EFFECT OF STAGE OF LAMBING ON HAEMATOLOGICAL AND IMMUNOLOGICAL PARAMETERS AND THEIR RELATIONSHIP WITH NEONATAL LAMB SURVIVAL IN PAK-KARAKUL SHEEP

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ABSTRACT

The study conducted on 525 ewes revealed significant ($P<0.05$) increase in TLC at post-lambing than pre-lambing stage. Serum globulins and total protein increased significantly ($P<0.05$) after parturition, while other parameters including RBC, PCV, Hb conc., serum immunoglobulins (ZST-units) and albumin showed relative increase at post than pre-lambing stage. Serum concentration of globulins at post lambing were significantly higher ($P<0.05$) in ewes given birth to male neonates with non-significant difference in other parameters. Concentration of colostral immunoglobulins was low ($P<0.05$) in dams whose lambs died within a week of parturition than those whose lambs survived, however, other parameters including serum immunoglobulins, serum total proteins , albumin and globulins showed non-significant difference between dams whose lambs survived or died. The RBC counts were significantly ($P<0.05$) lower at post lambing in ewes given birth to neonates weighing 4 Kg and above than weighing 2-3 Kg. Serum immunoglobulins at pre-lambing were significantly ($P<.05$) higher in ewes at their 5th parity than ewes at their 4th parity. Colostral immunoglobulins showed no correlation with serum immunoglobulins both at pre and post-lambing stage, while globulins were significantly ($P<0.05$) correlated with serum immunoglobulins at pre-lambing ($r = 0.21$). TLC showed significant ($P<0.01$) inverse correlation with serum immunoglobulins at pre-lambing ($r = -0.29$) stage.

INTRODUCTION

Mortality in sheep especially at neonatal life causes considerable economic losses to sheep industry. Other than infectious causes, unhealthy dams (anaemic or otherwise), failure or inadequate passive transfer of immunoglobulins to lamb (Vihan, 1986), parity of dam (Trejo *et al.*, 1988), health status and birth weight of lamb (Tuah *et al.*, 1987; Jordan and Le-Feurve, 1989) are precipitating factors to neonatal lamb mortality.

Haematological values indicate health status of the ewe and deviation from normal values in pregnant ewe are correlated with neonatal lamb mortality (Brockway *et al.*, 1976). It has been observed that passive immunization of lambs increases significantly by the amount of colostrum ingested and is positively related to colostral immunoglobulins concentration (Esser *et al.*, 1989). The maternal immunoglobulins acquired through colostrum play a significant role in the defense mechanism of neonatal lamb to combat diseases until its own immune system is primed (Otesile and Oduye, 1991). Information about these parameters in Pak-Karakul breed of sheep is scarce, therefore, this study was carried out to investigate: i) the hematological values, ii) the immunoglobulin status in serum and colostrum of the same ewe about one week before and 24 hours post lambing and iii) relationship of haematological parameters and immunoglobulin status of dam with neonatal lamb mortality.

MATERIALS AND METHODS

Animals

This study was carried out on 525 Pak Karakul ewes during lambing season 1998, i.e., February to April, at Sheep and Goat Development Center, Rakh Khairewala, District Layyah. Parity of the ewe, and sex and birth weight of neonates born to them were recorded. Birth weight of neonates was grouped into three categories, i.e., 2-3, 3-4 and > 4 Kg. Survival or death of neonates during pre-weaning (60 days) period was recorded.

Management of Animals

All the ewes were kept under identical conditions of feeding and management. The ewes were grazed on lush green pastures of Barseem during the day and in the evening were stall fed with green fodder and concentrate.

Collection of Samples

Blood samples with and without anticoagulant were collected from jugular veins of ewes, 7-8 days before lambing and at 24 hours post lambing. Samples collected

with anticoagulant were used for haematological studies whereas serum was separated from samples collected without anticoagulant. Colostral samples were collected from each ewe within 0-6 hours post lambing. Serum and colostral samples were stored at -20°C till analysis.

Haematological Studies

Haematological studies including red blood cell (RBC) counts, haemoglobin (Hb) concentration, packed cell volume (PCV) and total leukocyte counts (TLC) were carried out on blood samples following the methods described by Benjamin (1978).

