J. Dairy Sci. 101:1–9
https://doi.org/10.3168/jds.2017-14207

Measurement of dairy calf behavior prior to onset of clinical disease and in response to disbudding using automated calf feeders and accelerometers

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ABSTRACT

We determined if feeding and lying behavior, recorded by automatic calf feeding systems (ACFS) and accelerometers, could be used to detect changes in behavior before onset of neonatal calf diarrhea (NCD) or in response to disbudding pain in dairy calves. At 4 d of age, 112 calves had accelerometers attached to their hind leg and were housed in pens with ACFS. Calves were examined daily for signs of illness or injury. Of the 112 calves monitored, 18 were diagnosed with NCD; activities of calves with NCD were then compared with those of 18 healthy controls (calves that had no symptoms of NCD, other illnesses, or injury). Feeding (milk consumption and the number of rewarded and unrewarded visits to the feeder) and lying behavior during the 5 d leading up to calves displaying clinical signs of NCD were analyzed. Calves with NCD performed fewer unrewarded visits and consumed less milk than healthy calves during the 2- and 4-d periods before diagnosis with NCD, respectively. Calves with NCD tended to perform fewer lying bouts than healthy calves over the 5-d period before diagnosis with NCD. At 3 wk of age, a subset of 51 healthy calves were allocated to 1 of 5 treatment groups: (1) sham handling (SHAM, n = 10), (2) cautery disbudding (DB, n = 11), (3) administration of local anesthetic (LA) and DB (LA+DB, n = 11), 4) administration of a nonsteroidal anti-inflammatory drug (NSAID) and DB (NSAID+DB, n = 9), and (5) administration of LA, NSAID and DB (LA+NSAID+DB, n = 10). Feeding and lying behavior were recorded continuously for 24 h pre- and postdisbudding. We found no effect of treatment on the number of rewarded or unrewarded visits to the feeder and milk volume consumed 24 h before administration of treatments. During the 24-h postdisbudding period, SHAM calves performed more unrewarded visits than DB, LA+DB, and NSAID+DB calves, but the number of unrewarded visits did not differ between SHAM and LA+NSAID+DB calves. During the first hour of the posttreatment period we noted a difference in lying times among treatments, with DB and NSAID+DB calves spending less time lying than SHAM calves and lying times being similar between SHAM, LA+DB, and LA+NSAID+DB calves. The ACFS and accelerometers have the potential to automatically gather valuable information regarding health status and pain in calves. Therefore, it may be advantageous to combine both of these measures (ACFS and accelerometers) when evaluating NCD on farm or pain in calves in future research.

Key words: behavior, disbudding, feeding, automated measures, welfare

INTRODUCTION

Automated techniques for measuring individual calf behavior on-farm are now available; feeding behavior can be detected remotely with automatic calf feeding systems (**ACFS**; Svensson and Jensen, 2007; Borderas et al., 2009) and activity can be recorded using accelerometers (e.g., Hobo data loggers; Bonk et al., 2013). Automated systems have the advantage of collecting data noninvasively with reduced labor input. Feeding and lying behavior have been shown to change in response to sickness (Svensson and Jensen, 2007; Borderas et al., 2008; Szyszka and Kyriazakis, 2013) and pain (Graf and Senn, 1999; Heinrich et al., 2010) in calves. Hence, automated measures of feeding and lying behavior could potentially be used to detect early signs of disease and pain in calves.

Neonatal calf diarrhea (**NCD**) is an enteric disease that is associated with severe diarrhea. Once an animal displays clinical signs of NCD, much of the associated tissue damage to the intestinal submuscosa has already occurred (Schroeder et al., 2012); therefore, early de-

Received November 27, 2017.
Accepted May 4, 2018.
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tection of NCD would enable calves to be promptly treated and moved to sick pens thereby reducing tissue damage and risk of disease transmission to other calves. Previous studies using ACFS and accelerometers have reported changes in feeding (Svensson and Jensen, 2007; Borderas et al., 2009; Lowe et al., 2016) and lying behavior (Swartz et al., 2017) in response to NCD and respiratory disease. However, those studies predominantly focused on changes in behavior once calves became clinically ill or the time period just prior (Svensson and Jensen, 2007; Borderas et al., 2009), or calves that were diagnosed with respiratory disease (Swartz et al., 2017). To our knowledge, no studies have measured changes in feeding in conjunction with lying behavior in calves before diagnosis with NCD. It would be valuable to measure changes in feeding and lying behavior concurrently, several days before calves become clinically ill, to assess if information collected from ACFS and accelerometers could be used for early detection of NCD on-farm.

