Evaluation of the benefits of the timing of pregnancy testing by transrectal palpation in dairy cattle

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Objective—To determine the benefits that were associated with pregnancy testing by use of transrectal palpation during the period 30 to 65 days after unsuccessful insemination of dairy cows.

Design—Nonconcurrent, cohort study.

Animals—Cows in 15 dairy herds in the United States and Canada.

Procedure—Reproductive records of cows (n = 713) that did not calve within 294 days of first-service insemination and that had been evaluated for pregnancy 30 to 65 days after first-service insemination were examined. Records were analyzed to determine the day of parturition or date of culling and to determine if the probability of a cow being culled or the interval to parturition was related to the number of days after insemination that pregnancy testing was performed.

Results—For cows that calved more than 294 days after first-service insemination, the interval from first-service insemination until parturition was associated significantly with herd, season, and treatment on the day of pregnancy testing. Pregnancy testing was less likely to be performed in a herd in which cows were being treated with prostaglandin F2α (PGF2α) with one of its analogues. Cows treated with prostaglandin F2α on the day of pregnancy testing were less likely to be culled than nontreated cows. For cows pregnancy tested 30 to 65 days after insemination, each additional day after day 30 before pregnancy testing was performed resulted in an increase of 1.09 days in the interval until parturition.

Clinical Implications—Pregnancy testing by means of transrectal palpation as soon as possible after day 30 after insemination can result in shorter calving intervals.

There is considerable variation among estimates of the economic value of reducing the calf-to-calf interval for dairy cows. Despite this variation, most researchers predict at least some economic benefit to decreasing the calf-to-calf interval. Scheduled pregnancy testing remains a key component of reproductive herd health programs aimed at decreasing this interval. However, the optimal time at which to perform pregnancy examinations continues to be debated. Researchers have suggested that transrectal palpation during the early (day 30 to 60) stages of gestation may alter risk of abortion. These investigations have assumed that benefits exist for early testing, namely that early detection of nonpregnancy will promote intervention that will result in shorter, more economic calving intervals and a reduction in culling rate. Members of our group have reported that the risk of early palpation varies among herds, but the magnitude of the risk is small, and the mean risk is near zero (no risk); however, that study did not address the potential benefit of early pregnancy testing by transrectal palpation.

Cows that are not pregnant after an insemination usually continue to come into estrus at 21-day intervals. Inseminated cows subsequently observed in estrus will be assumed to be not pregnant and will be re inseminated, leaving only pregnant and anestrous cows to be examined for pregnancy. Therefore, the diagnosis of not pregnant also implies a diagnosis of failure to observe estrus. Intervention logically would be aimed at treatment consisting primarily of injection of prostaglandin F2α (PGF2α) or one of its analogues. The likelihood of a good response to PGF2α is influenced by the date after insemination at which pregnancy testing is performed, because the most beneficial effect of PGF2α administration would be during periods in which nonpregnant cows would be in diestrus.

The objective of the study reported here was to determine whether earlier pregnancy testing (performing pregnancy testing on a day prior to the day on which it actually was performed) by means of transrectal palpation during the period 30 to 65 days after insemination was associated with a decrease in calving intervals. The model we used helped us to determine the importance of day of palpation on calving intervals, when adjusting for effects of PGF2α treatment and season. An additional model was used to determine whether earlier pregnancy testing was associated with a decrease in culling rates.

Materials and Methods

Herds—Herds (n = 15) throughout the United States and Canada that were on a computer-based record-keeping system were used in the study. Data from January 1990 to October 1992 were obtained, allowing evaluation of inseminations performed in 1990 and 1991. To ensure independence of events, records for only 1 calving interval/cow were included for analysis. Records of cows (n = 713) that did not calve within 294 days of first-service insemination were analyzed to determine when cows gave birth or were culled. Only herds with 10 or more eligible cows that had results of pregnancy tests performed 30 to 65 days after insemination were included in the study.

