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Changes in serum lecithin: cholesterol acyltransferase and apolipoprotein B-100 in dairy cattle either with 1-7 Days in milk displaced abomasum or with 8-21 Days in milk displaced abomasum

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Abstract

Displacement of the abomasum (DA) is a common and economically important problem of dairy cattle in early lactation. This study described the clinical findings and serum biochemical changes of lecithin:cholesterol acyltransferase (LCAT) and apolipoprotein B-100 (apoB-100) in cows during 1-7 and 8-21 days in milk (DIM) from day 0 before surgery up to day 30 after surgical interference. The study was conducted on DA cattle (n= 24) belonged to dairy farms in the Hokkaido area, Japan. The examined cows were classified based on the onset of DA into two groups: DA (1-7 DIM) group (n=11) and DA (8-21 DIM) group (n=13). Cows were examined and sampled at days 0 (operation), 7 and 30. Dairy cattle in the two DA groups showed significant ($P<0.01$) elevation of serum LCAT and apoB-100 at days 7 and 30 when comparing with their values at day 0. These significant changes were not reported between the 2 DA groups at any day of sampling. This study concluded the recovery of diseased groups and the significant effect of surgical operation where serum LCAT and apoB-100 returned to their physiological values.

Keywords: Apolipoprotein B-100, displaced abomasums, dairy cattle, lecithin, cholesterol acyltransferase, post-operative

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Introduction

Displacement of the abomasum (DA) is a common and economically important problem of dairy cattle in early lactation (Stengärde and Pehrson, 2002; Doll et al., 2009). Affected cows produce less milk at least in the short term (Raizman and Santos, 2002; Van Winden and Kuiper, 2003) and have a higher culling rate (GrÖhn et al., 1998; Raizman and Santos, 2002; Radostits et al., 2007) that may reach 10% (Van Winden and Kuiper, 2003).

The metabolic load on the cow varies over time during the first month post-partum, and blood profiles in DA cows may therefore show differences due to time

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from calving. The DA has also been associated with other diseases such as retained placenta, metritis, and ketosis (Rohrbach et al., 1999), as well as with hepatic lipidosis (Bobe et al., 2004).

Clinically, left displaced abomasum (LDA) is characterized by gas accumulation in the abomasum resulting in a tympanic, resonant and high-toned ping sound (Breukink and Kroneman, 1963). Furthermore, diseased cows with DA were febrile with tachycardia, increased respiratory rates and ruminal hypomotility (Goetze and Müller, 1990; El-Attar et al., 2007).

Some authors described the serum biochemical changes and clinical finding in DA cows such as serum lecithin:cholesterol acyltransferase [LCAT] (Nakagawa and Katoh, 1998), apolipoprotein B-100 in (apoB-100) DA cows (Oikawa et al., 1997; Civelek et al., 2006). The current research work focused on the relationship between time of DA incidence in dairy cows and response to treatment through estimation of clinical and serum LCAT and apoB-100 at different times before and after surgery.

Materials and Methods

Materials

The study was conducted on DA cattle (n= 24) belonged to different dairy farms in Hokkaido perfecture, Japan. The dairy farms were distributed in Terasaki, Tsurui, Ishikari and Soya. All animals were treated surgically to correct the displaced abomasum. After calving, the cows were classified according to time of DA occurrence i.e., days in milk (DIM) into two groups; DA (1-7 DIM) group (n=11) and DA (8-21 DIM) group (n=13). These animals were sampled at 3 different times; the 1st one was before surgery (0 day) while the last two times after surgical interference (on the 7th and 30th days). All cattle were treated under the Laboratory Animal Control Guidelines of Rakuno Gakuen University, which basically conform to the Guide for the Care and Use of Laboratory Animals of the National Institutes of Health in the USA (NIH publication No. 86-23, revised 1996).

All blood samples were collected from the jugular vein into plain vacutainer tubes, and then were centrifuged at 3000 rpm for 15 min. Sera were separated and stored at -20ºC till analysis.

Clinical examination and estimation of serum biochemicals were conducted 3 times: days 0, 7 and 30. Clinical examination of all dairy cattle using clinical chart according to Rosenberger (1990) was done. Body condition score (BCS) of all cows was estimated based on a 5-point scale (Ferguson et al., 1994).

