

THE EFFECT OF PROSTAGLANDIN PGF_{2a} WHEN ADMINISTERED AT DIFFERENT STAGES DURING THE OESTRUS CYCLE

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ABSTRACT

The oestrus cycle of 69 S A Mutton Merino ewes was brought about by the application of a synthetic intravaginal progestagen preparation. The ewes were then divided into seven groups representing seven different stages of the oestrus cycle ranging from 5 to 11 days after ovulation. All ewes were then simultaneously treated with a single injection of a PGF_{2a} - analogue. The luteolytic effect of PGF_{2a} was positively demonstrated by the outcome of the above treatment. Plasma progesterone concentrations dropped sharply within 24 hours after the injection to low and even zero levels. There was no significant difference ($P > 0,05$) between the group means regarding the time interval from PGF_{2a} treatment until oestrus which was $33,7 \pm 3,83$ hours for the seven groups. Only 78,1% of all the ewes in the experiment came on heat during an 84 hour time limit of which 85,19% showed oestrus between 24 and 36 hours after treatment. The administration of PGF_{2a} had no effect on the function of the corpus luteum during the subsequent cycle as normal plasma progesterone concentrations were recorded during this cycle.

Conception rate of animals inseminated during the synchronised oestrus was 56,52% compared to 73,33% during the following oestrus period. The percentage lambs born was 92,75% from ewes inseminated during the synchronised period and 133,3% during the following oestrus period. It was once again demonstrated that fertility was suppressed in ewes inseminated during the oestrus period following synchronisation.

INTRODUCTION

It is generally accepted that PGF_{2a} is the luteolytic hormone which occurs naturally in the female animal including the sheep. (Acritopoulou, 1979; Silvia & Niswender, 1984). The hormone is secreted by the endometrium normally from day 12 of the ovine cycle (Silvia & Niswender, 1984). PGF_{2a} or any of its analogues causes luteal regression which will result in the cessation of the secretion of progesterone, followed by oestrus and ovulation (Greyling, Van der Westhuysen & van Niekerk, 1979; Cognie, Colas & Thimonier, 1984). Prostaglandins and its analogues are however not capable to induce oestrus and ovulation outside the active breeding season, which limits the application of these substances in the production of sheep (Cognie et al., 1984). A single administration of PGF_{2a} or any of its analogues administered at random should be able to synchronise 66% of ewes from a cyclic herd (Acritopoulou & Haresign, 1980) as a result of the fact that the corpus luteum is only responsive to PGF_{2a} between days 5 and

14 of the oestrus cycle (Greyling & Van der Westhuysen, 1979).

This test was conducted with the purpose to investigate the reaction of a single administration of PGF_{2a} analogue on the duration of oestrus, conception, influence on the development of the corpus luteum and the secretion of progesterone after a synchronised oestrus when injected at different stages of the oestrus cycle.

MATERIALS AND METHODS

Oestrus and ovulation of 69 ewes were synchronised with progestagen impregnated intravaginal pessaries as described by Schoombée (1988). Oestrus response was determined with the aid of teaser rams. The day after oestrus was assumed to be the day of ovulation (day 0).

As the ewes responded to treatment they were sorted into groups representing different stages of the oestrus cycle : group 1, four ewes, day 11 of cycle; group 2, fourteen ewes, day 10 of cycle; group 3, ten ewes, day 9 of cycle; group 4, eight ewes, day 8 of cycle; group 5, thirteen ewes, day 7 of cycle; group 6, twelve ewes, day 6 of cycle and group 7, seven ewes, day 5 of cycle.

All ewes simultaneously received an intramuscular injection, of 10 mg Dinoprost (PGF_{2a}, Lutalyse, Upjohn). Ewes were monitored for oestrus with teaser rams immediately after PGF_{2a} treatment was concluded. Blood samples were collected from half the ewes in each group daily from two days before PGF_{2a} treatment until one day after treatment and then on days 7,8,9,10 and 11 during the cycle following PGF_{2a} treatment. Serum progesterone concentrations were determined according to the procedure as described by Faure (1975).

