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Some effects of using progesterone and gonadotrophin releasing hormone on the reproductive performance of inseminated cows

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ABSTRACT

The administration of progesterone (P4) within 3 days following insemination can reduce pregnancy rates. In contrast, an injection of gonadotrophin releasing hormone (GnRH) at about 12 or 13 days after insemination can increase them by around 10%. This field trial tested the hypothesis that the negative effects reported for the P4 treatment on fertility could be eliminated by strategically injecting GnRH to convert the two ovarian follicle waves per cycle created by using P4, into three wave ones, with increased fertility.

A total of 830 cows in 13 dairy herds received comparative treatments involving: (i) the insertion of a P4 intravaginal device 2 or 3 days after first insemination (1st insem.) for 10 days, with an injection of 10 mg of GnRH at device removal (P4 + GnRH); (ii) the same GnRH treatment but without P4 pre-treatment (GnRH); and, (iii) no post-insemination intervention (Control). Pregnancy status and conception date were confirmed by rectal palpation of uterine contents Calving data were recovered from 10 herds to monitor gestation length, dystocia and calf birth weight.

The conception rates to 1st insem. were highest for the 255 cows treated with GnRH (64%; $p = 0.05$), but similar in the other two groups of 273 and 302 cows (57%). Second insemination results were not affected by the treatments; neither were final pregnancy rates. Birth weights were higher for bull than heifer calves (36.9 vs 33.0kg; $p<0.01$), but were not affected by treatment.

The results of this trial showed that the P4 + GnRH treatment did have normal fertility and that GnRH injected 12 or 13 days after first insemination could increase conception rates.

Keywords: Gonadotrophin releasing hormone, progesterone, pregnancy.

INTRODUCTION

The bovine oestrous cycle is characterised by wave-like patterns of ovarian follicle development which are repeated every 7 to 10 days (Savio *et al*. 1988; Sirois & Fortune 1988). The members of a newly, emerged cohort of follicles of 4 to 5mm diameter compete to achieve dominance and numbers diminish progressively until one dominant follicle (DF) remains. While the DF retains its functional integrity, it can suppress the emergence of a new follicle wave; but it must eventually lose dominance as a sequel to ovulation or to becoming atretic. Successive waves emerge on Days 0 and 10 (oestrus = day 0) in cattle having 2 waves per cycle compared to Days 0, 9 and 16 for those with 3 waves per cycle (Ginther *et al*. 1989).

A recent study (Ahmad *et al*.1997) showed that the number of waves in the cycle preceding an insemination did not affect fertility, but that in the period equivalent to an oestrous cycle after insemination, the 3 wave sequence was associated with a higher probability of conception than a 2 wave one.

Systematic attempts to affect fertility by varying follicle wave patterns have produced variable results. Administering progesterone (P4) to inseminated cows during metoestrus can accelerate development of the early embryo, blastocyst hatching and trophoblast elongation (Garret *et al*. 1988). The potential advantages of these changes are negated by the creation of 2 wave cycles (Burke *et al*. 1994) of about 16 to 18 days duration (Lynch & Macmillan 1996a) which also have reduced fertility (Van Cleeff *et al*. 1996). Similar studies in ewes have shown that the progesterone-stimulated embryos which do continue to develop result in heavier lambs with compromised postnatal survival (Kleemann *et al*. 1994).

Whereas P4 can be used to create 2 wave cycles (Burke *et al*. 1994), GnRH can be used to create 3 wave ones (Macmillan & Thatcher 1991; Lynch & Macmillan 1996a; Clark *et al*. 1998). Strategic administration of a GnRH analogue on Days 11, 12 or 13 of the cycle following insemination can reduce the incidence of return-to-service intervals of less than 20 days, with an associated increase in conception rate (Macmillan *et al*. 1986). Subsequent studies have obtained similar effects (Peters *et al*. 1992; Sheldon & Dobson 1993) but others have not (Jubb *et al*. 1990; Ryan *et al*. 1994). This may partly reflect the possibility that population of cows which mainly had 2 wave cycles may be more responsive to a treatment which creates 3 wave ones.

It has recently been reported that combining a metoestrous treatment of P4 with a mid-dioestrous treatment of GnRH could eliminate the detrimental effects of the former treatment and utilise the beneficial effects of the latter one (Lynch & Macmillan 1996 a & b). These interactions may be associated with the ability of the GnRH to convert the 2 wave cycles created by the P4 treatment to 3 wave cycles of potentially enhanced fertility (Clark *et al*.

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1998). The hypothesis tested in the following experiment was that GnRH alone or GnRH + P4 could be administered to increase the probability of conception in inseminated dairy cattle. Supplementary hypotheses were that use of these treatments would not affect gestation length, calf birth weight, nor increase the recorded incidence of dystocia.

