Some effects of injecting a prostaglandin $F_2\alpha$ (Lutalyse) during the post-partum period on the subsequent fertility of dairy cows

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ABSTRACT

Three trials were completed using 1813 cows in seasonal dairy herds to study the effects of an injection of a prostaglandin $F_2\alpha$, dinoprost tromethamine (Lutalyse® ; Upjohn Co.) given from 14 to 35 d post-partum on the subsequent fertility of normally calving dairy cows (Trial 1), cows induced to calve prematurely and herdmates calving normally on similar dates (Trial 2), and all cows on a whole herd basis (Trial 3).

The prostaglandin injection did not alter interval from calving to first oestrus (48.5 d), start of the artificial breeding (AB) programme to first insemination (12.9 d), AB start to conception (24.8 d), calving to insemination (77.2 d), calving to conception (88.3 d), or the pregnancy rate to first insemination (58.5%), even though there were large differences in each of these parameters among the 5 herds in Trial 1.

The pregnancy rate to first insemination among cows induced to calve prematurely was 47.2% compared to 56.7% in normally calving herdmates with similar calving dates (Trial 2). A prostaglandin injection around 20 d post-partum did not affect this difference. In Trial 3, induced cows injected with prostaglandin from 28 to 34 d post-partum did have a higher pregnancy rate to first insemination than untreated induced herdmates (69.2% *v* 42.3%). None of the parameters used to measure reproductive efficiency were affected by a prostaglandin injection given from 28 to 34 d post-partum to normally calving cows in Trial 3.

The comparatively high level of fertility in the cows, combined with efficient breeding management in the herds included in these trials, may have minimised the potential usefulness of this form of prostaglandin therapy previously demonstrated in herds with less fertile cows.

Keywords Prostaglandin; post-partum; fertility; conception; pregnancy.

INTRODUCTION

When prostaglandin $F_2\alpha$ (PGF) was injected once into lactating dairy cows at from 14 to 28 d post-partum, their subsequent pregnancy rate to first insemination was increased from 45% in untreated herdmates to 62%. The trial was conducted using cows in 3 herds in 2 consecutive years and has been reported on several occasions (Young and Anderson, 1986a, b; Young *et al.*, 1984). Several aspects of the results suggested that the PGF effect was not related to its luteolytic properties, and an undefined endometrial effect was postulated. Fortunately Young's trials included routine blood sampling for progesterone assay when the cows were injected with PGF. There were 63% of cows with plasma progresterone concentrations of <0.5 ng/ml. It was this group which produced the treatment response in pregnancy rate (64% *v* 44%). Among the cows with >0.5 ng/ml plasma progesterone concentration, there was no PGF treatment effect on pregnancy rate (56% *v* 55%), even though one would have expected any beneficial effects from an induced luteolysis to have occurred in this group of cows.

The PGF injection did not produce a marked increase in oestrous activity around 2 to 3 d later as only 12% of injected cows (16/138) were detected in oestrus within 7 d. Yet the average post-partum interval to first oestrus was 57 d in the PGF treated group compared to 70 d in contemporary controls (Young and Anderson, 1986b). PGF has a well recognised role in parturition, and frequent PGF injections from 1 h post-partum can reduce the incidence of retained foetal membranes (Gross *et al.*, 1986). Consequently, it is possible that the PGF fertility effects reported by Young and Anderson may involve a uterine form of action exclusive of any ovarian interaction (Paisley *et al.*, 1986).

Demonstrating similar effects in dairy cows in seasonal dairy herds in New Zealand could be important to improved breeding management. This is because pasture fed dairy cows calving in late winter have an average post-partum interval to first oestrus and/or ovulation of 45 d. Simply reducing this interval, especially with later calving cows should increase submission rates. It could also mean that cows induced to calve prematurely could have an *open* oestrus before being inseminated. Any increase in pregnancy rate would be an additional bonus, even though the average pregnancy rate in well managed dairy herds in New Zealand is around 60% (Macmillan *et al.*, 1986).

The possible beneficial effects of administering a single injection of PGF in the post-partum period

before oestrous cyclicity normally recommenced was studied in 3 field trials in selected seasonal dairy herds in the Waikato during 1985 and 1986.

MATERIALS AND METHODS

Trial 1: Normally Cycling Cows

This trial included 5 herds and involved those cows which had had a normal calving during the 6 weeks following the date of each herd's planned start of calving in 1985. Five weeks after this date, all the cows which had calved normally in the first 3 weeks of the calving programme were presented for examination. Those cows which fulfilled the required criteria were divided into 2 similar groups based on age, breed, post-partum interval on the date of examination and whether or not the cow had been detected in oestrus or ovulated (cycling), or was still anoestrus.

Each cow in 1 of these groups was injected intramuscularly with 5 ml Lutalyse® (Upjohn Co.) containing 6.71 mg/ml of dinoprost tromethamine (THAM salt), and 0.9% benzyl alcohol as preservative. This was referred to as the treated group, with the other half of the cows as the control group.

