Impact of milk feeding levels and housing on the incidence of respiratory disease in young dairy calves

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Introduction

Bovine respiratory disease (BRD) continues to be the leading cause of death in feeder cattle, with losses approaching $1 billion annually in North America. In contrast to beef cattle, dairy calves are more likely to be affected with BRD during the pre-weaning (incidence, 58%) and post-weaning (incidence 42%) periods. Additionally, the impact of BRD extends beyond the actual disease episode, with negative effects evident on subsequent productivity and survivability of replacement stock. The ability to identify calves during the initial stages of BRD by behavior monitoring would allow for earlier treatment intervention and potentially decrease the disease's effects on subsequent productivity. Results of recent studies indicate that group housing or daily increased provision of milk decreased the incidence of disease and increased the daily gain. These findings suggest the potential for a positive effect of the social interactions stemming from group or paired housing. The objective of this study was to determine the effects of milk feeding levels and housing on the incidence of BRD in young dairy heifers.

Materials and Methods

Two hundred-fifteen female Holstein calves from a commercial dairy farm were randomly assigned to one of 3 treatment groups (calves individually housed in a hutch and fed a standard amount of milk [4 L/day; control group], calves individually housed in a hutch and fed a high amount of milk [8 L/day; high group], or calves housed in hutches in pairs and fed a standard amount of milk [paired group]) in a randomized block design. Social interaction, activity levels and feeding behavior were measured by fitting calves with an animal activity-monitoring collar developed at the University of Tennessee. Calves were weighed at study enrollment and weaning. Data were analyzed to identify changes in social interaction or feeding behavior associated with the development of BRD. Blood samples were collected for determination of serum IgG concentration (ie, determination of passive transfer status) at 48 hours after birth and at monthly intervals for the duration of the study for determination of serum antibody titers against various BRD pathogens. To monitor extent of seroconversion to various pathogens associated with BRD, paired serum samples were collected from any calf with BRD and a healthy cohort.

Results

The automated sensor system successfully recorded activity levels of calves in the 3 treatment groups. Total activity levels were correlated with milk consumption, with a substantial increase in calf activity preceding feeding. We also identified a unique time-series signature from the acceleration data (activity levels) that corresponds with normal specific behaviors such as sleeping, standing, walking, and bottle feeding, and we used these data to identify deviations from normal behavior. Unfortunately, to this point, the BRD incidence in calves on this farm has been much lower than anticipated and only 2 calves have developed BRD (incidence, 0.93%). Average daily gain was 1.28 lb (0.58 kg)/day and 1.06 lb (0.48 kg)/day for the high and control groups, respectively. Average daily gain was comparable between calves in the high and paired (1.25 lb [0.57 kg]/day) groups.

Significance

This preliminary work demonstrates the growing potential of alternative management strategies for lowering the incidence of disease and increasing performance of dairy calves, as well as the use of behavioral monitoring to identify calves in the early stages of disease. Future work should include immune system challenges to quantify the response to disease with a known starting point to further elucidate the relationship between disease and behavioral changes.

Validation of an activity monitoring system for detecting early behavioral markers of respiratory disease development in young dairy calves

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Introduction

Dairy calf pneumonia (DCP) is a highly prevalent and economically significant problem of dairy calves. DCP commonly affects calves during the pre-weaning and/or post-weaning periods, and is one of the most diagnosed conditions postmortem in calves less than 5 months of age (Hill et al, 2009; Virtala et al, 1996). Aside from the deleterious effects that DCP has on the calf (i.e. decreased performance), the negative impact extends well into adulthood affecting its subsequent productivity and lifespan within the herd (Bach, 2011; Waltner-Toews et al, 1986; Warnick et al, 1997).The ability to identify calves during the initial stages of respiratory disease development is difficult and relies on subjective observations made by farm personnel. However, some behavioral changes in sick calves might be more associated with early disease stages, such as spending more time in the bucket and remaining standing for longer periods after feeding when compared to healthy calves (McGuirk, personal communication). Thus, objective monitoring of activity and feeding behavior may allow for earlier disease detection and intervention, potentially decreasing the consequences of DCP later in the calf's life. Recent studies demonstrated that group housing or daily increased provision of milk decreased the incidence of disease and increased the daily gain. These findings suggest the potential for a positive effect of the social interactions stemming from group housing. The objective of this study was to identify early behavioral markers of respiratory disease using an activity monitoring device in young dairy calves subjected to standard or high-milk feeding levels (standard or high) and housing (individual or group) on the incidence of respiratory disease in young dairy heifers.

Materials and Methods

Animals. Holstein calves from 3 different commercial dairy farms were enrolled in the study.

Experimental Design. Treatments consist of 3 farms with 1 of 3 different management systems (standard milk/individual housing, high milk/individual housing, and standard milk/group housing) with 3 replicates of 40 calves each/farm. Briefly, groups of 40 calves per farm were fitted with an animal activity-monitoring collar developed at the University of Tennessee to measure social interaction/activity levels and feeding behavior. We collected and analyzed the activity data to identify behavior changes in social interaction and/or feeding associated with the development of respiratory disease. Serum samples were collected to determine passive transfer at 48 hours after birth. Calves were screened daily for clinical signs of disease. Deep pharyngeal swabs were obtained from sick calves for detecting pathogens associated with respiratory disease by PCR, and serum samples were collected for serology.

Results

The automated sensor system successfully recorded activity levels of calves in the different treatment groups. Total activity levels were correlated with milk consumption, showing significant increases during the time preceding the feedings. In addition, we established a unique time series signature from the acceleration data (activity levels) that corresponds with normal specific behaviors such as sleeping, standing, walking and/or bottle feeding. We used these data to identify any deviations from the norm. Overall respiratory disease incidence was approximately 20% in the first replicate of calves analyzed. In this group, calves that developed respiratory disease maintained a minimum level of activity when compared to the healthy cohorts. Behavioral data for the sick calves did not show the bursts of activity observed in the healthy calves, particularly when feeding. In addition, no prolonged periods of rest were detected in the sick calves when compared to the healthy ones. These data would appear to suggest that sick calves were always active, but could not reach the level of activity observed in the healthy calves.

Significance

This preliminary work demonstrates the growing potential of alternative management strategies for lowering incidence of disease and increasing performance of dairy calves as well as the use of behavioral changes to identify calves in the early stages of disease. Future work will focus on improving the prototype for the activity monitoring system and further analysis of behavioral data obtained from all farms.