Theriogenology 38:45–61, 1992

REDUCED INCIDENCE OF RETAINED PLACENTA WITH INDUCTION OF PARTURITION IN THE COW

G.A. Bo, M. Fernandez, A.D. Barth and R.J. Mapletoft

Department of Herd Medicine and Theriogenology
Western College of Veterinary Medicine
University of Saskatchewan
Saskatoon, Saskatchewan, Canada S7N 0W0

Received for publication: *November 13, 1991*
Accepted: *April 10, 1992*

ABSTRACT

Two experiments were designed to determine whether pretreatment with Opticortenol (OPT), a long-acting corticosteroid, prior to induction of parturition with 25 mg of dexamethasone (DEX) alone or in combination with 500 μg cloprostenol (CLO) would result in a reduced incidence of retained placenta. In Experiment 1, 70% of the cows pretreated with 25 mg OPT on Day 270 of gestation calved before or within 24 hours of the scheduled induction treatment on Day 277. Cows induced to calve with DEX plus CLO without OPT pretreatment had an increased rate of placental retention ($P < 0.05$), whereas, cows that received OPT were not different from the controls. In Experiment 2, cows received either 1 mg/25 kg OPT (high dosage) or 1 mg/50 kg OPT (low dosage) on Day 270 of gestation and were induced with DEX plus CLO on either Day 274 (4 days) or Day 276 (6 days). Cows calved 29.0 to 31.8 hours after induction treatment with 95% beginning to calve between 0700 and 1900 hours. The interval from calving to placental release and the incidence of retained placenta was not different between the high dosage 6-day group (29.4 ± 8.2 hours, 29%) and the non-induced control cows (16.1 ± 10.7 hours, 5%). When three cows in the high dosage 6-day group that retained their placentas for 30 to 36 hours were considered as not retained, the incidence of placental retention for that group was reduced still further to 17%. First service conception rates and pregnancy rates were lower in cows with retained placentas. Differences were significant ($P < 0.01$) in Experiment 1 but not in Experiment 2. It was concluded that pretreatment with 1 mg/25 kg OPT 6 days prior to induction of parturition with DEX plus CLO in combination results in a predictable calving time, high calf viability, and a low incidence of placental retention.

Key words: bovine, induction, parturition, retained placenta

Acknowledgments

Supported by the Dean's CDA funding. We thank Coopers Agropharm Inc., Ajax, ON, Canada, for Estrumate, Ciba-Geigy, Mississauga, ON, Canada, for Opticortenol and the University of Saskatchewan Goodale Research Farm for the cattle. Special thanks to R.A. Pierson, D.Haines, B. Chelack, B. Kerr, D. Anderchek, C. French E. Lammerding and B. Tornesi for their assistance.

INTRODUCTION

In the week prior to parturition, rapidly rising levels of fetal cortisol initiate a series of endocrine events which trigger the onset of parturition (1,2,3). Conventional methods of parturition induction, which utilize either short-acting corticosteroids or prostaglandins to mimic these natural endocrine events, result in a high incidence of placental retention. In addition, induction failures have been shown to occur in 10 to 20% of cows treated, and the interval from treatment to parturition has been too variable to allow predictable daytime calving (4-6). Recently, the combination of cloprostenol and dexamethasone has been shown to be 100% efficacious and to result in predictable daytime calving. However, this method also has resulted in an unacceptably high incidence of retained placenta (7).

Reduction in the incidence of placental retention has been the goal of many research efforts since the first effective method of inducing parturition in the cow was reported (8). Corticosteroids or prostaglandins with various estrogen preparations (6,9-13) and oxytocin (14) have been used without appreciably reducing the incidence of placental retention. Dimenhydrate (15) and relaxin (16) in combination with dexamethasone have been reported to reduce placental retention; however, the number of cows treated with dimenhydrate was very small, and relaxin is not yet commercially available. The use of prostaglandin F2α within 1 hour after calving was reported to be effective in reducing the incidence of retained placenta in dairy cows after induction of parturition with dexamethasone (17). However, 2 recent studies from our laboratory involving beef cows showed no benefit when either of two commercial prostaglandin products were administered within 1 hour of calving, after induction of parturition with dexamethasone alone or in combination with cloprostenol (18).

The cause of placental retention has been postulated to be due to an imbalance or insufficiency of hormones near term, resulting in delayed placental maturation (19,20). Fetal cortisol appears to gradually reduce uteroplacental synthesis of progesterone (2,21) and increase estrogen production (2,3,22). Estrogens appear to stimulate the production and release of prostaglandins (23), which in turn induce luteolysis and parturition ensues (3,7). Since fetal cortisol levels gradually rise in the last month of gestation, particularly in the last week (2,24), placental maturation may require exposure to elevated cortisol levels for a period of time prior to calving. This hypothesis is supported by a reduction in the incidence of retained placenta when long acting corticosteroids were used to induce parturition (25-28).

Induction of parturition with long-acting corticosteroids has gained widespread acceptance with dairy producers in New Zealand and Australia as an important management tool for the initiation and synchronization of lactation (3). However, undesirable features of the technique include a high calf mortality rate due to early placental detachment, prematurity and hypogammaglobulinemia (3,25-28). Another disadvantage is the variable interval (7 to 23 days) from treatment to parturition (25,28).

