THE ONSET OF PUBERTY IN THE BOVINE: UTERINE AND OVARIAN HORMONAL INTERRELATIONSHIPS

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SUMMARY

Twenty prepubertal Holstein heifers were utilized to determine the incidence of abnormal estrous cycles during the onset of puberty in cattle. Upon observation of first behavioral estrus (d=0; 1st Estrus), daily blood samples were collected from the jugular vein until the heifers had experienced a minimum of 3 estrous cycles with the last being of normal length (18 to 24 d). The average weight and age at 1st Estrus was 549 ± 10.6 lb and 304.0 ± 7.5 days, respectively. Frequency of abnormal length estrous cycles was greater ($P < .02$) during the first estrous cycle (30%; 1st cycle) and second estrous cycle (30%; 2nd cycle) compared to the third estrous cycle (0%; 3rd cycle). There was a greater ($P < .05$) incidence of abnormally long estrous cycles compared to short cycles during the 1st cycle; whereas, short cycles occurred more frequently during the 2nd cycle than long cycles. The incidence of silent estrus was more frequent during the 1st cycle than the 2nd cycle ($P < .07$) or the 3rd cycle ($P < .05$). Behavioral estrus with inadequate corpus luteum formation occurred with greater frequency ($P < .05$) during the 1st cycle than the 2nd cycle or 3rd cycle. In addition, behavioral estrus with elevated progesterone concentrations occurred in 10% of the heifers during the 1st cycle and 2nd cycle; during the 3rd cycle, none of the heifers exhibited this behavior. Abnormally short or long estrous cycles, silent estrus and behavioral estrus during elevated progesterone were observed in 45% of the heifers during the first 2 estrous cycles. These data demonstrate that there are anomalies which occur during the 1st cycle and 2nd cycle of puberty. There appears to be a high incidence of abnormally long and short estrous cycles along with silent and asynchronous behavioral estrus as well as behavioral estrus with inadequate corpus luteum formation. Thus, it can be concluded that reproductive maturation continues beyond the occurrence of first behavioral estrus.

INTRODUCTION

Detection of the first puberal estrus in heifers is generally considered to be the point at which the animal has reached puberty. Conception rates, however, appear to be lower in heifers bred at their first spontaneous or induced estrus as compared to the third estrus.

Abnormal estrous cycles and abnormal estrus activity may be contributing factor involved in the decreased incidence of pregnancies occurring after breeding at the first behavioral estrus (1st estrus) as compared to subsequent estrus.

The occurrence of a phenomenon termed nonpuberal estrus (NP estrus), has been reported and is defined as instances of behavioral estrus in prepubertal heifers that are not followed by ovulation and formation of a functional corpus luteum (CL; required for maintenance of pregnancy). Other researchers have concluded that NP estrus is not an uncommon event, but NP estrus can bias the interpretation of results where behavioral estrus is the only criteria used to assign date of puberty.

The objective of this study was to investigate the incidence of abnormal length (short and long) cycles and to evaluate silent and asynchronous behavioral estrus.

PROCEDURES

Twenty prepubertal Holstein heifers, born between March 1 and May 9, 1987, were managed as a group and maintained on Coastal bermudagrass and ryegrass pastures. The heifers were fed daily 6.1 to 8.0 lb/head of supplement (3 parts corn : 1 part soybean meal) along with Coastal bermudagrass hay and trace mineral salt offered free choice which allowed for at least 1.5 lb of gain/day. The heifers were weighed at 28 day intervals and within 24 hours after 1st estrus. A sterile marker bull was maintained with the heifers throughout the duration of the trial to assist in detection of estrus.

Heifers were observed for 30 minutes, four times daily for estrous activity. A heifer was considered to have been in estrus if she stood to be mounted by the bull and/or other heifers, or if mounting behavior was not observed (i.e., when estrus occurred at night), more than one well defined mark along the back and tail-head area of the heifer by the bull was required.

Blood samples were collected on a daily basis from the jugular vein beginning at 1st estrus (d=0) and continuing until the heifer had experienced a minimum of three estrous cycles with the last being of normal length (18 to 24 days). The blood samples were allowed to clot at 4°C overnight and were then centrifuged to yield serum. The serum was stored at -20°C until radioimmunoassay for progesterone concentration.

