Pregnancy and Peripheral Plasma Progesterone Levels in Cows Inseminated after Synchronization of Estrus with Prostaglandin F$_2$$\alpha$

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SUMMARY

Fifteen Holstein cows were treated with two doses of 25 mg of a prostaglandin F$_2$$\alpha$ (PGF$_2$$\alpha$ as dinoprost tromethamine) administered intramuscularly 11 days apart. The cows were then divided into three groups and inseminated either at 72, 80 or 72 and 96 hours after the second dose of PGF$_2$$\alpha$. Thirteen cows ovulated after the second prostaglandin treatment. Eight cows were diagnosed pregnant by rectal palpation 42 days after insemination but only five calved. PGF$_2$$\alpha$ induced luteolysis in cows with active corpora lutea as evidenced by the dramatic decreases in the plasma progesterone concentrations after treatment. In contrast, following PGF$_2$$\alpha$ administration to cows in follicular or late luteal phase the concentrations of plasma progesterone either increased gradually or remained low for several days before increasing to maximal levels. The ovulatory rate after the two doses of PGF$_2$$\alpha$11 days apart was high. However, the pregnancy rate after this treatment was influenced by other factors including abnormal ovarian function.

INTRODUCTION

The use of prostaglandin F$_2$$\alpha$ or prostaglandin analogues for estrus synchronization in cattle has been the subject of several reports in the last decade (5, 9, 11, 13). A single injection of prostaglandin F$_2$$\alpha$ (PGF$_2$$\alpha$) or an analogue given during the luteal phase induces luteolysis in cows, and the subsequent manifestation of estrus is associated with ovulation and the formation of corpora lutea (2, 10, 15). A greater degree of estrus synchronization in a group of cows is achieved by a two-injection schedule, consisting of two doses of prostaglandin 11 to 12 days apart (11). The fertility rates after the use of prostaglandin for estrus synchronization in cows has been studied in various ways. It has been expressed as percent of cows calving after treatment or as percent pregnant at 42 and 90 days after insemination. Fertility rates are reported to range from 52% to 66% (6, 7, 8, 9, 12).

In view of the wide use of PGF$_2$$\alpha$ or its analogue for estrus synchronization in cattle, it is important to determine the possible factors affecting fertility rates in cows bred at prostaglandin induced estrus.

The aim of this study was to monitor the temporal changes in the levels of progesterone in the peripheral plasma, of cows inseminated after estrus synchronization with prostaglandin F$_2$$\alpha$. Data regarding luteolysis, ovulatory rates, conception rates and calving rates was also collected.

MATERIALS AND METHODS

Fifteen adult Holstein cows were selected randomly for the experiment from a group of cows maintained at the Ontario Veterinary College. Each cow had calved within six months prior to the start of the experiment. The cows were housed in one barn and tied in stalls in order to facilitate inspection and blood collection. Each cow had shown at least two normal estrous cycles prior to the start of the experiment. Transrectal examinations were carried out to determine gross characteristics of the reproductive tract before the first prostaglandin injection.

Each cow received intramuscular injections of 25 mg PGF$_2$$\alpha$ (dinoprost tromethamine$^1$) on day 1 and 2 of the

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$^1$Lutalyse injection, 5 mg/mL. Tuco Products, Orangeville, Ontario.

experiment. After the second injection the cows were divided randomly into three groups of five cows each. Groups 1 and 2 (Figures 1 and 2) were artificially inseminated at 72 or 80 hours after the second prostaglandin treatment while group 3 (Figure 3) was inseminated twice at 72 and 96 hours after the second injection of PGF-α. Each cow was inseminated by one technician with fresh semen from a proven bull.

After prostaglandin treatments and inseminations the cows were observed twice daily for signs of estrus (0800 and 1700 hours) until experimental day 55. Samples of blood were collected from the jugular vein of each cow from day 1 to day 18 (six days after the second prostaglandin injection). Thereafter, blood samples were collected at two or three day intervals until day 55 of the experiment. Blood sampling was done between 1300 to 1500 hours. After centrifuging the blood, the plasma was removed and stored at -20°C until it was assayed for progesterone, by radioimmunoassay method (1).

Cows that failed to exhibit estrus within 24 days after breeding were presumed pregnant. Transrectal palpations for pregnancy diagnosis were carried out in the anestrous cows at 42, 75 and 150 days after insemination.

RESULTS

The interval from treatments to estrus, number of cows exhibiting estrus, and the results of transrectal palpations for pregnancy diagnosis at day 42 after insemination are summarized in Figures 1 to 3. The number of cows exhibiting estrus following either first or second prostaglandin injections were eight and seven respectively. Estrus was observed in each case between 48 to 72 hours after treatment.