Statistical analysis—Least-squares multiple regression analysis was used. The dependent variable was the number of days between first-service insemination and parturition. Independent first-order variables were selected in a stepwise selection procedure, with a value of $P = 0.15$ necessary for a variable to enter the model and a value of $P = 0.05$ needed to retain a variable in the model. Variables included herd, treatment with PGF2α, on the day of pregnancy testing, number of days after insemination that pregnancy testing was performed, and season of the insemination, with the period from June 21 to September 21 considered as a risk factor. Higher-order variables, including all possible two-way interactions and the quadratic term for number of days after insemination at which pregnancy testing was performed, were entered in a stepwise selection procedure. When analyzing the effect of pregnancy
testing, the model was used to determine the benefit of day of palpation while purposefully ignoring the results (diagnosis) of that palpation. This was done to test the value of the procedure, rather than the value of a specific diagnosis.

Logistic-regression analysis was used to determine the effects of independent variables on culling of cows. Only culling events that were more than 294 days after first-service insemination were studied. The same independent variables as for analysis of parturition interval were entered in a stepwise selection procedure.

To determine the distribution, herd effects were calculated, using the assumptions that there was not a seasonal effect (ie, assumed that insemination was performed during the period from September 22 to June 20). PGF2α was not given (ie, no treatment), and pregnancy testing was performed at 45 days after insemination. The calculated effect was plotted against number of herds. To determine the distribution for effects of PGF2α treatment among herds, the herd effect for PGF2α treatment was added to the main effect for PGF2α treatment, and the total value was plotted against number of herds. The probability that cows were administered PGF2α on the day of pregnancy examination was determined for 5 intervals, each of 7-days' duration. Two of the 5 intervals were near dates for subsequent expected estrus (days 38 to 44 and 58 to 65 after insemination), and 3 intervals were during periods of expected diestrus (days 31 to 37, 45 to 51, and 52 to 58 after insemination). Probability of treatment for each interval was compared by means of an ANOVA, using Duncan's multiple-range test. All analyses were performed by use of a computer-based statistics program.19

Results

Of the 713 cows studied, 508 had calved, 57 had been culled, and 148 had not been culled but had not calved by the end of the study. Outcome for the interval from insemination to parturition was related to herd (P < 0.0001), season of insemination (P = 0.047; 95% confidence interval [CI], –23.3 to –0.6), day of pregnancy testing (P = 0.04; 95% CI, 0.07 to 2.11), and treatment with PGF2α (P = 0.004; main effect [B value], 17.4). The herd × PGF2α-treatment interaction was associated significantly (P = 0.009) with the interval from insemination to parturition. Other two-way interactions and the quadratic term for day of pregnancy testing were not related significantly to the interval from insemination to parturition. Values for herd estimates of insemination-to-parturition intervals ranged from 347 to 491 days (Fig 1). For each day after day 30 after insemination before pregnancy testing was performed, the interval for insemination to parturition was increased by 1.09 days (95% CI, 0.07 to 2.11).

Prostaglandin F2α was administered to 197 of 713 (27.6%) cows on the day of pregnancy testing. Cows examined between 31 and 38 days after insemination were more likely (P < 0.05) to receive PGF2α on the day of pregnancy testing than were cows examined 38 to 51 and 59 to 65 days after insemination. Cows examined 52 to 58 days after insemination were more likely to receive PGF2α than were cows examined 59 to 65 days after insemination (Fig 2). The effect of PGF2α treatment varied among herds (Fig 3). Cows treated with PGF2α had calving intervals that were 17.4 days less than cows that did not receive PGF2α. The most prominent effect for treatment with PGF2α was recorded for a university teaching herd in which cows that did not receive PGF2α treatment had a prolonged insemination-to-parturition interval.