Two experiments were designed with the overall objective of finding a safe and reliable method of inducing parturition in the cow, without the complication of placental retention. It was hypothesized that exposure to elevated blood corticosteroid levels prior to induction of parturition would induce placental maturation and result in a reduced incidence of retained placenta. The purpose of Experiment 1 was to determine whether pretreatment with dexamethasone trimethylacetate (Opticortenol[a]), a long-acting corticosteroid, 7 days prior to induction of parturition with dexamethasone or a combination of dexamethasone and cloprostenol, would result in a reduced incidence of retained placentas without a reduction in calf viability. Experiment 2 was designed to determine the optimum dosage and interval from pretreatment with Opticortenol to induction with dexamethasone and cloprostenol, which would provide high predictability of onset of calving and reduced placental retention.

MATERIALS AND METHODS

The experiments were performed at the University of Saskatchewan Goodale Research Farm, during March and April 1989 (Experiment 1) and during March, April and May 1990 (Experiment 2). Breeding dates were determined by observing breeding over the 60-day breeding season. Conception and breeding dates were confirmed by palpation per rectum 6 weeks after the end of the breeding season (Experiment 1), or by palpation and ultrasonography (29,30) 30 days after bulls were taken out of the pasture (Experiment 2).

Experiment 1

One hundred and twenty-one Hereford and Hereford-Angus cows were used in this trial. Eighty-five cows with known breeding dates were randomly selected for induction of parturition, while the remaining 36 cows served as the nontreated controls (Group V). On Day 270 of gestation, cows in Groups I, II and III received 25 mg of Opticortenol (OPT) by intramuscular injection (i.m.). Cows that had not calved by Day 277 were treated with either 25 mg, i.m. of dexamethasone[b] (DEX, Group II) or the combination of DEX and 500 μg, i.m. of cloprostenol[c] (CLO, Group III). Cows in Group IV were induced with the combination of DEX and CLO at Day 277 without the OPT pretreatment.

The end points recorded were the induction success rate, interval from induction treatment (DEX or DEX+CLO) to completion of delivery, length of stage II of labor, calf viability, interval from calving to placental release, incidence of placental retention, subsequent first-service conception rate, and pregnancy rate.

---

[a]Ciba-Geigy Ltd., Basle, Switzerland.
[b]Dexamone "2", Rogar/STB, BTI Products Inc., London, ON, Canada.
[c] Estrumate, Coopers Agropharm Inc., Ajax, ON, Canada.

Induction success was defined as a cow calving between 24 and 72 hours after the induction treatment. Cows that had not expelled their placentas within 24 hours after calving were considered to have placental retention. Calving difficulty was scored on a scale from 1 to 4: 1) normal calving; 2) moderate assistance (up to two people); 3) major assistance (calf puller); and 4) Caesarian section. Calf viability was recorded as normal if the calf was able to stand and nurse within 2 hours of birth.

Experiment 2

Ninety-nine cows, selected from the same pool used in Experiment 1, were randomly assigned, in a 2x2 factorial design, to one of four treatment groups and an untreated control group. On Day 270 of gestation, cows in the treatment groups received either a high dose (1 mg/25 kg body weight) or a low dose (1 mg/50 kg body weight) of OPT i.m. The cows were further subdivided to be induced with the combination of 25 mg DEX and 500 μg CLO (DEX+CLO) on Day 274 (4 days) or Day 276 (6 days), respectively. Induction treatments were performed at 0900 hours in order to achieve daylight calvings.

The end points recorded were the induction success rate, interval from induction treatment (DEX+CLO) to completion of delivery, length of stage II of labor, interval from calving to placental release, incidence of placental retention, subsequent first-service conception rate, and pregnancy rate. Calving difficulty and calf viability were evaluated as in Experiment 1.

The interval from calving to the first ovulation was determined in 25 cows by per rectum real-time, B-mode ultrasonography with a 7.5 Mhz transducer.[d] Fifteen cows that retained their placentas and 10 cows that did not were examined every 2 days until their first postpartum ovulation. The day of ovulation was determined as previously described (31), and was corroborated 7 days later by detection of a corpus luteum in the same ovary.

Immunoglobulin G Analysis (IgG)

In Experiment 2, blood samples were collected from 15 calves in each treatment group at 48 hours of age for IgG analysis. Serum was harvested, frozen and stored at -20 °C until analyzed by a radial immunodiffusion plate (32). Dilutions were made as necessary to obtain values that could be read from the standard curve.

Progesterone Analysis

In Experiment 2, daily blood samples were taken from 8 cows in each group from Day 270 to one day post calving using heparinized tubes. Within 1 hour of collection, the samples were centrifuged and plasma was collected and frozen at -20°C until an

[d] Aloka SSD 210 DX, Tokyo, Japan.

assay was performed. Progesterone was extracted from an aliquot of 200 μl of plasma with 3 ml of hexane and measured by a validated radioimmunoassay (33). Extraction efficiency was 58%. The standard curve range was from 20 pg to 20 ng, and the sensitivity revealed that 5 pg of progesterone significantly displaced the labeled ligand from the antiserum. The intrassay coefficients of variation were 6.1% for the low references and 4.2% for the high references.

Postpartum Temperatures

Rectal temperature was measured daily at 0800 hours for 5 days after calving in all cows, regardless of whether or not they retained their placentas. Day 1 was defined as the first day after calving.

Statistical Analysis

Quantitative data were analyzed by one-way analysis of variance (ANOVA), and means were compared by Duncan's Multiple Range Test. Qualitative data were analyzed by the Chi-square Test.

