Effectiveness of Prostaglandin Treatment of Anestrus in Dairy Cows

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Summary

The reproductive record of nine dairies that used prostaglandin for anestrus dairy cows were analyzed to determine effectiveness of treatment. All herds utilized a herd health program administered by one veterinarian. Anestrus cows; i.e., cows that were eligible for breeding and had not shown signs of estrus for the past 30 days, were examined. If a corpus luteum was palpable on either ovary, treatment with prostaglandin (either Lutalyse or Estrumate) was advised. The herdsman then elected to treat the cow. A total of 179 doses were used in the study and 73% of treated cows were served within 10 days of treatment. The average interval from treatment to service was 5.4 days. If only cows that were served within 10 days were considered, the average interval to service was 3.4 days and 70% of these services occurred on day 3 or 4 after treatment. If the cow was not served within 10 days of treatment, the average interval to service was 26.9 days. This was not different ($p>0.05$) from the average interestrus interval of 27.4 days for these herds. Furthermore, if the cow served within 10 days of treatment returned to service, the average interestrus interval between the first and second service after prostaglandin treatment was 27.5 days. It appears that the phenomenon of anestrus follows the laws of probability in these nine herds.

The average intervals to service and pregnancy rates were then used in a decision tree to analyze the economic effectiveness of prostaglandin treatment. All costs including those due to days open, semen costs and treatment were assigned to the pregnant cows that resulted from the first service after the decision node of the tree. The economic effectiveness of prostaglandin varied with the assumptions. At the high levels of reproductive performance observed in these herds, prostaglandin was cost effective at a treatment cost of $2.50 and cost of days open at $2.00/day. As the ratio of treatment cost to cost of a day open increased, the cost effectiveness decreased. At a prostaglandin cost of $5.00 and day open of $2.00, treatment was not cost effective. Treatment with prostaglandin was most cost effective when treatment increased the number of cows observed in estrus from 50 to 75%. When prostaglandin resulted in increased heat detection efficiency, every dollar invested resulted in a return of $4.30 even when only one service cycle was considered.

Introduction

Prostaglandin F2α and its analogues are potent luteolytic agents in cattle.[1,2,3] Prostaglandins have not been effective synchronization agents in cattle because of a variable interval from treatment to ovulation.[4–9] Pregnancy rates with times breeding even when cattle are inseminated twice 245 hours apart have been disappointing.[10] However, some studies have observed an increase in pregnancy rates after prostaglandin treatment if insemination took place after detection of estrus.[11,12] Such programs still require detection of estrus and hence submission rates of cows to service will be lower than with timed breeding. Prostaglandin use was not effective in reducing days open in one study because of a low submission rate of treated cows.[13]

Treatment of anestrus dairy cows with prostaglandin is a common practice in midwestern dairies of reproductive herd health programs. This study was undertaken to determine the response of cows to this practice and determine its cost effectiveness.

Materials and Methods

Herds

Nine herds were studied. All records on current lactations were included and the analysis was done on July 30, 1988. All records were maintained on a microcomputer in the veterinarian's office and included dates of calving, reproductive examination, breedings, treatments and production data.

Selection of Cows for Treatment

Anestrus cows were examined at the reproductive herd health visit. If a corpus luteum was palpated, treatment with prostaglandin was advised. The herdsman then decided to treat the cow.

TABLE 1. Reproductive performance of nine dairy herds utilizing prostaglandin for anestrus cows.

Herd	Calving Interval	Days to Pregnancy	First Service Pregnancy Percent	Service per Pregnancy	Average Heat Interval	Heat Detection Efficiency	Ratio of 21 to 42 Day Cycles	Days to First Service
1	369	123	43	2.4	26.1	80	3.6	88
2	444	137	58	1.9	24.0	88	8.0	107
3	395	113	42	2.2	27.1	77	4.7	80
4	385	93	56	1.8	27.3	77	2.9	72
5	419	134	53	1.9	27.4	77	2.6	111
6	377	84	50	1.9	27.9	75	1.83	65
7	386	117	35	2.2	31.2	67	2.0	75
8	399	127	50	1.7	38.1	55	1.1	97
9	394	126	39	2.4	27.5	76	1.1	82

TABLE 2. Response to prostaglandin use in nine dairy herds.

Herd	1	2	3	4	5	6	7	8	9
Cows	45	42	56	61	81	45	97	36	74
Cows Rx	5	10	13	15	22	15	30	7	28
Percent Cows Rx	11	24	23.2	25	27	33	31	19	38
Total Doses	6	12	16	14	27	19	42	8	35
No. Bred (%)	2(33)	11(92)	14(89)	12(85)	29(77)	15(83)	28(66)	6(75)	23(65)
DIM when treated	136	138	125	83	113	86	110	125	113

TABLE 3. Effectiveness of prostaglandin treatment for anestrus across herds.

