Journal of Animal and Veterinary Advances 7 (3): 308-311, 2008
ISSN: 1680-5593

Comparison of Blood Serum Glucose, Beta Hydroxybutyric Acid, Blood Urea Nitrogen and Calcium Concentrations in Pregnant and Lambed Ewes

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Abstract: A study was conducted to compare the serum concentrations of glucose, Beta-hydroxybutyric acid, blood urea nitrogen and calcium in the prepartum and postpartum periods. One hundrad and thirty four blood samples were taken from native ewes in 2 periods (prepartum and postpartum) randomly in Tabriz area in Iran. The levels of glucose, Beta Hydroxybutyric Acid (BHBA), urea and calcium in blood were measured by spectrophotometer. The mean level of BHBA in prepartum period was higher than postpartum period significantly ($p<0.05$). The mean level of glucose in prepartum period was lower than postpartum period significantly ($p<0.05$).There was negative and significant correlations between BHBA and glucose levels in serum in prepartum and postpartum periods ($r = - 0.55$, $p<0.01$ and $r = - 0.59$, $p<0.01$, respectively). The level of BUN in prepartum period was greater than postpartum period but there was not significant. The level of calcium concentration in serum in prepartum period was higher than postpartum period significantly ($p<0.01$) but there was no significant correlation between glucose and calcium levels in serum in two periods. If concentration of BHBA in serum of pregnant ewes is being over 0.7 mmol L^{-1} which were considered as sub clinical pregnancy toxemia. Twenty ewes (14.9%) suffered from it, that its occurrence was significant ($p<0.05$). It is concluded that hypoglycemia, uremia and hyperketonaemia in late pregnancy could be considered as sub clinical pregnancy toxemia. that should be considered in order to support prevention.

Key words: Glucose, BHBA, BUN, calcium, ewe

INTRODUCTION

Blood glucose, Beta hydroxibutyric acid, blood urea nitrogen and calcium concentrations were mainly recommended to diagnose pregnancy toxemia in ewes.

Pregnancy toxemia is a metabolic disease that commonly affects ewes during late pregnancy. Terminology such as twin lamb disease, lambing sickness, lambing paralysis, or lambing ketosis is often used to describe the disease. Pregnancy toxemia is common in both range and farm flocks and can affect both over conditioned and thin ewes, usually pregnant with multiple fetuses. Ewes pregnant with a single fetus are occasionally involved. Pregnancy toxemia in the ewe flock typically occurs during the last 4-6 weeks of gestation. Clinical cases usually follow a period of negative energy balance resulting in hypoglycemia, increased fat catabolism, ketonaemia and ketonuria in susceptible ewes. Blood glucose is sources of energy and is necessary to fetus and mother. The serum BHBA concentration is final product of fat and is the predominant circulating ketone body. BUN concentration is protein metabolisms and indicates renal failure in the pregnancy toxemia. The economic effect of the disease is considerable. Without treatment, the case fatality rate approaches 100% and in individual flocks the disease can reach a level of incidence sufficient to be classed as an outbreak. Flocks that experience pregnancy toxemia will also have a higher than normal mortality in neonatal lambs and usually a decrease in wool quality (Henze *et al*., 1998; Radostits *et al*., 2007; Schlumbohn and Harmeyer, 2004).

In sheep, the initial changes are hypoglycemia, ketonaemia, ketonuria and uremia. Hypoglycemia can be used as a diagnosis aid in early stages of the disease but is of limited value later in the course as by the time that sheep become recumbent, blood glucose levels may be normal or grossly elevated. This may be the result of fetal death which has been shown to remove the suppressing effect of the fetus on hepatic neoglucogenesis (Marteniuk and Hedt, 1988; Schumbohm and Harmeyer, 2004). Ketonaemia are constant and serum Beta hydroxybutyrate concentrations are in excess. Sheep

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develop a severe metabolic acidosis, renal failure with a terminal uremia. Occasionally pregnancy toxemia is with hypocalcaemia (Radostits *et al*., 2007; Scott *et al*., 1995). For treatment used parenteral glucose with corticosteroid and oral glucose precursors such as propylene glycol, occasionally insulin. Cesarean section or induction of parturition recommended. For control order correction of energy imbalance and herd and flock biochemical monitoring coupled with condition scoring (Bickhardt *et al*., 1998; Radostits *et al*., 2007).

