Time of ovulation in ewes after treatment with a prostaglandin F-2α analogue*

Stella Acritopoulou†, W. Haesign‡ and G. E. Lamming

Department of Physiology and Environmental Studies and ‡Department of Agriculture and Horticulture, University of Nottingham School of Agriculture, Sutton Bonington, Loughborough, Leics LE12 5RD, U.K.

Summary. Treatment of 18 cyclic Clun Forest ewes with two i.m. injections of ICI 80,996, given 9 days apart and without reference to stage of the oestrous cycle, synchronized ovulation in all ewes at a mean time interval of 73·1 ± 1·6 (s.e.m.) h from the second injection. The interval from the LH peak to ovulation was 22·6 ± 0·7 h and this is comparable to previously reported figures for a natural oestrus.

Introduction

The prostaglandin (PG) F-2α analogue, ICI 80,996, results in rapid luteolysis when given to ewes as a single intramuscular (i.m.) injection of 100 μg during the mid-luteal phase of the oestrous cycle. Moreover, the changes which occur in plasma concentrations of LH and progesterone at the induced oestrous cycle immediately following treatment more closely resemble those occurring during a natural oestrous cycle (Acritopoulou, Haesign, Foster & Lamming, 1977) than do those obtained when ovulation is synchronized by progestagen treatment (Cumming et al., 1970; Lintin, Lamming & Butt, 1973).

The corpus luteum of the ewe is only sensitive to ICI 80,996 between about Days 4 and 14 of the oestrous cycle (S. Acritopoulou & W. Haesign, unpublished data); it is therefore necessary to give two injections of the analogue 9 days apart to ensure that all ewes respond when treatment commences without regard to stage of the oestrous cycle. However, before using a PG analogue with artificial insemination (A.I.) in controlling breeding programmes for sheep the degree of synchrony in the timing of ovulation after treatment must be determined. The present experiment was designed to provide such data.

Materials and Methods

Regularly cyclic Clun Forest ewes were housed under conditions of natural daylength and temperature and given two i.m. injections of 100 μg ICI 80,996 9 days apart during the breeding season (November 1975). On the 7th day after the first injection each ewe was fitted with an indwelling jugular vein cannula to facilitate the collection of blood samples. Daily blood samples (10 ml) for measurement of progesterone concentrations were collected from 2 days before the second injection until the first natural oestrus after treatment, and samples for determination of LH concentrations (2·5 ml) were collected every 2 h from 24 h after the second injection until 24 h after the onset of the induced oestrus. Blood samples were centrifuged at 4°C and 1600 g for 30 min and the resultant plasma stored at −20°C until assayed. Ewes were individually tested with a colour-marked vasectomized ram at hourly intervals from 24 h after the second injection to determine the onset of oestrus. Thereafter there were no further associations with the male.

* Reprint requests to Dr W. Haesign.
† Present address: Department of Animal Husbandry, Aristotelian University of Thessaloniki, School of Agriculture and Forestry, Thessaloniki, Greece.

189
Laparoscopy was performed on all ewes at 6-h intervals starting approximately 12 h (Group 1, N = 9) or 24 h (Group 2, N = 9) after the onset of the induced oestrus until each ewe was seen to have ovulated. The anaesthetic was pentobarbitone sodium (Nembutal: Abbott Laboratories); ewes were conscious and standing within 30 min of each investigation.

Plasma progesterone concentrations were measured by the radioimmunoassay described by Haresign, Foster, Haynes, Crighton & Lamming (1975). Sensitivity of the assay was 0.08 ng/ml plasma, and both inter- and intra-assay coefficient of variation in this study were <10%. The degree of cross-reaction with other major steroids was <1%. Plasma LH concentrations were measured by a specific double-antibody radioimmunoassay (Foster & Crighton, 1974). Cross-reaction with ovine FSH, GH, TSH and prolactin were negligible and the sensitivity of the assay was 0.1 ng NIH-LH-S18 equivalents/ml plasma. The inter- and intra-assay coefficients of variation were both <10% in this study.