Each herd was revisited 3 weeks later, and the examination-treatment routine repeated with a second group of cows which were at 14 to 35 d post-partum.

Herd owners maintained complete records of dates of calving, oestrus and insemination for every cow. They used tailpaint (Coopers New Zealand Ltd.) as an aid for detection of oestrus. All matings for at least the first 6 weeks of each herd's breeding programme were by artificial insemination. A bull (or bulls) ran with cows in a herd after the artificial breeding programme for a further 6 to 9 weeks. Each herd was visited from 2 to 6 times to pregnancy test cows in the treated and control groups which had at least a 4½ week interval from last insemination or mating. Some cows were examinated twice to confirm conception date.

Trial 2: Induced Cows

The trial was conducted using animals in 10 herds which each had from 10 to 45 cows induced to calve prematurely in late winter or early spring of 1985. The induced cows had received recognised pre-partum treatments involving an initial depot injection of a corticosteroid analogue. From 10 to 12 d after the induced cows had calved relatively synchronously, each treated cow in each herd was examined to determine its suitability for inclusion in this trial. Ten days later, approximately 20 days post-partum, each of these cows was re-examined as well as those herdmates which had not been induced to calve prematurely but which had calved within 1 week of their induced herdmates. Those cows in the induced or normal groups which fulfilled similar criteria to those which applied in Trial 1 were then redivided into 2 balanced groups. One group was injected with 5 ml Lutalyse® and the other group acted as a control. The 10 herds included 3 of the 5 herds in Trial 1.

Trial 3: Whole Herd Application

Half of the cows in each of 3 herds were injected with 5 ml Lutalyse® when at 28 to 34 post-partum during the 1986 calving programme. This was achieved by injecting the cows in the treated group on the same selected day of each week as they reached the appropriate post-partum period. The herds were relatively large and had been in Trial 1 (1 herd) or Trial 2 (2 herds) the previous season. Pre-treatment examinations were not made, but dates of conception were confirmed by pregnancy testing either by the practitioner who tested all the cows in Trials 1 and 2 (1 herd) or by the practitioner normally servicing that particular herd (2 herds).

RESULTS AND DISCUSSION

PGF injection from 14 to 35 d (Trial 1) or 28 to 34 d (Trial 3) post-partum produced small reductions in the intervals used to measure breeding efficiency in seasonal dairy herds and small increases in 3-week submission rate and pregnancy rate in normal calving cows (Tables 1 and 3). These improvements in breeding efficiency and fertility were not statistically significant, and the effects were not consistent in all herds.

TABLE 1 Effects of injecting a prostaglandin $F_2\alpha$ on breeding efficiency parameters among cows in 5 seasonal dairy herds (Trial 1).

Parameter	Mean	T-C[1]	Herd range
Calving to: 1st oestrus (d)	48.5	−0.2	35.7-58.5
1st insemination (d)	77.2	−1.3	66.8-86.1
Conception (d)	88.3	−1.8	82.8-92.9
AB[2] start to: 1st insemination (d)	12.9	−0.2	10.6-15.6
Conception (d)	24.8	−1.0	19.4-28.5
3-week: Submission rate (%)[3]	84.0	+1.0	78.0-94.1
Pregnancy rate (%)[4]	54.6	+1.0	42.0-74.0
1st insem. pregnancy rate (%)	59.0	+1.0	51.1-71.0
Final empty rate (%)	5.1	+1.0	1.5-9.0

[1]T Treated with 5ml Lutalyse® (Upjohn Co.); C Control.
[2]Artificial breeding programme.
[3]Proportion of herd inseminated in first 3 weeks.
[4]Proportion of herd conceiving in first 3 weeks.

The 3 trials involved a total of 1813 cows and collectively included all the main subgroups in a seasonal calving dairy herd. These subgroups relate to age, time of calving within a herd (e.g. early *v* late *v* very late), type of calving (e.g. normal *v* induced),

post-partum cycling status (e.g. cycling *v* anoestrus), in herds of varying size achieving different levels in relation to breeding management goals.

The percentage of cows responding to PGF treatment and being detected in oestrus within 7 days of injection will be influenced by the average interval from calving to first ovulation within a herd or within a subgroup in that herd. Young and Anderson (1986) found that 51% of the cows included in their original PGF trials had plasma progesterone concentrations indicative of some corpora luteal activity at the time of examination and treatment. Their post-partum intervals ranged from 14 to 28 d. Even though the New Zealand trials reported here had ranges of 14 to 35 d (Trial 1) and 28 to 34 d (Trial 3), an average interval of 48.5 d from calving to first oestrus would mean that few cows would have ovulated before treatment. Only 18.7% of 611 cows (114/611) in Trial 1 had a corpora lutea present at first examination from 14 to 35 d post-partum.

