. Management and housing practices during the calving period is highly variable, especially during the peri-parturient period. To better understand the effect of calving management and housing on dairy cow behavior, we conducted a series of experiments at the University of British Columbia in Canada and at the Aarhus University in Denmark. In our first experiment, we determined the effect of a common management practice on pre-parturient behavior and labor progress. Many producers move cows from group pens into individual pens, and this sometimes occurs while labor is in progress. We discovered that moving cows during a sensitive period between the first and second stages of labor (i.e., showing signs of abdominal contracts and mucous coming from the vulva) disrupts normal recumbent behavior and prolongs the second stage of labor. In the

next 2 experiments, we gave cows the choice to calve in an open setting or in a secluded setting much like where you would find cows in a more natural environment when calving. We were able to provide evidence that indoor-housed dairy cows will also seek seclusion when given the opportunity, especially when calving during the daytime and when there is no competition for the secluded area. This new information can help improve calving management and housing practices by accommodating the behavioral changes of cows as calving approaches. Further research is encouraged to determine any long-term benefits to allowing cows seclusion at calving and not disrupting them while labor is in progress.

Introduction

The transition period around calving is a critical time for the dam, as she is at high risk of disease shortly after the calf is born. Due to the importance of this period, there has been decades of research addressing proper nutrition during transition, epidemiology of the diseases, as well as their appropriate treatments (LeBlanc et al., 2006). Yet, disease risk remains high, suggesting that we take a new approach to address the challenges that might occur during the transition period.

One area that we are beginning to better understand is the behavior of transition cows,

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particularly the acute period around calving. In a recent review, von Keyserlingk and Weary (2007) suggested that maternal behaviors might provide great insight into improving the care and management of transition cows. Currently, housing and management of cows during the calving period is highly variable, partly due to a lack of science about best practices. However, we are beginning to develop a greater understanding of the cows' natural behaviors during the calving period, and some of this information could be directly applied to practice. In the following sections, we will cover the research to date on the behavioural changes of peri-parturient dairy cattle and how this information can help improve practices during this sensitive period. Much of this review will focus on the work undertaken by the Animal Welfare Program located at the University of British Columbia and the Animal Science Program located at the Aarhus University in Denmark.

Management of Transition Dairy Cows

For the purpose of this proceedings chapter, the transition period can be separated into three phases: 1) the pre-calving, 'close-up' phase beginning 3 wk before calving and ending when calving is imminent, 2) the 'parturient' phase in the hours just before and during labor, and 3) the post-calving or 'fresh' phase lasting from calf delivery until 3 wk later. Management of cows during these phases is often dependent on the size and the nutritional regime used on the farm (Overton and Waldron, 2004). For instance, the industry-standard for nutritional management in the pre-calving phase in North America consists of a two-group scheme, meaning that cows are moved from a low-energy diet to a high-energy diet approximately 3 wk before calving (Overton and Waldron, 2004). Each diet change also reflects a pen change; cows are usually regrouped at least once before calving (Cook and Nordlund, 2004).

Little research has been done on housing and managing cows during the parturient phase. When signs of calving are present, or the cow has reached her expected calving date, she is either left in a group pen or moved to an individual pen to calve (Cook and Nordlund, 2004). According to the latest NAHMS survey in the US, 70% of farms with a usual calving area house cows in groups at calving (USDA, 2008). Cows are sometimes housed on bedded packs or yards during the full 3 wk close-up period and calve in these same pens. In other cases, cows are moved from the freestall into a group calving pen a few days or hours before calving. A third option is to move cows from freestall or bedded packs into individual pens a few days or hours before calving (26% of farms in the US use this practice). Regardless of the type, these pens are sometimes in high traffic areas, allowing producers to frequently monitor the progress of labor.

Soon after the calf is born, the cow is typically moved out of the calving pen and switched to a high-energy diet to support their lactation. On some farms, cows are moved into a 'fresh' pen for the first few days after calving; the time spent in this pen often coincides to when their milk is not saleable, thus easing the work of the milker (Cook and Nordlund, 2004). According to Cook and Nordlund (2004), the 'traditional' movement of cows during transition can include as many as 5 pen changes during the 6 wk period. For the purpose of this proceedings chapter, we will focus the remainder of the discussion on the peri-parturient phase during and just after labor.