Colostral/Serological Studies

Colostral immunoglobulins were estimated by colorimetery following the method described by Bradford (1976). Immunoglobulins concentration was estimated by using zinc sulphate turbidity method as described by McEwan *et al.* (1970). Serum total proteins were measured by biuret method (Anonymous, 1984). Albumin was measured by bromocresol green binding method (Northam and Widdowson, 1967).

Data Analysis

Data thus collected from haematological and serological studies were analyzed by applying ANOVA, chi-square or correlation coefficient by using S.P.S.S. microcomputer program (Anonymous, 1996).

RESULTS

This study was carried out on 525 Pak-Karakul, ewes during February to April, 1998, at Sheep and Goat Development Center, Rakh Khairewala, District Layyah. These ewes gave birth to 528 neonatal lambs comprising 281 females and 247 males. Three twinning lambs (1.14 %) were recorded. The twins were female neonates (2.35 %). These twin neonates survived well during the course of study. The overall neonatal lamb mortality observed up to pre-weaning period was 9.28 per cent (49/528) comprising of 25 females and 24 males.

Effect of Stage of Lambing

Among haematological parameters, TLC showed significant increase ($P<0.05$) at post-lambing than pre-lambing stage (Table 1), while RBC, PCV, and Hb showed relative increase at post-lambing stage. Serum globulins and serum total proteins increased significantly ($P<0.05$) at post-lambing, whereas other biochemical parameters showed non-significant difference between pre- and post-lambing values.

Table 1: Comparison of haematological and serum biochemical parameters (Mean ± SD) in ewes at pre- and post-lambing periods.

Parameters	Pre-lambing	Post-Lambing
RBC (10^{12}/L)	7.42 ± 2.41	7.68 ± 1.95
PCV (%)	33.73 ± 5.33	35.51 ± 6.29
Hb.Conc. (g/dL)	7.99 ± 1.21	8.13 ± 1.17
TLC (10^{9}/L)	8.02 ± 3.53a	9.21 ± 3.31b
Total proteins (g/dL)	5.91 ± 0.88a	6.39 ± 0.68 b
Albumin (g/dL)	4.02 ± 0.48	4.07 ± 0.41
Globulin (g/dL)	1.90 ± 0.82 a	2.32 ± 0.82 b
Immunoglobulins (ZST-units)	23.10 ± 2.46	23.74 ± 4.02

Values bearing different capital letters in a row are statistically different at $P<0.01$.

Effect of Parity

Haematological parameters showed non-significant difference between ewes of different parities. However, the values of RBC and PCV were relatively lower in ewes at their 2nd and 3rd parity at pre-lambing while at post-lambing, RBC counts were lower in ewes at 5th parity and PCV in ewes at 6th parity. TLC showed relatively lower values in ewes at 6th and 7th parity (Table 2). Colostral immunoglobulins (Igs), serum globulins, albumin and serum total proteins both at pre- and post-lambing stages showed non-significant difference among different parities. However, serum Igs (ZST-units) were significantly ($P<.05$) higher in ewes at their 5th than 4th parity at pre-lambing with non-significant difference from others (Table 2).

Effect of Sex of Lamb Born

Haematological parameters assessed in dams given birth to male or female lambs showed non-significant difference at pre and post-lambing stage (Table 3). Similar were the observations for Igs in colostrum and serum and serum total proteins. However, albumin and globulin showed significantly ($P<0.05$) higher values at post- than pre-lambing stage in ewes given birth to neonates of each sex (Table 3).

Status of Dams Who Has Lost Their Neonates

Concentration of colostral Igs were significantly ($P< 0.05$) lower in dams whose lambs died as compared to dams whose lambs survived (Table 4). However, other parameters including serum Igs (ZST-units), serum total proteins, albumin and globulins showed non-significant difference between dams whose lambs survived than those whose lambs died. However, serum globulins at pre-lambing along with PCV and TLC were relatively higher in dams whose lambs survived. Serum Igs (ZST-units) were also higher in dams whose lambs survived (Table 4).

Effect of Birth Weight of Neonates

The RBC at post-lambing were significantly ($P<0.05$) lower in ewes given birth to neonates weighing 4 Kg and above than those weighing 2-3 Kg (Table 5). All other parameters studied showed non-significant difference between ewes given birth to neonates weighing 2-3, 3-4 and above 4 Kg.

