The effect of pre-natal nutrition and type of birth and rearing of lambs on vigour, temperature and weight at birth, and weight and survival at weaning

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ABSTRACT

Two hundred and thirty 5-year-old Romney ewes were synchronised with progestagen intravaginal sponges and injected with dexamethasone 142 or 143 days after the median mating day of the first and second cycles of oestrus. Seventy-one % of the lambs were born 30 to 50 h after injection. The ewes were offered 2 pasture allowances for the last 6 weeks of pregnancy (approximately 6 and 1 kg DM/ewe/d). Lambs were vigour scored (1 to 10) and probed for rectal temperature and ewe lambs were cross-fostered as soon as possible after birth in order to obtain a 2^4 factorial design incorporating birth type (single and twin), rearing types (single and twin), pre-natal nutrition of dam (high and low allowance), and pre-natal nutrition of foster dam (high and low allowance.)

Lambs born from high allowance ewes had higher rectal temperatures at birth than those born from low allowance ewes, and female lambs had higher rectal temperatures than male lambs. Single-born lambs scored higher on vigour than those born as multiples. Increasing vigour was associated with increasing birth weight for all lambs, but increasing temperature was associated with increasing birth weight only for male lambs. There were no effects of pre-natal nutrition on lamb growth either through the dam or foster dam. The effect of birth type on lamb live weight was significant to 9 weeks of age whereas the effect of rearing type was significant to 33 weeks. There were no significant birth type x rearing type interactions at any age.

Keywords Ewes; pre-natal; pasture allowance; cross-fostering; neo-natal; rectal temperature; vigour; survival; growth

INTRODUCTION

This experiment was designed to isolate the effects of ewe pre-natal nutrition, type of birth and type of rearing on survival and growth of lambs. The 3 effects were separated by means of cross-fostering lambs shortly after birth. Only ewe lambs were cross-fostered. Effects on subsequent reproduction of these ewe lambs will be reported separately. Both sexes were considered in the birth data. The effects of the above factors on the relationships between weight, vigour scores and rectal temperature at birth are reported.

MATERIALS AND METHODS

The design of the experiment was a 2 x 2 x 2 x 2 factorial with 2 birth types (single and twin), 2 rearing types (single and twin), 2 types of dams (high and low allowance pre-natally) and 2 types of foster dams (high and low allowance pre-natally).

The dams were synchronised with progestagen sponges which were removed on 13 April when 400 i.u. of PMSG were injected. Tups were recorded daily at the peak of the first and second cycles of conception. On day 100 of pregnancy, the ewes were X-rayed and the number of foetuses counted. The ewes were then divided into 2 treatments such that each treatment received the same number of single- and twin-bearing ewes from cycles 1 and 2, and the same range and mean of live weight. For the last 6 weeks of pregnancy, a high pasture allowance group (H) received 6 kg DM/ewe/d while a low allowance group (L) received 1 kg DM/ewe/d. The H and L allowances were effected by introduction to paddocks of calculated area with mean pasture masses 1690 (range 1430—1890) and 1070 (range 880—1260 kg/ha respectively and removal 1 week later.

The first cycle non-return ewes were injected with 16 mg of dexamethasone and put in single indoor pens at 2000 h on 6 September (143 d after median of first oestrus). The peak of lambing occurred on 8 September. The second cycle ewes were injected with 12 mg dexamethasone at 2000 h on 22 September (142 d after median of second oestrus). The peak of lambing occurred on 24 September. All ewes and lambs were released to pasture 24 to 36 h after lambing and grazed together. The ewes were fed fresh-cut green grass *ad lib* while indoors.

Immediately after birth the lambs were removed (n = 210) and their sex, wet birth weight, vigour score (1 to 10) and rectal temperature recorded within 15 minutes. Rectal temperaturees were recorded by the method of Cockrem and Sutcliffe (1968), and vigour score was assessed by the amount of struggling and general appearance. Ewes included in the growth experiment (randomly selected) were given 1 or 2 female lambs shortly after lambing and assigned to 1 of

the 16 treatments. Lambs were weighed at weekly intervals for a 9-week period and thereafter at 2 to 3 week intervals. Lambs from both cycles were weaned on 25 November.

