VACCINATION OF EWES AND LAMBS AGAINST PARAINFLUENZA^3 TO PREVENT LAMB PNEUMONIA

Michael L. Thonney[a], Mary C. Smith[b], and Raluca G. Mateescu[a]

[a]Department of Animal Science, College of Agriculture and Life Sciences
[b]Department of Population Medicine and Diagnostic Sciences,
College of Veterinary Medicine
Cornell University
Ithaca, New York

Introduction

Pneumonia is a major cause of lamb mortality in many sheep flocks and can be a particular problem in artificially-reared lambs in dairy flocks. More than 20% of the non-predator lamb losses reported in the recent National Animal Health Monitoring System sheep survey were due to pneumonia (NAHMS, 2002). While overcrowding, poor ventilation, and inadequate bedding often are contributing factors, lamb pneumonia can be severe even in carefully managed flocks or in flocks kept out of barns. For example, 80% of the lambs in some New Zealand flocks are infected (Goodwin et al., 2002) even though New Zealand lambs rarely see the inside of a barn. Additionally, while Bighorn Sheep live in well-ventilated environments, they are particularly susceptible to pneumonia (Callan et al., 1991; Cassirer et al., 2001; Monello et al., 2001).

Despite the fact that the barn doors are kept open to allow air to be sucked across the pens and up through large fans at the top of the ceilings, many lambs at the Cornell Sheep Farm are treated for pneumonia and it contributes significantly to lamb mortality in the flock. Parainfluenza3 (PI3) is a virus that may contribute to lamb pneumonia by allowing Mannheimia (Pasteurella) haemolytica type A to invade the lung tissue (Cutlip et al., 1993; Martin, 1996). Although there is no sheep vaccine, several companies sell a nasally-administered cattle vaccine against a combination of IBR (Infectious Bovine Rhinotracheitis) and PI3. Some veterinarians have used the PI3 in these vaccines to reduce the incidence of lamb pneumonia (Davies et al., 1980; Davies et al., 1983; Hansen et al., 1995; Lehmkuhl and Cutlip, 1985; Rodger, 1989). The objective of this experiment was to determine if a nasal vaccine against PI3 reduced the incidence of lamb pneumonia in lambs born and housed indoors in the Cornell flock.

Materials and Methods

The experiment was carried out using 176 Dorset ewes and their 1/4 East Friesian lambs born from 15 March to 8 April 2002. A week before the start of the lambing season when the ewes were given a booster clostridial vaccine (to prevent enterotoxemia and tetanus in lambs by providing antibodies in the colostrum), 90 ewes were vaccinated with 1 mL TSV-2® (Pfizer Inc., Animal Health Group, 235 E. 42nd St., New York, NY 10017). TSV-2® is a modified live bovine rhinotracheitis-parainfluenza3 vaccine administered intranasally. At the time of eartagging each litter of lambs within a few days of birth, lambs in alternate litters within vaccinated and control ewe groups received 0.5 mL of TSV-2®. Alternate litters – and not alternate lambs – were vaccinated because there is some evidence that the vaccine can be transferred by close contact.

Lamb health was monitored by recording all treatments and deaths in the Cewe database management system (Thonney, 2002). The data base was interrogated based upon data recorded through 8 October 2002 to determine number of lambs born, lambs born delivered, lambs that died after being born alive, lambs treated for pneumonia, lamb treatments for pneumonia, and lambs that died of pneumonia. Effect of lamb vaccination within ewe vaccination was evaluated by c2.

A subset of 36 male lambs was slaughtered for another experiment at ages ranging from 77 to 161 days. The lungs of those lambs were evaluated for evidence of pneumonia and the effect of lamb vaccination within ewe vaccination was evaluated by c2.

Results and Discussion

Of the 306 lambs in this experiment, 20 lambs were delivered dead for a stillborn death loss of 6.5% (Table 1). The live lambing rate was 1.6 per ewe. Lambs were all weaned by 70 days after the start of the 24-day lambing season when the youngest lambs were 46 days old.

The first lamb was sold at 66 days of age (Figure 1). Therefore, the data were analyzed in two groups. The first group included records from birth to 66 days of age. The second group included records from birth to 183 days of age because the youngest lamb was 183 days old on 8 October 2002 when the data base was interrogated. Sixty-four of the 286 lambs born alive had been sold by this date so the analysis for the second group assumed that lambs sold would not have been treated or died at a later date.

Table 1. Number of lambs born, treated lambs, lamb treatments, and lambs dying to 66 days of age.