Correlation

Colostral immunoglobulins and serum total proteins showed no correlation with serum Igs (ZST-units) both at pre- and post-lambing stage whereas globulins were significantly ($P<0.05$) correlated with serum Igs at pre-lambing stage ($r = 0.21$). TLC showed significant ($P<0.01$) inverse correlation with serum Igs (ZST-units) at pre-lambing stage ($r = -0.29$). Birth weight showed non-significant correlation with serum Igs (ZST-units) at pre-lambing ($r = 0.11$) and with colostral Igs ($r = 0.10$). Serum Igs (ZST-units) showed non-significant correlation with RBC ($r = -0.16$; $r = -0.14$) both at pre- and post-lambing stage. Colostral Igs showed significant negative correlation with RBC ($r = -0.23$) at post-lambing stage.

DISCUSSION

Haematological Findings

The haematological studies showed non-significant difference between values at pre- and post-lambing stages, however, TLC was higher ($P<0.01$) at post-lambing stage. The values of other parameters including RBC, PCV and Hb were relatively higher in ewes at post-lambing stage. These findings indicated relative improvement in blood picture after parturition. Mbassa and Poulsen (1991) also reported significant increase in TLC after parturition while decrease in Hb and RBC in late pregnancy. Present findings also compared well with the findings of Jacob and Vadodaria (1994), they reported low PCV, and Hb concentration before lambing and higher after parturition. The increase observed in TLC was probably contributed by increase in neutrophils after parturition. Near to parturition, corticosteroids are released for the induction of parturition which have depressing effect on lymphocytes and reverse effect on neutrophils. This is why neutrophilia along with leukocytosis was observed at post-lambing stage in ewes. It was also inferred from the present findings that haematological variations at both stages do not indicate ewes whose lambs will survive or die. The TLC were, however, relatively higher in ewes whose lambs survived. Non-significant difference in hematological parameters in ewes given birth to male or female lambs indicated that haematological parameters are independent of the sex of the neonate and later have no bearing on haematological status of the ewes. The higher ($P<0.05$) RBC count in ewes given birth to lambs of 2-3 Kg with a decreasing trend as the weight of the lamb increased, probably reflects that higher birth weight of neonate has a suppressing effect on haematology of the dam.

Immunoglobulins and Serum Proteins

Colostral Igs observed during present study were 12.11 ± 1.97 and 15.81 ± 3.72 g/L in ewes whose lambs died and in those whose lambs survived, respectively. This concentration was within range of 9.9-18.2 g/L as reported by Csapo and Lengyel (1986) within 24 hours of parturition. However, the values were comparatively less in ewes whose lambs died. Ha *et al.* (1986) also reported 15.3 G% Igs in colostrum within 24 hours.

The present findings suggest that colostral Igs in concentration are independent of neonatal sex and in both, colostral Igs concentration was above 15 g/L (15.78, 15.44 g/L in male and female, respectively). Similarly, colostral Igs did not vary with parity of the ewes. The correlation analysis of colostral Igs with parity was low but negative ($r = -0.07$), this indicates a probable decrease in concentration of colostral Igs with further increase in parity. Ha *et al.* (1986) reported low level of colostral Igs in primiparous than multiparous ewes. A non-significant positive ($r=0.12$) correlation observed both with colostral Igs and birth weight of neonates indicated a probable increase in colostral Igs as the weight of the lamb increases.

Lower serum globulins and Igs (ZST-Units) less than 20 ZST-units at post-lambing indicated possible relation of lower serum Igs in dams with mortality in their lambs. These findings compared well with the findings of Villar and Vulich (1980) who stated that ZST-units below 20 in dams is an indication of high risk of subsequent death in neonates. Significantly ($P<0.05$) higher serum albumin and lower globulin at post-lambing were observed in ewes given birth to female lambs. However, serum Igs (ZST-units) did not reveal any difference both at pre- and post-lambing stage. It was interesting to note that serum ZST-units were relatively higher at pre-lambing in ewes given birth to male lambs. Present findings suggested an increase in serum protein concentration after parturition. However, Vihan (1986) reported higher levels before parturition than after parturition. Variation could be due to difference in environmental, managemental or genetic factors.

The present findings of higher serum ZST-units at pre-lambing in ewes of 5th parity and higher colostral Igs and low serum ZST-units at post-lambing stage were in line with the findings of Lascelles (1969), who reported that serum Igs fell at the time of parturition because of selective transfer of IgG_1 to mammary glands. Present findings and those of Bakele *et al.* (1992) suggest no effect of lamb birth weight on serum Igs and total proteins in dams. However, Harker (1973) reported higher serum ZST-units in lambs of 3-4 Kg birth weight with 2nd highest levels in lambs weighing more than 4 Kg.

