Liver Function in Dairy Cows with Abomasal Displacement

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SUMMARY

The aim of this study was to establish the changes that may occur in liver function in dairy cows with abomasal displacement. The liver biopsies from cows with abomasal displacement had 31.5±6.1 % fat infiltration. Some chemical parameters (bile acid, glucose, total protein, urea, albumin, globulin, total bilirubin, direct bilirubin, indirect bilirubin, AST, ALT, GGT, CK, triglyceride, total cholesterol, HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol) were measured. Serum AST ($p<0.01$) and GGT ($p<0.001$) levels were significantly increased, and HDL-cholesterol ($p<0.001$) significantly decreased in cows with abomasal displacement compared to healthy cows. There were significant alterations in urea, total protein, albumin, total cholesterol, total bilirubin and indirect bilirubin concentrations, but they were within normal range limits in the same animals. In conclusion, GGT and AST concentrations, and liver biopsy seem to be helpful in the assessment of liver function in cows with abomasal displacement.

KEY-WORDS: Liver function - abomasal displacement - dairy cows.

RÉSUMÉ

Fonction hépatique chez les vaches laitières atteintes d'un déplacement abomasal. Par M. SEVINC, M. OK et A. BASOGLU.

Le but de cette étude était d'établir les changements qui peuvent se produire dans la fonction hépatique chez des vaches laitières avec le déplacement abomasal. Les biopsies de foie des vaches atteintes d'un déplacement abomasal ont eu 31,5 ± 6,1 % d'infiltration graisseuse. Quelques paramètres chimiques (acide de bile, glucose, protéine totale, urée, albumine, globuline, bilirubine totale, bilirubine directe, bilirubine indirecte, AST, ALT, GGT, CK, triglycéride, cholestérol total, HDL-cholesterol, LDL-cholesterol, VLDL-cholesterol) ont été mesurés. Les niveaux d'AST ($p < 0.01$) et de GGT ($p < 0.001$) ont été sensiblement augmentés, et HDL-cholesterol ($p < 0.001$) a été sensiblement diminué chez les vaches avec déplacement abomasal comparé aux vaches saines. Il y a un changement significatif dans les concentrations d'urée, de protéine totale, d'albumine, de cholestérol total, de bilirubine totale et indirecte, mais ils restaient dans des limites normales d'intervalle chez les mêmes animaux. En conclusion, des concentrations d'AST et de GGT et la biopsie de foie semblent être utile dans l'évaluation de la fonction hépatique chez les vaches atteintes d'un déplacement abomasal.

MOTS-CLÉS : Fonction de foie - déplacement abomasal - vaches laitières.

1. Introduction

In cattle, diseases of abomasum are of great importance and include right and left displacement, torsion, impaction, pyloric stenosis and ulceration [9]. Displacement of the abomasum has become one of the most important metabolic and organic internal disorders of cattle and the disease is most prevalent in high performing milk breeds [10]. Abomasal displacement occurs most frequently in high yielding cows during early lactation [21, 25, 41]. It has been reported that feeding a large amount of concentrations or corn silage [34] to dairy cows inhibits the motility resulting in gas accumulation followed by dilation and atony and thereby causing displaced abomasum [27].

The laboratory test used for detecting liver dysfunction due to decreased functional hepatic mass or reduced hepatic blood flow are endogenous substances normally extracted by the hepatobiliary system, eg, bile salts (bile acid) or bile pigments (biluribin) and plasma urea and total plasma protein; and intravenous administration of certain exogenous dyes, eg, sulphobromphtalein (BSP) [13]. Those tests are controversial because most of them lack specificity. Liver biopsy is frequently necessary in cases showing biochemical evidence of hepatobiliary disease.

The aim of this study was to evaluate the liver function in dairy cows with abomasal displacement.

2. Materials and methods

A) ANIMALS

In this study, 39 cows with tentative abomasal displacement, and 12 healthy cows have been used as materials. Age of animals varied from 3 to 7 years. These animals were calved and in early lactation period.

B) CLINICAL EXAMINATIONS

Routine clinical examinations including abdominal ausculo-percussion, ballotment of abdomen for splashing sound, liver percussion, rectal examination and abdominal ultrasonography were performed in all animals. Tentative diagnosis of abomasal displacement was verified during the surgery.

C) Blood sampling and serum Analysis

Blood samples were taken from the jugular vein just before the liver biopsies. Serum were obteined place immediately by centrifugation for 20 minutes at 3000 rpm. Collected serum were stored at —20°C before the analysis. Serum were analysed for bile acid (BA), total bilirubin, direct bilirubin, indirect bilirubin, urea, total protein, albumin, globulin, glucose, creatinin, total cholesterol, triglyceride, high density lipoprotein (HDL-cholesterol), low density lipoprotein (LDH-cholesterol), AST, ALT, GGT, CK. All the analysies were performed on an automated analyser (Olympus AU 5200) using commercial test kits (Olympus Diagnostic GmbH). Azobilirubin bichromatic method was used for T-bilirubin (Cat No: OHS2032) and D-bilirubin (Cat No: OHS2008). CHOD-PAP method (enzymatic colourimetric test) was used for total cholesterol (Cat No: 66004) and HDL-cholesterol (Cat No: OH3239), and GPO-PAP method for triglyceride (Cat No: 66003). LDL-cholesterol was calculated from the primary measurements using empirical equation of Friedewald et al. [LDL-chol] = [Total-chol] - [HDL-chol] - [Trigliceride]/5 [14]. Very low density lipoprotein-cholesterol (VLDL-chol) level was calculated by dividing the triglyceride concentration by five [39]. Total serum bile acid (SBA) concentrations were determined enzymatically (Sigma Chemically GmBH, Cat No: 450 A) on an semi-automated analyser (Technicon RA-XT).

