PERINATAL BEHAVIOUR AND PROGESTERONE
AND CORTICOSTEROID LEVELS IN SHEEP
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Summary

Merino ewes which had undergone regular handling to accustom them to the activities of observers were studied during lambing in outdoor yards. Quantitative behavioural records showed that: (1) individual ewes tended to isolate themselves from the main group before giving birth ($P < 0.01$) and to remain away during the first two postpartum days ($day \ 1$, $P < 0.01$; $day \ 2$, $P < 0.05$); (2) birth sites were most common in corners ($P < 0.05$) and least common in the centre of the yards ($P < 0.01$); (3) there was no apparent innate pattern in the ewe's licking of the lamb but the lamb appeared to be instinctively guided to the udder by the geography of the ewe.

At birth the corticosteroid and progesterone concentrations in lamb jugular vein plasma was $90 \pm 6 \text{ ng/ml}$ (mean $\pm$ S.E.) and $1.8 \pm 0.2 \text{ ng/ml}$ respectively. Levels of both steroids fell rapidly during the first hours of life.

During labour, progesterone levels in ewe jugular plasma did not change significantly and the mean concentration at delivery was $1.7 \pm 0.2 \text{ ng/ml}$. In contrast corticosteroid levels in the same samples increased rapidly during labour to a peak of $40 \pm 4 \text{ ng/ml}$ at delivery and then declined rapidly. The level at delivery was related to the length of labour ($r = 0.79$, $P < 0.01$). Furthermore, there was commonly an association between the occurrence of a long period of labour, high ewe corticosteroid levels at delivery and the exhibition of poor maternal behaviour.

I. INTRODUCTION

In an investigation of behaviour patterns and peripheral progesterone and corticosteroid levels during labour and the immediate postpartum period, behavioural records and blood samples were collected from a flock of Merino ewes and lambs.

II. MATERIALS AND METHODS

One hundred mixed-age Merino ewes were regularly handled during the last 8-12 weeks of pregnancy with the aim of minimising disturbances to corticosteroid levels and behavioural patterns caused by the presence of observers and the taking of blood samples. During thrice-weekly training sessions ewes were caught for blood sampling. Calm behaviour was reinforced with oats, group size was decreased and the amount of freedom was increased so that at lambing nearly all ewes could be caught easily when approached and offered oats.

Between September 7 and October 5, 1971, ewes were brought into lambing yards five days before they were expected to lamb, as calculated from mating records. At any one time in the yards there were about 25 ewes at various stages in relation to parturition. There were two adjoining yards each 40 metres square, with free movement between them. In yard 1 was a hayrack, the sole source of food. Hurdles had been placed at intervals around both yards at right angles to the fences to facilitate the capture of ewes.

Observation of ewes in the yards was maintained from 0600 to 1800 hours daily. At the first sign that a ewe was going to give birth, a record of its behaviour was begun and a blood sample taken. Behaviour was recorded continuously, and hourly

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blood samples were obtained by jugular venipuncture, until four hours after birth. The plasma was assayed for corticosteroid and progesterone concentrations by a competitive protein binding technique (Bassett and Hinks 1969).

Delivery was assisted after two hours of labour and weak lambs were helped to suckle. This will have introduced some bias into the results by preventing some effects of more prolonged labour.

III. RESULTS

(a) Behaviour patterns

Partial records were obtained for 85 ewes and complete records were obtained for 37 ewes and their single lambs. Before parturition ewes usually stayed around the hayrack but before going into labour they tended to move away so that 74% of the recorded birth sites (n = 85) were in yard 2 (P < 0.05). Further examination of birth site records showed that 46% of ewes lambed in 37% of the area of the yards which was within three metres of at least two objects, i.e., in the corners of fences and hurdles (P < 0.05) and that only 12% lambed in the 33% of the area which was more than three metres from any object, i.e., in the centre of the yards (P < 0.01).

The mean time intervals from delivery to the main events of labour and the immediate postpartum period were similar to those recorded by Alexander (1958, 1960).

Careful examination of the records did not reveal either a particular point on the lamb's body at which the ewe began licking or any apparent pattern to later grooming. Fifty six percent of lambs made their initial attempts at suckling in the udder area and in another 21% they were made in the region of the brisket.

