Pain at Parturition: What Do We Know? How Can We Treat and Prevent it?

Take Home Messages

- It is clear that parturition is a painful event, especially when a dystocia occurs. The pain associated with parturition has been shown to be mitigated through the use of NSAIDs, with the exception of flunixin meglumine.
- To truly prevent pain at parturition from occurring, a focus should be placed on:
    - Ensuring that cows are in the right Body Condition Score (BCS);
    - Calving ease is considered when choosing sires;
    - First lactation animals are the right size at calving; and
    - Ensuring that excellent calving supervision occurs to provide the appropriate intervention at the right time.

Introduction

It is generally accepted that parturition is painful, no matter the animal species. So, what are the signs of pain surrounding parturition in dairy cattle? Pain is defined as an unpleasant sensory and emotional experience normally associated with tissue damage (Merskey, 1979). Most research surrounding pain of parturition in the dairy sector has focused on dystocia: a difficult or abnormal calving. Reports of dystocia prevalence in dairy cattle range from 2% to 7% (Mee, 2008); however, the level of calving assistance is much higher than this, with up to 50% of calvings reportedly requiring assistance (Kovác et al., 2016).

Some studies have highlighted the occurrence of pain as a result of dystocia, mostly through observation of specific behavioral changes. Specifically, cows with difficult calvings consume less feed and transition from standing to lying positions more frequently than cows without dystocia (Proudfoot et al., 2009). Others have also found that assisted cows took longer to stand after parturition and spent less time self-grooming postpartum, when compared to cows that were not assisted (Barrier et al., 2012; Houwing et al., 1990).

Although these behavioral changes are subtle, many of these changes are indicators of pain. Reduction in food intake is likely related to pain, as one type of pain response in animals is a decline in the frequency or magnitude of certain behaviors that animals are highly motivated to perform, such as feeding and drinking behaviors (Weary et al., 2006). General restlessness is also a validated behavioral indicator of pain, which can be associated with tissue damage (Molony and Kent, 1997).

What are the Consequences of Dystocia Beyond Pain?

Beyond pain, dystocia in dairy cattle can have many consequences.

Cows experiencing a case of dystocia were seen to have (Dematawewa and Berger, 1997; Mee, 2008):

- 704 kg decrease in milk production, 24kg less milk fat, and 21 kg less milk protein over lactation period
- Increased days to first estrus, days to first service (+3 days), and services per conception
- Decreased conception rate (-5%), delayed uterine involution, and delayed onset of luteal activity postpartum
- Increased risk of the cow being culled (+15%), and increased calf and cow mortality
- Increased risk of disease including retained placenta, uterine disease, mastitis, and hypocalcaemia

For the calf, dystocia has been associated with (Lombard et al., 2007):

- Increased risk of being treated for respiratory disease (+35% for severe dystocia) and digestive disease (+19% for severe dystocia)
- Due to the reduced vigor of calves that experienced dystocia, they will not suckle or drink colostrum as well, leading to a lower volume of colostrum and milk consumed
- Increased risk of perinatal mortality (+37% for severe dystocia) and mortality up to 120 days of age (+14% for severe dystocia)
- Impacts later in life, including a 200-700kg loss in milk production in first lactation depending on the level of calving assistance needed

What Can We Do to Treat Pain Surrounding Parturition?

Pain in animals is associated with a suboptimal welfare status; therefore, it is important to try to prevent or manage the pain surrounding dystocia to mitigate the welfare consequences. The use of non-steroidal anti-inflammatory drugs (NSAIDs) have shown promise in mitigating some of the effects of dystocia, or pain associated with parturition in general.

Behavioural Parameters

With respect to the mitigation of behavioral indicators of pain, only a few studies have been conducted. In a study that administered either no treatment or a ketoprofen treatment to cows within 3 hours following parturition, cows treated with ketoprofen spent less time in lateral recumbency and more time with their head rested when in sternal recumbency, which is a behavior associated with comfortable resting (Gladden et al., 2021). Another study found that postcalving administration of meloxicam to eutocic first lactation animals lead to an increase in activity for the first 2 d postcalving, when compared to eutocic primiparous controls (Mainau et al., 2014). Similarly, Barragan et al. (2017) found that acetylalicylic acid administration to eutocic cows increased activity postcalving compared to untreated eutocic controls. Newby et al. (2013) also found behavioral changes when cows were administered meloxicam following a dysotica, where assisted cows treated with meloxicam visited the feed bunk more often and spent more time feeding than untreated controls.

