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Original article

Levels of antioxidant substances, acute phase response and lipid peroxidation in the left and right abomasum displacement in cows

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Abstract

The aim of the present study was to assess metabolic changes occurring in Holstein cows with left or right abomasal displacement. Total sialic acid (TSA) values of the left abomasal displacement (LDA) group were elevated significantly ($p < 0.0001$) as compared to the controls. In the LDA group, serum ceruloplasmin (CPN) and aspartate transaminase (AST) levels were increased significantly ($p < 0.0001$) as well. Compared to the control group, serum glutathione (GSH) level was decreased significantly in both LDA and right abomasal displacement (RDA) groups ($p < 0.0001$). Among the clinical examination parameters, rumen contraction rates were decreased in both LDA and RDA groups significantly ($p < 0.0001$). These results suggest that inflammatory and oxidative parameters might have taken part in the pathogenesis of abomasal displacement. In this regard, anti-cytokine and anti-oxidant therapies developed in human medicine may also play a potential therapeutic role in the fatty liver and abomasal displacement in cattle.

Key words: abomasal displacement, acute inflammatory markers, oxidative degradation, dairy cattle

Introduction

Abomasal displacement (AD) is one of the most common diseases in dairy veterinary practice. It is reported that ketosis and fatty liver often associate with AD, and it is thought that these three disorders are interrelated (Geishauser 1995). These interrelated disorders lead to a range of metabolic activities and

alterations in a wide variety of biochemical processes. Although biochemical parameters are useful indicators for diagnosis and evaluation of periparturient diseases, there have been few studies to assess the acute phase response, lipid peroxidation, antioxidant substances in the left and right abomasum displacement in cows. Sialic acid (SA) plays an important role in inflammation, and serum total sialic acid (TSA)

Table 1. Results of the biochemical analyses. Values are expressed as means \pm standard deviations.

Parameters	Healthy cows ($n = 8$)	Cows with AD ($n = 25$)		p
		RDA ($n = 7$)	LDA ($n = 18$)	
TSA($\mu\text{g/mL}$)	602.3 \pm 77.95 ^b	882.3 \pm 3.33 ^{ab}	1030.7 \pm 51.96 ^a	0.0001
MDA ($\mu\text{mol/L}$)	11.1 \pm 1.08	13.3 \pm 1.15	13.9 \pm 0.72	NS
GSH (μM)	1.6 \pm 0.02 ^a	1.3 \pm 0.02 ^b	1.3 \pm 0.01 ^b	0.0001
CPN (mg/dL)	5.7 \pm 0.61 ^c	12.2 \pm 0.66 ^a	8.59 \pm 0.4121 ^b	0.0001
AST (U/L)	86.5 \pm 31.11 ^b	142.9 \pm 33.26 ^b	244.0 \pm 20.74 ^a	0.001
ALT (U/L)	15.4 \pm 1.39	17.0 \pm 1.49	15.8 \pm 0.93	NS
TG (mg/dL)	25.3 \pm 2.13 ^a	26.0 \pm 2.28 ^a	18.4 \pm 1.42 ^b	0.007
CHOL (mg/dL)	116.2 \pm 14.15	92.4 \pm 15.12	95.19 \pm 9.4344	NS

TSA – total sialic acid, MDA – malondialdehyde, GSH – glutathione, CPN – ceruloplasmin, AST – aspartate transaminase, ALT – alanine transaminase, TG – triglycerides, CHOL – cholesterol, NS – not significant. Different superscripts a,b in the same row indicate significant differences among group ($p < 0.05$).

Table 2. Results of clinical examinations in the cows. Values are expressed as means \pm standard deviations.

Parameters	Healthy cows ($n = 8$)	Cows with AD ($n = 25$)		p
		RDA ($n = 7$)	LDA ($n = 18$)	
BT ($^{\circ}\text{C}$)	38.2 \pm 0.21	38.7 \pm 0.23	38.6 \pm 0.14	NS
PR (beats/min)	81.0 \pm 6.45	86.7 \pm 6.90	80.7 \pm 4.30	NS
RR (breaths/min)	27.8 \pm 2.64	27.7 \pm 2.82	21.5 \pm 1.76	0.071
RCR (contractions/5 min)	9.1 \pm 0.62 ^a	3.0 \pm 0.67 ^b	4.1 \pm 0.41 ^b	0.0001

BT – body temperature, PR – pulse rate, RR – respiratory rate, RCR – rumen contraction rate, NS – not significant. Different superscripts a,b in the same row, indicate significant differences among group ($p < 0.05$).

was assessed as an acute phase reactant (Sillanaukee et al. 1999). The effect of abomasum displacement on serum SA levels has not been reported previously.

