

BRIEF COMMUNICATION: Influence of birth rank on cause of lamb deaths prior to weaning

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Abstract

Post-mortem examinations were carried out on 1098 lambs that died between birth and weaning at 12 weeks of age to evaluate the causes of mortality in a high-fertility flock. These comprised 95% of all lamb deaths from a total of 14732 lambs born over nine years. Starvation/exposure was the biggest cause of lamb deaths (26%) followed by infection (20%), hypoxia (16%) and prenatal deaths (16%). Prenatal deaths were 18%, 12% and 10%; deaths due to hypoxia were 18%, 15% and 11% and to starvation were 28%, 26% and 12% for triplets, twins and singles respectively. There were no significant differences between birth ranks for deaths from infection.

Keywords: mortality; litter size; birth rank; dystocia; starvation; prenatal; single; twin; triplet; survival; sheep

Introduction

An increasing lambing percentage is associated with an increasing number of triplet lambs (Muir et al. 2005). Triplet survival rates vary widely, and a review by Kenyon et al. (2019) reported that triplet survival rates ranged from 50% to 88% with an average of 68%, compared to survival rates of 86% for twins and 90% for singles. Previously, survival rates at Poukawa averaged 76% for triplets compared to 89% and 91% for twin and single lambs, respectively, over six years (Thomson et al. 2004). The aim of this experiment was to evaluate cause of death and whether this differed between different litter sizes in a farm environment. An understanding of the causes of death in lambs born to high-fecundity ewes will assist in developing management practices to improve lamb survival and returns to farmers.

Materials and methods

Over nine years, lamb survival data was collected on a mixed-age crossbred ewe flock (East Friesian X Romney, Finn X Romney, Poll Dorset X Romney and Romney ewes aged 3 - 8 years and composite ewes aged 2-7 years). The work was carried out at the Poukawa Station in Hawkes Bay, NZ (GPS coordinates -39.745944, 176.731556, elevation 30m a.s.l.) from 2005 to 2015. The climate was winter warm and summer dry (annual average (\pm SD) temperature of 19.2 ± 3.6 °C and average rainfall (\pm SD) of 765 ± 102 mm) and the topography of the farm is flat to gently rolling. Prior to mating, ewes were weighed and body-condition scored (Jefferies 1961) with an average ewe mating weight (\pm SD) of 64.9 ± 9.6 kg and an average (\pm SD) body condition score of 3.5 ± 0.6 . Data were collected on 8096 ewe-lambing events, 14732 lambs born and 1134 lamb deaths (1098 post-mortemed) between lambing and weaning at twelve weeks of age.

All ewes were vaccinated against clostridial diseases (Multine 5 in 1, MSD Animal Health), toxoplasmosis and campylobacter. Foetal number and age were assessed by a commercial operator using transabdominal ultrasound at

or around 65 days of pregnancy. Ewes were rotationally grazed on established perennial ryegrass pastures until lambing. Prior to lambing, ewes were divided into early-, medium- or late-lambing mobs and the mob closest to lambing was divided into single-, twin- and triplet-bearing mobs. Ewes were set-stocked within 1-2 weeks of lambing with single-bearing ewes grazed on hill country on lower pasture covers (1000 kg DM/ha minimum) and twin-bearing ewes on flatter country with pasture covers around 1200 kg DM/ha minimum. Triplet-bearing ewes were set-stocked on higher pasture covers (1400 kg DM/ha minimum) in smaller, flatter, and sheltered paddocks.