Each ewe was inseminated twice during the PGF_{2a} synchronised oestrus and again during the subsequent oestrus following treatment. The first insemination was performed as soon as the ewe was diagnosed in oestrus and the second one 24 hours later. Fresh semen diluted with skimmed milk was used for insemination purposes.

RESULTS AND DISCUSSION

Duration of time from PGF_{2a} administration until commencement of oestrus

Statistical analysis has proven no significant difference ($P > 0,05$) between the group means with regard the duration of time from PGF_{2a} treatment until commencement of oestrus. The mean interval for all seven groups was $33,7 \pm 3,83$ hours (Table 1 ; Figure 1).

Table 1 : Duration (hours) from PGF_{2a} treatment until commencement of oestrus when treated at different stages of the oestrus cycle

GROUP	1	2	3	4	5	6	7
DAY	11	10	9	8	7	6	5
EWE NO.							
1	36	24	24	36	12	12	12
2	36	36	24	36	36	12	24
3		36	36	36	36	24	24
4		36	36	36	36	24	24
5		36	36	36	36	36	24
6		36	36		36	36	36
7		36	36		36	36	36
8		36			36	36	
9		36			36	36	
10		36			48	48	
11		36				72	
12		60					
x	36.00	37.00	32.60	36.00	34.80	33.80	25.70
s	0	8.02	5.86	0	8.85	16.82	8.28

Only 78,1% of the experimental animals reacted to PGF_{2a} treatment within an 84 hour time limit. Of these ewes 85,19% came on heat in a very narrow time interval viz. between 24 and 36 hours after PGF_{2a} treatment. This finding is closely correlated with the result of the preceding progestagen treatment where the total number of ewes which came on heat were somewhat higher viz. 97,2%. Consideration should be given to the fact that ewes were treated with PGF_{2a} only during the active luteal phase between days 5 and 11. It could however be expected that ewes treated during the early luteal phase i.e. between ovulation and day 5, would not react to treatment (Greyling & Van der Westhuysen, 1979).

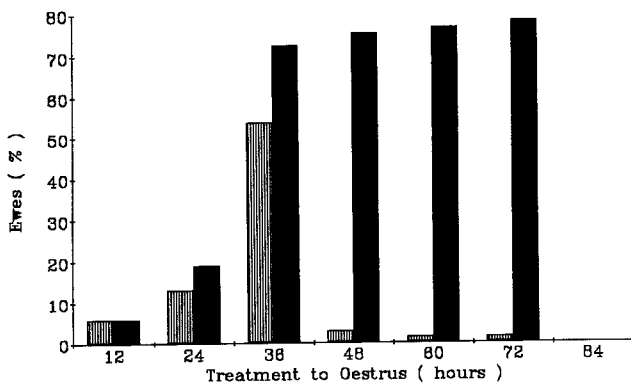


Figure 1: Cumulative percentage of ewes in oestrus after PGF_{2a}-treatment

Should a comparison be drawn between a single injection of PGF_{2a} and intravaginal progestagen treatment with regards to synchronisation of oestrus, it would appear from the above evidence that progestagen could be applied with greater success than PGF_{2a}.

Plasma progesterone concentrations of ewes treated on days 5 to 11 of the oestrus cycle

From Table 2 it can be concluded that the production of progesterone was normal in all the groups at the time when PGF_{2a} was administered (Schoombée, 1988). Administration of PGF_{2a} had an almost immediate and very significant suppressive influence on progesterone production and consequently on the corpus luteum. Progesterone concentrations in all groups declined dramatically within 24 hours after PGF_{2a} treatment (Table 2). The assumption can therefore be made that corpora lutea in ewes can effectively be disposed of with a single injection of 10 mg PGF_{2a} between days 5 and 11 of the oestrus cycle. These findings correspond with those of Greyling & Van der Westhuysen (1979) and Cognie *et al.* (1984).