Prostaglandin doses	179
Services within 10 days of treatment	132 (73.7%)
Services 10 days after treatment	19 (20.6%)
No service occurred	28 (15.6%)
Pregnancy rate of services within 10 days of Prostaglandin	53/117 (45%)*
Pregnancy rate of all other services	267/550 (48%)*

* Not significant at $p > 0.05$

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Analysis of Data

Reproductive performance was summarized for each herd (Table 1). The performance of cows treated with prostaglandin was summarized for each herd (Table 2) and across herds (Table 3). The days from treatment to service were then determined (Table 4) and finally the average interestrus interval was compared to the average interval between the first and second service after prostaglandin treatment (Table 5). A Z-test was used to compare interestrus intervals between groups and a Chi-Square test was used to compare pregnancy rates after prostaglandin to all other services.

TABLE 4. Interval to service after prostaglandin treatment by days to service

Interval (days)	Total	Percent (%)	Pregnancy Rate (%)
1	4	2	75
2	12	7	36
3	60	34	48
4	32	17	33
5	11	6	43
6	3	1	50
7	4	2	100
8	2	1	100
9	4	2	33
>9	19	10	66
Not bred	28	16	0

TABLE 5. Interestrus Intervals

Average interestrus intervals	27.4*
Average interestrus interval after prostaglandin treatment	27.5
Average interval from treatment to service for intervals > 9 days	26.9

* Differences not significant

Cost Effectiveness

The performance of prostaglandin treated cows was modeled with a decision tree. The tree is described in Figure 1 and utilized the data derived from this study.

Results and Discussion

As with other studies the interval from treatment to service was variable. When considering the first 10 days after treatment most services, 92/132 or 70%, occurred on day 3 or 4, 12% occurred prior to day 3 and 18% occurred after day 4. This was not as tight a period of synchronization as observed with cloprostenol when 93% of all the services occurred from day 2 through 5. [12] Submission rates of cows to service after treatment was similar to some studies[12] but superior to others.[13] Pregnancy rates after prostaglandin treatment, 45%, were not different from all other services in these herds, 47%. Since all cows were bred on the basis of signs of heat after treatment, this indicates the interval to ovulation is variable after prostaglandin treatment. The reduction in progesterone after prostaglandin treatment does not vary significantly; therefore, this variation is due to varied rates of folliculogenesis.[10] Lactation will delay the rate of folliculogenesis and the day of the estrous cycle also affects the interval from treatment to ovulation.[4-9]

This variation of interval from treatment to ovulation accounts for the generally lower pregnancy rates observed with timed insemination[10]. Double insemination at 72 hours and 96 hours (while it improves pregnancy rates by 6 to 10%) still results in less than normal pregnancy rates.[10] In this study only 70% of cows were in heat on day 3 or 4. It is unlikely that timed insemination, even double insemination, would have resulted in acceptable pregnancy rates.

A fertility enhancement effect has been observed when cows were observed in estrus and bred in estrus after prostaglandin treatment.[11,12] Pregnancy rates have been increased as much as 10%. This was not observed in this study and the reason is a matter of speculation. The reason may reside in the designs of these studies. Where prostaglandin was observed to increase pregnancy rates, substantially more cows were treated. This was a result of the design of these studies in that all eligible cows were treated. In the present study, fewer cows were treated and treatment of more than 3 cows at one time was infrequent. The number of cows in estrus at one time affects the amount of mounting activity. Mounting activity is at a maximum with 4 or more cows in estrus.[14] This may increase the efficiency of heat detection and accuracy; therefore, timing of insemination may be improved resulting in an improvement in pregnancy rates. This hypothesis has not been proven, however. Regardless, this study confirms others in documenting normal pregnancy rates after prostaglandin treatment if service occurs after a cow has been detected in heat.

The percent of cows treated that were detected in estrus varied by herd from 33% to 92% (Table 2). In almost all herds the percent found in heat was high, >65%, but heat detection efficiency was also high in these herds, 75%. Not all studies have reported as high a submission for service rate after prostaglandin treatment.[13] The percent of cows found in heat after prostaglandin treatment can be expected to vary from herd to herd for the same reasons that heat detection varies; i.e., the orga-