Behavior Around Parturition

Behavioral and physiological changes in preparation of calving

Labor in dairy cattle is considered to occur in 3 stages that gradually transition from

one to the next (Noakes et al., 2001). During the first stage, the calf moves into its appropriate position for birth and the cervix of the dam begins to dilate. The only true way to tell when a cow is in this stage is to palpate the cervix, but there are also changes in behavior that may be reflective of labor onset. For beef and dairy cows housed in extensive, pasture-based systems, the first sign of imminent labor occurs when the cow seeks isolation from the herd to find a secluded place to calve (Lidfors et al., 1994). When it is available, cows prefer a calving-site that is dry and has some cover overhead, such as tree branches (Lidfors et al., 1994). For dairy cows housed indoors, behavioral changes at the onset of labor are more subtle. The cow becomes restless, characterized by a high number of position changes and activity (Huzzey et al., 2005; Miedema et al., 2011; Jensen, 2012). She spends more time paying attention to her abdomen (Jensen, 2012), increasingly raises her tail while standing (Miedema et al., 2011), and spends less time eating and drinking during this first stage (Jensen, 2012). Other indications of this first stage of labor are engorged udder, relaxation of the pelvic ligaments, and the appearance of bloody mucus outside the vulva, as this reflects the opening of the cervix.

The second stage of labor begins as the calf begins to move through the birth canal and ends when the calf is delivered. This stage is much clearer to see, as it is characterized by the onset of rhythmic abdominal contractions and the amniotic sac (or 'waterbag') appearing outside of the vulva (Noakes et al., 2001). During stage II, the cow is usually recumbent to help facilitate calf delivery (Schuenemann et al., 2011). The third stage of labor occurs after the calf is delivered, and ends when the afterbirth is released from the uterus.

Behavioral changes after the calf is delivered

For many dairy cattle housed in intensive, indoor systems, the calf is removed soon after birth so there is usually little time for the cow to provide maternal care. To investigate the maternal behavior of indoor-housed dairy cows, Jensen (2012) kept the dam with the calf for the first 24 hr after birth. Dams with easy and unassisted calving stood within minutes of delivery and started linking their calf intensively; calves stood and started searching for the udder within 30 to 90 min of birth. Dairy cows spent most of the first few hours intensively licking and nursing the calf, then progressively decreased the time spent directing behaviors toward the calf, and spent more time lying and feeding.

Maternal care provided to calves is highly variable and can be influenced by aspects of both the dam and the calf (Stihulová et al., 2013). The environment may also influence maternal behavior; in a recent study, Newby et al. (2013) found that the provision of a brush for the cow during the 6 hr after calving increased the time that they spent licking the calf. Authors suggest that the brush may increase oxytocin levels, which are well-known to be involved in the expression of maternal behaviors.

Managing and Housing Cows during Parturition

Ideally, the maternity pen should be clean and dry, as well as accommodate the natural behavioral changes of the cow. Using a series of experiments, we have developed a better understanding about management and housing during this critical period. In the first experiment, we tested to see if physically moving cows from a group pen into an individual pen during various stages of labor could disturb behavior and labor progress. In the next 2 experiments, we asked the cow to choose the type of environment she wanted to be in at calving.

When should cows be moved to an individual pen?

Although there is a growing trend within the US to house cows in groups at calving, a large portion of cows are moved into individual maternity pens (USDA, 2008). Previous work on multiparous, non-lactating Holstein cows indicated that brief periods of social isolation in unfamiliar surroundings seem to be stressful to cows, as indicated by increased heart rate, hypothalamic-pituitary-adrenocortical axis activity, and vocalizations (Rushen et al., 1999). In response to these findings, or for other unknown reasons, there is a growing trend for producers to minimize the time cows spend isolated in maternity pens. This practice is frequently referred to as moving cows ‘just-in-time’, or when signs of labor are very clear (i.e., presence of amniotic sac or calf feet).

This type of management has both advantages and disadvantages compared to group calving pens. Individual pens may be easier to clean, and perhaps it is easier to monitor cows during labor in these pens although there has been no research in this area. An individual pen also may provide the cows some seclusion from other cows, if it is in a quiet area of the barn. In other cases, this pen may be in a high traffic area to allow farm staff visual access to ensure that cows are progressing through labor normally. After calving, the individual pen also protects the dam and calf from interference from other dams (Edwards, 1983). One criticism of this housing system is that cows are interrupted during labor, and it increases the risk that cows are not identified as being in labor and calve in unwanted areas, such as the freestalls. However, despite these perceived advantages and disadvantages, to our knowledge no scientific work has been done to address this topic.