Culling was not related to day of pregnancy testing, but was associated significantly with herd (P = 0.01) and season of insemination (P = 0.005). Cows given
PGF$_{2\alpha}$ on the day of pregnancy examination had a decrease in odds of being culled, compared with cows that did not receive PGF$_{2\alpha}$ (odds ratio, 0.52; 95% CI, 0.26 to 1.06). Cows that were inseminated during the summer that did not calve within 294 days of first-service insemination had higher odds of being culled, compared with cows inseminated at other times of the year that did not calve within 294 days of first-service insemination (odds ratio, 2.40; 95% CI, 1.31 to 4.87).

**Discussion**

A plethora of information has been published on the economic value of short calving intervals.\textsuperscript{1-5} Calving interval is known to be a function of voluntary waiting period, estrus detection, conception rate, and rate of embryonic failure.\textsuperscript{5,7,60-23} However, little has been published concerning the role of pregnancy testing. If a benefit exists, it would only accrue to cows that are not pregnant as a result of the insemination being evaluated. In the study reported here, records were used to obtain an objective measure of calving interval. Almost all cows that calved as a result of conception at first insemination would do so by 294 days after insemination (mean length of gestation ± 2 SD).\textsuperscript{3} Accurate transrectal palpation will detect pregnancies, some of which are destined to result in embryonic death or abortion, with the incidence of embryonic loss increasing with earlier performance of pregnancy testing; thus, false-positive predictions of parturition dates will be more common with early testing. Furthermore, positive diagnoses from earlier pregnancy testing may cause delays in intervention, because cows that subsequently have undetected pregnancy loss and that remain anestrous will be assumed to be pregnant. We included the potential increase in calving interval that may result with earlier testing in our analyses by classifying cows by the day of testing without regard to the subjective diagnosis of pregnancy. The value of pregnancy diagnosis by transrectal palpation, like all clinical tests, will depend on the accuracy of the test, value of potential interventions, and prevalence of the condition for which you are testing. In the study reported here, we used a probability sample (all cows) from a convenience sample of 15 herds. Herds with good records and a high prevalence of postinsemination anestrus constituted the target population for this study.

The study reported here did not include examination of the period between parturition and first insemination. The parturition-to-first-insemination period is variable and is likely to be independent of day of pregnancy testing.\textsuperscript{24} Mean interval from first insemination to parturition varied widely among herds. These herd effects could not be separated from effects associated with the veterinarian for each herd because of the structure of the data; however, evaluating the methods used by successful veterinarians may elicit reasons for herd differences.

In another study, the interval between 2 consecutive parturitions was examined to determine the effect of day of transrectal palpation for pregnancy testing on calving interval.\textsuperscript{25} In that study, effects of treatment with PGF$_{2\alpha}$ on the day of pregnancy testing or interactions between PGF$_{2\alpha}$ treatment × day of testing were not examined.

The number of days from insemination until pregnancy testing had a strong and clinically important association with days to calving. Over the range of 30 to 65 days, for each day beyond day 30 after insemination until pregnancy testing was performed, the period from first insemination until parturition was increased by 1.09 days. Because of an a priori interest in a possible curvilinear effect, the quadratic term for day of pregnancy testing was evaluated to determine if a nonlinear association existed between day of pregnancy testing and calving interval. A curvilinear effect was considered possible because of the potential influence of estrous cycles; however, a curvilinear effect was not detected.

More cows would have been expected to be near estrus during the days prior to day 42 after insemination, and, presumably, estrus detection could have been intensified after identification of nonpregnant cows.\textsuperscript{36} Researchers have suggested that the percentage of nonpregnant cows that return to estrus at 38 to 46 days after insemination may be considerably less than previously believed and that insemination on the second estrus of these irregular periods (23 to 35 days or more than 45 days after insemination) is as likely to result in pregnancy as inseminations performed on cows detected in estrus at a regular 21-day interval.\textsuperscript{15}