In the United States, 94% of dairy cattle producers routinely dehorn their cattle and of these 70% disbud using cautery (USDA, 2018). Disbudding is often performed without pain relief; however, studies have shown that this procedure causes behavioral changes indicative of pain (reviewed by Stafford and Mellor, 2011). For example, calves spent less time feeding and more time lying after being cautery disbudded than sham-handled controls (Graf and Senn, 1999; Faulkner and Weary, 2000). Therefore, a need exists to evaluate different pain-mitigation strategies to alleviate the pain caused by disbudding; to do this, however, labor-intensive behavioral studies are often needed. It would be useful if automated measures of feeding and lying behavior were sensitive enough to detect behavioral changes in calves in response to a painful procedure such as disbudding. Automated measures of feeding and lying behavior could then be used as a research tool to evaluate different pain-mitigation strategies for painful husbandry procedures in calves.

Disease and pain can negatively affect calf welfare, but these states are often difficult to detect and time-consuming to assess objectively. Information on feeding and lying behavior collected from ACFS and accelerometers could potentially be measured remotely on-farm and used by producers as a tool to help detect NCD early so that strategies could be promptly implemented to reduce the negative effects of this disease on calf health and production. In addition, automated measures of feeding and lying behavior could provide a useful and less labor-intensive research tool to evaluate different pain-mitigation strategies in calves. Therefore, the objectives of our study were to determine if behavioral data collected from ACFS and accelerometer data loggers could be used to detect changes in behavior before the onset of NCD or in response to disbudding pain in dairy calves.

MATERIALS AND METHODS

Animals, Housing, and Feeding

Our study was conducted between July and October 2014 on AgResearch's Tokanui Dairy Research Farm in South Waikato, New Zealand (175° 1800′E longitude, −38° 0300′S latitude). All procedures involving animals were approved by the Ruakura Animal Ethics Committee (no. 13283) under the New Zealand Animal Welfare Act 1999 (Ministry of Primary Industries, 2017).

Seventy-one Friesian dairy calves (n = 71 females) and 41 Friesian-Hereford cross calves (n = 18 females, n = 23 males) were monitored in this study. Calves were allocated to 1 of 4 pens (n = 30, 28, 27 and 27 calves/pen respectively) at 4 d of age according to their order of birth. One pen was filled at a time, which ensured pen mates were all of similar size and stage of development. All calves were monitored to obtain a sample of animals displaying clinical signs of NCD (as described below); a subset of 51 calves that never displayed signs of NCD or other health issues or injuries were used in the pain-assessment study.

Calves were separated from their dams within 24 h of birth and transported to the calf-rearing facility. Upon arrival at the facility, all calves were weighed and individually identified using numbered (Allflex, Irving, TX) and electronic identification ear tags (Allflex) placed in the left and right ears, respectively. At this time accelerometers were attached to the lateral side of the hind leg (as described below).

The calf-rearing facility had a roof, solid dirt floors, and walls on all 4 sides. Calves were housed in 2 indoor pens (8.85 × 7.45 m), located inside the calf rearing facility, with floors covered in wood chip bedding and post and rail fencing.

Each pen contained an ACFS, 3 water troughs, a hay feeder, and 2 meal feeders attached to the side of the pen. Water, meal (Calf-pro1 20%, Seales Winslow, Morrinsville, New Zealand), and hay were provided ad libitum. All calves were trained over a 3- to 4-d period to use the ACFS from d 1 of the trial.

Trained staff performed daily health checks to assess the calves' general health and to identify calves with signs of illness. A standard operating procedure developed in conjunction with a veterinarian was used. Health checks assessed calves for the presence of diarrhea, high rectal temperatures (39.5°C or higher), signs of dehydration (sunken eyes, or poor skin elasticity—assessed using the skin tent test), coat condition (shiny