PREDICTION OF TRAUMATIC PERICARDITIS IN COWS USING SOME SERUM BIOCHEMICAL AND ENZYME PARAMETERS

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An observational study was carried out to determine the indices in serum biochemical and enzyme parameters that would be useful in predicting the early diagnosis of traumatic reticulopericarditis (TRP) in cows. Serum glucose, protein, fibrinogen, bilirubin, BHB, Ca, IP, Mg, ALT, ALP and AST were investigated in 19 TRP cows confirmed by radiography and the results were compared to 10 healthy ones in Urmia, Iran. The mean values for glucose, Ca, Mg, IP and ALT in TRP cows were lower than in healthy cows (p<0.01), while for protein (Ptn), fibrinogen, bilirubin, BHB, ALP and AST were higher than in healthy cows (p<0.01). The correlations among parameters under study revealed that glucose, electrolytes and AST showed the greatest relationships among themselves and others. The regression results showed equations among glucose, Mg, AST (R^2 = 0.47, SE = 12.1) and Ca, IP, Mg, (R^2 = 0.89, SE = 0.35). Thus, it is concluded that the serum glucose and Ca concentrations could be the main indices in early diagnosis of TRP in cows.

Serum glucose (mg/dl) = 50.7 − [(8.9±3.3) Mg + (.015±0.06) AST]
Serum calcium (mg/dl) = 5.38 − [(0.7±0.2) IP + (0.52±0.14) Mg]

Key words: biochemical, cow, enzyme parameters, radiography, TRP

INTRODUCTION

Traumatic reticulo-pericarditis (TRP) was defined as an important gastrointestinal disease of the rumen and reticulum in cows. It is characterized by low appetence to anorexia with high mortality rate, and therefore is economically important. TRP occurs by penetration of sharp materials from feedstuffs into the reticulum and heart (Radostits *et al*., 2000). The disease may appear in forms of local and acute peritonitis, local chronic peritonitis and as unspecific form (Hateley, 2004). Decreased appetite, ruminal stasis, arching the back, mild fever, ruminal hypomotility, grinding of the teeth, and decreased milk yield are the main signs in TRP. Hematological and biochemical findings, such as hypoglycemia, ketonuria and glutaraldehyde tests (Braun *et al*., 1994; Radostits *et al*., 2000) are

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useful diagnostic methods for TRP. It must be distinguished from ketosis, simple indigestion and subclinical acute ruminal impaction (Steen, 2007; Grohn *et al*., 1990). Abdominal paracentesis analyses will help to confirm the disease. In spite of the early diagnostic and prophylactic methods such as magnet implantation (Radostits *et al*., 2000), metal detector and remover (Braun *et al*., 1994; Ramprabhu *et al*., 2003; Ramin *et al*., 2008), radiology and ultrasonography (Braun *et al*., 1994), hematology and biochemistry tests (Misra and Angelo, 1974; Ivanov *et al*., 1980), there are still huge economic losses to be treated in the cattle industry. Treatment is based on lapara-ruminotomy and conservative therapy which includes removal of the foreign body (Ramin *et al.,* 2008), and antibiotic and magnet administration (Radostits *et al*., 2000; Braun *et al*., 1994).

TRP is usually diagnosed by hematological and chemical findings. Biochemical and enzyme alterations are usually ignored. The results of blood fibrinogen and protein concentrations (Ramprabhu *et al*., 2003; Ramakrishhana *et al*., 1979), enzymatic alterations (Gokce *et al*., 2007; Braun *et al*., 2007) and calcium variations in TRP show that blood biochemistry may be considered a useful index in early diagnosis of TRP. The objectives of this study were firstly to compare the concentrations of glucose, protein, fibrinogen, BHB, bilirubin, Ca, IP, Mg, AST, ALT, ALP in early TRP and healthy cows. Secondly, to determine the correlations among parameters, and whether these equations will be useful for early diagnosis of TRP in cows.

