The Importance of Udder and Teat Conformation for Teat Seeking by the Newborn Calf

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ABSTRACT

Because antibody levels in colostrum and the efficiency of the intestinal absorption of these antibodies decrease with time after birth, late suckling newborn calves risk receiving inadequate passive immunity. The influence of the conformation and size of the udder and teats of the dam on the teat-seeking behavior of newborn calves with respect to the time they first suckle was studied in 42 cow-calf pairs housed in individual calving pens. A smaller distance from udder to floor (e.g., low slung udders) led to increased variation and a significant increase in the time spent teat seeking; it also had a significant effect on the time of the first suckle. The variation in the distance from udder to floor accounted for 24 and 15% of the variations in rank order of the calves with respect to duration of active teat seeking before first suckling and to the time to first suckle, respectively. The results of this study showed that calves born to cows or heifers with low slung udders cannot be expected to obtain colostrum soon enough by natural suckling. They should either be helped to suckle or be hand fed to ensure that they receive a good and adequate passive immunity.

(Key words: udder conformation, calf, behavior)

INTRODUCTION

Calves with low passive immunity because they received either insufficient or no colostral antibodies are at risk for both sickness and death (1, 2, 3, 22). Several factors affect the acquisition of passive immunity. The ability to absorb and transmit antibodies across the intestine from the mother’s colostrum decreases with age, usually ceasing within 24 to 48 h after birth (10, 19); the lower the concentration of these antibodies, the less efficient is the absorption (18). The amount of antibodies reaching the calf’s intestines depends on the amount of colostrum ingested and its antibody concentration (20, 21). The colostral antibody concentration decreases within 20 h to about 50% of the amount present at calving even if the cow is not milked (9, 12). For these reasons, a calf that begins to suckle late is at risk for obtaining lower passive immunity (15).

The prevalence of late first sucklings has been reported for several breeds of dairy calves (6, 13). Some of the most important reasons discussed were the conformation of the cow—more specifically that of the abdomen in relation to udder height (16)—and the shape of the udder and its distance to the floor (5, 6). In addition, Frisch (8) determined that beef calves that had difficulty in suckling “bottle teats” (teats with a median diameter ≥35 mm) showed a higher morbidity and mortality.

The primary aim of this study was to determine how the distance of the udder to the floor and the shape of the teats affected early teat seeking and the time of first suckling by newborn calves.

MATERIALS AND METHODS

A total of 42 Swedish Holstein cow-calf pairs were studied. Fourteen of the cows were first parity, 14 were second parity, and 14 had calved for at least the third time. The animals were part of the dairy research herd of the Swedish University of Agricultural Sciences at Alnarp Experimental Station, Alnarp, Sweden.

The cows were moved to individual calving pens 1 d before estimated calving to permit them to adapt to the new environment. The calving pens were located in a heated, insu-
lated barn with climate control (about 12°C). The 11-m², square pens had three enclosed sides and one side with a feeding gate; if necessary, the cow could be tethered to this side. Straw bedding was provided.

Half of the cows were housed loose in the calving pens; the others were tethered for their entire stay in the pen. Because of their restricted freedom of movement, the behavior of the tethered cows was expected to affect the behavior of the teat-seeking calves to a lesser extent than would the behavior of the cows kept loose in the pens. The distribution between tethered and loose cows was random among cows of the same parity. Thus, there were 7 cows per parity and per housing system.

Continual behavior studies were performed. These began at the first signs of parturition and stopped either after the calf had suckled for a total of 5 min or at 12 h postpartum. The studies were carried out using personal observation and continual video monitoring. The start and stop times of the activities were coded on a hand terminal; built-in times were given to the nearest whole second. However, the coding procedures required several seconds, which meant that the precision of the time notation was about .1 min.

