PROGESTERONE, MILK PRODUCTION AND FERTILITY IN DAIRY COWS

I. F DAVIS, R. A. PARR, T. J. SQUIRES, M. A. MILES, C. CHRISTODOULOU and C. J. HUGHES

Victorian Institute of Animal Science, Dept of Food and Agriculture, Werribee, Vic. 3030.

SUMMARY

The oestrous cycles of cows in 3 dairy herds were synchronized with controlled internal drug releasing devices (CIDR) inserted for 9 days and an injection of cloprostenol 1 day before CIDR removal. Cows observed in oestrus 60 h after CIDR removal were inseminated artificially by the same inseminator.

On day 6 after artificial insemination (AI) half the cows in each herd received a second CIDR for 10 days to provide supplementary progesterone in an attempt to increase conception rate. Milk yields of cows were recorded on day 11 after AI and blood samples were collected on day 12. The second set of CIDR were removed on day 16 after AI. At day 12 after AI, plasma concentrations of progesterone after insertion of CIDR at day 6 were increased in only 1 herd.

There were no significant differences in conception rates between treated and control cows in any herd. The correlation coefficient between milk production and day 12 progesterone concentration was not significant for any herd.

Keywords: dairy cows, fertility, embryo survival, progesterone.

INTRODUCTION

Early embryonic mortality is a major cause of economic loss in dairy herds. Fertilization rates after natural or artificial insemination are usually above 90% and embryonic survival rates of 56-66% have been reported with most losses occurring between 8-16 days after insemination (Diskin and Sreenan 1980). One possible cause of this embryonic mortality is progesterone insufficiency at critical times of embryo development.

Progesterone therapy has been attempted in the past but the results have been equivocal, perhaps due to the plane of nutrition of cows during early pregnancy, timing of treatment and milk production of the cow. Sreenan (1981) reviewed results of studies in which a positive response to progesterone supplementation had been demonstrated and found a range of 8-30% increase in embryo survival in progesterone-treated compared with control cows. A similar equivocal situation existed in the sheep until Parr *et al.* (1987) showed that as nutrition increased, blood progesterone concentrations decreased to critical levels in many ewes on a high plane of nutrition resulting in low pregnancy rates unless progesterone was administered over days 8-14 after mating.

In the cow a similar inverse relationship may exist between nutrition and concentration of progesterone in peripheral plasma (Donaldson *et al.* 1970). At the time of conception many dairy cows are at the peak of lactation and eating to capacity. There is also a loss of progesterone from the peripheral circulation into milk. These factors may cause reduced concentrations of progesterone in peripheral plasma with consequent increased embryo losses due to progesterone insufficiency. The experiment reported here was conducted to study the effect of progesterone supplementation at an expected critical time on the fertility of cows of known milk production.

MATERIALS AND METHODS

In Spring 1990, groups of 140-170 cows were chosen from 3 commercial dairy herds, 1 (A) located in South Gippsland and the others (B and C) near Kyabram, Victoria. The oestrous cycles of these cows were synchronized using intravaginal CIDR containing 1.9 g of progesterone (CIDR-B, Riverina Artificial Breeders, Albury, Australia) and injecting 0.5 mg of the prostaglandin $F2\alpha$ analogue, cloprostenol (Estrumate, Coopers Animal Health, North Ryde, Australia) 1 day before removal of the CIDR. Those cows which had shown oestrus by the time of AI at 60 h after removal of CIDR were inseminated by the same operator. Cows not in oestrus by the time of AI were excluded from the study. On day 6 after AI, new CIDRS to supply supplementary progesterone, were placed in half the cows, chosen at random in each herd. Milk production of each cow was measured on day 11 after AI. On day 12, a blood sample (10 mL) was taken from each cow and the plasma was frozen to be assayed later for progesterone concentration using a Direct Progesterone Radioimmunoassay Kit (Farrnos Diagnostica, Finland). The sensitivity of the assay was 0.18 ng/mL and the intra- and inter- assay coefficients of variation were 4.8 and 7.4% respectively. On day 16 after AI the CIDR used to supply supplementary progesterone were removed. Returns to oestrus were recorded by the farmers and pregnancy was diagnosed by rectal palpation about 120 days after AI.

Data relating to concentrations of progesterone at day 12 were analysed by analysis of variance. Data for milk production, or daily butterfat production, progesterone concentration at day 12 and pregnancy status for each cow were subjected to regression analyses. Pregnancy data were examined by Chi square analysis.

RESULTS

The percentages of cows judged, using visual assessment and tail paint, as having shown oestrus by the time of AI were 88, 79 and 67% for herds A, B and C respectively. The concentrations of progesterone in peripheral plasma for cows in each herd at day 12 after AI are shown in Table 1. Progesterone concentrations in CIDR-treated cows were higher than for control cows only in herd A ($P < 0.05$). Conception rates, expressed as the percentage of cows inseminated and pregnant at pregnancy diagnosis for CIDR-treated and control cows are shown in Table 1 and were not significantly different for any herd. The correlation coefficients between milk production or butterfat production and concentration of plasma progesterone for pregnant and non-pregnant cows were not significant for CIDR-treated or control groups in any herd (Table 2).

Table 1. Mean (± s.e.m.) plasma concentrations of progesterone (ng/mL) on day 12 after AI and conception rate (%) for cows from 3 herds. Cows in each herd were either treated with CIDR between days 6–16 after AI or left untreated (control)

For individual parameters in each herd, values with different letters differ significantly ($P < 0.05$)

Herd	Number of cows		Plasma progesterone		Conception rate	
	CIDR	Control	CIDR	Control	CIDR	Control
A	50	47	8.8 ± 0.40a	7.0 ± 0.47b	49	51
B	76	72	10.6 ± 0.40	11.0 ± 0.50	35	41
C	49	52	9.3 ± 0.43	9.1 ± 0.41	52	42

Table 2. Correlation coefficients between milk production on day 11 and concentration of plasma progesterone on day 12 after AI for pregnant and non-pregnant cows in each herd

Herd	CIDR – treated		Control	
	Pregnant	Non-pregnant	Pregnant	Non-pregnant
A	0.32	0.07	0.25	0.23
B	0.07	0.05	0.18	0.15
C	0.25	0.11	0.17	0.08

DISCUSSION

There was no benefit of using CIDR to supply supplementary progesterone during the period of days 6 to 16 after AI. The failure of CIDR to produce a net increase in concentrations of plasma progesterone, 6 days after insertion in 2 herds and a mean increase of about 1.8 µg/mL in the other herd casts doubt on the efficacy of the CIDR used and questions whether the hypothesis was tested in 2 herds.

The lack of a response in conception rate to CIDR treatment differs from the results of Macmillan and Asher (1990) in New Zealand and Robinson *et al.* (1989) in Canada. In the study from New Zealand, significant increases were achieved only when CIDR were inserted on days 7 and 8 after AI respectively. Robinson *et al.* (1989) inserted progesterone releasing intravaginal devices (PRID) for 7 days commencing on either day 5 or day 10 after AI and improved conception rate compared to controls from 30 to 60% for both times of PRID insertion. When PRIDS were inserted during days 10–17 after AI endogenous progesterone production was suppressed (Robinson *et al.* 1989).

In the study reported here, cows in all 3 herds had mean calving to AI intervals of more than 70 days and variation in recognition of expression of oestrus was standardized, leaving fertilization failure and embryonic mortality as the sources of loss. It may be that the CIDR delivered the progesterone within a few days of insertion so that no supplementary progesterone was available at a critical time of embryo development, resulting in loss of some embryos. Because of the low conception rates in these herds, further investigation of the extent and degree of this problem is required.

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