Pak. J. Agri. Sci. Vol. 36 (3-4), 1999

FACTORS AFFECTING NEONATAL LAMB MORTALITY IN PAK-KARAKUL SHEEP

Ahrar Khan, Muhammad Tariq Javed, Maqbool Ahmad! & Muhammad **Ajmal** Jalvis
Department of Veterinary Pathology and IDepartment of Animal Reproduction, University of Agriculture, Faisalabad, 2Sheep and Goat Development Center, Rakh Khairewala, District Layyah

This study was conducted on 528 neonates of Pak-Karakul sheep born during February to April, 1998 at the Sheep and Goat Development Center, Rakh Khairewala, District Layyah, Overall mortality observed in neonates was 9.28%. The mortality rate in male and female neonatal lambs was 9.72 and 8.90%, respectively. The survived lambs were significantly heavier (3.77 ± 0.63 kg) ($P< 0.001$) than those died during neonatal period (2.79 ± 0.49 kg). Male lambs were significantly ($P< 0.03$) heavier than female lambs (3.84 ± 0.71 vs. 3.52 ± 0.59 kg). Parity of the dam did not affect the survival of the lambs. The lambs that survived neonatal period had significantly ($P< 0.001$) higher serum immunoglobulin levels (30.89 ± 7.62 ZST units) than those who died (7.08 ± 5.26 ZST units). Serum total proteins and globulin concentration had also significant effect on survival rate of neonatal lambs ($P< 0.001$). The mean serum total protein values for survived and died lambs using refractometer were 7.85 ± 1.55 and 4.71 ± 1.28 g/dL and by using biuret method were 7.89 ± 1.54 and 4.65 ± 1.17 g/dL, respectively. The mean globulin concentration of lambs that survived was 3.95 ± 1.32 g/dL which was significantly ($P< 0.001$) higher than those died (1.02 ± 0.72 g/dL).

Key words: birth weight, immunoglobulins, neonatallamb mortality, serum total proteins

INTRODUCTION

Infectious diseases affecting young lambs are economically important since mortality during the neonatal and early adolescent period is higher than at any other stage of life (Poonia et al., 1983; Otesile and Oduye, 1991). These losses at many times are underreported (Ameghino et al., 1984). Many factors have been reported to influence survival of neonatal lambs such as parity of the dam (Wooliams et al., 1983), sex of neonates (Juma et al., 1975), birth weight (Tadich et al., 1990), immunological status of the neonate (Vihan, 1986; Otesile, 1994), etc. Precise information on factors involved in causing neonatal lamb mortality in Pak-Karakullambs is not available. This paper describes the results of a study carried out to determine the factors affecting neonatal lamb mortality in Pak-Karakullambs.

MATERIALS AND METHODS

Animals: The study was carried out on 525 Pak-Karakul ewes and their 528 neonatallambs, including 281 females and 247 males born during February to April, 1998 at the Sheep and Goat Development Center, Rakh Khairewala, District Layyah. Parity of dam, litter size, sex and birth weight of lambs were recorded. The lambs were grouped according to birth weights into three classes i.e. up to 3 kg, 3 to 4 and over 4 kg. Three twin lambings were observed during the course ofthe study. Health of all the lambs under study was monitored daily up to preweaning period (60 days).

Management of Animals: All the neonatal lambs were kept under identical conditions of feeding and management. They were housed collectively in partly covered sheds. The neonatal lambs were allowed to suckle their dams twice a day, early in the morning and in the evening. After one week, in addition to milk, green fodder was also offered to them.

Collection and Analysis of Serum Samples: Colostrum was fed to the neonatal lambs within 6-8 hours after birth and 24 hours after colostrum feeding, blood samples without anticoagulant were collected from jugular veins. Serum was separated from each sample and stored at 20 oC till analysis. Immunoglobulin levels were estimated by using zinc sulphate turbidity method (Spectronic-21, Bouch and Lomb) as described by McEwan et al. (1970). As mentioned by Reid (1972), Findlay (1973) and Logan and Irwin (19771,below 10 ZST units was considered as hypogammaglobulinaemia in lambs. Serum total protein was measured by biuret method (Anonymous, 1984)and albumin was measured by bromocresol green binding method (Northam and Widdowson, 1967). Globulin concentration was calculated by subtracting albumin ~alue from serum total proteins of each sample. The data obtained were analyzed by ANOVA using micro computer programme Minitab (Anonymous, 1989).