This longer post-partum interval to first oestrus need not have contributed to a reduced response in subsequent breeding efficiency to a PGF injection. Young and Anderson (1986) reported that the fertility effects which they observed were only found in those animals which had low plasma progesterone concentrations (< 0.5 ng/ml) at the time of treatment. Clearly, most of the cows in the 3 New Zealand trials would have been in this *low progesterone* category.

It has been hypothesised that the beneficial effects of the post-partum PGF injection may be mediated through modifications to uterine involution. In spite of the long interval from calving to first oestrus in cows included in Trial 1, the average interval from calving to first insemination was 77.2 d. This can be compared to the 76.5 d in the original trials of Young and Anderson (1986). In this original trial, PGF treatment reduced the average interval from first insemination to conception in control cows from 25 d to 21 d. In Trial 1 it averaged 11.1 d (88.3-77.2; Table 1) and was not affected by PGF treatment.

The pregnancy rates to first insemination in the original trial were 45% for untreated cows and 62% for PGF treated cows (Young and Anderson, 1986). The latter figure is similar to that obtained for treated and control cows in trials 1 and 3 (Tables 1 and 3). It is possible that the fertility effects originally reported from using PGF in the post-partum period may be much less in groups of cows which would normally be expected to have a pregnancy rate of 60% or more. An intriguing and undiscussed aspect of the original report is that the average interval from first insemination to conception for those cows which failed to conceive to first insemination was 47.2 d in both treated and control groups. This suggests that the cows either had long inter-service intervals or low fertility to second and subsequent inseminations. The comparable figure in Trial 1 was 27.7 d.

We could not find a consistent PGF fertility effect in groups of animals which may have had below average pregnancy rates to first insemination because of herd post-partum interval to examination or treatment, period of the breeding programme, or time of calving effects. The exception was among cows induced to calve and then treated from 28 to 34 d post-partum when there was a significant PGF fertility effect (Table 3). A similar effect was not

TABLE 2 Effects of injecting a prostaglandin $F_2\alpha$ on breeding efficiency parameters among late calving cows or herdmates induced to calve prematurely (Trial 2).

Parameter	Induced		Late calving	
	Mean	T-C[1]	Mean	T-C
AB[2] start to:				
1st insemination (d)	15.8	+0.2	15.5	+2.2
Conception (d)	35.2	+1.4	30.1	+2.5
1st insem. pregnancy rate (%)	47.2	−5.9	56.7	−1.7
3-week pregnancy rate (%)[3]	36.2	−6.7	49.5	−0.9
Final empty rate (%)	7.9	−4.3	2.8	−1.9
No. of cows	250		201	

[1]T Treated with 5ml Lutalyse® (Upjohn Co.); C Control.
[2]Artificial breeding programme.
[3]Proportion of cows conceiving in first 3 weeks.

TABLE 3 Effects of injecting a prostaglandin $F_2\alpha$ from 28 to 34 days post-partum on a whole herd basis on some breeding efficiency parameters in 3 seasonal dairy herds (Trial 3).

Parameter	Whole herd			Induced cows		
	T[1]	C[1]	T-C	T	C	T-C
AB[2] start to: 1st insemination (d)	13.0	15.2	−2.2	15.6	19.0	−3.4
Conception (d)	24.0	24.4	−0.4	25.0	28.1	−3.1
1st insemination pregnancy rate (%)	63.6	64.1	−0.5	69.2	42.3	+26.9
3-week pregnancy rate (%)[3]	58.3	56.0	+2.3	57.1	32.1	+25.0
Final empty rate (%)	6.2	8.4	−1.2	3.6	17.9	−14.3
No. of cows	324	359	—	28	28	—

[1]T Treated with 5 ml Lutalyse® (Upjohn Co.); C Control.
[2]Artificial breeding programme.
[3]Proportion of herd conceiving in first 3 weeks.

observed in Trial 2 with a larger number of cows (Table 2). If the result obtained in Trial 3 can be confirmed, then it means that PGF treatment for cows induced to calve prematurely is ineffective if applied around 3 weeks post-partum, but is effective at least from 28 to 34 d post-partum. While a further investigation of a possible PGF fertility effect in cows induced to calve prematurely is warranted, the results of these 3 trials have clearly shown that the routine treatment of normally calving cows with a PGF injection from 14 to 35 d post-partum does not affect subsequent fertility and breeding efficiency.

This study has produced extensive new information on breeding efficiency statistics of relevance to herds with a single seasonally concentrated calving pattern. These include the average interval from the start of the artificial breeding programme to first insemination, and the average interval from the start of the artificial breeding programme to conception. The results of Trial 2 have confirmed that induced cows have lower fertility and that many may have to be induced in consecutive seasons. In this study the comparison was not with all other cows in the herd, but with later calving herdmates.

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