All lambing mobs were checked at least twice a day with the triplet mob being checked more frequently. As soon as possible after birth (up to 12 hours after birth when born at night), lambs were tagged and sex and weight recorded. Ewes that had not lambed were quietly moved into another paddock every 1-2 days. When possible, dead lambs were autopsied up to weaning at 12 weeks (McFarlane 1965; Everett-Hincks & Duncan, 2008). Of all the lambs that died, 95% were autopsied. In some cases it was not possible to autopsy lambs for a number of reasons, e.g., partially eaten by hawk or too decomposed when found. Cause of death category was coded as prenatal death, dystocia, hypoxia, abnormal, exposure, starvation, infection, misadventure or unknown. Primary cause was determined by the symptom which occurred earliest. For example, cause of death was defined as dystocia if any dystocia symptoms were present regardless of starvation symptoms. Prenatal death was defined as a mummified foetus or presence of atrophy. Dystocia was defined as the presence of bruising or oedema around the head, shoulders or hind limb, internal bleeding or organ damage. Hypoxia was recorded when lambs had no physical symptoms of dystocia but failed to breathe properly and did not walk. Starvation was recorded when no milk was present in the stomach. Exposure was recorded when some or all of the heart and kidney fat reserves had been utilised. Infection covered a wide range of symptoms including navel infections, lesions, adhesions, scouring,

arthritis and pleurisy. Within each death category there was no attempt to determine the reason for the death occurring.

Statistical analysis of the cause of death and survival data was carried out using the Nominal Logistic Regression in Minitab for Windows (version 14). Data was analysed across all lamb deaths and within cause of death category using litter size as the treatment effect. Other potential contributing factors such as birth weight, ewe breed, year etc were not fitted in the model. Cause of death was categorised in post-mortemed lambs up to weaning at 12 weeks of age, but age of death was not evaluated.

Results and discussion

Increasing mortality with increasing litter size is well established (e.g., Kenyon et al. 2019; Kerslake et al. 2005; Muir et al. 2005). In the present dataset, the large number of twin- and triplet-born lambs and their associated higher mortality rates relative to single-born lambs meant they made up the majority (86%) of the dead lambs (Table 1). Although single lambs made up 16.3% of lambs born, they only made up 8.5% of the lamb deaths. While 29% of the quadruplets and quintuplets died, they only made up 0.01% of total lambs born, so their contribution to overall flock mortality was small (5.3%).

The percentage of dead lambs that died prenatally increased with birth rank (9.6% in singles to 18.4% in triplets). Prenatal deaths included late pregnancy abortions, non-viable early lambs and mummified fetuses. There is a greater risk of placental insufficiency with increasing litter size and, thus, decreased lamb survival (Kenyon et al. 2007, Mellor & Stafford, 2004). In addition, triplet-bearing ewes generally have a greater chance of metabolic upset (e.g., pregnancy toxemia), becoming immobilised (cast) or having a vaginal prolapse (Muir et al, 2005). It is hard to determine whether this prenatal category is included in many reports (e.g., Everett-Hincks et al. 2007; Everett-

Hincks & Dodds, 2008; Kerslake et al. 2005).

Kerslake et al. (2005) identified that of the lambs that died, 30% failed to breathe and of those that breathed, 23% never walked. In the current study, the percentage of dead lambs that did not breathe fully (hypoxia classification) increased with increasing birth rank from 10.6% in singles to 17.7% in triplets. Duration of parturition increases with litter size (Cloete et al. 1993) and Everett-Hincks et al. (2007) found increased duration of parturition was associated with decreased lamb survival.

In single (Everett & Dodds, 2008) and twin lambs (Kerslake et al. 2005) higher birth weights were associated with increased deaths from dystocia. However, Thomson et al. (2004) found that death rates in single-born lambs only increased at birth weights above 8 kg. In triplets, however, Everett-Hincks and Dodds (2008) reported that lower birth weights increased dystocia death rates. In the current study, dystocia death rates in triplet lambs were relatively low, possibly due to the frequency of shepherding. Dystocia can also result in lambs being slower to suckle or less active, thus increasing the risk of starvation and like Kerslake et al. (2005), these lambs were also deemed to have died of dystocia. Nevertheless, the total level of dystocia in this flock (8.8% dead lambs) was lower than the 48% dystocia (range 3 to 80%) reported by Kerslake et al. (2005) for twin and triplet lambs and the 33% for twins and triplets reported by Kenyon et al. (2019). But both these studies only examined effects in the first few weeks of life when the deaths from dystocia occur, and didn't include later deaths from other causes.