RESULTS

A total of 528 neonatal lambs was born to 525 ewes including twinning (1.14 %) in three cases. The twins were female neonates (2.35 %) and survived during the course of study. The overall mortality observed up to preweaning period (60 days) was 9.28%.

Table 1. Birth weight and neonatal lamb mortality in relation to parity of dams

Parity		Birth weight (kg)	Mortality	
#	n		No.	%
1	73	3.85 ± 0.67	7	9.59
2	75	3.84 ± 0.53	7	9.33
3	85	3.62 ± 0.62	8	9.41
4	74	3.11 ± 0.60	7	9.46
5	69	3.64 ± 0.75	6	8.70
6	87	3.71 ± 0.70	8	9.20
7	65	3.57 ± 0.96	6	9.23
Total	528		49	9.28

Factors Affecting Neonatal Lamb Mortality: There was non-significant effect of parity of dams on the death of neonatal lambs. It was observed that 12.24 to 16.32 oft; lambs died of various parity ewes. Parity had also non-significant effect on birth weight of neonatallambs (Table 1). The mortality in male and female neonatal lambs was 9.72 and 8.90%, respectively (Table 2). Male neonatal lambs were significantly (P<0.03) heavier than females (Table 3). The survived lambs were also significantly (P<O.OOl) heavier than those died during neonatal period. All lambs weighing more than 3.5 kg at birth survived during the period of study. The lambs that died were all in first week of their life except two (one male and the other female) that died during sixth week postpartum.

Disease Conditions: Overall morbidity due to various disease conditions was 13.63%. Morbidity was more due to pneumonia followed by diarrhoea and pneumo-enteritis (Table 4). Among congenital abnormalities, parrot mouth (2.04%) was observed in one lamb. Mortality was higher in male (57.14%) than in female (42.86%) neonates. Diseasewise mortality was more due to pneumonia (55.10%) followed by diarrhoea (26.53'7!,) pneumo-enteritis (16.33 %) and parrot mouth (2.04 %) (Table 4).

Table 2. Sexwise mortality in Pak-Karakul neonatallambs

Sex	Births	Mortality	
		No.	%
Male	247	24	9.72a
Female	281	25	8.90a
Overall	528	49	9.28a

Chi-square was applied to know the difference between sex.

Immunoglobulin Status and Serum Total Proteins: The serum immunoglobulin level ranged from 2,42 to 52.14 ZST units. The majority of lambs (444/528; 84.09%) had ZST values between 20 and 40 units, whereas 8.23% lambs were markedly hypogaulmaglobulinaemic (≤10 ZST units). There was non-significant difference between immunoglobulin levels of both sexes. The survived lambs had significantly (P<O.OOl) higher level of immunoglobulins than those who died (Table 5). Non-significant difference was found between the serum total protein, albumin and globulin values of male and female neonatallambs (Table 5). The levels of serum total protein and globulins were significantly (P<.OOl) higher in survived lambs than those who died during neonatal period, however, there was non-significant difference in albumin contents between survived and died neonatallambs (Table 5).

DISCUSSION:

Neonatal period is very critical in rearing of lambs. According to Eales et al. (1983), neonatal lamb mortality represents about 35% of all sheep losses and 15% of all lambs born. Juma et al. (1975) reported maximum losses (44.4 %) during first month of life. Overall mortality was 9.28% in the present study in Pak-Karakul neonates at the Sheep and Goat Development Center, Rakh Khairewala. Khan (1990) analyzed the data of the same farm during 1981-88

and reported a *comparatively low percentage* of *neonatal mortality* i.e. 6.45 and 5.56 in Pak-KarakuI and Kachhi breeds, while a higher mortality was observed in Thalli (11.97%)and Sipli (20.83%) neonates. Neonatal losses are sometimes concealed and are thus underreported giving an impression of Iow mortality (Ameghino et al., 1984).