We conducted an experiment to investigate if moving cows during different stages of labor can interfere with the calving process (Proudfoot et al., 2013). Multiparous cows were housed in a group close-up pen (bedded pack) and were moved into nearby individual pens during one of 3 periods: 1) before any signs of labor, 2) during ‘early stage I’ about 12 hr before calving when cows were showing signs of stage I labor (i.e., raised tail, engorged and leaky udder, or relaxed pelvic ligaments), or 3) during ‘late stage I’ labor, about 4 hr before calving when cows were showing more imminent signs of labor, such as bloody mucous and the start of abdominal contractions.

We discovered that cows moved before labor and during early stage I labor had very similar stage II labors of about 60 min, which is comparable to multiparous cows in other experiments (Schuenemann et al., 2011; Barrier et al., 2012). These cows were also recumbent during the final hour of calving, which is also considered a normal behavior of cows during stage II labor (Schuenemann et al., 2011). In contrast, cows moved during late stage I labor had longer stage II labor, and spent less time lying compared to the other treatments (Figure 1). Longer stage II labor was associated with increased inflammation in the first day after calving, and in other studies this has been associated with stillbirths (Gundelach et al., 2009) and dystocia (Schuenemann et al., 2011). These results suggest that moving cows during a sensitive period during labor may disrupt normal calving behavior and increase the length of labor.

Further research is necessary to determine the impact of moving cows during a late part of stage II labor (just-in-time) on factors, such as stillborn rate. In our case, we were unable to include cows that were moved during stage II labor, as they were not in the pen long enough

to record any meaningful data. More research is needed to determine the costs and benefits of moving cows during this late stage of labor. For instance, a potential cost may be increasing the chance of cows calving in unwanted areas like the freestalls, unless cows are checked very regularly. In our experiment, we examined the cows every 4 hr and yet 10 of 79 cows calved in the close-up group pen.

What type of environment do cows prefer during calving?

To determine the type of environment that cows prefer at calving, we conducted 2 'preference tests'. Preference tests allow us to give cows some control over their environment and observe the choices they make (Kirkden and Pajor, 2006). To determine the options to give cows at calving, we used evidence from cows kept in a more natural setting, where one of the clearest behavioral changes of cows is isolation-seeking. In many cases, dairy cows housed indoors likely do not have the opportunity to find seclusion in the barn while they are calving.

In our first experiment, we created a maternity pen with 2 large bedded packs: 1) an 'open' pack [7.3 x 2.4 m (24 x 8 ft)] where cows could easily see people and other cows in the barn, and 2) a 'sheltered' pack [6.1 x 2.4 m (20 x 8 ft)] surrounded by an 2.4-m (8 ft) high plywood enclosure where cows could find seclusion from the rest of the barn (Proudfoot et al., 2014). Cows entered the pen approximately 3 days before expected calving date to become accustomed to both areas, then we used video cameras to record where cows chose to calve. When cows were housed alone in the pen, they were more likely to calve in the shelter, but only if they calved during the daytime (81% of cows that calved in the daytime used the shelter). If cows calved at night, they showed equal preference for both areas. Cows began increasing their use

of the shelter about 8 hr before calving (Figure 2). When housed in pairs, cows were more likely to calve in the open pack, regardless of time of day. But, these cows also increased the amount of time they spent further away from their partners as calving approached.

In our second experiment, we replicated the study using a smaller, more practical individual maternity pen (Proudfoot et al., 2014). We used 5-ft high plywood around half of the walls of the pen to create a secluded 'corner' on one side, and a 'window' on the other side where cows could have visual and head-to-head contact with familiar cows in the close-up group pen. Again, we recorded where cows calved and found that a majority (79%; 15/19) of cows calved in the secluded corner of the pen. Cows began using the corner more in the hour before calving and remained in the corner with their calf during the hour after calving.