D) LIVER BIOPSY

Liver biopsies were performed in the right, 11th to 12th intercostal space [38]. Liver samples were put in Baker's formol-Ca solution and fixed for16 hours [5]. Thin sections (12 µm) were cut from each sample and stained with oil Red O and Sudan Black B and examined under light microscopy. The percentage volume of visible fat in hepatic paranchymal cells was estimated by stereological point counting method of Romeis [31]. Five fields from each animal were examined at x 1100 through the oil immersion lens of a light microscope and a 100 point eyepiece graticule. The average volume fraction of liver cell paranchyma occupied by oil red O positive droplets was recorded.

E) STATISTICAL ANALYSIS

Values were analysed statistically between healthy cows and cows with abomasal displacement by Two simple t test.

3. Results

Clinical findings

The cows with abomasal displacement had clinically appetite, decreased rumen motility and milk production, little or scant defecation along with secondary acetonemia. Auscultation and percussion of the left and right abdomen revealed tympanitic resonance (a ping sound) over the last 3 ribs (10th to 13th). Liver was displaced in the cows with right abomasal displacement. Splashing sound was also heard in left and right abomasum displacement. Surgery was performed in cows with abomasal displacement. All the healthy cows were clinically normal.

Liver biopsy

The liver biopsies from healthy cows were normal, no fatty infiltration of the liver was observed. The liver biopsies from cows with abomasal displacement revealed 31.5±6.1 % fat infiltration.

Biochemical Findings

There were significant alterations in urea, total protein, total cholesterol, albumin, total bilirubin and indirect bilirubin concentrations, but they were within normal range limits. Serum AST ($p < 0.01$) and GGT ($p < 0.001$) levels were significantly increased, and HDL-cholesterol ($p < 0.001$) level was significantly decreased in cows with abomasal displacement compared to healthy cows (Table I).

4. Discussion and Conclusion

The aim of this study was to evaluate the liver function in dairy cows with abomasal displacement.

The clinical findings obtained in this study were similar to the previous results [4, 9, 10, 21, 25, 27].

Fatty liver is frequently associated with abomasal displacement [2, 16]. Abomasal displacement, ketosis, parturient paresis, retain placenta and endometritis have been often associated with a fatty liver [19, 20, 26, 33, 35, 38]. Aslan et al. [4] have shown varying degrees of fat infiltration and 83.3 % incidence of fatty liver in cows with abomasal displacement. In this study, finding of moderate fatty liver in the cows with abomasal displacement was in accordance with previous studies above.

Cholesterol and phospholipid are the principal components of lipoproteins and accompanied with much smaller quantities of triglycerides. When there are disturbances in the lipoprotein synthesis, triglycerides accumulate in the liver cells. A high proportion of the plasma lipids is transported in HDL-cholesterol. The amount of cholesterol and phospholipid differed insignificantly in cows with ketosis compared to normal cows, and the cows with fatty liver had lower amount of cholesterol and phospholipid [6, 30, 36]. According to RAYSSIGUER *et al.* [28], animals with moderate steatosis had significantly lower values of HDL-cholesterol than the

Parameters		Healthy cows (n=39)	Cows with AD (n=12)	P
Bile Acid	**(μmol/L)**	34.9 ±8.3	46.1 ±6	0.29
T. Protein	**(g/L)**	77.7 ±1.6	70.1 ±2.2	0.0061**
Albumin	**(g/L)**	33.2 ±0.7	29.6 ±0.7	0.0022**
Globulin	**(g/L)**	44.5 ±1.3	40.4 ±1.7	0.057
T. Bilirubin	**(μmol/L)**	5.47 ±0.85	8.20 ±0.85	0.032*
D. Bilirubin	**(μmol/L)**	2.22 ±0.34	2.73 ±0.17	0.23
I. Bilirubin	**(μmol/L)**	3.24 ±0.51	5.30 ±0.68	0.022*
Creatinine	**(μmol/L)**	110.5 ±7.07	100.7±7.95	0.43
AST	**(U/L)**	78.5 ±9.00	123.2 ±12	0.0052**
ALT	**(U/L)**	31.6 ±3.00	27.69 ±1.3	0.25
CPK	**(U/L)**	154.5 ±21	220 ±30	0.079
GGT	**(U/L)**	22.33 ±2.10	47.8 ±5.60	0.0001***
Triglyceride	**(mmol/L)**	0.24 ±0.01	0.20 ±0.01	0.15
T. cholesterol	**(mmol/L)**	3.65 ±0.25	2.87 ±0.17	0.017*
HDL-cholesterol	**(mmol/L)**	2.53 ±0.11	1.83 ±0.09	0.0000***
VLDL- cholesterol	**(mmol/L)**	0.05 ±0.002	0.04 ±0.002	0.12
LDL-cholesterol	**(mmol/L)**	1.03±0.18	0.94 ±0.11	0.70
Glucose	**(mmol/L)**	4.93±0.40	4.41 ±0.45	0.40
Urea	**(mmol/L)**	3.26 ±1.04	5.54 ±0.46	0.0002***

