

# Change of biochemical parameters in cows with abomasal displacement after omentopexy

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The aim of the research is to evaluate the postsurgical health condition of cows with left abomasal displacement (LDA) based on the blood serum biochemical indices. The research has been performed at a Lithuanian cattle farm having 600 dairy cows in 2007–2014. The research included in total 30 cows diagnosed with LDA during the clinical trial. For the purpose of control, 25 clinically healthy cows were selected based on the analogy principle. All the cows with LDA have undergone surgical treatment according to omentopexia. For the ketosis prevention, cows were given 0.300 kg of monopropylenglycol for 14 days after surgical correction. For the purpose of biochemical testing, blood samples were collected from *v. coccigea* right before the surgery (Day 0), and subsequently seven days (Day 7), fourteen days (Day 14), and twenty-one days (Day 21) after the surgery. Blood serum was tested for the following parameters: calcium (Ca), phosphorus (P), magnesium (Mg), aspartataminotransferase (AST), albumines (Alb), beta-hydroxybutyrates (BHB), glucose concentration. Cows with LDA were observed to develop ketosis and hepatic lesions after surgical correction. Cows with LDA demonstrated reliably ( $p < 0.001$ ) higher BHB concentration than clinically healthy cows (average BHB of cows with LDA amounted to 1.16 mmol/l, whereas that of healthy cows was 0.8 mmol/l). The average AST concentration in cows with LDA amounted to 158 (IU/l), whereas that in control cows was 86.9 IU/l ( $p < 0.001$ ). The average blood glucose level in cows with LDA amounted to 2.27 mmol/l, whereas that in control cows was 2.62 mmol/l ( $p < 0.05$ ). Hypocalcemia is characteristic of cows with LDA. The average calcium concentration in the blood serum of cows with LDA amounted to 2.09 mmol/l, whereas that of healthy cows was 2.73 mmol/l ( $p < 0.05$ ). Calcium concentration remained low for the entire period of the trial (until Day 21 after the surgical correction). Risks of ketosis and hepatic lesions decreased after 21 days following the treatment (when BHB AST levels decreased and blood glucose level increased).

**Key words:** cows, LDA, surgical treatment, biochemical testing

## INTRODUCTION

Abomasal displacement in cattle is a worldwide disease, the majority of which is seen with higher frequency specifically after calving (Radostits et al., 2007). Higher incidence rate of LDA was observed in cows during their second to fourth lactation. The LDA incidence was very high in cows fed with a ration enriched in concentrates (>60%) compared to the incidence in animals fed with at least 50% forage. The body temperature, heart rate,

and respiratory rates were increased in LDA-affected cows (Mokhber et al., 2013).

The left displacement of the abomasum (LDA) is a common disease in periparturient dairy cows (Zurr, Leonhard-Marek, 2012). Plasma  $\beta$ -hydroxybutyrate (BHB) levels above the reference range are regarded as risk factors for the occurrence of LDA (Zurr, Leonhard-Marek, 2012). Cows with displacement of the abomasum (LDA) are at increased risk of complicated ketosis and metritis (Radostits et al., 2007). Displacement of abomasums has been introduced

as one of the most important metabolic and organic internal disorders of cattle. Abomasal displacement occurs most frequently in high-yielding cows during early lactation (Veysi et al., 2003).

Cattle with LDA showed reduction in appetite, selective appetite (eagerness to eat hay but reluctance to eat grains), pasty feces, characteristic high-pitched ping in percussion over the left middle to upper third of the abdomen between ribs 9 and 11, and a splashing sound with bell-like echo induced by ballottement (Mokhber et al., 2013).

Surgical correction of the left displaced abomasum (LDA) is common in lactating dairy cattle (Nathalie et al., 2013). The left abomasal displacement (LDA) is seen more frequently than the right displacement (Doll et al., 2009).

Development of the abomasal displacement is highly influenced by calcium deficiency: all sick cows showed increased enzyme AST activity. It was found that prophylaxis of high producing dairy cows in a herd against abomasal displacement may be comprised of regular evaluations of blood serum biochemical indices, milk testing data analysis and quantitative as well as qualitative analysis of the diets (Antanaitis et al., 2007).

## MATERIALS AND METHODS

The research has been performed at a Lithuanian cattle farm having 600 dairy cows in 2007–2014. The research included in total 30 cows diagnosed with LDA during the clinical trial. For the purpose of control, 25 clinically healthy cows were selected based on the analogy principle.

All the cows with LDA have undergone surgical treatment according to omentopexia. For ketosis prevention, cows were given 0.300 kg of monoprolynglycol for 14 days after surgical correction (Herdt, 2000). For the purpose of biochemical testing, blood samples were collected from *v. coccigea* right before the surgery (Day 0), and subsequently seven days (Day 7), fourteen days (Day 14), and twenty-one days (Day 21) after the surgery. Blood serum was tested for the following parameters: calcium (Ca), phosphorus (P), magnesium (Mg), aspartataminotransferase (AST), albumines (Alb), hydroxybutyrates (BHB), glucose (Glu). The blood serum was measured by a computerized analyzer Hitachi 705 (Hitachi, Japan) using DiaSys (Diagnostic Systems GmbH, Germany).