LCAT activity was determined using spectrophotometer with commercial kits (Sekisui medical, Tokyo, Japan) according to the method of Manabe et al. (1987), Uchida et al. (1995), Nakagawa and Katoh (1999).

Serum apoB-100 concentrations were estimated using single radial immunodiffusion assay and commercial kits (Bovis ApoB plate, Institute for Metabolic Ecosystem, Osaka, Japan) according to Marcos et al. (1989), Katoh et al. (1993), Oikawa and Katoh (2002).

Statistical analysis

All statistical analyses were performed using Computer Software (SPSS version 17.0, Chicago, USA). The data obtained from clinical examination and biochemical analyses were analyzed by analysis of variance (ANOVA). The significance of differences between the means at selected sampling days (days 7 and 30) and day 0 was in each DA group evaluated by Dunnett's test. The significance of differences between the means of diseased groups [DA (1-7 DIM) and DA (8-21 DIM)] at sampling day 0, 7 and 30, and DA group evaluated by Dunnett's test were expressed as means±SD (Spsswin, 1997).

Results

The clinical findings, including BCS (Table 1 and 2) showed no significant changes neither between the two diseased DA groups at days 7 and 30 when compared with their values at day 0 nor within each DA group at different sampling days (days 0, 7 and 30). Temperature, pulse and respiration were within the physiological reference range. Appetite and ruminal movement were reduced in each DA group at day 0 then both were improved after the surgical correction of DA at days 7 and 30.

Table 1: The clinical and biochemical findings in the diseased groups

Type	No	BCS (2.5-4)[#]			LCAT (U) (929-1059)[##]			ApoB-100 (g/l) (0.01-0.2)[###]		
		Day 0	Day 7	Day 30	Day 0	Day 7	Day 30	Day 0	Day 7	Day 30
DA (1-7 DIM)	11	3.16 ±0.46	3.09 ±0.30	2.91 ±0.30	214.12 ±66.34	320.32 ±87.58	695.72 ±241.17**	0.09 ±0.02	0.14 ±0.03**	0.21 ±0.04**
DA (8-21 DIM)	13	3.13 ±0.43	3.04 ±0.30	2.94 ±0.27	255.50 ±83.64	353.01 ±92.62*	540.21 ±119.97**	0.10 ±0.03	0.15 ±0.03**	0.23 ±0.04**

DA: displacement of the abomasum. DIM: days in milk. BCS: body condition score. LCAT: lecithin cholesterol acyltransferase. ApoB-100: apolipoprotein B-100; * Significant when compared with the value at day 0 (* P<0.05; **P<0.01); [#]Reference value according to Ferguson et al. (1994). [# #]Reference value according to **N**akagawa and Katoh (1998), [###] Reference value according to Mahley et al., 1984).

Table 2: The clinical and biochemical findings in the diseased groups according to sampling day

Days after surgery	No	BCS (2.5-4)[#]		LCAT (U) (929-1059)[##]		ApoB-100 (g/l) (0.01-0.2)[###]	
		DA (1-7 DIM)	DA (8-21 DIM)	DA (1-7 DIM)	DA (8-21 DIM)	DA (1-7 DIM)	DA (8-21 DIM)
Day 0	24	3.16±0.46	3.13±0.43	1.36±0.50	1.46±0.52	2.18±0.98	1.85±0.55
Day 7	24	3.09±0.30	3.04±0.30	2.91±0.30	2.85±0.38	2.73±0.65	2.46±0.52
Day 30	24	2.91±0.30	2.94±0.27	3.00±00.0	3.00±0.00	2.82±0.60	2.85±0.55

DA: displacement of the abomasum. DIM: days in milk. BCS: body condition score. LCAT:lecithin cholesterol acyltransferase. ApoB-100: apolipoprotein B-100; * Significant when compared with the value at day 0 (*P<0.05; **P<0.01); [#]Reference value according to Ferguson et al. (1994). [##]Reference value according to **N**akagawa and Katoh (1998), [###]Reference value according to Mahley et al., 1984).