These 2 experiments provide evidence that dairy cattle housed indoors seek seclusion during calving. This research provides insight into the optimal design of maternity pens, as allowing the dam to express maternal behavior may in itself be beneficial to her welfare. Future research is encouraged to determine other benefits to secluded housing, such as reduced dystocia and stillbirths.

Conclusions and Recommendations

Dairy cows express a suite of behavioral changes during the peri-parturient period, with many of these associated with maternal behavior. Around the onset of labor, cows become restless and begin to seek an isolated environment for calving. During the final stage of labor, the cow becomes recumbent to facilitate calf delivery. After the calf is delivered, the cow focuses on the calf for the first hours after calving.

Optimal housing and management during the calving period should attempt to accommodate some of these behavioral changes. If moving a cow into an individual pen, a producer should be aware that moving her during a sensitive period during labor (i.e., at first signs of abdominal contractions and mucous outside of the vulva) increases labor length and interferes with normal recumbent behavior. These individual pens can easily be retrofitted to allow cows the opportunity to find seclusion at calving; this could be as simple as attaching some plywood to one half of the pen or adding a curtain between maternity pens and other pens in the barn. In a group pen, producers could add barriers or hay bales to the pen to give cows some opportunity for isolation from others in the pen. This also may allow the cow to focus on the calf without disturbance from other cows.

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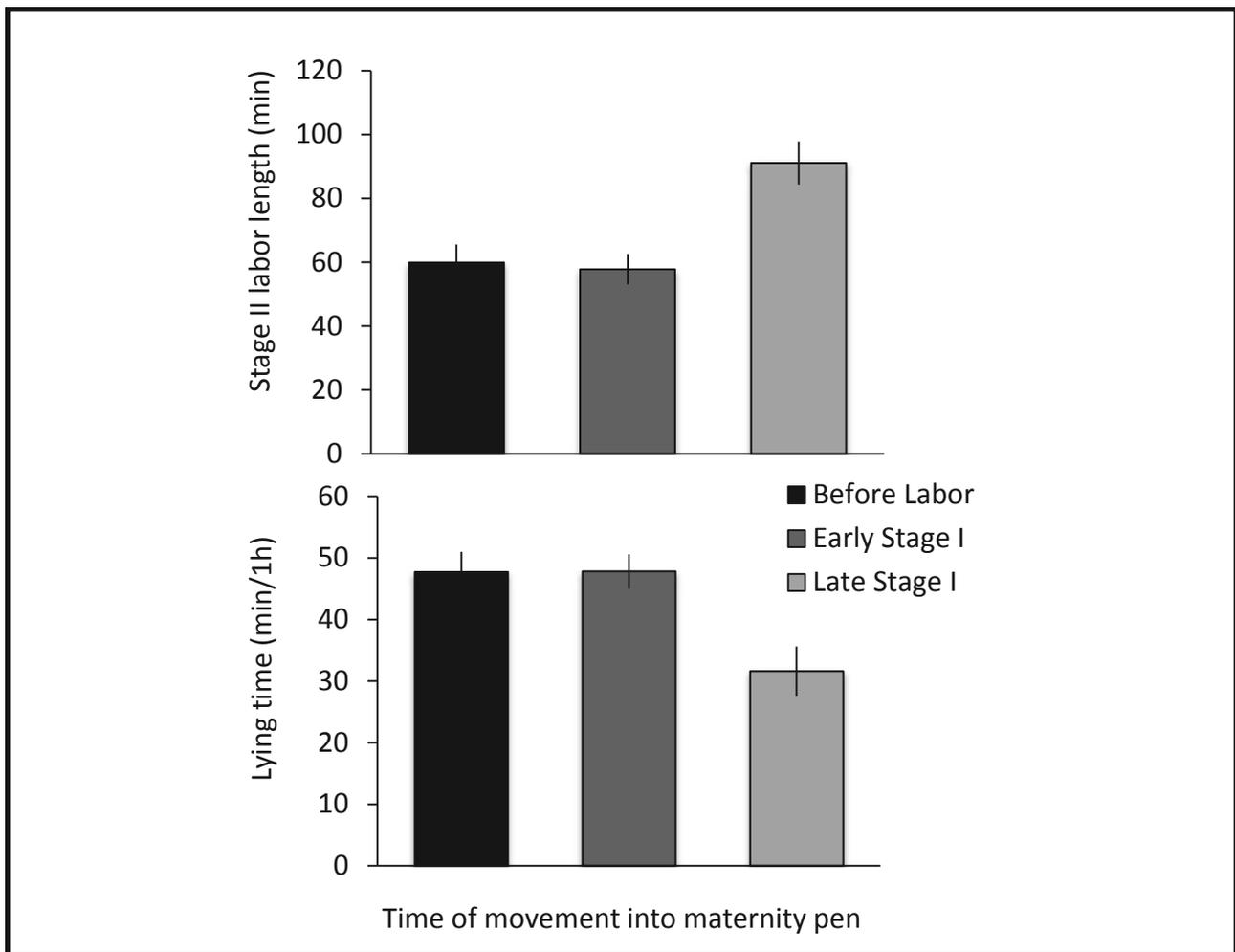