MATERIALS AND METHODS

A total of 60 hybrids Holstein cows aged from 3 to 7 years were diagnosed for TRP by clinical examinations in 2008-9 in Uremia, Iran. TRP was confirmed in 19 sick animals. Animal history was obtained and general clinical examinations including body temperature, milk yield and foreign bodies specific tests were recorded. Specific signs in traumatic pericarditis included: tachycardia, muffled heart rate, distended jugular veins, pericardial sounds like splashing, rubbing or squeaking sounds, brisket and ventral edema. A mount of 5 mL of blood from the jugular vein was prepared for PCV, protein, fibrinogen, WCC and differential count assessment by routine laboratory tests. The definitive diagnosis was made based on radiography findings of wire in the reticulum and heart. TRP was confirmed in only 19 cows with pieces of wire in their hearts. Cows which were positive for all mentioned tests, but did not reveal wire fragments in their hearts were not included in this study. Thus, the results of 19 cows with TRP were compared to 10 apparently healthy cows as control group. To find the biochemical alterations in TRP, other blood parameters such as glucose, BHB, bilirubin, Ca, IP, Mg, AST, ALT, and ALP were measured in cows previously TRP confirmed by radiography. The results of radiography in 3 cows are shown in Figure 1.

Serum glucose concentration was measured by the glucooxidase method, serum total bilirubin concentration by DCA method, protein and fibrinogen by refractometer, BHB by Ulter-violet method, Ca and IP concentrations by colorimetry, Mg by xyledin blue test, ALT, ALP and AST with autoanalyser machine (RA-1000) using an appropriate kit for each measurement (Pars Azmon, IR,

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Rumut, UK). SPSS statistical program and case summaries, t-test, Pearson correlation and regression tests were applied to analyze the obtained data.
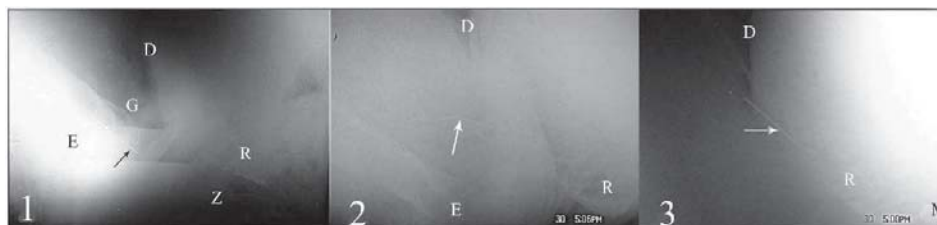

Figure 1. Lateral radiographs of the reticular region in three TRP positive cows. Fig. A: gas caped fluid (G) and a linear metal foreign body in the thorax. Fig. B: a linear metal foreign body (arrow) on the heart. Fig. C: a linear metal foreign body penetrated to the heart. E: Elbow joint, Z: Xiphoid, R: Reticulum, H: Heart, M: Magnet, D: Diaphragm

RESULTS

Mean serum glucose, Ca, Mg, IP and ALT concentrations, except for ALT, in TRP cows were lower ($p<0.01$) than in healthy cows (Table 1). The reduction percent for parameters were 14%, 12%, 14%, 24% and 13%, respectively. Mean serum protein, fibrinogen, bilirubin, BHB, ALP and AST were higher ($p<0.01$) than in healthy cows. The rate of increase was 30%, 141%, 59%, 30%, 16% and 61%, respectively. The maximum values were observed in TRP cows except for Ca and IP concentrations.

Table 1. Mean±SE and the range of blood parameters in TRP (n=19) and healthy cows (n=10)

Parameters	TRP cows		Healthy cows	
	Mean±SE	Range	Mean±SE	Range
Glucose[1]	54.7±2.9 [a]	34-81	63.2±2.73 [b]	48-75
Protein[1]	110.1±0.18 [a]	100.5-120	80.1±2.4 [b]	76-94
Fibrinogen[1]	1192.9±39.9 [a]	1000-1300	495±52.4 [b]	350-800
Bilirubin[1]	1.5±0.99 [a]	1.03-2.54	0.65±0.06 [b]	0.38-0.91
BHB[2]	0.57±0.02 [a]	0.44-0.85	0.42±0.02 [b]	0.33-0.58
Calcium[1]	9.1±0.18 [a]	7.9-10.3	10.3±0.24 [b]	9.3-11.5
Magnesium[1]	2.6±0.16 [a]	1.5-3.91	3.1±0.09 [b]	2.6-3.52
Phosphorus[1]	3.3±0.14 [a]	2.1-4.5	4.3±0.18 [b]	3.7-5.3
ALT[3]	32.7±4.2 [a]	15-98	37.7±1.26 [a]	31-43
ALP[3]	147.0±7.1 [a]	112-209	97.5±5.01 [b]	65-116
AST[3]	129.1±8.7 [a]	91-217	80±3.54 [b]	65-95