Glutathione (GSH) is a cofactor for glutathione peroxidase. Although various studies (Al-Qudah and Ismail 2012) have been performed about the GSH levels in some states of dairy cow medicine, we did not come across to any study that determined the relationship between GSH and AD. The disintegration of lipid hydroperoxides leads to a wide variety of end products, one of which is malondialdehyde (MDA), which is now defined as a reliable marker of lipid peroxidation (Ohkawa and Ohishi 1979). The objective of this study was to determine and discuss the oxidative damage with other related metabolic mechanisms in left and right abomasal displacement (LDA and RDA, respectively).

Materials and Methods

Thirty three Holstein cows in postpartum period, which were presented to the clinics constituted the material of the present study. Study groups were designed as: LDA ($n = 18$), RDA ($n = 7$), and control ($n = 8$). Serum ceruloplasmin (CPN), malondialdehyde (MDA) and total sialic acid (TSA) were

performed by a UV-spectrophotometer. Additionally, serum glutathione (GSH), aspartate transaminase (AST), alanine transaminase (ALT), triglyceride (TG) and cholesterol (CHOL) levels were measured with commercial test kits. Body temperature, pulse, respiratory and rumen contraction rates in the cows were determined and recorded. MINITAB® 16.1 program (Minitab Inc., USA) was used for the statistical analyses.

Results

Although mean TSA values of both the LDA and RDA groups were higher than those found in the control group, LDA group exhibited significant ($p < 0.0001$) difference in comparison to the control group (Table 1). Moreover, in the LDA group, serum AST level was increased significantly ($p < 0.0001$) as well. Mean values of serum CPN level showed significant ($p < 0.0001$) differences between all study groups. Similar significant ($p < 0.0001$) serum GSH level falls were determined in both LDA and RDA groups. Among the clinical examination parameters, rumen contraction rates were decreased in both LDA and RDA groups significantly ($p < 0.0001$) (Table 2).

Discussion

GSH plays a key role as a protective antioxidant against oxidative stress both in extra- and intracellular level (Rahman and MacNee 2000). Displacement of abomasum is one of the most important postpartum diseases which induce stress in cows and the resultant stress causes an increase in oxidants and decrease in anti-oxidants serum levels (Hasanpour et al. 2011). Although, we could not find any previous study reporting serum GSH levels in AD cases, in agreement with Hasanpour et al. (2011) we reasoned that decreased GSH values in AD cases would result from induced stress of the AD.

Oxidative stress, cytokines, and acute phase proteins are involved in inflammatory reactions and are proposed to promote metabolic disorders (Devrim et al. 2012). Serum SA has been reported as a marker of the acute phase response (Ponnio et al. 1990). In the present study, TSA values in both the RDA and LDA groups were found to be higher than those observed in control group. These results suggest that SA may be considered as a potent defense molecule against the oxidative damage in AD cases (Mohan and Priyav 2010).

Reciprocally, along with the assessed oxidative stress and acute phase response parameters, ALT in RDA group and CPN and AST significantly in LDA group increased in the present study. These results could be attributed to hepatic lipidosis, endotoxemia and hepatocyte damage (Zadnik 2003).

There are few studies which have investigated lipid peroxidation in AD. In our study, both in RDA and LDA groups, serum MDA levels were higher than those found in healthy controls what probably means the induced stress in AD causing an increase in oxidants and decrease in anti-oxidants serum level (Hasanpour et al. 2011).

In this study, significant decreases in rumen contraction rates (Table 2) were determined in both LDA and RDA groups, and this result was consistent with that determined in previous studies (Hull and Wass 1993).

The present results suggest that inflammatory and oxidative parameters might have taken part in the

pathogenesis of AD. In this regard, anti-cytokine (O'Dell 1999) and anti-oxidant (Firuzi et al. 2011) therapies developed in human medicine may also play a potential therapeutic role in the fatty liver and AD in cattle.

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