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Ovulation in the Merino Ewe in the Breeding and Anoestrous Seasons

D. T. Pearce and C. M. Oldham

School of Agriculture (Animal Science), University of Western Australia, Nedlands, W.A. 6009.

Abstract

The pattern of ovulation of Merino ewes was studied by repeated laparoscopy each 14 days in the anoestrous (n = 97) and breeding (n = 87) seasons. In the anoestrous season the proportion of ewes ovulating did not decrease below 11%, 42% of ewes never ovulated and the remainder fluctuated between the two states. On 20 occasions a clear anovulatory period was interrupted by an isolated spontaneous ovulation. In the breeding season the overall mean proportion of ewes with corpora lutea or albicantia at laparoscopy was 87%, 54% of ewes ovulated regularly throughout while in another 31% absence of corpora lutea or albicantia coincided with the follicular phase of an oestrous cycle as evidenced by an appropriately aged corpora lutea at the next laparoscopy. Of the remaining 15% of the flock 3% had anovulatory periods greater than 14 days while the remainder experienced irregular ovulatory cycles — the majority due to short periods of anovulation but some ewes retained corpora lutea for longer than 14 days while others ovulated twice between successive laparoscopies.

Introduction

The Merino ewe is one of the least seasonal of all sheep and it is commonly observed that some ewes are ovulating in the anoestrous season (Fletcher and Geytenbeek 1970; Wheeler and Land 1977; Oldham 1980). The proportion of ewes ovulating in the anoestrous season has also been found to vary widely between successive years (Pearce *et al.* 1984). Whether the proportion of Merino ewes ovulating at this time consists of some ewes which continue to ovulate or a high proportion of ewes having infrequent ovulations is not known mainly because successive ovarian observations in earlier studies have been too infrequent (Fletcher and Geytenbeek 1970; Oldham 1980). Studies in the Tasmanian Merino in Scotland have suggested that many ewes have infrequent ovulations in the anoestrous season (Wheeler and Land 1977).

Both Prealpes and Ile de France ewes have also been reported to have infrequent ovulations in the anoestrous season (Thimonier and Mauleon 1969) but all ewes ovulate in the breeding season. This contrasts with the Merino where it has been observed that the proportion of ewes ovulating in the breeding season does not reach 100% (Fletcher and Geytenbeek 1970; Wheeler and Land 1977; Oldham 1980).

These two paradoxical observations, the incidence of ovulation in the anoestrous season and the apparent incidence of periods of anovulation in the breeding season, were intensively investigated in Merino ewes in Western Australia. Repeated observation of the ovaries of ewes every 14 days by laparoscopy ensures that there is at least one observation for every ovarian cycle of normal length and thus allows any variability in the incidence of ovulation to be identified.

Materials and Methods

The studies used a single flock of 140 five-year-old Merino ewes of mixed strain purchased from the sale yards in October 1981. The ewes were subsequently maintained unmated and in forward store condition

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(45–50 kg live weight) at pasture at the university's field station, Shenton Park. The flock was shorn in November 1982.

Anoestrous Season

The ovaries of 97 ewes selected at random and maintained in isolation from rams were inspected by laparoscopy (Oldham *et al.* 1976) about every 14 days (range 12–15) between 11 August and 21 October 1982. At each laparoscopy the presence, position and age of ovarian structures were recorded as described previously (Oldham and Martin 1978; Oldham and Lindsay 1980). A ewe was defined as ovulating if corpora lutea (CL) were present on the ovaries and as being anovulatory if there was no evidence of ovulation, CL or corpora albicantia (CA), for two successive fortnightly laparoscopies. The accuracy of a single laparoscopy at predicting a ewe as being anovulatory was defined as the number of ewes with anovulatory ovaries at two successive laparoscopies divided by the number of ewes with anovulatory ovaries at the first laparoscopy.

Breeding Season

The ovaries of 87 ewes, selected at random and maintained in isolation from rams, were inspected by laparoscopy and ovarian data collected every 14 days as described above between 11 March and 19 May 1983.

Both Seasons

A total of 565 laparoscopies were conducted in the anoestrous season and 510 in the breeding season. The ovaries were not observed on 17 and 12 occasions respectively. Data were analysed using the χ^2 test.

Results

Anoestrous Season

The proportion of ewes ovulating decreased ($P < 0.001$) from 31% at the first laparoscopy to 11% at the sixth laparoscopy (Table 1). Consequently the accuracy of a single endoscopy at predicting a period of anovulation increased from 85% at the first, to 99% at the fifth laparoscopy ($P < 0.001$). In all, 8 out of 97 (8%) of the ewes ovulated continually, while of the 92% (89 out of 97) that were anovular, 46% (41 out of 89) were anovulatory throughout the period of observation and 54% (48 out of 89) had one or more shorter anovulatory periods (Table 2).

Table 1. Ovarian activity of Merino ewes in the anoestrous season and the accuracy of a single laparoscopy to identify an anovulatory period

Date of laparoscopy	11.viii.82	26.viii.82	9.ix.82	23.ix.82	7.x.82	21.x.82
No. of ewes	97	97	96	93	91	91
Ewes with CL (%)	31	13	26	21	10	11
Accuracy of laparoscopy (%)	85	78	94	91	99	

Table 2. Duration of the period of anovulation in the anoestrous season and incidence of isolated spontaneous ovulations

No. of successive laparoscopies	6	5	4	3	2	Total
No. of anovulatory ewes	41	12	7	13	16	89
Ewes with ovulations	0	1	0	7	12	20

Twenty-nine ewes had an anovulatory period lasting for only two or three successive laparoscopies and for 10 out of 29 ewes these were the last ovarian observations (Table 2). For 19 out of 29 ewes periods of anovulation were interrupted by isolated spontaneous ovulations. One ewe ovulated after having anovulatory ovaries for five successive laparoscopies and one other ewe had two isolated ovulations (Table 2). In total 22% of ewes had isolated spontaneous ovulations and these persisted for only one or two oestrous cycles.

