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Controlled Calving with induction of parturition on Day 274 of gestation in dairy cows

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ABSTRACT

The response and effects of inducing parturition on Day 274 of gestation in dairy cows with synchronised conception dates was investigated in selected herds around Victoria. Cows ($n=227$) were injected with dexamethasone trimethylacetate (30 mg, i.m.) with 444 herd mates as controls. Randomisation was based on scored udder development. Blood samples taken on Days 272 and 274 had average plasma progesterone concentrations of 4.50 and 4.49 ng/ml respectively ($P>0.05$). Treated (T) cows calved an average of 2.61 ± 0.21 days before their due date, compared to 0.17 ± 0.20 days for control (C) cows ($P<0.001$). There were no differences in the proportion of cows displaying symptoms of milk fever, mastitis, paralysis or acute metritis. The incidence of retained foetal membranes at 12h postpartum differed between the two groups (3% vs. 16%; C vs. T; $P<0.005$). Control cows received more assistance at parturition (15% vs. 10%, $P<0.05$). There were no differences between groups for cow or calf mortality, or for any parameter of milk yield. The effect of treatment on subsequent fertility was minimal.

Keywords: dairy; Controlled Calving; dexamethasone trimethylacetate.

INTRODUCTION

Average size of dairy herds in Australia and New Zealand is increasing with this average in Victoria being 129 cows in 1995/96 compared to 154 in 1998/1999 (Australian Dairy Herd Improvement Scheme, 1999). Average herd size will continue to increase with the proportion of herds over 300 cows also increasing. Breeding management in these large herds has seen increased use of Controlled Breeding Programs. Current research is focused on improving oestrous synchrony with Controlled Breeding Programs (involving three rounds of synchrony) in herds of more than 300 cows (Cavaliere *et al.*, 2000). This can condense conception patterns so that 88% of cycling cows included in a recent study were confirmed pregnant to inseminations made during a 49-day AI program (Taufa *et al.*, 1998). Around 50% of cows in these herds conceived over the first 3 days of these programs. Another New Zealand study resulted in 90% of animals conceiving within 6 weeks (Armer *et al.*, 1993).

Average gestation length of dairy cows in New Zealand herds is reported as 282 ± 4.5 days (\pm S.D.) with a normal range of 272 to 293 days (Macmillan & Curnow, 1976). The range means that overlapping of calving occurs between sequential rounds of insemination synchrony. Controlled Calving involves the induction of parturition close-to-term to reduce the incidence and duration of gestation lengths exceeding 282 days to minimise any overlapping between rounds. A condensed calving pattern for each round should improve pre-partum feeding management. This Program should be beneficial to the cow and its calf by reducing the proportion of large calves (i.e., those normally going past term) and the associated incidences of dystocia and calf mortality. Garverick (1976) reviewed papers on parturition synchrony programs designed to initiate parturition in dairy cows during the normal working week. The incidences of assistance at parturition and other complications varied between studies. The most consistent finding was an increased incidence of retained foetal membranes (RFMs) with Holsteins having a higher incidence (up to 75%)

compared to other beef and dairy breeds.

Using induced calving early in a seasonal calving program should have minor effects on subsequent fertility when compared with herd mates calving spontaneously and unassisted on the same dates (Garverick, 1976; Malmo & Beggs, 2000; Morton, 2000).

This study was designed to monitor the variation in gestation length following induction of parturition through Controlled Calving on Day 274 of gestation (insemination = Day 0) in dairy cows with common conception dates as a result of an insemination synchrony program. Subsequent milk production and fertility performance were regarded as key factors determining the success of the program.

MATERIALS AND METHODS

The study was conducted in six commercial herds in Victoria with from 57 to 254 multiparous cows selected in each herd. They had conceived to inseminations in the first and second rounds or only the first round (smaller herds) of oestrous synchrony. Breeding records and early pregnancy diagnosis were used to confirm conception dates. Only cows with one insemination date and no recorded natural matings were included. Pregnancy diagnoses were carried out approximately six weeks after the last round of AI by rectal palpation with the aid of ultrasonography (Aloka SSD-500, 5MHz probe fixed to a flexible metal extender). Predicted calving dates were based on these conception records and a predicted 282-day gestation period (Macmillan & Curnow, 1976). Only cows confirmed pregnant to a known insemination date were recruited. Those that had not yet calved on Day 272 of gestation received a veterinary examination (*per rectum*). Cows were removed from the trial if they were empty ($n=11$), ill ($n=1$) or at the herd owner's request ($n=6$). Blood samples were collected by coccygeal venipuncture (Days 272 and 274), and plasma stored at -10°C until assayed for progesterone. The enrolled cows were randomised into treatment (T) and control (C) groups on the subjective scores of udder development ranging from no visual signs of swelling (1)