Prostaglandin F$_{2\alpha}$ treatment had a large effect that did not vary with day of pregnancy examination. If PGF$_{2\alpha}$ had been given indiscriminately, it would have been expected to be least effective near days 42 and 63 after insemination. A decrease in effectiveness was not observed, possibly because PGF$_{2\alpha}$ was administered less frequently when cows were pregnancy tested near these days. It was not possible to determine if the decision to refrain from use of PGF$_{2\alpha}$ was made on the basis of a negative pregnancy test or on the basis of the number of days from insemination.\textsuperscript{18} It was assumed that cows selected for treatment were different from nontreated cows; thus, the effect of PGF$_{2\alpha}$ treatment should not be considered to have been the result of random treatments and did not provide support to the supposition that PGF$_{2\alpha}$ treatment was responsible for the decrease in calving interval. The size of the effect of PGF$_{2\alpha}$ treatment (a decrease in calving interval of 17.4 days) was more than could have been expected merely by decreasing days in estrus. Possibly, there were additional benefits, such as improved estrus detection.\textsuperscript{27,28} It was also possible that the cows not given PGF$_{2\alpha}$ treatments were more likely to have cystic ovarian disease or other conditions that predisposed them to prolonged anestrus. The number of cows treated with PGF$_{2\alpha}$ in our study was relatively low, considering the size of the treatment effects. It was possible that the negative-predictive value for transrectal palpation of corpora lutea, reported in 1 study to be 71.6%,\textsuperscript{37} reduced the potential effectiveness of treatment strategies that included the use of PGF$_{2\alpha}$. The large impact of PGF$_{2\alpha}$ treatment, relatively high likelihood that there would be a functioning corpus luteum, and low cost of PGF$_{2\alpha}$ should be considered when deciding to refrain from use of PGF$_{2\alpha}$ as a treatment for cows with postinsemination anestrus. In almost all situations, simulation models developed by researchers have predicted economic benefits for PGF$_{2\alpha}$ treatment.\textsuperscript{16} The relatively infrequent use of PGF$_{2\alpha}$ and large effects of PGF$_{2\alpha}$ treatment in our study, combined with prediction of benefits obtained by use of simulation models, led to the conclusion that more cows should have been given PGF$_{2\alpha}$ after a diagnosis of not pregnant.

Culling decisions are determined largely on the basis
of reproductive performance, and producers will decide to cull a dairy cow when the cow is observed in estrus, but is no longer considered profitable for another insemination.4,29,30 Culling decisions made in this manner would support the suggestion that early testing for pregnancy and treatment of postinsemination anestrus could increase a cow’s longevity in the herd. In our study, day of pregnancy testing was not associated with culling. Our primary goal was to examine the effect of day of pregnancy testing while controlling potential confounding effects that might have resulted from use of PGF2α. Cows treated with PGF2α were less likely to be culled, but because treatment with PGF2α was not administered to a random selection of cows, cows that were not treated with PGF2α already may have been candidates to be culled. Culled cows that were included in this study remained in these herds for more than 294 days after first insemination. Although not representative of all culled cows, they may be typical of cows culled for reproductive reasons. Cows culled because of low productivity, disease, illness, or behavior likely would be culled sooner during a lactation than cows culled for reproductive reasons.4,29,30 Differences between cows in our study and typical culled cows would not have confounded our analysis unless these differences also were related to day of pregnancy testing. In our study, the number of culled cows was small, and a larger study on culling decisions may reveal influences of herd health programs that use early postinsemination pregnancy testing.

The benefit of earlier transrectal palpation during the period 30 to 65 days after insemination was quite large. Depending on the value placed on each nonpregnant day by herd owners and the herd prevalence of postinsemination anestrus, it may be possible to justify frequent visits for pregnancy examination. Also, it may be possible to justify altering the day of pregnancy testing to maximize the benefit of PGF2α treatment by performing pregnancy testing on days more likely to be associated with PGF2α treatment (days 31 to 38), because in many herds, the effect of day of pregnancy testing was small, compared with the effect of PGF2α treatment.

References