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Abstract

Holstein cows milked twice daily were assigned to be inseminated at their first detected estrus (control) after 42 days in milk or received PGFza (PG) after 42 days, if they had a high milk progesterone (P4) test on any of 3 consecutive Mondays until first inseminated. Milk P4 tests and injections of PG were given on Mondays, and most of the breeding occurred on Thursdays and Fridays. The proportion of cows inseminated within 21 days of the beginning of the breeding period was greater in the milk P4 + PG group (52.8%) than in the control (38.9%). Compared to controls, use of PG reduced days to first service by 12.2 ± 3.1 d, calving intervals by 23.3 ± 8.9 d, rate of reproductive culling, and cost per pregnancy. We concluded that using PG as a management tool in an AI program is warranted and cost effective. However, the milk P4 test would not be justifiable unless its cost were significantly lower than the cost of a weekly injection of PG.; Dairy Day, 1993, Kansas State University, Manhattan, KS, 1993;

Keywords

Dairy Day, 1993; Kansas Agricultural Experiment Station contribution; no. 94-149-S; Report of progress (Kansas Agricultural Experiment Station); 694; PGF2α; Progesterone; A.I.

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USE OF MILK PROGESTERONE AND $PGF_{2}\alpha$ IN A SCHEDULED INSEMINATION PROGRAM

J. S. Stevenson and J. R. Pursley

Summary

Holstein cows milked twice daily were assigned to be inseminated at their first detected estrus (control) after 42 days in milk or received $PGF_{2}\alpha$ (PG) after 42 days, if they had a high milk progesterone (P_4) test on any of 3 consecutive Mondays until first inseminated. Milk P_4 tests and injections of PG were given on Mondays, and most of the breeding occurred on Thursdays and Fridays. The proportion of cows inseminated within 21 days of the beginning of the breeding period was greater in the milk P_4 + PG group (52.8%) than in the control (38.9%). Compared to controls, use of PG reduced days to first service by 12.2 ± 3.1 d, calving intervals by 23.3 ± 8.9 d, rate of reproductive culling, and cost per pregnancy. We concluded that using PG as a management tool in an AI program is warranted and cost effective. However, the milk P_4 test would not be justifiable unless its cost were significantly lower than the cost of a weekly injection of PG.

(Key words: $PGF_{2}\alpha$, Progesterone, AI.)

Introduction

Inefficient detection of estrus in dairy herds where AI is practiced contributes to a significant reduction in reproductive performance and potential milk yield. Although accuracy of detection of estrus may approach 90%, the proportion of all cows detected in estrus (efficiency) is much lower, around 50%. Prolonged intervals to first service resulting from inadequate detection of estrus contribute significantly to unacceptably long calving intervals. The two factors are highly correlated, because a l-day reduction in the interval to first service decreased calving interval by .86 day. Furthermore, nearly three times more variation was accounted for by days lost because of missed periods of estrus and total days open than by days lost because of conception failure and total days open.

Timely insemination of dairy cows at first service is enhanced through the use of $PGF_{2}\alpha$ (PG). Intervals to conception were reduced by as much as 3 wk when cows were treated with PG after detection of a palpable corpus luteum (CL) compared to those cows in which PG was not used. An alternative to palpation of a CL is the use of an on-farm milk progesterone (P_4) test to diagnose the presence of a CL when milk P_4 is high. Administering injections of PG on Monday mornings without prior assessment of CL or P_4 status also was effective in reducing intervals to first service compared to injecting PG based on palpation of a CL. Not only were more periods of estrus in cows synchronized or grouped together for weekly AI when PG was used, but the efficiency of detected estrus improved because the number of mounts increased when up to four or more cows were in estrus simultaneously.

The objective of our study was to determine whether the use of a milk P_4 test is warranted for identification of cows eligible for treatment with PG in a weekly scheduled AI program, based on the achieved reproductive efficiency and cost effectiveness compared to those for cows not receiving PG before first service.