RESULTS

Time interval between dexamethasone injection and lambing

The interval ranged from less than 5 h after injection to greater than 70 h with a mean of 38 hours, with 71% of the lambs being born from 30—50 h after injection. There was no influence of any of the main effects or cycle on this time interval and no significant interactions.

Ewe live weights

During the 6-week period with 2 allowances before lambing in the first cycle, high allowance ewes gained 15.4 kg while low allowance ewes gained 8.2 kg to give final weights of 65.1 and 58.0 kg. In the second cycle, high allowance ewes gained 19.4 kg while the low allowance gained 10.0 kg, weights before lambing being 69.2 and 58.3 kg. Average litter sizes in the 2 cycles were 1.3 and 1.4 respectively.

Birth weight

Lambs born from high allowance ewes were only slightly heavier at birth (4.6 *v* 4.5 kg, $0.05 < P < 0.1$). Males were heavier than females (4.8 *v* 4.4, P 0.001), and lambs born as singles were heavier than those born as twins (5.4 *v* 4.1, $P < 0.001$).

Rectal temperature

Lambs born from high allowance ewes had higher rectal temperatures at birth than those born from low allowance ewes (39.0 *v* 38.7°C, $P < 0.01$). Female lambs had higher rectal temperatures at birth than male lambs (39.0 *v* 38.7°C, $P < 0.01$), and lambs born in the second cycle had higher temperatures than those born in the first cycle (39.1 *v* 38.6°C, $P < 0.001$).

Vigour score

Single-born lambs scored higher on vigour than those born as multiples (6.6 *v* 5.7, $P < 0.001$). Lambs born in the second cycle scored higher than those born in the first cycle (6.6 *v* 5.8, $P < 0.001$).

Relationships between birth weight, rectal temperature and vigour score. There was a linear relationship between vigour and temperature for lambs born as twins, but not for those born as singles. The regression coefficients of vigour on temperature for twins and singles were significantly different (0.64 *v* 0.060, s.e.d. = 0.195). Vigour increased with increasing birth weight, but the rate of increase decreased with high birth weights. There was a linear relationship between temperature and birth weight for male lambs, but not for female lambs. The regression coefficients of temperature on birth weight for males and females were significantly different (0.37 *v* 0.04, s.e.d. = 0.127).

Survival

Of the 86 ewe lambs cross-fostered, 91%, 87% and 83% survived to 1 week, 2 weeks and weaning (9 to 11 weeks) respectively. None of the treatments affected survival to 1 or 2 weeks, but allowance of foster dam affected survival to weaning with 93% of lambs reared by low allowance ewes surviving and only 76% of those reared by high allowance ewes.

Lamb live weights

There were no effects of allowance of lamb live weights either through the dam or the foster dam. There were no significant birth type x rearing type interactions. The effect of birth type on lamb weight was significant to 16 weeks of age whereas the effect of rearing type was significant to 33 weeks (Tables 1 and 2). As a percentage of the mean, the birth type effect was greatest at 2 weeks while the rearing type effect was greatest at 9 weeks.

TABLE 1 Effect of birth type and rearing type on lamb growth from 0 to 9 weeks of age.

Age (weeks)	Live weight (kg)	Birth type effect Single-Twin (kg)	SE	Rearing type effect Single-Twin (kg)	SE
2	7.3	1.5	0.25	1.1	0.26
3	8.7	1.6	0.31	1.6	0.32
4	10.1	1.7	0.36	2.2	0.38
5	11.4	1.7	0.40	2.8	0.42
6	12.8	1.8	0.46	2.8	0.48
7	13.9	1.8	0.46	3.2	0.48
8	15.6	1.8	0.49	3.2	0.05
9	17.0	1.8	0.53	4.0	0.55

DISCUSSION

The synchronisation of mating with progestagen sponges followed by the early inducement of lambing with a synthetic corticoid (dexamethasone) was successful in producing a large number of healthy lambs in a short time period, a pre-requisite for cross-fostering. A single dose of dexamethasone will work only from day 135 onwards, so the correct conception cycle of the ewe must be identified. The technique was developed by Bosc (1972) and has subsequently been confirmed by other workers.