Table 3. Mortality in Pak-Karakul neonatal lambs in relation to birth weight

Parameters	Male	Female
Birth weight	3.84 ± 0.71a	3.51 ± 0.59b
Survived	3.95 ± 0.63a	3.57 ± 0.58a
Died	2.75 ± 0.64b	2.83 ±0.29c

One-way ANOVA was applied to check the significance. Significance level: Between male and female = P<0.03; between survived and died = P<O.OOl.

Huffman et al. (1985), Otesile and Oduye (1991) and Sharma et al. (1999) reported much higher neonatal mortality than that observed in the present study. Difference in neonatal mortality could be due to variation in environmental factors and managemental conditions prevailing at the respective sites of these studies.

Mortality rate in males was slightly higher than females (9.72 vs. 8.90 %). Similar were the observations of Sharma et al, (1999). The possible reason of low mortality in females could be that special attention is paid to females during neonatal period as these provide replacements in the flock. Juma et al. (1975), Wooliams et al. (1983) and Khan (1990) also reported slightly higher mortality rate in males as compared to female lambs. However, Malik et al. (1990) and Tadich et al, (1990) failed to find the effect of sex on mortality and survival of neonatal lambs.

The mean birth weight of survived lambs (3.77 ± 0.63 kg) was significantly (P<O.OOl)heavier than those died during neonatal period (2.79 ± 0.49 kg) in the present study. In fact, heavier lambs were quick to stand on their feet and suck their mothers, resulting in greater chances of survival (Owens et al., 1985; Tadich et al., 1990; Otesile and Oduye, 1991). Dalton et al. (1980) reported that the lambs having birth weight from 3.5 to 5.5 kg had the lowest mortality. McMillan (1983) reported an optimum range of 3.30 to 4.11 kg for *minimum* mortality. The effect of sex on birth weight during present study was significant and was higher (P<0.05) in male than female neonates. Everts (1985) also reported lower birth weight in females than males.

Table 4. Morbidity and mortality due to various disease conditions in neonatallambs

Disease	Morbidity		Mortality	
	No.	%	No.	%
Pneumonia	37	46.84	27	55.1
Diarrhoea	20	25.31	13	26.53
Pneumo-enteritis	21	26.58	8	16.33
Parrot mouth	1	1.27	1	2.04
Overall	79	13.63	49	9.28

All mortalities, except two, occurred during first week of life in the present study. Jordan and Le-Feuvre (1989) and Otesile and *Oduye* (1991) also reported maximum illortaUtyduring first week of life. This could be due to the fact that immune system oflambs at birth is in unprimed state, it takes about a week or more to become functional (Tizard, 1992), therefore, early age neonates are more susceptible to disease conditions. The sick neonates exhibited signs of pneumonia, pneumo-enteritis and diarrhoea. Mortality due to pneumonia and enteritis as major causes has been reported by many workers (Shamsal and Hamdoon, 1989, Sudhan et al., 1990). Sharma et al. (1981) reported 21.4% mortality in unweaned lambs with deaths due to pneumonia in 5.05% and enteritis in 2.35% cases. Fatima et al. (1985) reported pneumonia in 1.4% cases causing mortality. Shamsal and Hamdoon (1989) reported mortality in 18-21% cases due to pneumonia and enteritis. Sudhan et al. (1990) found that major cause of death was pneumonia (51%) followed by pneumo-enteritis (18.6%) and enteritis (18%). According to Roy (1990), in developed countries where milk substitutes are widely used, the main cause of death is enteric infection, whereas in developing countries where whole milk is the normal diet, the main cause of death

Table 5. Total serum protein, albumin, globulin and immunoglobrilins in lambs survived and died during neonatal period

Parameters	Male		Female		Overall	
	Survived	Died	Survived	Died	Survived	Died
hnmunoglobulins (ZST units)	31.56±7.59a	4.78±2.85b	30.21±7.79a	10.14±6.80b	30.89±7.62a	7.08 ±5.26b
Total serum protein (g/dL)	8.03±1.63a	4.45±0.87b	7.64±1.44a	5.07±1.86b	7.85±1.55a	4.71±1.28b
Albumin (g/dL)	3.94±0.66	3.80±0.75	3.89±0.62	3.40±1.02	3.91±0.64	3.63±0.82
Globulin (g/dL)	4.08±1.31a	0.61±0.39b	3.83±1.33a	1.56±0.76b	3.95±1.32a	1.02±0.72b

Figures bearing different letters in a row differ significantly (P<0.001).