The activities noted included "calf teat seeking", which indicated that the calf nosed the dam in combination with sucking or showing. The exact part of the body the calf was searching was noted, as was the type of contact the calf had with the teat, i.e., whether it had contact on the side or had gotten the end of the teat in its mouth. "Calf suckles" was indicated if the calf sucked the end of the teat in their mouth, the activities the calf had with the teat, i.e., whether it had managed to get the end of the teat tip in their mouth, the activities the calf had not managed to suckle within 12 h). Within 96 h postpartum, an evaluation of the dam's udder was made; the distance of the udder from the floor (median ± 4 cm, that is, 48 and 56 cm).

The effect of the distance from udder to floor on the duration of active teat-seeking for the entire period (begin to search to suckle) and within various intervals, on the duration of the period from the start of teat seeking to the beginning of the first suckling (teat-seeking period), and on the time of first suckling were analyzed using ANOVA and regression. Because the time parameters (Y) were expected to have a skewed distribution as the result of a changing variance for the different distances from udder to floor and because some observations consisted of minimum values (when the calf had not managed to suckle within 12 h), the observations were first ranked and then analyzed (3). This was done using the distance from udder to floor (Fd), type of housing system (E), and parity (P) as sources of variation and checking for possible interaction effects. Because no effect of parity when adjusted for distance from udder to floor or any interactions was significant, a simplified model, \( Y_{ijk} = \mu + F_d + E_i + e_{ijk} \), where \( e \) is the residual, was used in the general linear models procedures of SAS (14) and for partial analysis (Type III).

The influence of teat size and location on the time (Y) necessary for the calves to get the tip of the teat in their mouth was analyzed using the general linear models procedure, Type III, after testing for interactions using the model, \( Y_{ijkl} = \mu + T_l + T_d + T_h + C_{ijkl} \), where \( T_l \) = teat length, \( T_d \) = teat diameter, \( T_h \) = the height of the teat tip from the floor, and \( e \) = the residual. To make full use of observations when the calves did not manage to get the teat tip in their mouth, the activities (both successful and unsuccessful) were evaluated according to teat type (e.g., short-thick, short-thin, long-thick, and long-thin). These types were assigned using the arithmetic mean values for teat length and diameter. A chi-square test for goodness of fit was used for this evaluation.

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Statistical Analyses

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RESULTS

Udder and Teat Conformations

The mean distance between the floor and the base of the front teats was 51.3 cm (SD = 5.9). The back teats were located an average of 4 cm lower than the front ones. Individual teat length ranged from 40 to 95 mm with a mean of 60 mm (SD = 13); the diameter ranged from 21 to 54 mm with a mean of 28 mm (SD = 5).

The Teat-Seeking Sequences

For the 42 calves, the direction of movement from one body part to another when teat seeking is shown in Figure 1. Of the times each of 37 calves searched on its dam’s abdomen, the seeking transferred to the udder or to a teat in 22% of the instances (total for all calves = 109 instances). There was no significant difference in the sequence (abdomen vs. udder) or the number of times the calves began to seek on the abdomen between the different udder conformations. The calves of dams with a low slung udder sought 43% more times on the udder (P < .001) than expected. The calves often searched on the dorsal part of the udder and did not continue to a teat, at least not without a delay. The overall proportion of instances when the calves found the teats while seeking on the udder was 18% (Figure 1). The proportions were significantly different (P < .001) between high (51%) and low (8%) udder types. Three calves found the teats without searching any other part of the cow. Generally, the calves did not seek via the abdomen or udder after they located the teats.

A front teat was found first by 30 of the 40 calves that found a teat. The front teats also dominated the number of times the calves tried to get a teat in their mouth (chi-square test, P < .005). However, there was an even distribution between the front and back teats with respect to getting a teat tip in the mouth for both the first and subsequent attempts.