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Table 2: Effect of parity on haematological and serum biochemical parameters (Mean ± SD) in ewes at pre- and post-lambing stage .

Parameters		1	2	3	4	5	6	7
RBC								
	S-I	8.07 ± 2.89	6.42 ± 2.14	6.78 ± 2.11	8.14 ± 2.54	7.54 ± 2.54	7.60 ± 2.67	8.27 ± 1.11
	S-II	7.60 ± 2.09	7.63 ± 2.20	8.67 ± 2.07	6.78 ± 2.16	7.52 ± 1.81	7.50 ± 1.05	7.50 ± 1.05
PCV								
	S-I	34.64 ± 5.06	32.56 ± 5.37	32.90 ± 6.80	35.22 ± 6.62	33.0 ± 5.17	33.28 ± 2.92	35.40 ± 4.39
	S-II	35.78 ± 7.28	35.68 ± 5.54	34.60 ± 5.23	38.0 ± 8.81	34.50 ± 3.83	33.71 ± 5.73	35.20 ± 7.46
Hb								
	S-I	7.72 ± 1.27	7.84 ± 1.44	8.00 ± 1.39	8.03 ± 1.21	7.86 ± 1.16	8.50 ± 0.57	8.50 ± 0.70
	S-II	8.31 ± 1.00	7.81 ± 1.13	7.82 ± 1.41	8.93 ± 1.34	7.73 ± 1.18	8.30 ± 0.61	8.08 ± 1.18
TLC								
	S-I	8.13 ± 3.89	7.77 ± 3.34	8.97 ± 3.31	8.90 ± 3.09	7.04 ± 4.19	7.12 ± 3.08	7.34 ± 5.16
	S-II	9.02 ± 3.65	9.02 ± 2.78	9.33 ± 3.44	10.53 ± 2.92	8.55 ± 3.77	8.00 ± 3.62	10.18 ± 4.04
Colostral Ig		16.76 ± 3.22	14.97 ± 4.22	15.62 ± 3.76	14.26 ± 2.56	17.25 ± 4.43	15.15 ± 4.27	15.18 ± 4.16
Serum Total Proteins								
	S-I	5.92 ± 0.88	6.16 ± 0.60	6.42 ± 0.87	5.57 ± 0.42	5.44 ± 0.42	5.50 ± 0.46	5.83 ± 0.8
	S-II	6.29 ± 0.61	6.31 ± 0.57	6.42 ± 0.91	6.55 ± 0.91	6.51 ± 0.68	6.17 ± 0.88	6.77 ± 0.32
Serum Albumin								
	S-I	3.95 ± 0.26	3.97 ± 0.49	4.16 ± 0.53	4.18 ± 0.50	3.83 ± 0.81	3.94 ± 0.32	4.16 ± 0.52
	S-II	4.00 ± 0.47	4.14 ± 0.53	4.07 ± 0.27	4.22 ± 0.36	3.87 ± 0.39	3.99 ± 0.31	4.01 ± 0.20
Serum Globulins								
	S-I	1.95 ± 0.88	2.13 ± 0.80	2.25 ± 0.89	1.39 ± 0.43	1.85 ± 1.18	1.56 ± 0.31	1.67 ± 0.84
	S-II	2.28 ± 0.71	2.15 ± 0.89	2.35 ± 1.01	2.32 ± 0.90	2.64 ± 0.79	2.16 ± 0.79	2.75 ± 0.36
Serum ZST units								
	S-I	22.93 ^{ab} ±1.88	22.78 ^{ab} ± 1.98	23.15 ^{ab} ± 2.35	22.06 ^{b} ± 4.61	24.75 ^{a} ± 1.57	22.93 ^{ab} ± 1.02	24.70 ^{ab} ± 1.99
	S-II	24.39 ± 3.64	23.78 ± 2.83	24.45 ± 3.84	22.72 ± 5.09	22.41 ± 6.59	23.47 ± 2.81	24.20 ± 5.89

Values bearing different letters in a row are statistically different at P< 0.05.
S-I = (Pre-lambing stage); S-II (Post-lambing stage)

Table 3: Various blood and serum values (Mean ± SD) of ewes at pre- and post-lambing stage in relation to sex of lambs born.