Regression analyses were used to calculate the rate of decrease in plasma progesterone levels (slope) of individual animals. The slopes were calculated from Day 270 to Day 274 for high dosage 4-day and low dosage 4-day groups, and from Day 270 to Day 276 for the high dosage 6-day and low dosage 6-day groups. Slopes representing cows in the control group were calculated from Day 270 to Day 274 to be compared with the high dosage 4-day and low dosage 4-day groups and from Day 270 to Day 276 to be compared with the high dosage 6-day and low dosage 6-day groups. Data were analyzed by one-way ANOVA, and means were compared by Duncan's Multiple Range Test.

Postpartum temperatures were compared by the statistical analysis system (SAS) general linear models univariate and multivariate ANOVA for repeated measures (34).

RESULTS

Experiment 1

Although approximately equal numbers of cows were assigned to each treatment group, 45 of 64 (70%) cows treated with 25 mg of OPT on Day 270 of gestation calved before or within 24 hours of the scheduled induction treatment on Day 277 (mean 149.7 $\pm$6.0 hours). These calvings were considered as being due to the OPT treatment and consequently the cows were reassigned to Group I (OPT) for data analysis (Table 1). The interval from induction treatment to calving was shorter ($P < 0.05$) in cows that were pretreated with OPT and induced with DEX plus CLO (Group III, OPT-DEX+CLO) than in cows induced with the combination of DEX plus CLO but without OPT pretreatment (Group IV, DEX+CLO). The interval from calving to placental release was longer ($P < 0.05$) for cows in Group IV (DEX+CLO) than in cows in Group I (OPT),

Group III (OPT-DEX+CLO) and Group V (control). Furthermore, the interval from calving to placental release for cows in Group I (OPT) and Group III (OPT-DEX+CLO) did not differ from the control cows (Group V; $P>0.15$). The incidence of retained placentas in cows which received OPT pretreatment (Groups I, II and III) was not different from the controls, and the incidence of retained placentas was higher in Group IV cows (DEX+CLO) than in all the other groups ($P<0.05$).

Table 1. Interval from induction treatment to calving, calving to placental release and incidence of retained placenta (Experiment 1).

Group	n	Induction to calving (hours)	Placental release (hours)	Retained placenta (%)
I OPT	45	---------	23.2 ± 8.7^{ab}	11^{a}
II OPT-DEX	8	34.1 ± 2.6^{ab}	57.6 ± 33.9^{bc}	25^{a}
III OPT-DEX+CLO	8	28.3 ± 0.8^{a}	30.2 ± 23.4^{ab}	13^{a}
IV DEX+CLO	24	38.1 ± 2.2^{b}	105.8 ± 19.9^{c}	79^{b}
V Control	36	--------	13.6 ± 5.9^{a}	6^{a}

^{abc} Means and percentages within a column with superscripts not in common are different ($P<0.05$).

The length of stage II of labor, birth weights and calving difficulty were not different ($P>0.3$) among the groups. Two calves in Group I, three in Group II and one in each of Groups III, IV and V were considered premature based on their size and on the incomplete eruption of their incisors. These calves required assistance to nurse. One calf in Group V died.

In the following breeding season (1989), the first-service conception rates and pregnancy rates did not differ among groups. However, the first-service conception rate was lower ($P<0.01$) in cows that retained their placentas (47.8%) than in cows that did not (78.8%). Furthermore, the overall pregnancy rate of cows which retained their placentas was also lower (69.6%) than of cows that did not retain their placentas (93.8%, $P<0.01$).

Experiment 2.

Mean (±SEM) interval from induction to calving, from calving to placental release, and the rate of placental retention are shown in Table 2. All induced cows calved within 48 hours of the DEX+CLO treatment, and 95% began to calve between 0700 and 1900 hours. Cows in the high dosage 6-day group had a shorter interval from induction to calving ($P < 0.05$) than cows in the high dosage 4-day and low dosage 4-day groups. The interval for cows in the low dosage 6-day group was intermediate and differed only from the cows in the low dosage 4-day group ($P < 0.05$).

The mean interval from calving to placental release was not different between the cows receiving the high dosage of OPT 6 days prior to induction and the non-induced control cows. At the same time, the control cows differed ($P < 0.05$) from the remaining treatment groups (high dosage 4-day, low dosage 4-day and low dosage 6-day). The incidence of retained placentas was lower ($P < 0.05$) in the control cows than in the high dosage 4-day, low dosage 4-day and low dosage 6-day groups. Cows in the high dosage 6-day group had a 29% incidence of retained placenta, which was not different ($P > 0.09$) from either the control group or from the low dosage 6-day group. However, if 3 cows in this group which retained their fetal membranes for 30, 34 and 35 hours, respectively, were considered as not retained, the incidence of placental retention for the high dosage 6-day group would be 17%, which is statistically lower ($P < 0.02$) than all the other treatment groups but not different ($P > 0.3$) from the untreated control group.

Table 2. Interval from induction treatment to calving, percentage of cows calving between 0700 and 1900 hours, interval from calving to placental release and incidence of retained placenta (Experiment 2).

Group	n	Induction to calving (hours)	Cows calving 0700 to 1900 hours (%)	Placental release (hours)	Retained placenta (%)
High dosage 4-day	18	30.8 ± 0.59^{bc}	100	87.7 ± 20.0^{c}	67^{c}
High dosage 6-day	24	27.8 ± 0.71^{a}	92	29.4 ± 8.2^{ab}	29^{ab}
Low dosage 4-day	12	31.8 ± 0.81^{c}	100	150.0 ± 24.7^{d}	100^{d}
Low dosage 6-day	23	29.0 ± 0.75^{ab}	95	47.9 ± 8.1^{bc}	57^{bc}
Control	22	---------	68	16.1 ± 10.7^{a}	5^{a}

[abcd] Means and percentages within columns with superscripts not in common are different ($P < 0.05$).