to substantial swelling (4). Dexamethasone trimethylacetate (30 mg. i.m.) was administered to T cows on Day 274. There were 227 T cows across the six herds and 444 C cows. Blood plasma samples were assayed for progesterone concentrations as a retrospective indicator of spontaneous due calving date using the commercial kit SPECTRIA Progesterone RIA (Orion Diagnostica) in the University of Melbourne's Reproduction Laboratory. Samples taken at enrollment were also commercially tested for calcium, magnesium and β -hydroxybutyrate at the Melbourne University's Clinical Pathology Laboratory, at Werribee.

The enrolled cows received routine management appropriate to that herd. Herd owners and farm staff were asked to record the following calving details for every recruited cow: date and time of birth; presence of RFMs (defined as any membranes visible externally from 12 h post-partum); cow/calf well being; and calving ease score (scored 1 to 5 for no assistance to major assistance).

Production records were used to measure any effects of treatment on milk yield or composition. Subsequent fertility was monitored to determine the effect of treatment on reproductive performance.

Statistical Analyses

Paired Student's t-tests were used to determine differences in the change in progesterone concentrations between Days 272 and 274. A Kaplan-Meier log-Rank test was used to test the significance of differences between the different calving curves. This test is commonly used to analyse survival data. Chi-square tests were used to determine any differences between groups in the incidence of post-partum complications, assistance at parturition or conception patterns. Levene's test was used to test milk production data for equality of variance before performing Student's t-tests for comparison of means.

RESULTS

Blood samples

Plasma from cows was tested for calcium, magnesium and β -hydroxybutyrate with the following results:

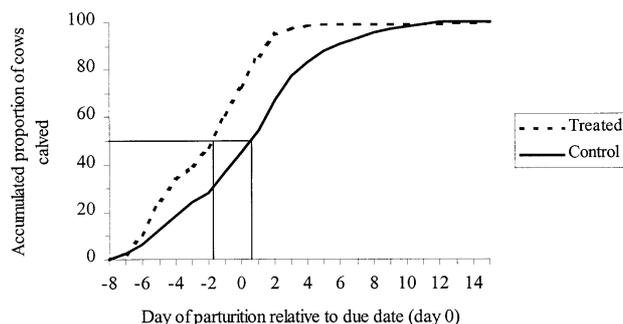
- 74% of cows had calcium levels in the normal range (2 to 3.05 mmol/L) with 24% being less than 2 mmol/L;
- 99% had normal magnesium levels (<0.50 mmol/L);
- 97% had normal β -hydroxybutyrate levels (>0.80 mmol/L).

The minimum detectable progesterone dose for the plasma progesterone assay was 0.125 ng/ml. The intra-assay covariates ranged from 7.4 to 13.2% from high to low concentrations respectively, while the inter-assay covariates ranged from 16.4 to 51.8% over the same range of concentrations. The concentrations on Day 272 and 274 for the T cows were similar (4.46 and 4.56 ng/ml respectively; $P>0.05$), whereas concentrations in the C cows decreased from 4.54 ng/ml on Day 272 to 4.18 ng/ml on Day 274 ($P<0.005$).

Gestation Length

The 227 T cows calved earlier than the 444 C cows (2.61 ± 0.21 and 0.17 ± 0.20 days prior to their due dates respectively; $P<0.001$). The calving distributions for the two groups are shown in Figure 1. A log-rank test of the calving distributions showed that they differed significantly

FIGURE 1: Accumulated proportion of cows calved on each day following treatment (30 mg dexamethasone trimethylacetate i.m. on day 274 of gestation) where day 0 is the calculated due calving date.



both with and without a correction factor for herd effects ($P<0.0001$). In both cases, the hypothesis of equality of distribution was rejected ($P<0.0005$).

There were 73% of T cows that calved before or on their due calving date, compared to 45% of C cows ($P<0.005$). By Day 12 post-treatment (4 days after due date), 99% of T cows had calved compared to 83% of C cows ($P<0.005$).

Calving Details

The T and the C groups had similar incidences of mastitis, milk fever, paralysis, acute metritis, cow mortality, and calf mortality (Table 1). The incidence of assistance required at parturition was greater for the C cows (15% vs. 10%; $P<0.05$), mainly involving minor assistance (C vs. T = 9% vs. 4%; $P<0.05$).