[1]= mg/dL; [2]= mmol/L; [3]=u/l; [a] &[b]= Different letters in rows mark values that differed significantly ($p<0.01$)

Table 2. Correlations among serum parameters in TRP cows

Parameters	Protein	Fibrinogen	Bilirubin	BHB	Ca	Mg	IP	ALT	ALP	AST
Glucose	0.59*	0.13	0.04	-0.49*	0.48*	0.52*	0.34	0.17	0.33	0.47*
Protein		0.55	0.49	-0.3	0.33	0.45	0.53	0.45	0.81**	-0.44
Fibrinogen			0.04	0.04	0.36	0.35	0.55	0.2	0.3	-0.09
Bilirubin				-0.32	-0.18	0.34	-0.04	0.37	-0.05	-0.16
BHB					-0.21	-0.14	-0.1	0.23	-0.12	0.49*
Ca						0.86**	0.89**	-0.19	0.29	-0.01
Mg							0.73	-0.18	0.21	-0.04
IP								-0.06	0.37	0.02
ALT									-0.13	-0.16
ALp										-0.01

*=p<0.05; **=p<0.01

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There were significant positive correlations between glucose/Ca (r=0.48), glucose/ Mg (r=0.52), protein/ALP (r=0.81), Ca/Mg (r=0.86), Ca/IP (r=0.89), Mg/IP (r=0.73), AST/glucose (r=0.47) and AST/BHB (r=0.49). A significant negative correlation was observed for glucose/BHB (r=-0.49). There were significant positive correlations between Ca/IP (r=0.81), AST/billirubin (r=0.64), AST/IP (r=0.77) and a significant negative correlation between glucose/Mg (r=−0.68) in healthy cows (Table 2).

The correlations among parameters under study showed that glucose, electrolytes and AST, respectively, had the greatest relationship among themselves and other parameters. The regression results showed equations among glucose, Mg, AST ($R^2 = 0.47$, SE = 12.1) and Ca, IP, Mg ($R^2 = 0.89$, SE = 0.35).

Serum Glucose (mg/dL) = 50.7 − [(8.9±3.3) Mg + (.015±0.06) AST]
Serum Calcium (mg/dL) = 5.38 − [(0.7±0.2) IP + (0.52±0.14) Mg]

DISCUSSION

TRP was confirmed in 31.7 % (19 cows) of cases by radiography. Braun *et al.* (1993, 2003) reported 49%. In 18 cases (94.7 %) the foreign bodies were metallic objects, while, Fubini *et al*. (1990) and Braun *et al*. (1993) reported 90% and 61%, respectively. The specificity and sensitivity of the test reported by Braun *et al.* (1993) was 57% and 64%, Fubini *et al*. (1990) was 91 % and 88% and in this study was 64% and 88%, respectively. These reports show that radiography is an appropriate method for final decision in TRP cows.

Serum glucose concentration in TRP was 14% less than in healthy cows (p<0.01, Table 1). The reason could be related to abdominal pain, anorexia, mild indigestion, low propionic acid production, digestion and absorption disturbances and hypoglycemia (Burtis and Ashwood, 1984; Ramin *et al*., 2005). In prolonged and chronic anorexia, serum glucose, liver glycogen decline and liver enzymes increases as described in this paper and by Steen (2001) too. Meanwhile, hypoglycemia promotes non-aerobic Crebs cycle and results ketonemia, as increased up to 30% in TRP cows (Table 1).

The reason for high protein (30%) and fibrinogen (141%) concentrations in TRP can be related to the amounts of globulin, albumin and protein in the blood, as reported by Ramprabhu *et al*. (2003), Ramakrishana *et al*. (1979), Jafarzadeh *et al*. (2004). Fibrinogen appears in inflammatory diseases and is not specific for TRP (Herzog *et al*., 2004; Ramprabhu *et al*., 2003). In glutaraldehide test value was increased up to 14 grams and therefore, TRP can be considered (Ramprabhu *et al*., 2003; Braun *et al*., 1994). Jafarzadeh *et al*. (2004) estimated TRP protein and fibrinogen concentrations of 7.78 g/dL and 691 mg/dL, respectively. Hirvonen and Pyorala (1998) emphased haptoglubulin concentration in cows during hypocalcemia in TRP. It seems that fibrinogen and calcium are more valuable than others.