This study was accomplished to compare the levels of metabolites in serum in the prepartum and postpartum periods and to determine the relationships between them. In this survey the levels of glucose, beta hydroxybutyric acid, blood urea nitrogen and calcium in serum in the pregnant and lambed ewes comprised.

MATERIALS AND METHODS

This study were conducted on 134 ewes blood samples in 2 periods (prepartum and postpartum) randomly. Ewes were apparently health with no clinical signs and aged over one year old. Five mililiter blood samples were taken from jugular vein in venoject tubes Samples were centrifuged at 3000 g for 15 min and serum separated. The levels of serum glucose with Glucooxidase Method (GOD/PAP), Beta Hydroxybutyric Acid (BHBA) with randox method, urea (BUN) with diasetylmonooxim method and calcium with orthocresolphethalein method in sera were measured. The mean levels of these parameters were calculated.

SPSS software program (version 13) and case summaries were used to determine mean, standard deviation and standard error. Student t-test was carried out for measuring the difference between blood parameters. Pearson correlation test was applied to establish relationship between parameters under study with in and between groups. The distribution and percentage of ewes in each group was determined and was analyzed by chi-squire test to find out of difference among their distributions.

RESULTS

The mean levels of BHBA and glucose in prepartum period were 0.46±0.15 m mol L^{-1} and 51.6± 16.04 mg dL^{-1} and in postpartum period they were 0.40±0.11 m mol L^{-1} and 62.19±11.12 mg dL^{-1}, respectively.

The mean level of BUN in prepartum period was greater than postpartum period (10.27±2.96 and 9.84±2.68 mg dL^{-1}, respectively). The mean level of calcium in serum in prepartum period was 12.59±2.73 and in postpartum period was 10.06±0.78 mg dL^{-1} (Table 1).

Table 1: The mean±SE concentrations of glucose, beta hydroxybutyric acid, blood urea nitrogen and calcium in serum in two periods (prepartum and postpartum)

	N	Mean	Std. deviation	Std. error mean
BHBA (mmol L 1)				
prepartum	134	0.46	0.15	0.01
postpartum	134	0.4	0.11	0.02
BUN (mg dL 1)				
prepartum	134	10.27	2.96	0.26
postpartum	134	9.84	2.68	0.57
Ca (mg dL 1)				
prepartum	134	12.59	2.73	0.24
postpartum	134	10.06	0.78	0.16
Glucose (mg dL 1)				
prepartum	134	51.6	16.04	1.39
postpartum	134	62.19	11.12	3.22

Table 2: Correlations between serum parameters in the prepartum and postpartum periods in the ewes under study

Prepartum		Postpartum	
Glucose and BHBA	r = -0.55	Glucose and BHBA	r = -0.59
Glucose and Ca	r = -0.06	Glucose and Ca	r = 0.26

Table 3: Ewes (in prepartum period) with sub clinical pregnancy toxemia with BHBA over 0.7 mmol L^{-1}

Below 3 years old		Above 3 years old	
Normal	Sick	Normal	Sick
59	11	55	9

Blood parameters showed significant difference in glucose ($p<0.05$), BHBA ($p<0.05$) and calcium ($p<0.01$) concentrations among groups (two periods), but BUN concentration was not significant. The correlation between BHBA with glucose levels in the serum and calcium with glucose levels were observed in Table 2. There were significant and negative correlations between BHBA and glucose concentrations in prepartum and postpartum periods both ($p<0.01$, $r = -0.55$ and $p<0.01$, $r = -0.59$, respectively) but the correlation between calcium and glucose concentrations in the two periods were no significant ($p>0.05$, $r = -0.06$ and $p>0.05$, $r = 0.26$, respectively). On the bases of age ewes in the prepartum period were divided in 2 groups (under 3 years old and above 3 years old groups). If the concentration of BHBA >0.7 mmol L^{-1} considered as sub clinical pregnancy toxemia (Ramin *et al*., 2007; Rook, 2000), therefore, the distribution of ewes with sub clinical pregnancy toxemia in two age groups was determined in Table 3.