The length of stage II of labor, birth weight, calving difficulty and calf viability were not different ($P > 0.4$) among groups. No premature calves were born in this experiment.

Cows that retained their placentas tended to have a longer interval from calving to first ovulation than cows that did not retain their placentas (55.3± 2.9 vs 46.8± 4.5 days, $P < 0.07$). Pregnancy examinations following the subsequent breeding season (1990) indicated that although cows that retained their fetal membranes had numerically lower first-service conception rates and pregnancy rates (59.4% and 83.3%, respectively) than the cows that did not retain their fetal membranes (65.2% and 92.4%, respectively), the differences were not significant ($P > 0.4$).

Serum Immunoglobulin G in Calves

Calves from the control cows had a mean (±SEM) IgG concentration of 2586 ±286 mg/dl 48 hours after birth, which appeared to be higher than the calves from the induced cows (high dosage 4-day, 1985 ±290; high dosage 6-day 1753 ±305; low dosage 4-day, 1805 ±195 and low dosage 6-day, 1678 ±206 mg/dl, respectively). However, the variance in all groups was so great that statistical differences could not be demonstrated. One calf in the high dosage 4-day group, two in the high dosage 6-day group and one in the low dosage 6-day had IgG levels below 500 mg/dl. Relationships between IgG levels and incidence of scours or any other sickness could not be determined. One calf in the low dosage 6-day group with low IgG levels (132 mg/dl) had diarrhea and signs of dehydration at 12 days of age. This calf recovered uneventfully after treatment with an oral electrolyte solution.

Progesterone Analysis

Plasma progesterone concentrations from cows in Experiment 2 are depicted in Figure 1. The rate of decrease in progesterone levels, measured by comparing the slopes of the lines defining the progesterone profiles for individual cows, was greater ($P < 0.05$) for cows in the high dosage 4-day, high dosage 6-day and low dosage 6-day groups that were pretreated with Opticortenol (0.67±0.08, 0.48±0.06 and 0.58±0.11 ng/day, respectively) than for the control cows (0.22±0.03 ng/day). Cows in the low dosage 4-day group had an intermediate value (0.36±0.12 ng/day), not different from the other groups. Significant and precipitous declines in plasma progesterone concentration occurred between 48 to 24 hours before calving in all groups, and were not different whether calving was natural (control) or induced.

Postpartum Temperatures

For statistical analysis of postpartum temperatures, cows in each year were classified as cows which were induced to calve and retained their placentas, cows which were induced to calve and did not retain their placentas and cows not induced to calve which did not retain their placentas. As the numbers of non-induced cows retaining their placentas were small (2 in Experiment 1, and 1 in Experiment 2), a fourth group representing these cows could not be formed. In Experiment 1 (1989; Figure 2), cows