*: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$

TABLE I. — Results of clinical chemistry in dairy cows with abomasal displacement (AD) (Mean ±SEM).

control animals as the decrease in HDL-cholesterol and HDL-phospholipid concentrations, whereas the LDL-cholesterol fraction was not altered. In the present study, although cholesterol and HDL-cholesterol levels were significantly lower in the cows with abomasal displacement than healthy cows, they were within normal range limits, and there were no differences in LDL-cholesterol, VLDL-cholesterol and triglyceride concentrations in the same cows. This may be due to the fact that cows had no severe fatty liver, because the most significant finding in cows with severe fatty liver is the dramatic decrease in plasma LDL-cholesterol, particularly VLDL-cholesterol.

GÜL and GRÜDNER [17] found that cows with abomasal displacement had mostly an increase in total bilirubin concentration. However, ASLAN *et al.* [4] determined that there was no significant alteration in total bilirubine concentration of healthy cows compared to cows with abomasal displacement. In the present study, serum total bilirubin ($p < 0.05$) and indirect bilirubin ($p < 0.05$) concentrations were significantly higher in cows with abomasal displacement than healthy cows, but they were within normal range limits. These results were in accordance with GÜL and GRÜDNER [17]. The increment in total and indirect bilirubin may be related to fat infiltration of the liver.

ASLAN *et al.* [4] and OK *et al.* [25] found that cows suffering from abomasal displacement had hyperglycemia. MUYYLE *et al* [24] found that 55 patients suffering from abomasal displacement had high glucose levels. In contrast to this, SEVINC *et al.* [35] determined low glucose levels in cows with fatty liver. In this study, no significant difference was found in serum glucose concentrations in cows with abomasal displacement compared to the healthy cows. It is necessary to interpret plasma glucose results with some caution from a diagnostic and prognostic viewpoint because plasma glucose may be normal or above the normal in secondary ketosis [23].

In various animal species (dog, horse and sheep) the determination of total serum bile acid concentration is considered to be a sensitive and specific indicator in the assessment of liver function [3, 11, 40, 45]. However, diagnostic value of SBA as a liver function test is controversial in cows : while some authors [1, 13, 32, 42, 43, 44] considered SBA as a reliable indicator for liver dysfunction, others did not []12, 15, 27). According to REHAGE *et al.* [29], determination of SBA concentration is a little value in the recognition of fatty liver and even liver failure due to considerable variance of SBA concentration in dairy cows. SEVINC *et al.* [35] have reported that SBA concentration seems to be helpful for liver function in cows with moderate and severe fatty liver. In the present study which is similar to the findings of GÜL and GRÜDNER [17], there was no significant alteration in serum bile acid concentration in cows with abomasal displacement compared to the healthy cows. This may be related to the lack of severe fatty liver in the cows.

SEVINC *et al.* [35] reported that cows with fatty liver had hypoalbuminemia. ASLAN *et al* [4] found that cows suffering from abomasal displacement had hypoalbuminemia. In the present study, serum total protein and albumin concentrations were also significantly lower in cows with abomasal displacement than healthy cows, but these parameters were within normal range limits. Because hypoalbuminemia is a common feature of chronic liver diseases, when the functional hepatic mass is reduced to 20 per cent or less [13]. The lowest albumin level has been found in cows with liver failure, but no cows with fatty liver. The plasma albumin concentration falls significantly in severe hepatic changes [44].

Measurement of serum activities of hepatic enzymes can be useful, but has limitations [7, 36, 37]. AST activity in serum is fairly well correlated to hepatic lipidosis, but this enzyme is non specific to hepatic tissue [30, 32]. LOTTHAMMER [22] has shown that serum activity of AST and serum concentration of total bilirubin are very sensitive indicators of liver disorders, even when subclinical. GGT is more specific to liver tissue, but the correlation of these serum activities with hepatic lipidosis is not as high [7]. ASLAN *et al.* [4], and GÜL and GRÜNDER [18] found that AST concentration increased in cows with abomasal displacement. Bogin et al. [8] found significantly increased AST level in cows with severe fatty liver. Similarly, SEVINC et al. [35] have shown that cows with severe fatty liver had higher levels of GGT and AST. In the present study in accordance with the references above, serum AST and GGT activities were significantly higher in the cows with abomasal displacement compared to the healthy cows.

In conclusion, GGT and AST concentrations, and liver biopsy seem to be helpful in the assessment of liver function in cows with abomasal displacement.

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