The high survival rate of lambs after cross-fostering showed the ease with which new born lambs can be swapped to other ewes shortly after parturition. The lower survival rate of lambs reared by high allowance ewes was probably due to the poorer adjustment

TABLE 2 Effect of birth and rearing type on lamb growth from 16 to 65 weeks of age

Date	Age (weeks)	Liveweight (kg)	Birth type effect: Single-twin (kg)	Birth type effect: SE	Rearing type effect: Single-twin (kg)	Rearing type effect: SE
6/1	16	20.4	1.7	0.66	3.4	0.69
28/1	19	25.5	0.8	0.72	3.0	0.75
17/2	22	25.9	1.0	0.79	2.5	0.82
10/3	25	26.6	0.8	0.74	2.7	0.78
24/3	27	27.6	0.8	0.70	2.3	0.73
7/4	29	28.6	0.7	0.77	2.1	0.80
21/4	31	29.4	0.4	0.79	2.0	0.83
5/5	33	32.3	0.6	0.80	1.6	0.84
6/6	38	32.8	0.7	0.85	1.6	0.88
6/7	42	33.4	0.7	0.83	1.5	0.87
13/12	65	42.4	0.6	1.33	-0.4	1.36

of these ewes to lambing in pens. Some of them refused to eat cut grass and one died of suspected pregnancy toxaemia.

Several authors (Alexander and McCance, 1958; Sykes *et al.*, 1976; Dussuel *et al.*, 1980) have previously found a positive relationship between rectal temperature and birth weight, and Hight and Jury (1970) found that a higher proportion of female lambs survived than did male lambs. However, our paper appears to be the first report of new-born wet female lambs having a higher rectal temperature than male lambs. Furthermore in females, rectal temperature was independent of birth weight; it was related to birth weight in male lambs. According to Sykes *et al.* (1976) and Alexander (1962), "birth weight is important in determining the ability to maintain body temperature only when heat loss approaches the capacity of the lamb to increase heat production. In this situation, the advantage of heavier lambs arises because heat loss is determined by surface area whereas heat production is related to body weight, and larger animals have a greater weight relative to surface area".

It would appear that the wet female lambs had a greater ability to control temperature at birth than the wet male lambs, and therefore the female lambs had higher rectal temperatures at the time of measurement (0 to 15 minutes after birth). Cycle 2 lambs had higher rectal temperatures than cycle 1 lambs. Ambient temperatures were higher in cycle 2 lambing than in cycle 1 lambing. During cycle 2 the maximum was 19.8°C as compared with 14.0°C in cycle 1. A higher ambient temperature would allow less cooling of a wet lamb during the period from birth to measurement.

This study agreed with the work of Rattray *et al.* (1981) who generated only small differences in lamb birth rate and growth with large differences in pasture allowance and ewe liveweight change in the last 6 weeks of pregnancy. At weaning at 9 to 11 weeks, the effect of birth plus rearing type on growth was 5.8 kg; the comparable values from Ch'ang and Rae (1970), Hight and Jury (1971) and Hight *et al.* (1973) were 4.2, 8.9 and 3.1 kg. At weaning, the effect of rearing type was 4.0 kg; the corresponding values of Ch'ang and Rae (1970) and Hight and Jury (1971) were 2.9 and 6.9 kg. These latter figures were calculated from the difference in growth between twins reared as singles and twins reared as twins. As there was no birth type x rearing type interaction in this study, this rearing difference can be extrapolated to singles. The effect of rearing type alone in June (9 months of age) was 1.6 kg; similar to the value of 1.5 kg of Ch'ang and Rae (1970) at 10 months of age.

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