Production Parameters

With respect to production parameters, several studies have found benefits to administering an NSAID around the time of parturition. Swartz et al. (2018) found that the administration of meloxicam before calving led to a higher amount of milk fat, protein, and lactose than an untreated control. In addition, cows that did not need assistance but had received meloxicam prior to calving, produced more milk (+6.8 kg/d) than controls for the first 15 weeks of lactation. Other studies found similar results, with Carpenter et al. (2016) showing meloxicam administration after calving leading to an increase in daily milk yield of 4 kg/d, whereas administration of sodium salicylate to mature cows lead to cows producing 3.5 to 8 kg/d more milk, as well as more milk fat and protein during a 305-day lactation (Carpenter et al., 2016; Farney et al., 2013). In addition, Shock et al. (2018) found that cows that had been administered meloxicam produced 0.64 kg/d more milk over the first 3 DHI test days, had a lower risk of subclinical mastitis, and were less likely to be culled or die in early lactation compared to untreated controls. It is likely that these effects resulted from the inhibition of calving-mediated inflammation. An elevation of inflammatory mediators in mice has been shown to increase apoptosis of milk-producing epithelium (Connelly et al., 2010). This demonstrates that reducing inflammatory mediators in cattle could result in an elevation in milk production, similarly to what has been seen in mice.

Health Parameters

Few studies have found an effect of administering an NSAID around the time of parturition on improved disease outcomes. Specifically, no studies have found a benefit to administering NSAIDs around parturition in terms of reducing the frequency of clinical disease (Newby et al., 2013; Mainau et al., 2014; Carpenter et al., 2016; Swartz et al., 2018). Evidence suggests that some NSAIDs may have negative consequences when used around the time of parturition. For example, the administration of flunixin meglumine around the time of calving has been shown to increase the risk for retained placenta, metritis, and stillbirths (Newby et al., 2017). In addition, precalving use of acetylsalicylic acid led to a higher incidence of retained placenta when compared to untreated controls (Grossi et al., 2013). However, it is important to note that administration of acetylsalicylic acid 12 hours or more after calving has been found to have no effect on frequency of disease effects (Carpenter et al., 2016). As both flunixin and acetylsalicylic acid have greater affinity for COX-1 inhibitors, this is likely the reason for a higher level of adverse effects. Meloxicam, which is a preferential COX-2 inhibitor, has been found to have no adverse effects regardless of the timing of administration (Newby et al., 2014).

How to Prevent Difficulties Surrounding Parturition?

To mitigate pain surrounding parturition, it is critical to prevent painful calving events, specifically dystocia. Luckily, modifying specific factors can reduce the risk of dystocia. Many of the factors that influence dystocia are associated with creating feto-maternal disproportion, where the pelvic diameter of the cow is not large enough to allow easy passage of the calf. The specific factors associated with dystocia (Fenlon et al., 2017; Mee, 2008) are:

1. Calf Birth Weight

- One of the most important predictors of dystocia risk; the odds of dystocia increase by 13% per kg increase in body weight
- Most influenced by gestational length (> 285 d gestation associated with increased risk of dystocia and stillbirth), followed by parity of the dam (higher parity of the dam results in increased calf birth weight), fetal gender (male calves are typically larger), size and dam breed, maternal nutrition, and climate in the last trimester of gestation

2. Calving Body Condition Score (BCS)

- Found to have the highest importance in ranking by Fenlon et al. (2017)
- When BCS is $\geq$ 3.5, the risk of dystocia was found to be highest, likely due to the build-up of adipose tissues in the birth canal leading to a reduced diameter

3. Genetics

- Genotype, whether parental or maternal, can have a significant influence on birthweight and subsequent dystocia risk

4. Parity

- There is a significant influence of parity with respect to dystocia, where first time calvers experiencing dystocia have a greater risk of perinatal mortality when compared to calves born from a dystocia in older cattle
- Weight at service, age, and body condition at calving for first lactation animals are important influencers of dystocia risk

5. Abnormal Fetal Position

- Abnormal fetal position, most commonly presenting as backwards presentation, foreleg malposture, and breech position, is the most common cause of dystocia in older dams
- Abnormal fetal position is most influenced by the presence of twins

6. Supervision and Timely Intervention

- Having excellent calving supervision and providing appropriate intervention in a timely manner will lead to a reduced risk of consequences related to a dystocia occurring

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