Duration of Teat Seeking

The median time for active teat seeking was 19 min. The relationship between the duration of teat seeking (birth to suckling) and the distance from udder to floor is shown in Figure 2a. Similar relationships with the birth to suckling period, divided into intervals from birth to the first time the calves found the udder, from
Figure 2. Duration of the 42 calves actively teat seeking on their dams within intervals in relation to distance from udder to floor (front teats). a. Total duration of active teat seeking from birth to the first suckling or within 12 h postpartum if the calves did not manage to suckle during the observation period. b. The period from birth to the time the calf finds the udder. c. The period between the time the calf finds the udder until it finds a teat. d. The period from finding the teat to the first suckling. • = Calves that managed to suckle within 12 h postpartum; ■ = Calf that during period b mostly searches on the front part of the cow. The cow lay down for most of this period; ○ = calves (n = 6) that did not manage to suckle during the 12 h postpartum observation period; □ = calves (n = 2) that did not manage to find a teat.

The results of the ANOVA are reported in Table 1. The rank order of the duration of active teat seeking \( Y_1 \) was described by \( Y_1 = 74.9 - 1.0X_{fd} \), where \( X_{fd} \) is the distance from udder to floor. Floor distance explained 24% of the variation in the rank order of the calves with respect to active teat seeking. The interval from first teat seeking to first suckling was significantly affected by the distance from udder to floor, if adjusted for the effect of the
TABLE 1. Significance levels and determination coefficient for ANOVA using the models $Y_{ij} = \mu + F_d + e_{ij}$ and $Y_{ijk} = \mu + F_d + E_i + I_l + e_{ijk}$.  

<table>
<thead>
<tr>
<th>Dependent variable $^2$ ($Y$)</th>
<th>Model</th>
<th>Source at model</th>
<th>Coefficient of determination using model</th>
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<tbody>
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<td>$F_D$</td>
<td>$E$</td>
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<tr>
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<td>.29</td>
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<tr>
<td>Finding udder to finding teat$^3$</td>
<td>.022</td>
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<td>.016</td>
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<tr>
<td>Finding teat to suckling$^3$</td>
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<td>.28</td>
<td>.12</td>
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<tr>
<td>Duration of teat-seeking period$^4$</td>
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<td>.010</td>
<td>.024</td>
</tr>
<tr>
<td>Time at the first suckling</td>
<td>.015</td>
<td>.012</td>
<td>.008</td>
</tr>
</tbody>
</table>

$^1$Fd = Distance of the udder to the floor, E = the housing system, and e = the residual.

$^2$The dependent variables are rank ordered.

$^3$Two calves that did not find a teat during this period were omitted.

$^4$The teat-seeking period is defined as the time from the first search on the dam to the time the calf first suckles.

hanging system. This period was longer for the calves of tethered cows than for those from cows loose in the pens. The time the calves first suckled varied considerably between 50 min after birth and the end of the observation period of 12 h; the median was 4 h 19 min; as shown in Table 1, this period was affected by the distance from udder to floor. When the rank order of the time ($Y_J$) was described by $Y_J = 62.5 - .79X_{fd}$, the distance from udder to floor explained 15% of the variation. Calves with tethered dams began teat seeking earlier than those with dams loose in a pen, which to a large degree compensated for the difference in the length of the teat-seeking period.

Effect of Teat Conformation

No significant effect of teat size on the time the calves needed to search before they managed to get the tip in their mouths was observed when an adjustment was made for height above the floor. In addition, the teats in which the calves managed to get the tip in their mouths did not have a significantly different conformation from those they were unable to get in their mouth.

DISCUSSION

The height of the udder from the floor significantly affected the length of time a calf needed to search before it was successful in obtaining a suckle for the first time after birth, as previously noted by Selman et al. (17), Derenbach et al. (5), and Edwards (6). In their studies, the udder had been classified as good or poor and high or low hanging udders and as small, intermediate, or pendulous, according to the height of the udder relative to the hocks. In the present study, the measurements of the udder were more detailed; with these criteria, the variation in the distance from udder to floor explained about 24% of the rank order of the calves with respect to the duration of active teat seeking before first suckling. Using the calculated model and transforming from average ranks back to numerical values via interpolation between the two values bracketing each average (4), a 10-cm decrease of distance from udder to floor within the interval 36 to 62 cm would lead to an increase in the duration of the active teat seeking of approximately 10 min (median). This represented a large increase in the median teat-seeking duration of 19 min (Figure 2a).