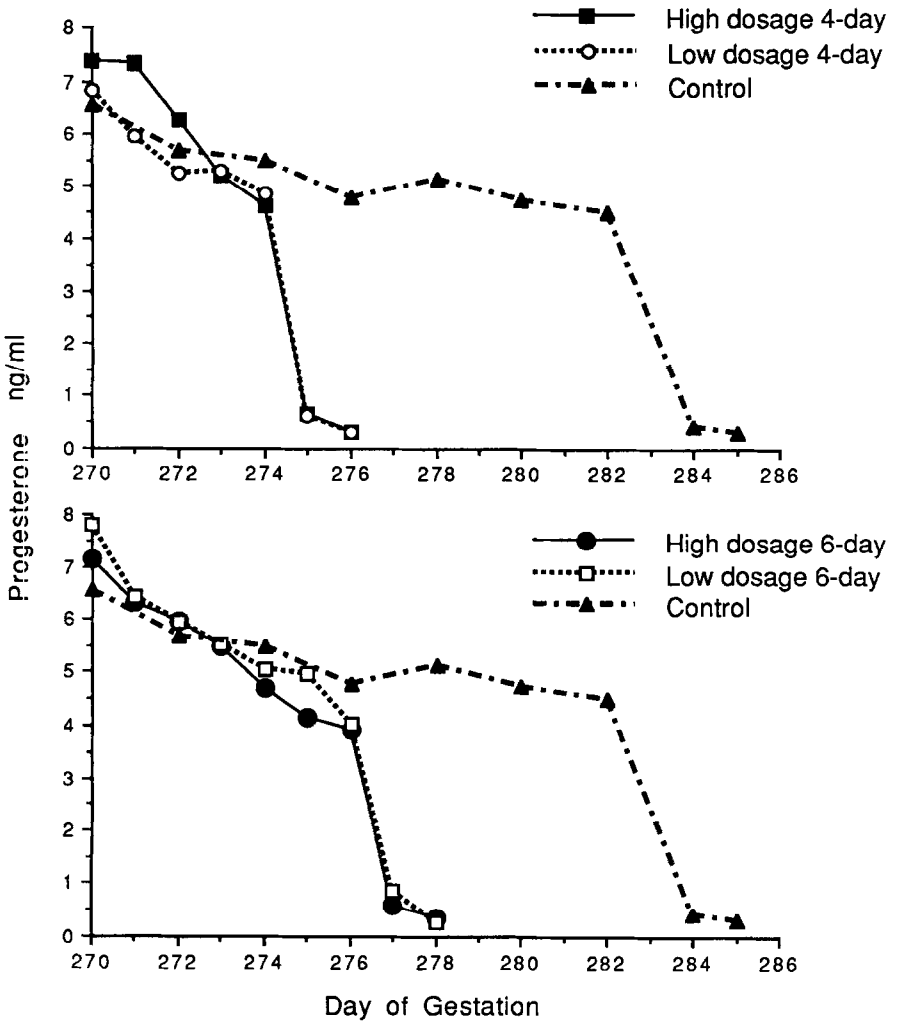

Figure 1. Mean plasma progesterone concentration from Day 270 of gestation to one day after calving in cows induced to calve with DEX+CLO 4 or 6 days after OPT pretreatment at Day 270 and the untreated controls. The rate of decrease in progesterone levels, measured by slopes, was greater ($P < 0.05$) for cows in high dosage 4-day, high dosage 6-day and low dosage 6-day groups than in the control cows.

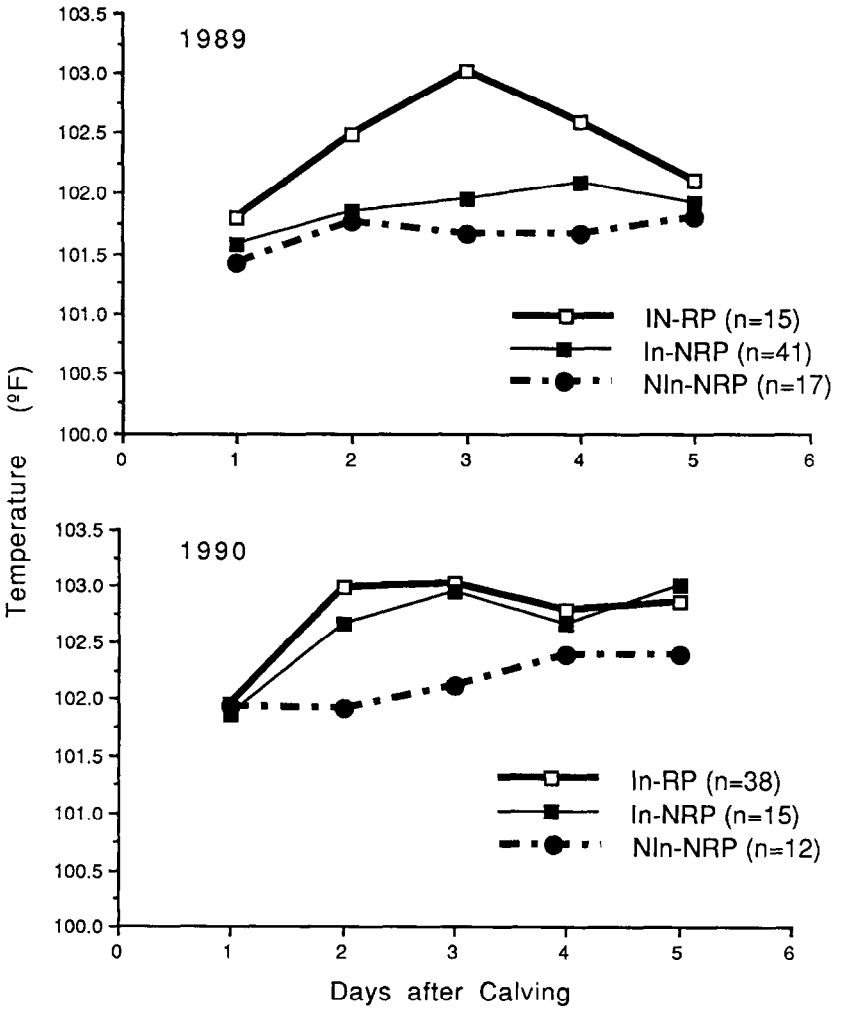

Figure 2. Mean rectal temperatures from Days 1 to 5 after calving in cows that were induced to calve and retained their placentas (In-RP), cows that were induced but did not retain their placentas (In-NRP), and cows that were not induced and did not retain their placentas (NIn-NRP). Temperatures of cows in the In-RP group differed from the NIn-NRP group between Days 2 to 4 in both years. However, cows in the In-NRP group exhibited a different profile in Experiment 1 (1989) than in Experiment 2 (1990).

that were induced and did not retain their placentas showed a slight increase in rectal temperature from Day 1 to 4, whereas the cows that were not induced and did not retain their placentas showed practically no change in rectal temperature during this period. On the other hand, the cows that were induced and retained their placentas showed an increase in rectal temperature from Day 1 (101.8°F) until Day 3 (103.0°F), and then a slow decrease until Day 5 (102.1°F). Differences between the cows that were induced and retained their placentas, those that were induced and did not retain their placentas and those that were not induced and did not retain their placentas were detected between Days 2 and 4 ($P<0.05$; Figure 2).

In Experiment 2 (1990), temperatures of cows that were induced and retained their placentas increased from Day 1 (101.9°F) to Day 3 (103.3°F) and then decreased slightly until Day 5 (102.9°F). As in Experiment 1, the cows that were not induced and did not retain their placentas showed practically no changes in rectal temperature. However, the cows that were induced and did not retain their placentas showed an increase from Day 1 (101.9°F) to Day 3 (102.9°F), maintaining approximately the same temperature until Day 5 (103.0 °F; Figure 2). Univariate analyses revealed a day effect ($P<0.0001$) but no day-by-year or day-by-group interactions. Overall, there was a group effect ($P<0.0001$) and a year effect ($P<0.0001$). Retrospective examination of the data revealed that the year effect was due to the different profiles shown in 1989 and 1990 by the cows which were induced and did not retain their placentas. Temperatures for cows that were induced and retained their placentas and the cows that were not induced and did not retain their placentas were not different between years. In spite of elevated temperatures in all cows which retained their placentas, there was no evidence of systemic illness, and antibiotic therapy was not administered.