The incidence of RFMs was 16 and 3% for T and C cows respectively ($P<0.05$). Within 4 days postpartum, 72% of all RFMs had resolved spontaneously with a further 17% resolved on Day 5 postpartum.

TABLE 1: Calving details and post-partum complications occurring within 3 weeks of parturition for Treated (30 mg dexamethasone trimethylacetate i.m. on day 274 of gestation) and Control cows (n)

| | Treated | Control | Significance (P) |
|-------------------------------|---------|---------|------------------|
| Milk fever (%) | 4 (9) | 3 (14) | NS |
| Mastitis (%) | 4 (8) | 4 (19) | NS |
| Paralysis (%) | 0 (0) | 1 (3) | NS |
| Acute metritis (%) | 0 (0) | 0 (0) | NS |
| Cow mortality (%) | 0 (0) | 0 (0) | NS |
| Calf mortality (%) | 2 (4) | 4 (18) | NS |
| Retained foetal membranes (%) | 16 (37) | 3 (14) | * |
| Incidence of assistance (%) | 10 (22) | 15 (67) | * |

* $P<0.05$

Milk Production

Herd tests were carried out in four of the six herds resulting in production data for 116 treated cows and 278 control cows. Levene's test of equality of variance showed all milk parameters to have equal variance ($P>0.05$). There were no differences between the two groups in any parameter of milk yield at the first herd test postpartum. At this test, cows had averaged 51 (T) and 48 (C) days in

milk and had produced 1251 (T) and 1196 (C) litres of milk with 7.0% (T) and 7.2% (C) milksolids ($P > 0.05$).

TABLE 2: Reproductive performance in a Controlled Breeding Program following a Controlled Calving Program for Treated (30 mg dexamethasone trimethylacetate i.m. on day 274 of gestation) and Control cows.

| | Treated <i>n</i> = 209 | Control <i>n</i> = 421 | Significance |
|-------------------------------------|---------------------------|---------------------------|--------------|
| 3-week SR (%) | 94.7 | 93.3 | NS |
| 1 st insemination CR (%) | 33.8 | 46.8 | * |
| 7 week ICR (%) | 60.8 | 70.0 | * |

SR = Submission Rate; CR = Conception Rate; ICR = In-Calf Rate.

* $P < 0.05$

Subsequent Fertility

Four of the six herds used Controlled Breeding Programmes in the breeding season following induction, while the other two herds used conventional AI systems. Final empty rates are not presented here as data is pending for three of the herds. There was no effect of treatment on 3-week submission rate (C vs. T = 93.3% vs. 94.7%; $P > 0.05$). There were treatment differences in first insemination conception rates and 7-week in-calf rates ($P < 0.05$; Table 2).

DISCUSSION

This study has shown that a strategic injection of a corticosteroid at day 274 of gestation can initiate parturition prior to due date in 73% of cows without affecting calf survival. A further 26% of T cows calved in the following 4-day period. Observed response rates and times were more variable than those reported by Garverick (1976) who defined response to treatment using a shorter acting preparation of dexamethasone as the occurrence of parturition within 72 h. Bailey *et al.* (1973) reported 100% response with a mean response time of 12.1 (range 4–20) days following induction on day 240–252 of gestation with dexamethasone trimethylacetate. In our study, only 25% of T cows responded to the treatment using the definition of Garverick (1976), but response times had a close resemblance to those reported by Bailey *et al.* (1973). The response we observed may be more manageable in a large herd synchronised at insemination. If a complete Controlled Calving Program were put in place, then all cows that had not calved by Day 274 would be treated. If the standard deviation of gestation length was 4.5 days (following spontaneous parturition), then nine days prior to a due calving date an average of 2.27% of cows due would already have calved leaving a potential 48.9% of the whole herd available for involvement in a Controlled Calving Program. A program with an average response time of 5.4 days and a standard deviation (SD) of 3.1 days may be easier to manage than a response time of 1.9 days with a SD of 0.5 days if large numbers of animals were involved.

Progesterone concentrations were measured as a retrospective indicator of spontaneous calving dates. Reported concentrations suggest that the C group may have had slightly biased spontaneous calving dates, with these cows possibly being slightly closer to calving than the T cows. If this was the case, then the difference in calving pattern associated with treatment at Day 274 may have been

slightly more pronounced than we have reported.

The incidence of assistance required at parturition was greater in the C cows and contrasts with other studies. An increase in required assistance resulting from treatment so close to term would likely be a result of lack of dilation and relaxation of the birth canal structures (Garverick, 1976). The results achieved with the Controlled Calving Program implementing dexamethasone trimethylacetate suggest that the controlling factor in this program was more likely to be a reduction in the number of large calves. It is expected that an average difference of ~2.5 days in gestation length should result in lighter birth weights resulting in a lower incidence of calving complications and required assistance at parturition.