Procedures

The study was conducted over 2 yr in Holstein cows that were housed in outside concrete lots with sheltered free stalls and fed a total mixed diet to meet or exceed NRC requirements for lactating cows. Cows were milked twice daily in a parlor and observed twice daily for signs of estrus. Reproductive tracts of cows were palpated per rectum before 42 days postpartum to determine breeding eligibility. Any cow with obvious uterine infection or other health complications was not assigned to the experiment. Uterine palpations were performed between 42 and 56 days after the last insemination to determine pregnancy status and confirmed by subsequent calving dates.

Cows were grouped together into 3-wk breeding clusters according to calving dates. Each breeding cluster was comprised of cows that were 42 to 63 days in milk. Cows were assigned randomly but unequally to two treatment groups. Control cows (n = 72) were untreated and inseminated at their first detected estrus after 42 days in milk, whereas cows (n = 127) assigned to the treatment group (milk P_4 + PG) were handled as described below.

Once a breeding cluster was formed, with the freshest cow at least 42 days in milk, a Monday morning milk sample was collected from all cows. Poststripping milk was collected directly into antibody-coated tubes and stored in a refrigerator at 5 °C for up to 6 h. Samples were brought to room temperature before P_4 was determined by a commercially available, qualitative, milk P_4 test (Accufirm®, ImmuCell, Portland, ME), with the aid of a hand-held spectrophotometer used to compare color intensities of test samples and the within-batch standard. When milk P_4 was high, cows in the treatment group (milk P_4 + PG) were injected with 25 mg PG (Lutalyse®, The Upjohn Company, Kalamazoo, MI) on Monday afternoon. If milk P_4 was low, cows were retested on the following Monday. Once treated cows were inseminated upon detected estrus, the sampling procedure was terminated. No cow was tested or injected more than three times. If a cow had not been inseminated at the end of test wk 3, first service was made at the first detected estrus without further use of PG.

Results and Discussion

Intervals to first service, pregnancy rate at first service, and the 2l-day insemination rate are summarized in Table 1. The milk P_4 + PG treatment reduced ($P<.01$) postpartum interval to first service by 12.2 ± 3.1 days (X ± SE) compared to the control. Pregnancy rate to first service was unaffected by treatment, although it was numerically higher in the milk P_4 + PG treatment group. This trend probably occurred because fewer cows in the treated group were inseminated in the 40- to 60-day postpartum period when fertility is lower than at later postpartum intervals. The 21-day insemination rate was higher ($P = .053$) in the treated than control group, with an average of 52.8% of the cows in each cluster group inseminated after 3 wk, whereas only 38. 9% of the controls were inseminated during the same interval.

Actual calving intervals, pregnancy rates at 120 days in milk, and overall pregnancy rate are summarized in Table 1. Although the proportion of cows conceiving at the end of the experiment (73.4%) was unaffected by treatments,_ calving intervals were 23.3 ± 8.9 days (X ± SE) shorter ($P = .068$) in the milk P_4 + PG treatment group than in controls. Pregnancy rate by 120 days in milk was not different but numerically favored the treated cows.

Reasons for disposal of 26.6% of the cows in our experiment were many. Amount of culling was similar between groups, except in the categories of low milk production and reproductive problems. Fewer ($P< .05$) treated than control cows (33 vs 56%) were culled for reproductive problems, which allowed a greater ($P<.05$) proportion of voluntary culling for low milk production in the treated than the control group (33 vs 12%).

We attempted to examine the cost effectiveness of our two treatments relative to the cost of each pregnancy achieved. Cost comparisons for our two treatments and for two other PG systems recently reported in the literature are summarized in Table 2. The latter two programs involved either weekly injections of PG on Monday mornings, without prior assessment of CL or P_4 status, or injections of PG based on detection of a CL by weekly palpation of the ovaries. Costs were estimated to approach realistic values for milk P_4 tests, PG, and individual palpations of cows.

An additional cost was added to our control group because of its longer calving interval. The cost of days open beyond 365 days (12-mo calving interval) has been reported to range from $.25 to $4.68 per day open beyond 85 d. For controls, we conservatively used the estimate of $1 per day open beyond the number achieved in the milk P_4 + PG group, for a total of $23.30 per pregnancy. The cost per pregnancy in controls was $30.32 compared to a lower cost of $20.59 for the treated cows. To make the cost per pregnancy equal in our two treatment groups, the cost of 1 day open beyond 85 days would have to equal only $.35.