Parameters	Male		Female	
	1	2	1	2
RBC (10^{12}/L)	7.83±2.41	7.48±1.78	7.10±2.40	7.69±2.09
Hb. Conc. (g/dL)	8.05±1.06	8.13±1.01	7.93±1.33	8.13±1.29
PCV (%)	34.93±4.96	35.93±7.12	32.81±5.49	35.18±5.65
TLC (10^{9}/L)	7.64±3.48	8.97±3.17	8.31±3.59	9.39±3.41
Serum Total Protein (g/dL)	5.89±0.77	6.47±0.57	5.92±0.97	6.32±0.75
Albumin (g/dL)	4.02±0.37a	4.18±0.31b	4.01±0.55a	4.17±0.48b
Globulins (g/dL)	1.86±0.82a	2.55±0.55b	1.92±0.83a	2.15±0.94b
Immunoglobulins (ZST units)	23.65±1.68	23.25±4.34	22.68±2.87	24.11±3.78
Colostral Ig. (g/L)	----	15.78±3.84	----	15.44±3.70

1= Pre-Lambing Stage, 2=Post-Lambing Stage. Values bearing different letters in a row differ significantly (P<0.05).

Table 4: Haematological and biochemical parameters (Mean ± SD) at pre and post-lambing period along with colostral immunoglobulins between ewes whose lambs died or survived.

Parameters	Pre-lambing stage		Post-Lambing stage	
	Lamb survived	Lamb Died	Lamb Survived	Lamb Died
RBC (10^{12}/L)	7.41±2.30	7.51±4.35	7.62±1.97	7.27±1.75
PCV (%)	33.76±5.41	33.25±4.50	35.62±1.14	33.75±4.35
Hb. Conc. (g/dL)	7.97±1.22	8.25±1.19	8.11±1.14	8.42±1.77
TLC(10^9/L)	8.07±3.52	7.13±4.09	8.47±3.42	9.26±3.30
Serum Total Protein (g/dL)	5.93±0.90	5.54±0.58	6.38±0.73	6.56±0.73
Albumin (g/dL)	4.00±0.48	4.26±0.21	4.05±0.41	4.32±0.39
Globulins (g/dL)	1.94±0.82	1.28±0.68	2.33±0.82	2.27±0.76
Ig (ZST-units)	23.25±2.45	20.87±1.65	23.81±4.04	22.75±4.09
Colostral Ig (g/L)			15.81±3.72a	12.11±1.97b

Values bearing different letters in a row differ significantly ($P<0.05$).

Table 5: Haematological and biochemical parameters (Mean ± SD) in ewes at pre and post-lambing periods in relation to birth weights of lambs born.

Parameters	2-3 Kg		> 3-4 Kg		> 4 Kg	
	1	2	1	2	1	2
RBC (10^{12}/L)	.85±2.23ab	8.33±1.93a	8.02±2.26ab	7.67±1.67ab	6.73±2.54ab	6.94±1.94b
Hb. Conc. (g/dL)	8.24±1.03	8.33±1.16	8.04±1.16	7.99±1.04	7.73±1.36	8.05±1.24
PCV (%)	34.56±5.35	36.65±6.47	34.43±4.73	36.50±7.34	32.64±5.61	34.00±5.32
TLC (10^9/L)	8.57±3.22	8.94±3.33	8.69±3.77	8.82±3.82	7.17±3.57	8.50±3.17
Serum Total Protein (g/dL)	5.85±1.13	6.31±0.62	6.01±0.66	6.41±0.82	5.89±0.78	6.43±0.64
Albumin (g/dL)	4.03±0.61	4.06±0.39	4.05±0.38	4.03±0.39	3.99±0.39	4.08±0.44
Globulins (g/dL)	1.99±0.95	2.25±0.79	1.90±0.67	2.38±0.85	1.90±0.80	2.34±0.83
Ig (ZST units)	22.78±3.36	23.61±4.17	23.12±1.87	23.13±4.90	23.36±1.88	24.21±3.40
Colostral Ig (g/L)	-----	16.09±3.89	------	14.08±2.64	-------	16.04±4.01

1= Pre-Lambing stage; 2=Post-lambing stage; Values bearing different letters in a row are statistically different at $P<0.05$.

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