MATERIALS AND METHODS

A total of 830 cows in 13 dairy herds was used in comparative treatments involving: (i) the insertion of a CIDR™ intravaginal device (InterAg, NZ) to administer P4 for 10 days from at 2 or 3 days after a first insemination, with an injection of 10 µg GnRH (Receptal™; Bomac Laboratories, NZ) at device removal (P4 + GnRH); (ii) the same GnRH treatment without the preceding use of P4 (GnRH); and, (iii) no post-insemination intervention (Control). Two or three groups of cows were included from each herd, with animals in each set being divided equally between each treatment, taking into account date and sire of first insemination, and postpartum history. Pregnancy status and conception date were confirmed by rectal palpation of uterine contents. Calving data were obtained for cows in 10 of the herds to monitor gestation length, dystocia and calf birth weight.

Chi- square statistics or analyses of variance were used to compare group mean differences.

RESULTS

The average conception rate (CR) for the total of 830 first inseminations was 59% (Table 1), being higher for the cows included in the GnRH group than for contemporaries included in the other two groups (64% vs 57%; p = 0.05). The average conception rate for 343 second inseminations was 67%, which was higher than the average for first inseminations (p<0.01), but did not differ significantly between groups. By the end of the breeding programmes in the 13 herds, only 5% of the 830 cows had not conceived, with treatments not affecting this incidence.

There was a tendency for the average interval between first and second inseminations to be longer in the cows included in GnRH-treated groups (29.4 & 29.2 vs 27.6 days; p = 0.08), but this trend was not consistent in the pattern of return intervals.

No differences were found in gestation length or incidence of dystocia among the three treatment groups. The average gestation length was 281 days. Among the 355 recorded calvings, there were no major calving difficulty reported. The average birth weight of the 355 calves was 35kg. This was affected by the sex of the calf (bull vs heifer = 36.9 vs 33kg; p<0.01, Table 1), but not by either GnRH treatment (p>0.2).

TABLE 1: Fertility and calf birth weight statistics for groups of cows treated with gonadotrophin releasing hormone (GnRH) alone or also with progesterone (P4); or remaining as untreated control animals.

	Group			
	Control	GnRH	P4 + GnRH	Total
(a) Fertility				
n	302	253	283	830
CR% (1st insem)	57[b]	64[a]	57[b]	59
CR% (2nd insem)	65	64	70	67
Empty %	5	5	4	5
(b) Calf birth weights				
Bull (kg)	37.4	35.2	38.1	36.9[c]
Heifer (kg)	32.8	33.3	33.0	33.0[d]
Bull & Heifer (kg)	35.1	34.2	35.7	35.0

CR = conception rate a vs b : p = 0.05 c vs d : p<0.01

DISCUSSION

The results of this trial have confirmed some of those obtained in the original trial involving the use of this analogue of GnRH being injected 11, 12 or 13 days after first insemination (Macmillan *et al*. 1986). However, the conception rate increase in the present trial was only 7% (57% vs 64%; Table 1), compared to 11.5% (60.9% vs 72.4%) in the original study. The current trial has not confirmed initial observations in two exploratory studies which indicated that cows treated with P4 + GnRH as described in the current trial's protocol could have their conception rates increased by around 10% compared to untreated contemporary herdmates (52.0% vs 61.1%; p< 0.05; Lynch & Macmillan 1996b). This treatment may have variable effects on fertility similar to those referred to previously, involving an injection of GnRH 11 to 13 days after an insemination.

The P4 + GnRH treatment did not produce lowered conception rates reported for a P4 treatment on its own. For example, synchronised heifers (n = 22) which had a CIDR device inserted on Days 2 or 3 after insemination had a conception rate of 45% compared to 74% in untreated contemporaries (n = 23) (P. Lynch, unpublished). Van Cleeff *et al*. (1996) reported negative differences of 21% and 37%, also in dairy heifers when devices were inserted on Days 1 or 2 after insemination. When equivalent treatments with P4 were administered to ewes per vaginum on Day 1, the depression in conception rate with natural mating was 17.6% (Kleemann *et al*. 1994).

In contrast to the results from using P4 during metoestrus in ewes to produce larger foetus and lambs of higher birth weight (Kleemann *et al*. 1994), the use of either GnRH or P4 + GnRH did not affect calf birth weight (Table 1). It is possible that preventing the decline in conception rate associated with using P4 on its own by injecting GnRH may have reduced the proportional influence of any effects on calf birth weights. For example, if P4 treatments commenced during metoestrus can accelerate early embryo development, then it may be that the stimulated embryos are best able to produce sufficient interferon tau to prevent an earlier onset of luteolysis. Clark *et al*. (1998) have shown that the effect of injecting a GnRH analogue 10 days after initiating the P4 treatment converted the 2 wave cycles to 3 wave ones, and consequently prevent the earlier onset of luteolysis with its associated decline in conception rate.

Although the ideal experimental design would have had some cows in the participating commercial herds treated with P4 alone from Days 2 or 3 after insemination, the economic consequences of depressing conception rate were not acceptable to the herdowners.

The results of this trial must be taken in concert with a series of trials which have shown that ovarian follicle wave patterns can be manipulated. These manipulations have the potential to increase as well as to decrease conception rates. They may also provide a basis to develop new treatment protocols which may consistently increase conception rates in herds of cows which have ovarian follicle wave patterns systematically controlled to improve their reproductive performance.

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