Vaccination Ewe	Vaccination Lamb	Ewes lambing	Lambs delivered (per ewe)	Lambs born alive (per ewe)	Lambs that died (% died[a])	Lambs treated for pneumonia (% treated[a])	Lamb treatments for pneumonia (per lamb[a])	Lambs that died of pneumonia (% died[a])
Yes	Yes	45	78 (1.7)	73 (1.6)	7 (9.0)	6 (8.2)	8 (0.11)	3 (4.1)
	No	45	79 (1.8)	76 (1.7)	6 (7.6)	5 (6.6)	10 (0.13)	3 (3.9)
No	Yes	43	70 (1.6)	62 (1.4)	4 (6.4)	2 (3.2)	4 (0.06)	2 (3.2)
	No	43	79 (1.8)	75 (1.7)	11 (14.7)	4 (5.3)	9 (0.12)	2 (2.7)
	Total	176	306 (1.7)	286 (1.6)	28 (9.7)	20 (5.9)	31 (0.11)	10 (3.5)

[a]Of those born alive.

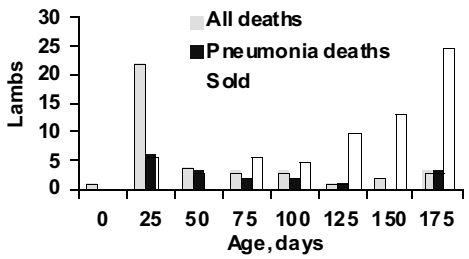

Figure 1. Distribution of ages of dead and sold lambs.

Twenty-eight, or 9.7% of lambs born alive died before they were 66 days old (Table 1, Figure 1) and 39, or 13.6% died before they were 183 days old (Table 2). Weaning in most flocks occurs within the range of 66 to 183 days of age. Previously published losses to weaning of lambs born alive in closely-managed research flocks ranged from 9.4 to 24.4%

(Table 3). Losses generally were higher in more prolific breeds. Thus, lamb losses in the present experiment were not excessive. However, pneumonia caused the deaths to 66 days of age of 3.5% and to 183 days of age of 6.3% of lambs born alive. These represented 36 and 46% of the lamb losses, respectively.

Table 2. Treated lambs, lamb treatments and number of lambs dying to 183 days of age.

Vaccination		Lambs that died	Lambs treated for pneumonia	Lamb treatments for pneumonia	Lambs that died of pneumonia
Ewe	Lamb	(% died[a])	(% treated[a])	(per lamb[a])	(% died[a])
Yes	Yes	8 (11.0)	6 (8.2)	8 (0.11)	3 (4.1)
	No	9 (11.8)	7 (9.2)	12 (0.16)	5 (6.6)
No	Yes	9 (14.5)	3 (4.8)	5 (0.08)	6 (9.7)
	No	13 (17.3)	5 (6.7)	11 (0.15)	4 (5.3)
	Total	39 (13.6)	21 (7.3)	36 (0.13)	18 (6.3)

[a]Of those born alive.

Within ewe vaccination groups, there was no significant effect of lamb vaccination on any of the counts of lamb mortality (Tables 1 and 2). From 9 to 14.7% of lambs born alive died to 66 days of age and from 11.0 to 17.3% of lambs born alive died to 183 days of age in each of the four ewe-vaccination, lamb vaccination groups. From 3.2 to 8.2% of lambs were treated for pneumonia to 66 days of age and from 4.8 to 9.2% of lambs were treated for pneumonia to 183 days of age. Neither the number of lambs treated nor the number of treatments were significantly affected by lamb vaccination within ewe vaccination groups. Within the vaccinated ewe group, 4.1% of vaccinated lambs and 3.9% of control lambs died of pneumonia to 66 days of age while 4.1% of vaccinated lambs and 6.6% of control lambs died of pneumonia to 183 days of age. Within control ewes, vaccinated lambs had a slightly higher death rate from pneumonia than control lambs. Thus, vaccination with PI3 did not reduce the incidence of treatments or deaths due to pneumonia.

Table 3. Lamb death losses reported in the literature in closely-managed research flocks.

Reference	Breed	Death loss of lambs born alive	Lambs born alive per ewe lambing
(Johnston et al., 1999)	Greyface, Suffolk-Cheviot	9.4%	1.5
(Wassmuth et al., 2002)	Rhönschaf, German Blackface	10.3%	1.2
(Oltenacu and Boylan, 1981)	Finnsheep, Minnesota 100, Suffolk, Targhee	14.9%	1.6
(Matos et al., 2000)	Rambouillet, Finnsheep	21.4%[a]	2.0[a]
(Hulet et al., 1984)	Polypay	22.9%[b]	1.4[b]
(Carson et al., 2002)	Texel, Rouge de l'Ouest	24.4%	1.8

[a]Includes lambs born dead.