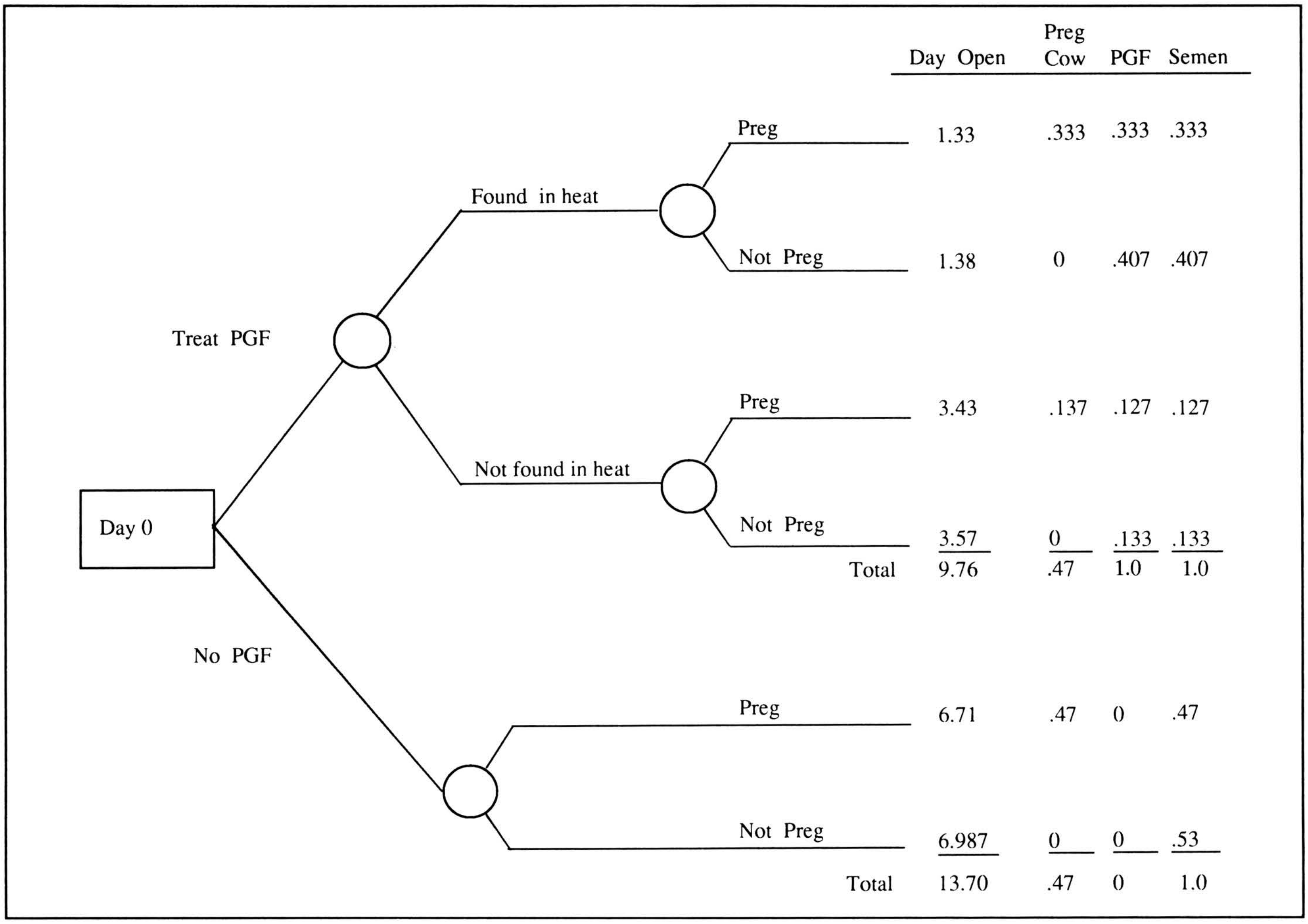

FIGURE 1. Decision Tree for analyzing effectiveness of PGF treatment of anestrus cows.

nization and time commitment of herd management to detection of estrus. No effort was made to explain the herd to herd variation as the number of herds (n=9) was too small to statistically analyze. Any attempts to explain such herd to herd variation in response to prostaglandin will require a larger number of herds and should also include the number of cows treated at any one time as a variable.

In general, the selective use of prostaglandin treatment of anestrus cows in these herds was effective. Of treated cows, 73% were observed in heat within 10 days and pregnancy rates of these services did not differ from other services in this herd.

In order to estimate the cost benefit of prostaglandin treatment we analyzed the economics using Fetrow's Decision Analysis Model (Table 6).[15] This model determines the advantage in days saved not pregnant amongst cows that conceive by 20 days after the decision to treat or not to treat. The days saved not pregnant are compared to a baseline cow who is not detected in heat so she cannot conceive who is assigned a value of 0. If a cow conceives on day 10 after treatment she would have an advantage of 10 days over the baseline cow and return $20.00 (10 x $2.00/day saved). If a cow does not conceive by day 20 she would not have an advantage over the baseline cow and would be assigned a value of 0. The costs of the days open of this cow would not be considered unless she ultimately conceives because culls are not considered. Therefore, the cost of days open is not directly accounted for in this model, only indirectly as days saved not pregnant. This is a significant cost in breeding cows and perhaps should be accounted for in a direct manner.