Results and Discussion

The results for the timing of oestrus, ovulation and LH release, and their interrelationships are given in Table 1. Since there were no significant differences between the two groups the data from them have been pooled.

<table>
<thead>
<tr>
<th>Table 1. Time of oestrus, LH release and ovulation in 18 ewes after treatment with ICI 80,996</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interval</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>Injection to onset of oestrus</td>
</tr>
<tr>
<td>Onset of oestrus to onset of LH peak</td>
</tr>
<tr>
<td>Onset of oestrus to peak LH</td>
</tr>
<tr>
<td>Onset of oestrus to ovulation</td>
</tr>
<tr>
<td>Injection to peak LH</td>
</tr>
<tr>
<td>Injection to ovulation</td>
</tr>
<tr>
<td>Peak LH to ovulation</td>
</tr>
</tbody>
</table>

Values are mean ± s.e.m.  
* N = 16; all other values N = 18 (see text).

Two ewes failed to show a pronounced LH peak, although their LH concentrations did rise from a basal value of between 5 and 10 ng/ml up to approximately 20 ng/ml; in all other ewes the maximum LH concentration exceeded 40 ng/ml. However, ovulation and oestrus in these two animals occurred within the times for these events in the other ewes and therefore their poor LH response was presumed to be due to too infrequent blood sampling. If anaesthesia had impaired LH release then it would have been expected that ovulation would also have been affected, but this was not the case.

Pentobarbitone sodium anaesthesia will inhibit the oestradiol-induced release of LH in ewes if given in the period immediately before the LH peak (Radford & Wallace, 1974). However, in the present study anaesthesia was not induced in any ewe in Group 1 before the onset of the preovulatory LH peak, and was therefore assumed to have had no effect on gonadotrophin release patterns. Support for this assumption is provided by the lack of any significant differences in LH release between the ewes in Group 1 and those in Group 2 in which the LH concentration had already returned to basal values by the time of first anaesthesia.

The time of onset of oestrus after the second injection of ICI 80,996 in this study is comparable to that previously reported (38.6 ± 0.9 h) for the double-injection regimen with a larger number of animals (Haresign, 1976).

The interval between the peak of plasma LH and ovulation is almost identical to that previously reported for a natural oestrus (Cumming et al., 1973), and the interval between the onset of oestrus
and the onset of the LH peak is similar to that observed for this breed of sheep at a natural oestrus (Acritopoulou et al., 1977). Ovulation rate was not determined in this study because, in order to avoid undue stress to the ewes, it was considered inadvisable to repeat the laparoscopic observations beyond the time at which the first follicle was seen to have ruptured. The peripheral plasma progesterone profiles of all the ewes throughout the induced oestrous cycle were similar to those reported previously (Acritopoulou et al., 1977) and there were no apparent effects of the frequent laparoscopy examinations.

These results therefore provide further evidence of normal endocrine changes and timing of ovulation following treatment of cyclic ewes with ICI 80,996. The high degree of synchrony in the timing of ovulation after the second injection indicates a possible practical use of A.I. at a fixed-time interval from treatment, especially since conception rates of such treated ewes is equivalent to that of control untreated animals when natural mating is used (Haresign, 1978). This is currently being investigated.

The absence of differences between the hormone changes at the oestrus induced with the PG analogue treatment and those of a normal cycle may allow the use of frozen rather than fresh semen, a factor which has not been routinely possible when synthetic progestagens and PMSG have been used to synchronize ovulation in sheep (Haresign, 1978).

We thank the Meat and Livestock Commission for financial support, and I.C.I. Ltd for supplies of ICI 80,996. The work was carried out whilst one of us (S.A.) was in receipt of a Scholarship from the Republic of Greece State Scholarship Foundation.

References


Received 14 March 1978