Table 6. Percentage of hypogammaglobulinaemic (≤10 ZST units) lambs and those died during first week of life

Lambs (%) < 10 ZST units	Lambs (%) ≤10 ZST units died during first week of life	References
18	30.77	Ried (1972)
-	50	Findlay (1973)
20.2	-	Logan and Irwin (1977)
8.23	85.71	Present study (1999)

is often respiratory infection. Similar views have been expressed by Schoning and Sagartz (1986) and Khan (1990).

The mean serum immunoglobulin level in the present study was 28.90 ± 9.95 ZST units which almost agree with the values (27.40 ± 1.70 and 30.90) reported by Reid (1972) and Al-Salarni and Sinclair (1977), respectively. The majority oflambs (76.19%) had ZST values between 20 and 40 units. According to Logan and Irwin (1977), majority of lambs fall in the range of 10 to 30 units. In the present study, the mean serum immunoglobulin values for male lambs (29.07±10.70 ZST units) were slightly higher than those of females (28.73 ±9.22 ZST units), the difference being non-significant. Halliday and Williams (1979) also reported slightly higher value in males. Contrarily, Sawyer et al. (1977) found slightly higher values in females. In the present study, 8.23% lambs had below 10 ZST units, comparatively lower than that reported by Logan and Irwin (1977). More' than 85.71% ofhypogammaglobulinaemic lambs died during first week of life which was comparatively higher than reported by other workers (Table 6).

The lambs which survived during neonatal period had significantly (P < 0.001) higher level of immunoglobulins (30)9 ±7.62 ZST units) than those who died (7.08 ± 5.26 ZST units). Similar findings have been reported by Vihan (1986), Hodgson et al. (1992) and Otesile (1994). This indicated less chances of survival of lambs with weak immune system.

The newborn leaves the sterile uterus to an environment containing many pathogens. The neonates often are overcome by infectious diseases, even by such agents that are relatively non-pathogenic to the adults (Banks, 1982). In the absence

of specific immunity at birth (Klobasa and Werhahn, 1989) because of placental barriers (Tizard, 1992), the neonatal lambs have to rely on antibodies received via colostrum (Butler, 1973): These antibodies play a significant role in the defense mechanism of newborn lambs until their own immune systems are primed and produce protective level of antibodies (Tizard, 1992). Fisher (1980) reported that septicaemic and bacteraemic deaths in neonates are related to a deficiency of immunoglobulin of IgM class, while diarrhoeic deaths are associated with a deficiency of IgG. IgA seems to be re-excreted and somehow stops the diarrhoeic process. According to Smith et al. (1976), a small amount of colostrum IgG after being absorbed is secreted in the nasal and lachrymal secretions of lambs which play a valuable role in preventing respiratory infections before local production of IgA and IgM at 2 to 3 weeks of age.

Like immunoglobulin levels, the total serum protein had also significant effect on survival oflambs during neonatal period. Values for survived and died lambs were 7.85 ± 1.55 and 4.71 ± 1.28 g/dL, respectively. Rea et al, (1996) observed the greatest risks of mortality in calves with serum protein concentration <4.5 g/dL.

ACKNOWLEDGEMENT

Financial support provided by the Pakistan Science Foundation, Islamabad under Research Project No. P-AUlAGR (199) is thankfully acknowledged.

REFERENCES

Al-Salami, M.T.H. and KB. Sinclair. 1977. Use ofthe zinc sulphate turbidity test for determining plasma globulin in sheep. Vet. Record, 100: 93.

Ameghino, E., J. S. Reif, L. Inope, A Laos and M. Gamarra. 1984. Perinatal lamb mortality in the Central Sierra of Peru. Prev. Vet. Med. 2(6): 833-843.

Anonymous. 1984. Manual of Veterinary Investigation Laboratory Techniques. Vol. 2, 3l'd ed. Her Majesty's Stationary Office Publication, London: 49-50.