DISCUSSION

The mean level of BHBA in prepartum period was higher than postpartum period. There was significant difference between these two periods ($p<0.05$). BHBA is the predominant circulating ketone body (Radostits *et al*., 2007). Factors affecting hyperketonaemia include long term starvation, reproduction disorders, energy deficiency in nutrition, poor quality hay and other disorders

(Firat and Ozpinar, 2002; Hamadeh *et al*., 1996; Radostits *et al*., 2007) The BHBA concentration should not be exceed 0.7 m mol L^{-1} (10, 11)but it is considered at present study. The increase of BHBA to 0.86 and 1.6 mmol L^{-1} will lead sub clinical and clinical pregnancy toxemia in ewes, respectively (Lacetera *et al*., 2001). According to cut off point (BHBA>0.7 m mol L^{-1}), 20 ewes (14.9%) suffered from sub clinical pregnancy toxemia that this occurrence was significant ($p<0.05$). If the cut of point were 0.86 m mol L^{-1} (Lacetera *et al*., 2001; Robinson, 1980) the affected animals were 8 ewes (5.9%).Nine ewes with sub clinical pregnancy toxemia were more than three years old and 11 head were below 3 year old Relationship between age and occurrence of disease in two groups were not significant.

The mean level of glucose concentration in prepartum period was lower than postpartum period significantly ($p<0.05$). Blood glucose is known as metabolic profile test, thus, it has distinguishable value in pregnancy toxemia, retarded growth, weight loss, production and reproduction defects (Hamadeh *et al*., 1996; Ramin *et al*., 2005). The difference in glucose concentration between prepartum and postpartum periods reveals the consumption of glucose by fetus and milk yield, so glucose administration before and after parturition results reduction in hypoglycemia and pregnancy toxemia (Bickhardt *et al*., 1998; Ramin *et al*., 2007; Rook, 2000; Schumbohn and Harmeyer, 2004; Scott *et al*., 1995).

There was negative and significant correlation between BHBA and glucose levels in serum in prepartum and postpartum periods ($r = -0.55$ and $r = -0.59$, respectively) ($p<0.01$ in both. Results of correlation among these parameters indicate a physiological relationship among hypoglycemia in hypoketonaemia. The mechanisms could be substitution of fats in energy production, results an increase in BHBA and depletion of glucose in blood, liver and muscle. These mechanisms are approved in bovine ketosis, pregnancy toxemia, fat cow syndrome and liver lipidosis (Bickhardt *et al*., 1998; Robinson, 1980). While, there is no correlation between glucose and calcium concentrations in two periods. Relationship between glucose and BHBA were reported by others (Rook, 2000; Schumbohm and Harmeyer, 2004). In the one study there was hypocalcaemia with hyperketonaemia (Scott *et al*., 1995).

The mean level of BUN in prepartum period was greater than postpartum period but there was not significant. Urea production raises to 67% during pregnancy and fall to 36% following parturition and lactation (Ramin *et al*., 2007) as it was observed in this study. Dehydration and starvation result no clinical uremia, while diarrhea, renal frailer and pregnancy toxemia cause clinical uremia (Radostits *et al*., 2007; Ramin *et al*., 2007). The reason for high urea concentration in pregnant ewes could be related to either high protein metabolism during pregnancy or nutritional management. This finding is agreement with other reports about uremia in ewes with pregnancy toxemia (Ramin *et al*., 2007).

The mean level of serum calcium in prepartum period was significantly higher than postpartum period ($p<0.01$). Calcium discharge in the milk in lactation period result in decreasing of calcium concentration in serum.

CONCLUSION

Present study findings indicate that the ewes of Tabriz area have been suffering by sub clinical pregnancy toxemia. According to its economic importance due to loss of lambs and occasionally dams, prevention must be done. Therefore, adjusting carbohydrates toward the end stages of pregnancy simultaneously monitoring BHBA and BUN would reduce the occurrence of sub clinical pregnancy toxemia.

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