DISCUSSION

Results of these experiments suggest that the use of a long-acting corticosteroid on Day 270 of gestation as a pretreatment for a short-acting induction treatment, will result in a reduced incidence of retained placenta, with no increase in calf losses. The poor predictability of calving time observed in Experiment 1, when induction treatments were scheduled at Day 277 (7 days after the OPT pretreatment), was overcome in Experiment 2, when the cows were induced either 4 or 6 days after OPT pretreatment. In Experiment 2, 95% of the cows pretreated with OPT and induced 4 or 6 days later with DEX+CLO calved between 0700 and 1900 hours.

The interval from treatment to calving was shorter in cows induced to calve with the combination of DEX plus CLO after OPT pretreatment than when DEX plus CLO was used without the benefit of the OPT pretreatment (Experiment 1, Table 1). Results from Experiment 2, suggest that the OPT dosage and the interval from OPT pretreatment to the DEX+CLO induction treatment are inversely related to the interval from induction to calving and the incidence of retained placenta. For example, cows that were exposed to higher dosages of OPT for a longer period of time (6 days) had a shorter interval from induction to calving than cows that were exposed for a shorter period of time (4 days)

to either the high or low OPT dosage. In addition, the incidence of retained placenta in the high dosage 6-day group was not different from that of the control group. These results may be interpreted to suggest that cows pretreated with OPT were more prepared endocrinologically for calving than those induced without OPT pretreatment, allowing for a more rapid and more physiological response. Thus, placental maturation was sufficient to permit detachment in less than 36 hours in 20/24 (83%) cases in the high dosage 6-day group. This finding is also supported by the greater rate of reduction of plasma progesterone levels showed by cows in Experiment 2 after pretreatment with 1 mg/25 kg of OPT compared with the untreated control cows.

The combined use of long-acting and short-acting corticosteroids has been reported to improve the precision and reliability of the induction of parturition with long-acting corticosteroids (3, 27, 28, 35-38). Optimal results were obtained when an initial injection of Opticortenol was followed 6 to 12 days later by 20 mg of Bethametasone (27, 35, 36). However, predictability was not as great as in the present experiment, and calf loses ranged from 6 to 10% (27,35). In the present study (Experiment 2), precision was very high, with 95% of calvings occurring between 0700 and 1900 hours, and there were no calf losses related to the induction treatments.

Calf IgG concentrations at 48 hours of age, were not different whether the calves were born to induced cows or to untreated control cows. Calves born to control cows appeared to have higher mean IgG levels, but the differences were not significant, and there was no indication of a higher rate of neonatal illness in the calves born to the induced cows. When short-acting corticosteroids have been used to induce parturition, IgG levels have not been shown to be different from those of the non-induced calves (39,40). Although it has been reported that cows treated with long-acting corticosteroids had lower levels of colostral immunoglobulin, and calves born to these cows had impaired ability to absorb immunoglobulin (26), these effects were observed in calves born more than 10 to 15 days before the due date (8,25,26,41). In Experiment 2, calves were born no earlier than Day 276 of gestation, which is 8 days before the mean day of parturition of the untreated control cows (284 days of gestation).

In Experiment 1, first-service conception rates and pregnancy rates were lower for cows retaining their placentas. However, in Experiment 2, neither the first-service conception rate nor the pregnancy rate was significantly different whether the cows retained their placentas or not. We have previously shown inconsistent first-service conception rates and pregnancy rates in cows that retained their fetal membranes (18). In spite of no consistent level of significance over 4 years of study, both the first-service conception rate and the overall pregnancy rate have been numerically lower in cows with retained placentas than in cows that expelled their placentas. Although there are several reports showing that fertility was affected by placental retention (28,42-44), other studies have demonstrated that induction of parturition, which is most often associated with a high incidence of placental retention, had no adverse effects on subsequent reproductive performance (6,7,13,45-49). It has also been suggested that cows with retained placentas are much more likely to develop metritis and/or pyometra than their herdmates (50). A recent study attempted to relate reproductive abnormalities and reproductive performance

in dairy cows (51). In this study, cows with retained placentas had longer intervals to first estrus (14.4 days longer), to first service (20.5 days longer), and to conception (32.8 days longer) than the average of the herd. Collectively, these data suggest that placental retention can affect postpartum fertility. Therefore, a high incidence of retained placenta must not be accepted as a natural consequence of induction of parturition.

The analysis of rectal temperatures in Experiments 1 and 2 indicates that cows with retained placentas tended to have elevated temperatures for a short period of time after parturition, whereas cows that were not induced and did not retain their placentas did not. The reason for the elevated rectal temperatures in the cows that were induced and did not retain their placentas in Experiment 2 could not be determined in the present study. Elevated rectal temperatures in cows retaining their fetal membranes were seldom associated with signs of systemic illness (7,18). We have previously shown that antibiotic therapy resulted in a rectal temperature decrease within 1 day (18). However, this was not associated with a corresponding increase in postpartum fertility.