Bilirubin concentration increased up to 59% in TRP (Table 1). Bilirubin originates from hemoglobin (Hb) and red blood cells. Porphyrine is released from Hb and converted to bilirubin in the liver, spleen and bone marrow. Evaluation of

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bilirubin is related to the liver activity, thus, hyperbilirubinemia results from the inability of the liver to clear the bilirubin from the blood (Burtis and Ashwood, 1994). This condition occurs in hemolytic diseases, anorexia, starvation, TRP and lack of excretion of bilirubin into the bile sac (Kilmoveskaia *et al*., 1982). The reason for hyperbilirubinemia in this study will be related to anorexia and infection following TRP as mentioned by Gokce *et al*. (2007).

Ca, Mg and IP decreased during TRP up to 12%, 14% and 24%, respectively. The reasons were anorexia, starvation and low absorption (Steen, 2001; Braun *et al*., 2007). Changes in electrolytes could be observed in nutritional deficiency (Karatsias *et al*., 1992), ketosis, indigestion and sub-clinical acidosis, as well as TRP (Steen 2001). The amount of reduction in electrolytes depends on the time of TRP diagnosis. If affected cows are not treated or slaughtered, the decline becomes severe and cows demonstrate specific signs of mineral deficiency. The reason for recumbency in TRP can be related to hypocalcaemia as reported by Gokce *et al*. (2007). Meanwhile, there is no report of Mg and IP variations in TRP.

ALP and AST increased in TRP while ALT did not. The same result was reported by Gokce *et al*. (2007) and Braun *et al*. (2007). ALP can be observed in the blood, liver, bone, placenta, guts and is an useful index for the diagnosis of obstructive icterus and rickets (Radostits *et al*., 2000). AST and ALT belong to the transaminase group and can be found in the liver, muscles, kidneys and are important in the diagnosis of human viral hepatitis and liver necrosis (Burtis and Ashwood, 1994). In liver diseases, muscle injuries and heart infarction, AST concentration increases to 100 times (Burtis and Ashwood, 1994). Increase in AST by up to 61%, could be related to a functional damage of the liver and heart in TRP cows.

The presence of significant correlations between parameters in TRP revealed that glucose, minerals and enzymes, demonstrated in the greatest correlations among themselves and others, while such correlations were not observed in the healthy group (Table 2). It means that glucose and Ca concentrations are the most important parameters affected in TRP. Although the regression equation for glucose was 0.47% and for Ca it was 0.89% it means that Ca is more reliable than glucose to estimate TRP. Hypocalcaemia in TRP was previously reported by Gokce *et al*. (2007), but for glucose no equation was presented before and hence needs further studies. Thus, the results of this study indicate that TRP causes significant biochemical and enzyme alterations in dairy cattle, although not specific for TRP, but serum glucose and Ca could be useful indices for the determination of TRP in cows.

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PREDVIĐANJE TRAUMATSKOG PERIKARDITISA KRAVA NA OSNOVU VREDNOSTI NEKIH BIOHEMIJSKIH PARAMETARA I AKTIVNOSTI POJEDINIH ENZIMA U SERUMU

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SADRŽAJ

U ovoj studiji, sprovedenoj u Urmiji (Iran), vršeno je određivanje vrednosti biohemijskih parametara i aktivnosti enzima u serumu kao indikatora za postavljanje rane dijagnoze traumatskog retikuloperitonitisa (TRP) krava. Ispitivane su koncentracije glukoze, ukupnih proteina, fibrinogena, bilirubina, beta hidroksibutirata (BHB), Ca, Mg, neorganskih fosfata (IP) i aktivnost enzima ALT, ALP i AST u krvnom serumu 19 krava sa TRP potvrđenim radiografijom. Ovi rezultati su upoređeni sa nalazima dobijenim od 10 zdravih krava.

Srednje vrednosti koncentracije glukoze, Ca, Mg, IP i aktivnost enzima ALT bile su niže kod krava sa TRP nego kod zdravih krava (p<0,01). Koncentracije proteina, fibrinogena, bilirubina, BHB i aktivnost enzima ALP i AST bile su više nego kod zdravih krava (p<0,01). Ispitivanjem korelacije između pojedinih parametara utvrđeno je da je ona najveća za glukozu, elektrolite i aktivnost AST. Rezultati regresione analize ukazali su na sledeće odnose: glukoza, Mg, AST (R^2=0,47, SE=12,1) i Ca, IP, Mg, (R^2=0,89, SE=0,35). Može se zaključiti da nivoi glukoze i Ca u serumu mogu da budu od koristi u ranom dijagnostikovanju TRP kod krava.