Figure 1. The effect of moving cows from a group to individual pen during different stages of labor. Adapted from Proudfoot et al., 2013.

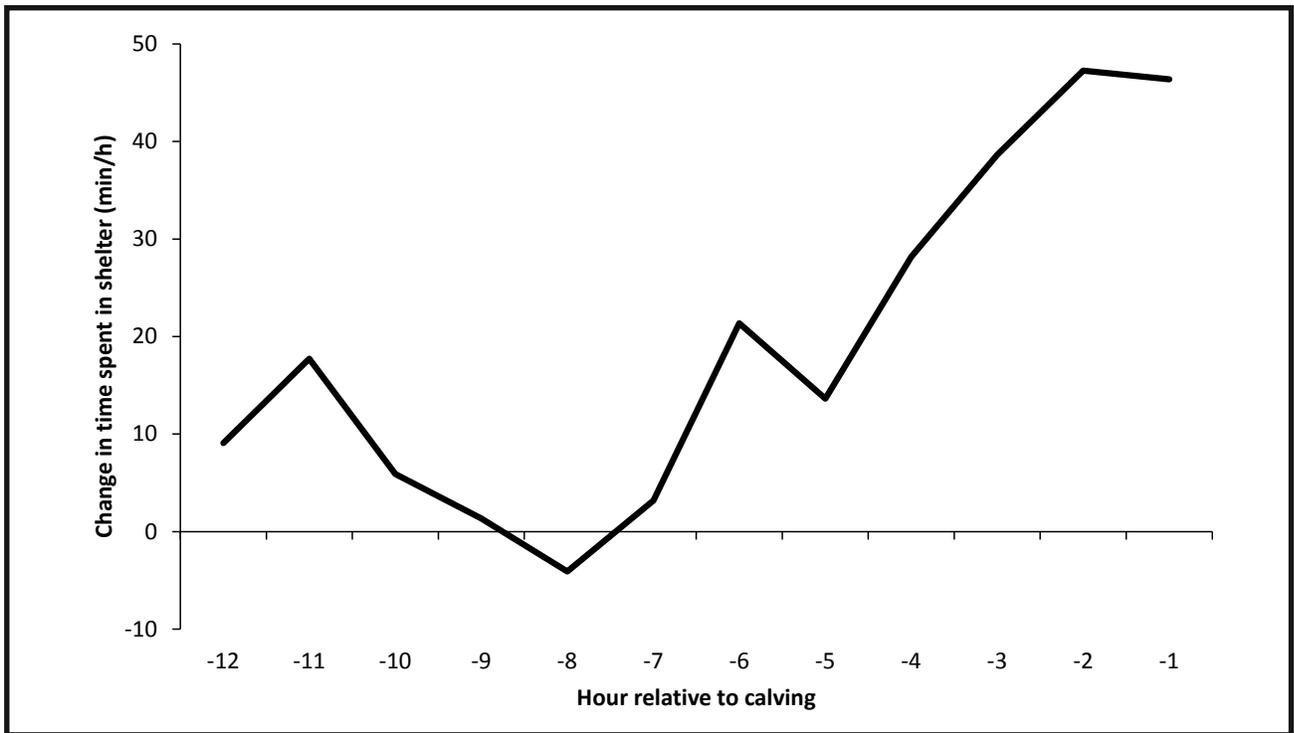


Figure 2. Use of a secluded shelter to calve during the 12 h before calving for 11 cows that calved in the shelter. Data were subtracted from baseline values collected during the day before calving. Adapted from Proudfoot et al., 2014.