An examination of the data from this study indicates that anestrus follows the laws of probability. That is, anestrus is simply a matter of chance a cow does not appear to be anestrus due to factors intrinsic to that cow. This is evident by the similarity in interestrus intervals between all cows and the average interval between the first and second service after prostaglandin treatment (27.4 days versus 27.5 days N.S.). This is supported by the average interval from treatment to service in those treated cows that were not bred within 10 days of treatment (26.9 days). It was decided to construct a decision tree using these intervals to model the days saved to service and economic benefit of the alternatives; treatment or no treatment with prostaglandin.

TABLE 6. Economics of prostaglandin use as modelled with Fetrow's Decision Analysis Tree. Assumptions were 47% of cows conceived to service, heat detection rates of 74%, and 74% of cows found in heat after treatment.

Cost Assumption Days Open	Drug	Days Open Saved	Profit Earned
$2.00	$3.00	5.5	$8.08
$2.00	$5.00	5.5	$6.08
$3.00	$3.00	5.5	$13.62
$3.00	$5.00	5.5	$11.62

The tree is described in Figure 1. It was assumed that 74% of cows would be found in heat after treatment and the average interval to service would be 3.4 days. It was also assumed that the interval to service of the other 26% of treated cows would be 26.9% days. The decision not to treat would result in an interval to service of 13.7 days or one-half of the average interestrus period. Pregnancy rates did not differ. All costs of semen and days open resulting from one interval to service were assigned to the pregnant cows resulting from that service.

With this method of accounting events subsequent to service including culling, days to service and semen cost can vary between alternative treatments; therefore, only one opportunity for service was considered.

The results are in Table 7. The cost effectiveness of prostaglandin treatment varied with the assumptions. At a cost of a day open of $3.00 and prostaglandin of $5.00, treatment was cost effective. It appears that a significant factor in the cost effectiveness of prostaglandin is the ratio of cost of a day open to drug cost. As the cost of a day open approached the cost of the drug, the cost effectiveness improved. The selective use of prostaglandin treatment was economically justified in these herds.

This fact is also interesting considering the high reproductive performance of these herds. Heat detection efficiency was higher (75%) than generally reported. Prostaglandin use would be expected to be less cost effective because of fewer days saved in these herds. Considering this fact it was decided to extrapolate beyond the range of performance observed in this study to determine the cost effectiveness when heat detection averages 50% but is increased to 74% after prostaglandin treatment. In this instance the average interestrus interval would be 21/.5 or 42 days. The interval from treatment to service of those cows that were not observed in heat was assumed to be 42 days. The cost effectiveness of treatment was particularly marked under these conditions, returning $4.30 for every dollar invested.

In conclusion, pregnancy rates of service that occurred within 10 days of prostaglandin treatment were not different from other services. A high percentage of treated cows were serviced within 10 days of treatment (74%) but interval to service varied; only 70% of services occurred on day 3 or 4 after treatment. Pregnancy rates of services that occurred on day 3 or 4 did not differ from other services within 10 days of treatment. At the high levels of heat detection efficiency in these herds, prostaglandin treatment was economically sound even when only one cycle of opportunity was considered. The main factor affecting cost effectiveness was the ratio of cost of the drug to cost of a day open, with the most benefit occurring at a ratio of 1:1. Furthermore the cost effectiveness of prostaglandin was particularly marked when prostaglandin increased heat detection efficiency.

TABLE 7. Effect of prostaglandin treatment on costs of breeding cows.

COSTS Day Open DRUG COST	Drug	Days Saved per Pregnant cow	COST PER PREGNANT COW Treatment	No. Treatment		RETURN per $1.00 ADVANTAGE
$2.00	$5.00	3.94	62.02	59.30	- $2.72	$ .74
$2.00	$2.50	3.94	56.72	59.30	$2.58	$1.74
$3.00	$5.00	3.94	71.78	73.00	$1.22	$1.12
$3.00	$2.50	3.94	66.68	73.00	$6.52	$2.23
$3.00	$2.50*	16.10	77.42	94.8	$17.38	$4.30

* Heat detection efficiency was assumed to average 50% so interestrus interval would equal 42 days (21/.5). It was assumed that treated cows would exhibit heat in 3.4 days and 74% of treated cows would be bred within 10 days. The average interval to breeding of cows within 10 days would be 42 days.

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