In summary, data from these experiments suggest that pretreatment with 1 mg/25 kg of OPT 6 days prior to induction of parturition with a combined treatment of DEX and CLO results in a highly predictable calving time and in a low incidence on placental retention without compromising calf viability. In addition, it appears that cows that retain their placentas are more likely to exhibit high rectal temperatures 2 or 3 days after calving, and tend to ovulate later and have lower first-service conception rates than cows that do not retain their fetal membranes. Further studies are required to determine if cows can be induced safely without a known breeding date and if other long-acting corticosteroids available on the market will have the same beneficial effects on placental maturation.

REFERENCES

1. Wagner, W.C., Thompson, F.N., Evans, L.E. and Molokwu, E.C.I. Hormonal mechanisms of controlling parturition. J. Anim. Sci 38 (Suppl. 1):39-57 (1974).

2. Hunter, J.T., Fairclough, R.J., Peterson, A.J. and Welch, R.A.S. Fetal and maternal hormonal changes preceding normal bovine parturition. Acta. Endocrinol. 84:653-662 (1977).

3. McDiarmid, S.C. Induction of parturition in cattle using corticosteroid: a review. Part I. Reasons for induction, mechanisms of induction and preparations used. Anim. Breed. Abstr. 51:403-419 (1983).

4. Kordts, E. and Jochle, W. Induced parturition in dairy cattle: a comparison of a corticoid (Flumethasone) and prostaglandin (PGF2α) in different age groups. Theriogenology 3:171-178 (1975).

5. Henricks, D.M., Rawlings, N.C., Elliott, A.R., Dickey, J.F. and Hill, J.R. Use of prostaglandin F2α to induce parturition in beef heifers. J. Anim. Sci. 44:438-441 (1977).

6. Barth, A.D., Adams, W.M., Manns, J.G. and Rawlings, N.C. Induction of parturition in beef cattle using estrogens in conjunction with dexamethasone. Can. Vet. J. 19:175-179 (1978).

7. Lewing, F.J., Proulx, J. and Mapletoft, R.J. Induction of parturition in the cow using cloprostenol and dexamethasone in combination. Can. Vet. J. 26:317-322 (1985).

8. Adams, W.M. The elective induction of labour and parturition in cattle. J. Amer. Vet. Med. Assoc. 154:261-265 (1969).

9. Lavoie, V.A. and Moody, E.L. Estrogen pretreatment of corticoid induced parturition in cattle. J. Anim. Sci. 37:770-774 (1973).

10. Garverick, H.A., Day, B.N. and Mather, E.C. Use of estrogens with dexamethasone for induction of parturition in beef cattle. J. Anim. Sci. 38:584-590 (1974).

11. Grunert, E., Ahlers, D. and Jochle, W. Effects of a high dose of diethylstilbestrol on the delivery of the placenta after corticoid-induced parturition in cattle. Theriogenology 3:249-258 (1975).

12. Kesler, D.J., Peterson, R.C., Erb, R.E. and Callahan, C.J. Concentrations of hormones in blood and milk during and after induction of parturition in beef cattle with dexamethasone and estradiol-17ß. J. Anim. Sci. 42:918-926 (1976).

13. Beardsley, G.L., Muller, L.D., Garverick, H.A., Ludens, F.C. and Tucker, W.L. Initiation of parturition in dairy cows with dexamethasone. II. Response to dexamethasone in combination with estradiol benzoate. J. Dairy Sci. 59:241-247 (1976).

14. Veznick, Z., Holub, A., Zraly, Z., Kummer, V., Holcak, V., Jost, K. and Cort, J.H. Regulation of bovine labor with a long-acting carba-analog of oxytocin: a preliminary report. Am. J. Vet. Res. 40:425-429 (1979).

15. Morrison, D.G., Humes, P.E. and Godke, R.A. The use of dimenhydrate in conjunction with dexamethasone for induction of parturition in beef cattle. Theriogenology 19:221-233 (1983).

16. Musah, A.I., Schwabe, C., Willham, R.L. and Anderson, L.L. Induction of parturition, progesterone secretions and delivery of the placenta in beef heifers given relaxin with cloprostenol or dexamethasone. Biol. Reprod. 39:797-803 (1987).

17. Gross, T.S., Williams, W.F. and Moreland, T.W. Prevention of the retained fetal membrane syndrome (retained placenta) during induced calving in dairy cattle. Theriogenology 26:365-370 (1986).

18. Garcia, A., Barth, A.D. and Mapletoft, R.J. The effect of cloprostenol or dinoprost treatment within one hour of induced parturition on the incidence of retained placenta in cattle. Can. Vet. J. 33:175-183 (1992).

19. Arthur, G.H. Retention of the afterbirth in cattle: a review and commentary. Vet. Ann. 19:26-36 (1979).

20. Grunert, E. Placental separation/retention in the bovine. Proc. 10th Int. Cong. Anim. Reprod. and Artif. Insem. IV:17-24 (1984).

21. Johnson, W.H., Manns, J.G., Adams, W.M. and Mapletoft, R.J. Termination of pregnancy with cloprostenol and dexamethasone in intact and ovariectomized cows. Can. Vet. J. 22:288-900 (1981).

22. Hoffmann, B., Wagner, W.C., Hixon, J.E. and Bahr, J. Observations concerning the functional status of the corpus luteum and the placenta around parturition in the cow. Anim.Reprod. Sci. 2:253-266 (1979).

23. Lindell, J.O., Kindahl, H. and Edqvist, L.E. Prostaglandin release at dexamethasone induced parturitions in cows. Acta Vet. Scand. 18:257-265 (1977).

24. Smith, V.G., Edgerton, L.A., Hafs, H.D. and Convey, E.M. Bovine serum estrogens, progestins and glucocorticoids during late pregnancy, parturition and early lactation. J. Anim. Sci. 36:391-395 (1973).