Anonymous. 1989. Minitab Data Analysis Software, Release 7.1, Standard Version, Minitab Inc., USA

Banks, KL. 1982. Host defense in the newborn animal. J. Am. Vet. Med. Assoc. 181(10): 1053-1056.

Butler, J.E.1973. Synthesis and distribution of immunoglobulins. J.Am. Vet. Med. Assoc. 163(7): 795-798.

Dalton, D.C., T.W. Knight and D.L. Johnson. 1980. Lamb survival in sheep breeds on New Zealand hill country. New Zealand J. Agri. Res. 23(2": 167-173.

Eales, F.A, J. Small and S.J. Gilmour. 1983. Neonatal mortality of lambs and its causes. In Sheep Production. Proc. 35th Eater School in Agricultural Science, University of Nottingham (Ed. E.Haresign), pp. 289-298. London.

Everts, H. 1985. Relationship between the nut-itio-i of the ewes, lamb birth weight and survival in prolific crossbreeds: Factors affecting the survival of newborn lambs. A Seminar in the CEC Programme of Coordination of Agricultural Research. Held.in Brussels, 22-23 Jan.

Fatima, 1., KD. Ranjit and M.R. Jainudeen. 1985. Causes of mortality of Dorset Horn sheep in Malysia. Kajan Vet. 17(1):62-67.

Findlay, C.R. 1973. Serum immune globulin levels in lambs under a week old. Vet. Record, 92: 530-532.

Fisher, E.W. 1980. Neonatal survival.. Br. Vet. J. 136: 585-589.

Halliday, R. and M.R. Williams. 1979. The absorption of immunoglobulin from colostrum by bottle-fed lambs. Ann. Res. Vet. 10(4): 549-556.

Hodgson, J.C., G.M. Moon, L.A. Hay and M. Quirie. 1992. Effectiveness of substitute colostrum in preventing disease in newborn lambs. Occasional Publication - Br. Soc. Anim. Prod. 15: 163-165.

Huffman, J., H. Kirk and M. Pappaioanou.1985. Factors associated with neonatal lamb mortality. Theriogenology, 24(2): 163-171.

Jordan, D.J. and AS. Le-Feuvre. 1989. The extent and causes of perinatal lamb mortality in 3 flocks of Merino sheep. Aus. Vet. J. 66(7): 198-201.

Juma, KH., J. Eliya, AL. AL-Rawi and H.N. Abumaaly. 1975. Survival of lambs in Awassi sheep. Indian J. Anim. Sci. 44(4): 252-256.

Khan, F.8. 1990. Comparative study of factors contributing to the mortality in lambs and kids. M. Sc. (Hons) Thesis, Univ. Agri., Faisalabad.

Klobasa, F. and E. Werhahn.1989. Variations in the concentrations of IgGI, IgGz, IgM and IgA imrnunoglobulins in sheep. 2. Changes in the blood of lambs of different breeds and crosses during the rearing period. Berliner und Munchner Tierarztliche Wochenschrift, 102(10): 331-337.

Logan, E.F. and D. Irwin. 1977. Serum immunoglobulin levels in neonatallambs. Res. Vet. Sci. 23: 389-390.

Malik, RC., N.R Singh, RM. Acharya and O.P. Dutta. 1990. Factors affecting lamb survival in crossbred sheep. Tropical Anim. Hlth. Prod. 12(4): 217-223.

McEwan, AD., K W.Fisher, 1. KSalman and W. J.Penhale. 1970. A turbidity test for the estimation of immune globulin levels in neonatal calf serum. Clinical Chem. Acta, 27: 155-163.

McGuire, T. C., J. Regnier, T.Kellon and N. L. Gates. 1983. Failure in passive transfer of immunoglobulin Gi to lambs: Measureinent of immunoglobulin Gi in ewe colostrum. Am. J. Vet. Res. 44(6): 1065-1067.

McMillan, W.H.H. 1983. Lamb Mortality. In Proc. New Zealand Soc. Anim. Reprod. 43:33-36.

Northam, B.E. and C. M. Widdowson. 1967. Determination of serum albumin by auto analyser using bromocresol green. Association of Clinical Biochemists Technical Bull. No. 11.