One cow (810, Figure 2) was observed in estrus nine days after insemination and three other cows (826, Figure 2; 803 and 808, Figure 3) exhibited estrus three weeks after breeding. Estrus was not detected in three cows (820, 822 and 825, Figure 3) until 27 and 35 days after insemination. The remaining eight cows that were in anestrous 42 days after breeding were diagnosed pregnant on transrectal palpation. Only five were pregnant at 75 days, and subsequently calved.

The plasma progesterone patterns in individual cows are shown in Figures 1 to 3. The results were grouped according to the time of artificial insemination after the second prostaglandin treatment. Two distinct patterns of plasma progesterone changes were observed in six cows with low progesterone levels at the time of the first treatment. The progesterone levels either increased gradually within four days after treatment (824, Figure 1; 804, 811, 812, Figure 3) or remained low for six to seven days after prostaglandin treatment and then increased during the next few days (822 and 825, Figure 1). In the other nine cows, the plasma progesterone concentrations were 2-6 ng/mL at the time of the first prostaglandin injection which is typical of cows with corpora lutea. The levels declined dramatically in each case within 24 hours after treatment. The progesterone levels then remained low for six or seven days before any appreciable increases occurred.

The plasma progesterone levels were 2 ng/mL or more in all but two cows at the time of the second prostaglandin injection. Within 24 hours after the injection the progesterone levels had decreased to 0.5 ng/mL or less and remained low for seven to nine days after treatment. Thereafter, gradual increases to mid-luteal phase values occurred. Two cows had differing progesterone patterns after the second PGF₂ injection. Cow 826, Fig. 2, had a progesterone value of 2 ng/mL at the time of the second prostaglandin injection. A decrease to less than 0.5 ng/mL occurred a day afterward. Subsequently, the progesterone concentration remained at 0.5 ng/mL or less for a period of 35 days after insemination. The second cow (810, Figure 2) had a plasma progesterone value of 1.5 ng/mL on the day of the second prostaglandin injection. Fol-
lowing the injection, progesterone values ranged between 0.5 ng/mL to 2 ng/mL and then declined to less than 0.5 ng/mL seven days after breeding.

**Discussion**

The observations regarding the time of onset of estrus and absence of estrus in some cows after prostaglandin injection are consistent with previous reports (6, 9, 13). Examination of the progesterone profiles in these cows after two injections of prostaglandin indicate a high rate of synchronized ovulations similar to the observations of Louis et al. (10). The plasma progesterone levels were indicative of failure of luteolysis in one cow (810, Figure 2). In another cow (826, Figure 1) the plasma progesterone levels indicate failure of functional corpus luteum formation following prostaglandin induced luteolysis. A closer examination of the progesterone patterns before the second injection of prostaglandin in one cow (810, Figure 2) would suggest the cow was treated during the early luteal phase. The lack of response to prostaglandin injection in the early luteal phase has been documented (4).

In the present study a high rate of luteolysis and subsequent ovulation occurred following the second injection of prostaglandin. Breeding at 72, 80 or 72, and 96 hours resulted in pregnancy in two, three and three cows respectively. However, the calving rate was low, compared to previous reports (6, 7). It is evident however that the two dose regimen of prostaglandin treatment results in optimal synchronization of estrus and ovulation. In the present study, one animal displayed a progesterone pattern indicative of failure of luteolysis, while in another case the progesterone pattern was indicative of failure of corpus luteum formation.

The low calving rate observed in this study may be due to intrauterine factors such as slow grade endometritis or abnormal ovarian function. An examination of the clinical findings and progesterone levels in the cows that did not calve were suggestive of (a) infertile matings or failure of fertilization (826, 803, 808, Figures 2 and 3), (b) early embryonic death or spontaneously prolonged cycle following breeding (820, 822, 825, Figure 1), and (c) late embryonic loss (809, 807, Figure 2; 804, Figure 3). In an earlier report (14) low conception rate following the use of prostaglandins was attributed to insemination at suboptimal time (72 hours after treatment) or genital infections (2, 14).

In conclusion, it can be stated that complaints regarding poor conception or calving rates in cows bred following estrus synchronization with prostaglandin cannot be blamed on the drug. The luteolytic effect of the drug and subsequent high ovulatory rates have been clearly demonstrated in the present study. It must be emphasized that normal conception rates can be achieved only if the drug is used in animals which are free from infections of the reproductive tract and are showing normal estrous cycles.

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**References**