In the present study, starvation rates increased with increasing litter size (Table 1) and accounted for 25.8% of total lamb deaths to weaning at 12 weeks of age. McCutcheon et al. (1981) found starvation/exposure accounted for about 30% of lamb deaths on farms. As lambs grow, their energy requirement increases and, in

Table 1 The pattern of lamb deaths (number of lambs (percentage of lambs)) from pre-birth to weaning at 12 weeks by litter size and cause of death as determined by post-mortem of lambs born to crossbred ewes over nine years in Hawkes Bay.

	Birth rank					Average
	1	2	3	4	5	
No born	2402	8892	3249	192	15	14732
No died/removed*	96	481	497	55	5	1134
% died	4.0 ^a	5.4 ^a	15 ^b	28.8 ^{ab}	33.3 ^{ab}	11.4
Prenatal	9 (9.6) ^a	58 (12.4) ^b	88 (18.4) ^c	16 (30.2) ^{abc}	0	15.7
Hypoxia	10 (10.6) ^a	72 (15.4) ^b	85 (17.7) ^c	8 (15.1) ^{abc}	2 (40.0) ^{abc}	16.1
Dystocia	20 (21.3)	37 (7.9)	34 (7.1)	6 (11.3)	0	8.8
Exposure	3 (3.2)	17 (3.6)	16 (3.3)	2 (3.8)	0	3.5
Starvation	11 (11.7) ^a	121 (25.9) ^b	134 (28.0) ^c	17 (32.1) ^{abc}	0	25.8
Misadventure	4 (4.3)	10 (2.1)	10 (2.1)	0	0	2.2
Infection	22 (23.4)	108 (23.1)	81 (16.9)	3 (5.7)	1 (20.0)	19.6
Abnormal	6 (6.4)	18 (3.9)	7 (1.5)	1 (1.9)	1(20.0)	2.9
Other	0	4 (0.9)	0	0	1 (20.0)	0.4
Undiagnosed	9 (9.6)	22 (4.7)	24 (5.0)	0	0	5.0

*Includes lambs removed that lived. ^{abc}different superscripts indicate significant differences (P<0.05) between birth ranks based on a nominal logistic regression. Litters with 4 and 5 lambs were not significantly different due to insufficient numbers. No superscripts indicate no significant differences

multiples, this increased demand is less likely to be matched by increasing ewe milk supply (Muir et al. 2000; Peterson et al. 2006). Initially there is a limit to how much pasture a lamb is able to successfully substitute for the lack of ewe's milk and is probably why starvation deaths continue to occur for up to six weeks. The present study recorded for longer than most other studies (e.g., Everett-Hincks & Dodds, 2008; Kerslake et al. 2005) and includes lambs that died of starvation at older ages as well as those that died in the first few days after birth. A relatively mild climate and shelter (Muir et al, 2005) is associated with low rates of mortality and this may be why the deaths from exposure are low (3.5%) in this present study.

Infection appeared to cause high numbers of deaths in the current study (20% of all deaths) but it is difficult to know whether this is normal as most studies only report post-mortem data for the first three days after parturition. In older lambs, infections tended to be seen as adhesions or lesions around the liver, heart and lungs. It is possible that our mild lambing environment meant that more lambs with minor issues survived but were more vulnerable to infections.

This study's results differ from previous studies (e.g., Everett-Hincks et al. 2007; Everett-Hincks & Dodds, 2008; Kerslake et al. 2005) in that deaths were monitored up until weaning at twelve weeks in high-fecundity sheep, and lambing occurred in a different environment. The wider time frame and inclusion of deaths prior to parturition means that the proportions of lambs that died in each category differs from these previous studies and varies with litter size. This means that the type of changes in management required to reduce death rates will change as lambing percentage increases. In addition, the importance of the deaths from starvation, infection and those that occur shortly before the start of parturition means that further work is needed on why this is happening and how they can be prevented is needed.

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