Dairy cattle showed significant elevation of both of serum LCAT [P<0.01 for day 30 in the two groups and P<0.01 for day 7 in DA with 8-21 DIM] and apoB-100 [P<0.01 for days 7 and 30 in the two DA groups] in the two DA groups on day 7 and 30 when compared with their values at day 0 (Table1). These significant changes were not reported between the two DA groups at any day of sampling (Table 2).

The serum activities of LCAT and apoB-100 in each DA group started to increase gradually after operation at day 7 and reached maximum at day 30 where they reached to their reference values particularly for apoB-100.

Discussion

LDA commonly occurred in the postpartum period (Rohn et al., 2004) and most frequently in high-yielding cows during early lactation (Veysi et al., 2003). DA cases were also recorded within a period from 3 to 7 weeks after parturition (Constable et al., 1991; Zadnik, 2003; El-Attar et al., 2007).

The clinical findings, including appetite, temperature, pulse, respiration and rumen movements, in all DA cases showed no significant changes neither between the DA [DA (1-7 DIM) and DA (8-21 DIM)] groups nor within each DA group. All these findings were within the physiological reference range reported by Ferguson et al. (1994) and Radostits et al. (2000). On the other hand, the previous reports about DA stated that diseased cows with DA were febrile with increased heart and respiratory rates and ruminal hypomotility (Goetze and Müller, 1990; El-Attar et al., 2007).

BCS showed no significant changes neither between the two diseased groups, nor within each DA group. Other previous studies reported that cows with excess BCS at parturition are at increased risk for LDA. The increased incidence rate of LDA for cows with high BCS may be associated with increased ketosis and fatty liver, greater reduction of prepartum intake, and slower increases in postpartum intake for overconditioned cows at parturition (Grummer, 1995).

The serum biochemical changes through the current study referred to the improvement of the health status of DA cattle after surgical correction of DA. The serum activities of LCAT were remarkably elevated in DA (1-7 DIM) and DA (8-21 DIM) groups particularly at day 30. They reached their reference values reported by Nakagawa and Katoh (1998). These significant changes were not reported between the two DA groups neither at day 0, 7 nor 30. The previous reports said that LCAT activity, together with the CE and FC concentration, is reduced in cows with ketosis and LDA (Nakagawa and Katoh, 1998). It was thought that estimation of the LCAT activity and of the CE concentration during the non-lactating stage would be useful in discovering cattle that are susceptible to postparturient disorders such as ketosis (Nakagawa and Katoh, 1998). The reduction in LCAT activity was detected prior to diagnosis of ketosis or milk fever (Nakagawa and Katoh, 2000).

The serum levels of apoB-100 were remarkably elevated in DA (1-7 DIM) and DA (8-21 DIM) groups at day 7 and 30. They reached their reference values that were reported by Mahley et al. (1984) and Itoh et al. (1997) in healthy cattle. These significant changes were not reported between the two diseased groups at any of the sampling days. In contrast, the apoB-100 concentration decreased in cows with LDA, ketosis and retained placenta (Oikawa et al., 1997).

The current research reported that serum concentrations of apoB-100 in the two DA groups were within the physiological reference values, whether before surgery (Day 0) or after surgery (Days 7 and 30). The previous reports indicated that the decreased apoB-100 concentrations were similar among all diseased cows (40 to 60% of healthy controls during early lactation) and are not largely different from that in cows with fatty liver. Same decreased rates suggest that decreases of apoB-100 concentrations in ketosis, LDA, retained placenta, milk fever and downer cow syndrome are primarily due to fatty liver, thereby supporting the hypothesis that these diseases are related to fatty liver (Reid, 1980; Gerloff et al., 1986; Herdt, 1988).

Some research articles reported that serum LCAT activity as a diagnostic marker for fatty liver-related diseases such as DA and ketosis, is more useful than apoB-100 concentrations because the reduction in its activity precedes clinical signs such as ketonuria or recumbency and also because the activity is not altered during the peripartum period, at least in some healthy cows (Nakagawa and Katoh, 1998).

Conclusion

No significant change neither clinically nor biochemically was observed between the two groups (1-7 DIM) and (8-21 DIM). A significant effect of surgical operation on serum LCAT and apoB-100 returned to their physiological values indicating that the cows could restore these physiological parameters.

Authors' contribution

Authors have conducted the study equally and discussed the results, read and approved the final manuscript.

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