25. Welch, R.A.S., Newling, P. and Anderson, D. Induction of parturition in cattle with corticosteroids: an analysis of field trials. NZ Vet. J. 21:103-108 (1973).

26. Bailey, L.F., Mc Lennan, M.W., Mc Lean, D.M., Hartford, P.R. and Munro, G.L. The use of dexamethasone trimethylacetate to advance parturition in dairy cows. Aust. Vet. J. 19:175-179 (1973).

27. Welch, R.A.S., Crawford, J.E. and Duganzich, D.M. Induced parturition with corticosteroids: a comparison of four treatments. NZ Vet. J. 25:111-114 (1977).

28. Welch, R.A.S., Day, A.M., Duganzich, D.M. and Featherstone, P. Induced calving: a comparison of treatment regimes. NZ Vet. J. 27:190-194 (1979).

29. Curran, B.S., Pierson, R.A. and Ginther, O.J. Ultrasonographic appearance of the bovine conceptus from Days 20 through 60. J. Amer. Vet. Med. Assoc. 189:1295-1302 (1986).

30. Pierson, R.A. and Ginther, O.J. Ultrasonography for detection of pregnancy and study of embryonic development in heifers. Theriogenology 22:225-233 (1984).

31. Pierson R.A. and Ginther O.J. Ultrasonography of the bovine ovary. Theriogenology 21:495-504 (1984).

32. Pourciau, S.S., Barta, O. and Huang, L. Radial immunodiffusion quantitative determination of immunoglobulins. In: Barta O. (ed) Manual of Veterinary Clinical Immunology. School of Veterinary Medicine, Louisiana State University, Baton Rouge, LA, 1981, pp. 71-78.

33. Rawlings, N.C., Jeffcoate, I.A. and Rieger, D.L. The influence of estradiol-17ß and progesterone on peripheral serum concentrations of luteinizing hormone and follicle stimulating hormone in the ovariectomized ewe. Theriogenology 22:473-488 (1984).

34. SAS User's Guide: Statistics. SAS Institute Inc., Cary, NC, 1985.

35. McGowan, L.T., Welch, R.A.S. and Hunter, J.T. Studies on induced calving in cattle. Proc. N. Z. Soc. Anim. Prod. 35:92-96 (1975).

36. Welch, R.A.S. The use of corticosteroids to induce parturition. NZ Vet. J. 25:274 (1977).

37. Davis, D.L., Kesler, D.J., Garverich, H.A., Massey, J.W., Bierschwal, C.J. and Day, B.N. Induction of parturition in cattle with long acting and short acting corticoids and estradiol benzoate. J. Anim. Sci. 49:560-566 (1979).

38. McDiarmid, S.C. Betamethasone alcohol suspensions for the induction of parturition in dairy cows: a comparison with dexamethasone trimethylacetate. NZ Vet. J. 27:86-89 (1979).

39. Hoerlein, A.B. and Jones, D.L. Bovine immunoglobulins following induced parturition. J. Amer. Vet. Med. Assoc. 170:325-326 (1977).

40. Langeley, O.H. and O'Farrel, K.J. Immune status of dairy calves following induced parturition. Vet. Rec. 99:187-188 (1976).

41. Field, R.W., Bretzlaff, K.N., Elmore, R.G. and Rupp, G.P. Effect of induction of parturition on immunoglobulin content of colostrum and calf serum. Theriogenology 32:501-506 (1989).

42. Moller, K., Newling, P.E., Robson, H.J., Jansen, G.J., Meursinge, J.A. and Cooper, M.G. Retained fetal membranes in dairy herds in the Huntly district. NZ Vet. J. 15:111-116 (1967).

43. Poncelet, G.R. and Moody, E.L. Induction of parturition in conjunction with antibiotic treatments. Theriogenology 6:437-445 (1976).

44. Kay, R.M. Changes in milk production, fertility and calf mortality associated with retained placenta or the birth of twins. Vet. Rec. 102:477-479 (1978).

45. Poncelet, G.R., Winter, J.L., LaVoie, V.A. and Moody, E.L. Subsequent fertility after induced parturition. J. Anim. Sci. 38:1338-1339 (1974).

46. Wagner, W.C., Willham, R.L. and Evans, L.E. Controlled parturition in cattle. J. Anim. Sci. 38:485-489 (1974).

47. LaVoie, V.A., Winter, J.L., Lambert, P.W. and Moody, E.L. Flumethasone induced calving in beef management. J. Anim. Sci. 41:365 abstr. (1975).

48. LaVoie, V.A, Winter, J.L. and Moody, E.L. Effect of route of dexamethasone administration on parturition, fertility and calf performance in beef cattle. Theriogenology 7:225-237 (1977).

49. Echternkamp, S.E., Hays, W.G. and Kvasnicka, W.G. Synchronization of parturition in beef cattle with prostaglandin and dexamethasone. Theriogenology 28:337-347 (1987).

50. Sandals, W.C.D., Curtis, R.A., Cole, J.F. and Martin, S.W. The effect of retained placenta and metritis complex on reproductive performance in dairy cattle - a case control study. Can. Vet. J. 20:131-135 (1979).

51. Etherington, W.G., Martin, S.W., Dohoo, I.R. and Bosu, W.T.K. Interrelationships between postpartum events, hormonal therapy, reproductive abnormalities and reproductive performance in dairy cows: a path analysis. Can. J. Comp. Med. 49:261-267 (1985).