In comparison, similar estimates of cost per pregnancy in a previous study were $17.69 for weekly Monday morning injections of PG and $14.14 for palpation + injections of PG (Table 2). Median days open were 97 and 110 days for the two previous groups, which were similar to that in our milk P_4 + PG group (mean = 101 d). Although the absolute costs will vary geographically, the relative ranking of costs is probably correct. In addition, the cost of our milk P_4 + PG treatment would have been more, if the number of milk tests and subsequent injections of PG had not been limited to three. In the previous report, the use of PG was limited only by occurrence of first inseminations or culling of the cow from the herd. Thus, the number of injections of PG per pregnancy was 3.6 compared to 1.4 in our milk P_4 + PG group (Table 2). The milk P_4 test + injection of PG is cost-effective when compared to our control within the given rates of detected estrus and level of fertility in our herd. Furthermore, the PG schemes described in the previous study probably are more cost-effective than either of our treatments.

The accuracy of the milk P_4 test was good at 87.4%, but its high rate of false positive tests (52. 8%) resulted in cows receiving $\mathbf{PGF_2\alpha}$ that did not have a functional CL. The palpation method is also not error free, because one review, which summarized 402 palpations in four separate studies confirmed by concentrations of P_4 in serum, reported that accuracy of diagnosing a functional CL (actively producing P_4) was 82%, whereas the accuracy of diagnosing a cow without a functional CL was only 70%. Because the costs of inaccurate milk P_4 tests and individual palpations are included in Table 2, improving accuracy of either method of assessing CL status should reduce the estimated cost per pregnancy. Assuming 100% accuracy and eliminating the high rate of false positive tests, the cost per pregnancy of the milk P_4 test would have decreased by $1.63, making it more comparable in cost ($18.96) to the weekly PG system ($17.69). The obvious problem in cost comparisons for the milk P_4 test and the weekly injections of PG is that their costs are similar. Achieving a greater accuracy by milk P_4 testing and reducing the cost of administering injections of PG to cows without a CL would require the cost of the milk test to be significantly lower than its current price. Even when the number of injections of PG in the weekly scheme was nearly 3 x that for the milk P_4 + PG treatment or that for the palpation + PG (Table 2), the weekly injection system seemed to be cost effective.

Using PG as a tool to control the onset of estrus is warranted in a dairy AI program, because it reduces days to first service, calving intervals, rate of reproductive culling, and cost per pregnancy. However, the additional use of the milk P_4 test probably is not justifiable in this application unless its cost is significantly lower than the cost of a weekly injection of PG.

Table 1. Reproductive Performance of Dairy Cows Given Weekly Injections of Prostaglandin $F_{2\alpha}$ (PG) versus Using No PG (Control)

	Treatment			
Trait	Control	Milk P_4 + PG	SE	P value
No. cows	72	127	—	—
Days to first service	83.6	71.4	3.1	.006
First-service pregnancy rate, %	34.7	41.7	–	.257
Percentage bred once in first 21 d	38.9	52.8	–	.053
Calving interval	406.4	383.1	8.9	.068
Pregnant by 120 d, %	62.3	72.0	–	.174
Overall pregnancy rate, %	73.6	73.2	–	.993

Table 2. Cost Comparison for Breeding Programs Involving Only Visual Detection of Estrus (Control), Milk Progesterone (P_4) + Prostaglandin $F_{2\alpha}$ (PG), Weekly Blind Injections of PG, and Palpation + PG.

	Treatment			
Item	Control	Milk P_4 + PG	Weekly PG	Palpation + PG
No. cows assigned	72	127	184	188
No. pregnancies	53	93	156	154
Cost of milk P_4 ($3 each)	o	864	0	0
Cost of PG ($3 each)	o	399	1665	507
No. of injections/pregnancy	o	1.4	3.6	1.1
Cost of palpations ($2 each)	372	652	1094	1670
Cost of longer days open ($1/d)	1235	0	0	0
Total costs, $	1607	1915	2759	2177
Cost/pregnancy, $	30.32	20.59	17.69	14.14