Breeding Season

The overall proportion of ewes ovulating, with CL or CA present on the ovaries was 87 ± 2% (mean ± s.e.m.) and was highest (95%) at the second laparoscopy ($P < 0.05$, Table 3). The incidence of CL followed by CA at the same location at the next laparoscopy was 87%. Ewes had anovulatory ovaries at 13 ± 2% (mean ± s.e.m.) of observations (Table 3). On 19 out of 51 occasions an observation of anovulatory ovaries was followed by a further observation of anovulatory ovaries with no evidence of ewes having ovulated in the intervening 2 weeks. One ewe had three successive records of anovulatory ovaries and two ewes had four successive records of anovulatory ovaries. Thus approximately 17 ewes or 20% had an interovulatory period of more than 14 days, a genuine period of anovulation. There was no clear evidence to suggest a high frequency of short-length ovarian cycles.

Table 3. Ovarian activity of Merino ewes in the breeding season

Date of laparascopy	11.iii.83	25.iii.83	8.iv.83	20.iv.83	4.v.83	19.v.83
No. of ewes	84	85	87	87	86	81
Ewes with CL or CA (%)	89	95	90	82	80	85
Ewes with anovulatory ovaries (%)	11	5	10	18	20	15

During the 70 days of observations 4.5 ± 0.1 (mean ± s.e.m.) different ovarian cycles per ewe were observed in the 76 ewes with complete ovarian records. This compared with a theoretical maximum of five if all ewes had cycles of 17 days' duration (Table 4). When data for ewes with two or more successive observations of anovulatory ovaries were deleted, the mean number of ovarian cycles increased to 4.9 ± 0.1 (Table 4). Only 3% of ewes had three ovarian cycles because of persistent CL and 6% of ewes had six ovarian cycles, apparently because of short cycles (Table 4).

Table 4. Distribution of number of ovarian cycles observed in the breeding season. Data for all ewes and after deleting data for ewes with two or more successive observations of anovulatory ovaries given

No. of cycles	1	2	3	4	5	6	Mean (± s.e.m.)
All ewes	1%	4%	5%	31%	54%	5%	4.5 (± 0.1)
Less anovulatory ewes			3%	33%	58%	6%	4.9 (± 0.1)

Discussion

The ovulatory patterns of the Merino ewes in the breeding and anoestrous seasons were similar to earlier reports (Fletcher and Geytenbeek 1970; Wheeler and Land 1977; Oldham 1980) but the observation of ovaries every 14 days, and therefore potentially twice within some ovarian cycles, enables some explanation of the patterns of ovulation.

In the anoestrous season, ewes were either anovulatory, cyclic, or fluctuated between either state, having periods of anovulation broken by isolated spontaneous ovulations. The incidence of these isolated ovulations lowered the accuracy of prediction of reproductive state by a single laparoscopy but as the proportion of anovulatory ewes increased so too did the accuracy of a single laparoscopy. Isolated ovulations persisted for only one or two cycles and then ewes became anovulatory again. These observations for Merino ewes contrast with most other breeds where during the anoestrous season all ewes are anovulatory (Wheeler and Land 1977). This difference can be explained in part by the lower sensitivity of Merino ewes, than Suffolk ewes, for example, to negative feedback by oestrogen on the secretion of luteinizing hormone (LH) (Thomas *et al.* 1984). Negative feedback by oestrogen on the secretion of LH is one of the mechanisms blocking ovulation in the anoestrous season and ovulation will occur from time to time if the sensitivity of the brain to negative feedback by oestrogen cannot prevent increased secretion of LH. This variable endocrine state makes the Merino a poor choice for studies in reproductive endocrinology in the anoestrous season.

In the breeding season the proportion of ewes ovulating did not reach 100% and confirmed earlier reports in Merinos (Fletcher and Geytenbeek 1970; Wheeler and Land 1977; Oldham 1980). It had been suggested that this may have been due to ovarian observations being made in the follicular phase of the ovarian cycle when no prominent ovarian structures were present (Fletcher and Geytenbeek 1970). In the data presented here, where observations were made every 14 days, and assuming the cycle was 17 days long, then successive observations of anovulatory ovaries should not have occurred. In fact, on 37% of occasions, observations of anovulatory ovaries were repeated and some ewes had anovulatory ovaries for three or four repeated observations. Over the 70 days of observations only 6% of ewes had more than the expected five ovarian cycles and so there was no evidence to suggest a high frequency of repeated ovarian cycles of short length. Thus our observations were not always in the follicular phase of the cycle and consequently there is evidence to suggest that the Merino ewe has anovulatory periods during the breeding season. At this time ewes would not be expected to show a negative feedback response to oestrogen on LH secretion but recent data (Thomas *et al.* 1984), using the oestrogen-implanted ovariectomized ewe as a model, found that 4 out of 12 Merino ewes, but no Suffolk ewes, showed a negative feedback response. Thus this may be the mechanism blocking ovulation in the breeding season in some Merinos.

The mean number of ovarian cycles observed for each ewe, apart from those ewes having anovulatory periods, was close to a theoretical maximum of five and indicated that most cycles were about 17 days long. Some ewes had persistent CL and some had short cycles, making up 9% of all ewes, indicating that, although the mean length is about 17 days there is some, albeit minor, variation in cycle length in the Merino ewe.

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