Otesile, E.B. and O.O.Oduye. 1991. Studies on West African Dwarf sheep: Incidence of perinatal mortality in Nigeria. Rev. Med. Vet. Trop. 44(1): 9-14.

Otesile, E.B. 1994. Mortality in one to six month old West African Dwarf lambs. Bull. Anim. Hlth. Prod. (Africa), 42(1): 31-35.

Owens, J.L. M.B. Bindon, T.N. Edey and L.R Pifer. 1985. Behaviour at parturition and lamb survival of Booroola Merino sheep. Livestock Prod. Sci. 13(4): 359-372.

Petrie, L. 1984. Maximising the absorption of colostral immunoglobulins in newborn dairy calf. Vet. Record, 114: 157-163.

Poonia, J.S., B. Singh and D.S. Balaine. 1983. Studies on preweaning mortality in lambs of Nali and its crosses with Corriedale and Russian Merino. Livestock Adviser, 8(12): 7-10.

Rea, D.E., W.J. Tyler, D.D. Hancock, T.E. Besser, L. Wilson, D.S. Krytenberg and S.G. Sanders. 1996. Prediction of calf mortality by use of tests for passive transfer of colostral immunoglobulin. J. Am. Vet. Med. Assoc. 208(12): 2047-2049.

Reid, J.F.S. 1972. Serum immune globulin concentrations of newborn hill lambs. Vet. Record, 90: 371-372.

Roy, J.H.B. 1990. The Calf: Management of Health, Vol, 1, 5th ed. Butterworths, London.

Sawyer, :."1..C.S. Willadsen and T.C. :-IcGuire. 1977. Passive transfer of colostral immunoglobulins from the ewes to lambs and its influence on neonatal lamb mortality. J. Am. Vet. :-Ied. Assoc. 171(12): 1255-1259.

Schoning, P. and J. Sagartz. 1986. Lamb mortality in a small confined sheep flock. l\Iodern Vet. Prac. 67(1): 20-23.

Shamsal D.Q.Z. and XI. Y. Hamdoon. 1989. Determination of causes of preweaning lamb mortality in two Iraqi breeds. Aeta Vet. 39(5/6):365-368.

Sharma, 1\I.,1\1., P.B. Mathur, P.N. Kumar and P.K. Uppal. 1981. Causes of mortality in lambs under semi-arid climatic condition of Rajasthan. Indian Vet. J. 58(1): 859-864.

Sharma, P.R., B.K. Beniwal, V.K Singh and G. Das. 1999. A note on mortality of Nali lambs in arid zone of Rajasthan. Indian Vet. J. 76: 445-447.

Smith, W.D., P.W. Wells, C. Burrells and AM.L. Dawson. 1976. Maternal immunoglobulins and para-influenza 3 virus inhibitors in nasal and lachrymal secretions and serum of newborn lambs. Clinical Exp. Immun. 23(3): 544-553.

Sudhan, N.A., KS. Rima, F.A Mattoo and G.M. Wani.1990. Lamb mortality in exotic sheep. Indian Vet. J. 67(1): 51-54.

Tadich, N., V. Cubillos, KParedes, R Murray and K Ortiz. 1990. Neonatal lamb mortality in Valdivia Province, Chile. Arch. Med, Vet. 22(1): 45-54.

Tizard, 1. 1992. Veterinary Immunology: An Introduction, 4th ed. W. B. Saunders Company, London: 248-257.

Vihan, V.S. 1986. Sheep and goat immunoglobulins and their effect on neonatal survi ability (ability to survive) and performance. World Rev. Anim. Prod. 22(4): 65~68.

Villar, JA and S.A Vulich. 1980. Mortality in newborn lambs: Immunoglobulin values in Corriedale lambs up to one week of age. Rev. Med. Vet. Argentina, 61(1): 21-26.

Wooliams, C., G. Wiener and N.S.M. Macleod. 1983. The effects of breed, breeding system and other factors on lamb mortality. 3. Factors influencing the incidence of weak lambs as a cause of death. J. Agri. Sci. (UK), 100(3): 563-570.