[b]May include lambs born dead.

Table 4. Numbers of lambs dying from causes other than pneumonia.

Vaccination		Other causes	Age from birth	
Ewe	Lamb	of death	66 days	183 days
			------lambs (% dead of lambs born alive)-----	
Yes	Yes	Omphalitis	1 (1.4)	1 (1.4)
		Starvation[a]	1 (1.4)	1 (1.4)
		Unknown	2 (2.7)	2 (2.7)
		Urolithiasis	0 (0.0)	1 (1.4)
	No	Grain overload	1 (1.3)	1 (1.3)
		Hypothermia	1 (1.3)	1 (1.3)
		Listeriosis	0 (0.0)	1 (1.3)
		Unknown	1 (1.3)	1 (1.3)
No	Yes	Arthritis	0 (0.0)	1 (1.6)
		Starvation[a]	2 (3.2)	2 (3.2)
	No	Birth defect	1 (1.3)	1 (1.3)
		Pyelonephritis	1 (1.3)	1 (1.3)
		Starvation[a]	3 (4.0)	3 (4.0)
		Unknown	4 (5.3)	4 (5.3)

[a]Starvation was diagnosed if the lamb had no obvious fat tissue and no milk in the stomach.

Table 5. Lambs dying of pneumonia or of unknown causes.

Vaccination		Deaths[a] (% died)	
Ewe	Lamb	to 66 days	to 183 days
Yes	Yes	5 (6.8)	5 (6.8)
	No	6 (7.9)	6 (7.9)
No	Yes	2 (3.2)	6 (9.7)
	No	5 (6.7)	8 (10.7)

[a]Of those born alive.

The other lambs died of arthritis, birth defect, grain overload, hypothermia, listeriosis, omphalitis, starvation, urolithiasis, or unknown causes (Table 4). A determination of cause of death was attempted by necropsy of all dead lambs, but sometimes no necropsy could be done or no cause of death could be determined. For that reason, the number of lambs dying of unknown causes was added to the number known to have died from pneumonia (Table 5). Still, there was no meaningful effect of vaccination on lamb deaths in this experiment.

Table 6. Incidence of pneumonia in 34 slaughtered male lambs.

Vaccination		Slaughtered lambs	Evidence of pneumonia
Ewe	Lamb		
Yes	Yes	8	8
	No	14	8
No	Yes	6	6
	No	6	5

Data from the subset of 34 male lambs that were slaughtered for another experiment at ages from 77 and 161 days are shown in Table 6. Only one lamb – in the vaccinated ewe, control lamb group – had been treated for pneumonia, and it was 15 to 20 days of age at the time of treatment. None of the lambs showed clinical signs of pneumonia just prior to slaughter. All of the lambs that were vaccinated – regardless of whether their dams were vaccinated – had evidence in their lungs of having had pneumonia. Eight of 14 control lambs from vaccinated ewes ($P<0.03$) and 5 of 6 control lambs from control ewes had evidence in their lungs of having had pneumonia. Thus, while only about 6% of the lambs born alive died from pneumonia (Table 2), based upon the data in Table 6 it is likely that more than 75% of all other lambs had pneumonia and that most of those went undetected. Furthermore, vaccination with PI3 was ineffective in preventing sub-clinical or clinical pneumonia in this experiment.

Conclusions

Lamb death losses in the Cornell Dorset flock are within the range of those reported for other research flocks and pneumonia is a major cause of those losses. Vaccination with PI3 did not change the incidence of pneumonia in 286 lambs born alive from 176 ewes. Perhaps the virus was not a factor for inducing pneumonia in this flock. Other vaccines or methods need to be developed to control lamb pneumonia. There is evidence from the Ohio Experiment Station more than 30 years ago that, in flocks with high levels of pneumonia, lambs may be infected orally via absorption of Mannheimia (Pasteurella) haemolytica shortly after birth through the gut wall followed by transmittal to the lungs (Smith et al., 1969). Sulfamethazine treatment of ewes prior to lambing prevented lamb pneumonia in the Ohio studies (Smith et al., 1969; Smith et al., 1970; Smith et al., 1971). This is now an off-label use for sulfamethazine, however, and requires a veterinary prescription and a significant withdrawal time to ensure that no residue remains in animal tissues or milk destined for human consumption. The best approach would be to develop a sheep vaccine against several of the organisms known to cause pneumonia in lambs so that ewes could be vaccinated prior to lambing. Like vaccination to prevent enterotoxemia (de la Rosa et al., 1997), this would provide protection against lamb pneumonia through colostrum.

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