As was expected, the conformation of the udder did not play a role in teat seeking before the calf found the udder (Figure 2b). Where the calf began to search on the body apparently depended on the relative positions of the cow and the calf rather than on an instinctive search pattern.

Part of the reason the calf had more difficulty in finding low hanging teats (Figure 2c) may be a result of the distance from the upper part of the udder to the teats, as reflected by the distance from udder to floor. Also, the calf was forced to search in a crouching position,
which is not a normal seeking position. The calf’s position, of course, also depends on the height of the calf.

Frequently, even after a teat was located, some time elapsed before the calf got the tip in its mouth (Figure 2d). However, after location of a teat, subsequent seeking was concentrated on the teats, as noted by Edwards and Broom (7). The distance from udder to floor did not play a significant role in how quickly the calves learned to use the teat tip, unless the teats were extremely low hanging. In these instances, the proportion of calves that were not successful in managing to suckle within 12 h postpartum was significant (Figure 2d).

Edwards (6) pointed out that the teats and their location, size, and direction (toward the front, pointing out, pointing down) have additional effects on the success of the calf’s suckling. This appears to be both logical and probable, but analysis of the present data and data obtained from 105 newborn calves in a comparison of calving environments (Ventorp and Michanek, unpublished data) did not confirm this observation. The calves alternated between various teats in their attempts to get a teat tip in the mouth. Thus, it is difficult to distinguish between the effect of the location, size, and direction of the teat and the calf’s ability to learn by experience, that is, to improve its technique in getting the tip of the teat in its mouth.

The most important aspect with respect to passive immunity is the exact time the calf begins to suckle after birth. This time not only depends on how long the calf must search before suckling but also on how old it is when it begins, the number and length of pauses, and the relationship between these factors. However, the distance from udder to floor had an overall effect on the time the calves first sucked. If using the transformation from rank to numerical values, when distance from udder to floor is 60 cm, the calves should obtain their first suckle at an average of 3.75 h postpartum. A distance from udder to floor of 50 cm leads to an extension of first suckling time by an average of 40 min; a further 10 cm less would add 50 min more to the time. This average 90 min extension should not have any practical importance for the concentration of antibodies in the ingested colostrum or for the intestinal absorption of colostral antibodies (10, 19) by the average calf. But for individual calves, low hanging udders—especially if combined with such factors as a dam’s lack of “mother instinct”, low vitality, or other “delay” factors—can lead to a considerable delay in the time of first suckling, or worse, no suckling. In this study, 6 cows had a distance from udder to floor less than 46 cm. Two of the calves managed to suckle within 12 h; the remaining 4 did not. Two other calves failed to suckle within 12 h after birth. However, dams of these calves had distances from udder to floor within the second quartile (52 to 56 cm), so failure cannot be attributed to low udders.

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The effect of parity on the time of the first suckle varies among studies (5, 6, 17), which in turn may mainly be caused by differences in cow behavior, calf vitality, and distance from udder to floor. An interaction between parity and distance from udder to floor on the time of the first suckling was found by Derenbach et al. (5). A positive correlation between parity and udder and teat size is widely accepted (11). Consequently, parity has an indirect impact on the time to first suckling. There also are behavioral differences in the postpartum period between animals of different parities (7), which may influence the calf’s search for teats. In the present study, there was an indication that the parturition environment affected mothering behavior, and differences in this behavior, in turn, affected the teat seeking and time of first suckling. However, any possible parity effects have been overshadowed by the effect of the distance from udder to floor. In practice, it is possible to avoid failure of passive immunity transfer caused by low udders by helping calves suckle from cows or heifers with short distance from udder to floor (for example ≤45 cm) or by feeding calves by hand.

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