Plasma progesterone concentrations of ewes during the oestrus cycle following PGF_{2a} treatment

The corpora lutea of all ewes in the seven different treatment groups developed normally after PGF_{2a} synchronised oestrus and consequently progesterone secretion proceeded normally (Table 2). It can therefore be concluded that treatment with PGF_{2a} at different stages of the previous cycle from day 5 to 11 does not have an influence on ovulation and the normal development of and secretion by the corpora lutea during the subsequent cycle.

The reproductive system of the ewe must be under the influence of progesterone for a minimum period of 5 days before a normal fertile ovulation followed by a normal corpus luteum will occur (Mac Donnel, 1985). From the results

Table 3: Conception, lambing percentage and fecundity after PGF_{2a}-treatment at different stages of the oestrus cycle

Number	Percentage
Ewes treated	69
Ewes inseminated	69
Conception with first oestrus	39
Conception with second oestrus	22
Total conception	61
Ewes not in lamb	8
Lambs from first oestrus	64
Lambs from second oestrus	40
Total number of lambs	104
Lambing percentage1 first oestrus	92.75
Lambing percentage1 second oestrus	133.33
Total lambing percentage	150.72
Fecundity2 first oestrus	1.64
Fecundity2 second oestrus	1.82
Total fecundity	1.71

Table 2: Mean plasma progesterone concentrations (ng/ml) as determined in 7 groups of ewes from day 7 for 5 consecutive days during the oestrus cycle following PGF_{2a} treatment

DAY OF CYCLE	MEAN PLASMA PROGESTERONE CONCENTRATION (ng / ml) PER GROUP						
	1	2	3	4	5	6	7
7	2,037±1,502	3,399±0,657	3,000±0,916	3,249±1,077	2,273±0,317	2,649±1,493	3,158±1,117
8	2,707±0,718	3,611±0,276	3,449±1,046	3,524±0,890	2,897±0,901	3,662±0,922	3,196±1,196
9	2,603±0,384	3,237±0,851	3,625±0,702	3,737±0,901	2,324±0,579	3,162±0,707	3,849±1,488
10	3,123±0,436	4,287±1,313	3,760±1,344	3,987±0,509	2,784±0,814	3,811±0,522	3,737±1,448
11	3,500±1,125	4,448±1,326	4,062±1,721	4,499±0,936	3,137±0,984	3,736±0,475	4,060±1,408

one can conclude that treatment with PGF_{2a} can accomplish an effective synchronisation of the oestrus cycle followed by ovulation and the development of a normal secretory corpus luteum as early as 5 days after the previous ovulation. It is doubtful whether conception will occur when the reproductive system was under the influence of progesterone for only 4 days (7-8 days less than in a normal cycle) (Fairnie & Wales, 1980).

Conception, lambing percentage and fecundity of ewes after PGF_{2a} treatment

78,1% Of the ewes came into oestrus within the time limit of 84 hours after PGF_{2a} treatment (Figure 1). The rest of the ewes (21,9%) came into oestrus over a further 7 day period. It is assumed that these ewes were not affected by the treatment. They were, however, inseminated which implies that all the ewes included in the experiment were inseminated (Table 3).

Because there were no statistically meaningful differences in conception between the seven treatment groups, the results of all groups were pooled together in Table 3.

$$\text{Lambing percentage} = \frac{\text{Number of lambs born alive and/or dead}}{\text{Number of ewes inseminated}} \times 100$$

$$\text{Fecundity} = \frac{\text{Number of lambs born alive and/or dead}}{\text{Number of ewes lambed}}$$

CONCLUSION

A single intramuscular injection of PGF_{2a}, administered at different times during the active stage of the corpus luteum between days 5 and 11 after ovulation, will dispose of the corpus luteum effectively and the production of progesterone will drop significantly within 24 hours. Oestrus periods of ewes treated with a single injection of PGF_{2a} are closely synchronised viz. 85,19% came on heat between 24 and 36 hours after treatment.

Fertility obtained after the synchronised oestrus was substantially lower than normal. PGF_{2a} treatment had, how-

ever, no effect on the development and function of the corpus luteum during the subsequent oestrus cycle since the production of progesterone in all groups was normal.

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