The lack of difference in post-partum complications and cow/calf mortality is indicative of a successful Controlled Calving Program in herds with relatively normal calcium, magnesium and β -hydroxybutyrate levels. Routine induction programs in seasonally calving herds can result in increased incidences of milk fever and mastitis (Verkerk *et al.*, 1997; Garverick, 1976) and reduced milk yield in early lactation because of retarded udder development (Verkerk *et al.*, 1997). This was not the case with the Controlled Calving Program and may be due to the timing of the treatment in relation to due calving dates.

The results suggest that the Controlled Calving Program had some effect on reproductive performance. This is contrary to reports on induced calving (Garverick, 1976; Malmo & Beggs, 2000; Morton, 2000). While the submission rates for the two groups were similar, the differences in first insemination conception rate and the 7-week in-calf rate were significant. Survival analyses of the patterns of conception would be required to reveal whether there was any effect on the days from start of mating to conception but requires final empty rates for cows in every herd.

The incidence of RFMs in this study was lower than other studies in which incidences ranged from 20–80% (Garverick, 1976; Grunert *et al.*, 1975). The results presented here agree with results published by Bailey *et al.*, (1973) using dexamethasone trimethylacetate at 240–252 days of gestation. Recorded RFMs in this study were only those externally visible without internal examination, which may have underestimated the actual incidence.

The Controlled Calving Program as implemented in this study was successful in reducing gestation length through the strategic use of dexamethasone trimethylacetate by 2.44 days. The potentially limiting issues were the increased incidence of RFMs as well as the effects on conception rate to first insemination and 7-week in-calf rate.

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REFERENCES

- Australian Dairy Herd Improvement Scheme. 1999: Australian Dairy Herd Improvement Report 1998-1999. Pp. 17.
- Armer, C.C.; Macmillan, K.L.; Jellie, H.P. 1993: The application of controlled calving and breeding programs to the management of large dairy herds. *Proceedings of the New Zealand Society of Animal Production* 53: 87-90.
- Bailey, L.F.; McLennan, M.W.; McLean, D.M.; Hartford, P.R.; Munro, G.L. 1973: The use of dexamethasone trimethylacetate to advance parturition in dairy cows. *Australian veterinary journal* 49: 567-573.
- Cavalieri, J.; Eagles, V.E.; Ryan, M.; Macmillan, K.L. 2000: Patterns of onset of oestrus and reproductive performance in dairy cows enrolled in controlled breeding programs. *Proceedings of Australian and New Zealand combined dairy veterinarians' conference, Vanuatu*. Pp. 161-182.
- Garverick, H.A. 1976: Induction of parturition in dairy cattle. *In: Wilcox, C.J.; Van Horn, H.H.; Harris, Jr.B.; Head, H.H.; Marshall, S.P.; Thatcher, W.W.; Webb, D.W.; Wing, J.M. ed. Large Dairy Herd Management*. University Presses of Florida, Florida. Pp. 231-246.
- Grunert, E.; Ahlers, D.; Jochle, W. 1975: Effects of a high dose of diethylstilbestrol on the delivery of the placenta after corticoid-induced parturition in cattle. *Theriogenology* 3: 249-258.
- Macmillan, K.L.; Curnow, R.J. 1976: Aspects of reproduction in New Zealand dairy herds. 1. Gestation length. *New Zealand veterinary journal* 24: 243-252.
- Malmö, J.; Beggs, D. 2000. Reproductive management programs for seasonal calving dairy herds. *Proceedings of Australian and New Zealand combined dairy veterinarians' conference, Vanuatu*. Pp. 229-240.
- Morton, J. 2000: The InCalf Project - Some risk factors for reproductive performance in Australian dairy herds. *Proceedings of Australian and New Zealand combined dairy veterinarians' conference, Vanuatu*. Pp. 43-61.
- Taufa, V.K.; Macmillan, K.L.; Morgan, S.; Hooper, R.; Day, A.M. 1998: The efficacy of oestradiol in improving oestrous synchrony and fertility of lactating dairy cows in a progestin-based synchronisation system. *Australian Society for Reproductive Biology* 29: 18.
- Verkerk, G.A.; Goble, G.; McDougall, S.; Woods, M.; Clark, B. 1997: Induction of parturition in dairy cows: a survey from spring 1996 in the Waikato region. *Proceedings of the New Zealand Society of Animal Production* 57: 231-233.