Maternal behaviour patterns which impeded the lamb's progress to suckling were commonly observed but usually short lived. They were observed more frequently in the group of ewes in which labour lasted more than 130 minutes than in the group in which it lasted 10 minutes or less (P < 0.07). This did not greatly impede lamb progress to suckling as the duration of the interval from delivery until the lamb had its first drink was not significantly influenced by length of labour.

(b) Peripheral plasma progesterone and corticosteroid levels

Lamb plasma samples obtained at delivery contained a mean of 91 + 6 ng/ml corticosteroids and 1.8 + 0.2 ng/ml progesterone (n = 17). Concentrations of both hormones declined rapidly after birth. By four hours postpartum corticosteroids levels were below 40 ng/ml and progesterone levels were less than 0.6 ng/ml in the few samples analysed at this time. Neither the lamb corticosteroid nor progesterone levels at delivery were significantly related to length of labour.

During labour progesterone concentrations in samples from individual ewes were low and variable. There was no significant change in the mean value (Figure 1) which, at delivery was 1.7 + 0.2 ng/ml (mean ± S.E., n = 33).

In contrast corticosteroid levels in these samples showed large changes (Figure 1). There was an increase from below 10 ng/ml in the early stages of labour to a peak of 40 ± 4 ng/ml (n = 33), at delivery, this being followed by a decline to about 10 ng/ml by three to four hours postpartum. The most marked increase was during the interval from the appearance of the lamb in the vulva and its subsequent delivery. This resulted in a positive correlation between the duration of this interval and ewe corticosteroid levels at delivery (r = 0.79, P < 0.01). Furthermore, all ewes which had prolonged labour (> 30 mins) and high corticosteroid levels at delivery (> 40 ng/ml) exhibited some aspects of poor maternal behaviour. However, these features were not always associated.
IV. DISCUSSION

The tendency of ewes to seek isolation during the perinatal period has been noted by several workers since it was reported by Fraser (1926). The importance of isolation in the formation of the ewe-lamb bond is indicated by the number of ewes which, when lambing under intensive farming conditions, form permanent relationships with lambs born to other ewes (Winfield 1970). The attempts at isolation seen in this study cannot be explained as avoidance of observers or shelter-seeking behaviour as most observer activity was necessarily centred on the area where lambs were being born and it was the most exposed corner of the yards. The tendency for birth sites to occur in corners and not in the open space in the centre of the yards similarly cannot be explained as an attempt to obtain shelter.

Some workers have observed that ewes commonly begin licking of their lambs at the muzzle, apparently to facilitate breathing, and that licking proceeds rearwards to align the lamb with the udder. There was no quantitative evidence of such innate guidance of grooming in this study. The lamb, however, did appear to be instinctively guided to the udder by the geometry of the ewe as suggested by previous workers. Mutual stimulation of ewe and lamb actions seemed to occur during attempts to suckle. Lamb movements stimulated ewe cooperation and licking while ewe licking and orientation of lamb to udder stimulated lamb suckling efforts.

High concentrations of corticosteroids have been found in the blood of the newborn young of several species, this being consistent with the possible involvement of the foetal adrenal cortex in the initiation of parturition and a response to the stress of delivery. The levels found in plasma of lambs at delivery in the present study were similar to those in other studies (e.g., Drost, Kumagai and Guzman 1973). It would appear, though, that the postpartum decrease in levels was more
rapid than would be expected from the results of Bassett and Alexander (1971) and 
others.

In samples taken at delivery there did not appear to be any correlation between
the progesterone levels of individual ewes and those of their lambs but the mean ewe
concentration (1.7 ± 0.2 ng/ml) was closely matched by the mean lamb concentration
(1.8 ± 0.2 ng/ml). -These values are generally in agreement with reported values
(e.g., Bassett et al. 1969). Ewe progesterone levels were already low at the
onset of labour and although fluctuations occurred in levels of individual ewes
the mean value throughout labour was remarkably constant (Figure 1).

As also found in this study, Obst and Seemark (1972) noted a sharp rise in
maternal corticosteroid levels near delivery and a similar change has been
reported in other farm animals. The correlation between length of labour and
ewe corticosteroid level at delivery suggests that the pain and exhaustion of a
difficult labour may activate a stress response. As several workers since Wallace
(1949) have noted that poor maternal behaviour may also result from a prolonged
labour it was not surprising to find that all ewes in this study which had both a
prolonged labour and high corticosteroid levels at delivery also exhibited some
aspects of poor maternal behaviour.

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VI. REFERENCES

J. Endocr. 45: 449.