RESULTS

The average weights and ages at 1st estrus were 549.7 ± 10.6 lb and 304.0

± 7.5 d, respectively, and were similar to the averages reported for Holstein heifers by other investigators. The occurrence of abnormal length estrous cycles (< 17 to > 25 days) was more frequent ($P < .02$) during the first estrous cycle (1st cycle) and the second estrous cycle (2nd cycle) than during the third estrous cycle (3rd cycle; Figure 1). This agrees with other researchers who reported that the occurrence of long estrous cycles (25 to 57 d) was observed during the 1st cycle and 2nd cycle which caused the average length of the 1st cycle and 2nd cycle to be significantly longer than subsequent estrous cycles. There was a higher incidence of long estrous cycles when compared to short estrous cycles during the 1st cycle; however, during the 2nd cycle, short estrous cycles were more frequent ($P < .07$) than long estrous cycles (Figure 1). The occurrence of silent estrus (as determined by hormone profiles) was more frequent during the 1st cycle than the 2nd cycle ($P < .07$) or 3rd cycle ($P < .05$; Figure 2). The high incidence of silent estrus observed in this study is similar to observations made by other researchers. Behavioral estrus with elevated serum progesterone concentrations (above 1 ng/ml) occurred in 10% of the heifers during the 1st cycle and 2nd cycle; while during the 3rd cycle, 0% exhibited this behavior (Figure 2). This phenomenon has not been previously reported. Although only 10% of the heifers exhibited this activity, the fact that the behavior exists warrants mentioning. In addition, estrus followed by inadequate subsequent CL formation (NP estrus) occurred more frequently during the 1st cycle than during the 2nd cycle and the 3rd cycle ($P < .05$; Figure 3). The incidence of NP estrus was not as great in the present study as was reported by others where up to 62.8% of beef heifers exhibited NP estrus after their 1st estrus. Breed type has been shown to affect the occurrence of NP estrus which may account for the lower proportion of Holstein heifers demonstrating NP estrus. Collectively, abnormally short or long estrous cycles, silent estrus and behavioral estrus during elevated progesterone concentrations were observed in 45% of the heifers during the first two estrous cycles.

These findings support and lend additional evidence to the theory that reproductive maturation continues beyond the 1st cycle. These data also indicate that there are numerous behavioral and physiological anomalies that occur during the pubertal transition period. This suggests that a person should be cautious when assigning a date of puberty to heifers where 1st cycle is the sole criteria.

Figure 1. Frequency of abnormal estrous cycles in Holstein heifers.

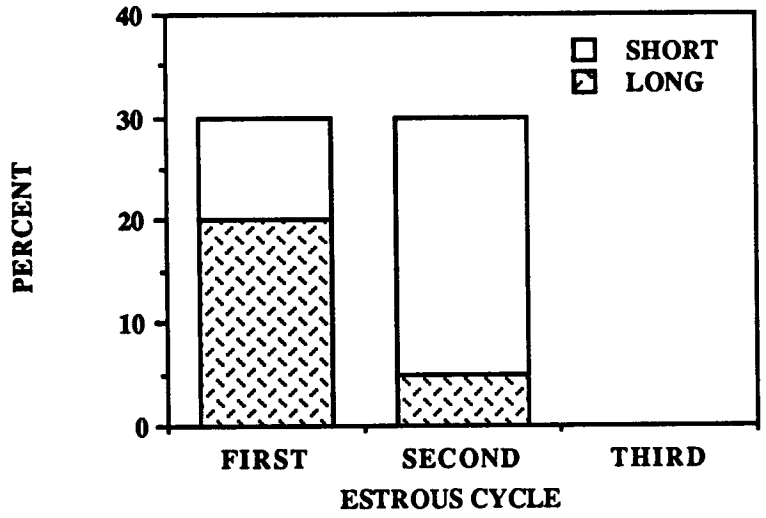

Figure 2. Frequency of silent estrus and estrus during high progesterone.

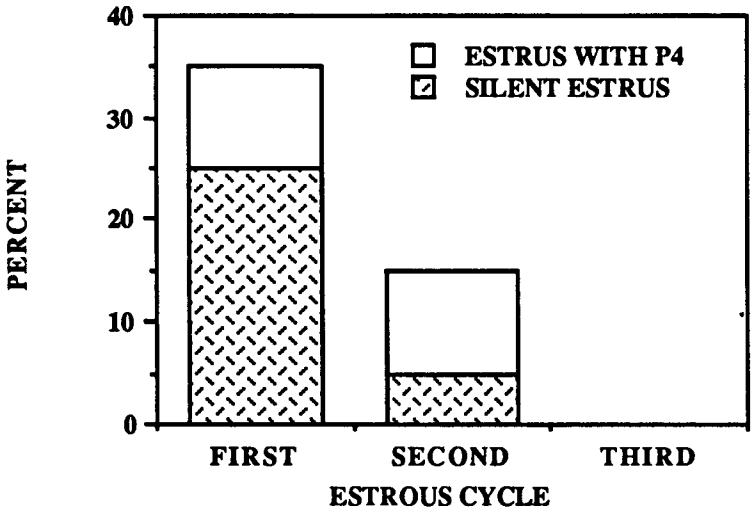

Figure 3. Frequency of estrus without formation of a corpus luteum.