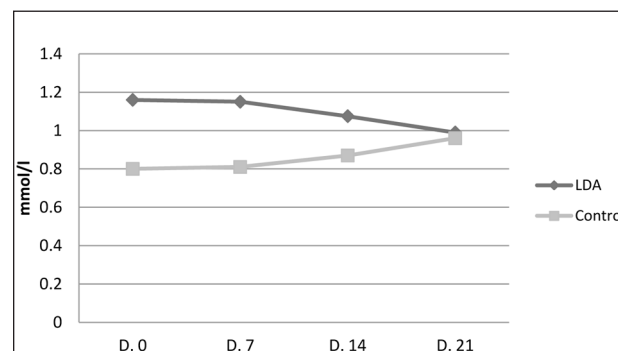
The test data were processed using the SPSS statistical package (SPSS for Windows 15.0, SPSS Inc., Chicago, IL, USA, 2006). The data were considered reliable from the statistic point of view when  $p < 0.05$ .

Scientific research was carried out in accordance with the Law of the Republic of Lithuania on Animal Care, Housing, and Use No. VIII-500 (Valstybės žinios No. 108, 28.11.1997) as well as statutory acts – Order of State Veterinary Service Regarding Veterinary Requirements on Laboratory Animal Breeding, Care, and Reproduction (No. 4–361, 31.12.1998) and Regarding Use of Laboratory Animals for Scientific Experiments (No. 4–16, 18.01.1999). The new edition of the Law came into force on 01.01.2013, subparagraph 10 of Article 8 came into force on 01.07.2013, and subparagraph 2 of Article 7 and subparagraph 4 of Article 2 come into force on 01.01. 2016.

**The aim of the research** is to evaluate changes of some blood biochemical parameters in cows with LDA after omentopexy.

## RESULTS AND DISCUSSION

**Hydroxybutyrates.** Cows with LDA demonstrated reliably ( $p < 0.001$ ) higher BHB concentration than clinically healthy cows (average BHB of cows with LDA amounted to  $1.16(\pm 0.23)$  mmol/l, whereas that of healthy cows was  $0.8(\pm 0.1)$  mmol/l) (Fig. 1). After the LDA treatment, gradual reduction in BHB was observed, whereas BHB of cows in the control group started increasing on Day 14 and reached the same level as that of cows with LDA on Day 21. BHB indicates the completeness of oxidation (“burning”) of fat in the liver. Ketone bodies (BHB, acetone and acetoacetate) are intermediate



**Fig. 1.** BHB variation in the blood serum of cows with LDA and the control group

metabolites of oxidation of fatty acids; as the supply of NEFA to the liver exceeds the ability of liver to completely oxidize the fatty acids to supply energy, the amount of ketone body production increases. Ketone bodies can be used by muscle as an alternative fuel source to glucose, sparing glucose for milk production (Herdt, 2000).

For the cows with LDA, the average AST concentration during surgery was found to amount to  $158(\pm 5.3)$  IU/l, whereas that for healthy cows was  $86.9(\pm 8.2)$  IU/l ( $p < 0.001$ ). After the surgical correction, the AST concentration was observed to gradually decrease, while on Day 21 it reached almost the same level as that of control cows (cows with LDA –  $84(\pm 13)$  IU/l, control –  $87.1(\pm 7.0)$  IU/l) (Fig. 2). Serum biochemical changes in cows with LDA revealed a significant increase in ALP and AST. These results were agreeable with those of O'Zkan and Poulsen (1986), Zadnik (2003), and El-Attar et al. (2007). Metabolic imbalances in dairy cows have a strong impact on liver function and vice versa. In line with this, increased levels of AST activity and ALP were also significantly associated with failure (Voros, Karsai, 1987; Lenz, 1993) that could be attributed to hepatic lipidosis, endotoxemia, and hepatocyte damage as well (Zadnik, 2003; El-Attar et al., 2007). Aspartate aminotransferase (AST) is an enzyme that becomes elevated with cell damage and may be elevated in cows with fatty liver disease. Although there have been associations between AST and subsequent occurrence of displaced abomasums (Geishauser et al., 1998), the test lacks both sensitivity and specificity. For assessing the adaptive response to energy balance NEFA and BHBA are the best two measures. Subclinical ketosis (BHBA  $> 1\ 200\text{--}1\ 400\ \mu\text{mol/L}$ ) in early lactation

is associated with 3 to 8 times increased risk of LDA (Geishauser et al., 2000; Duffield et al., 2009).

The trial showed the average calcium concentration in the blood serum of cows with LDA of  $2.09(\pm 0.17)$  mmol/l, whereas that of healthy cows was  $2.73(\pm 0.14)$  mmol/l ( $p < 0.05$ ). The statistically reliable difference between the two groups persisted throughout the entire period of the trial ( $p < 0.05$ ) (Fig. 3). The present results demonstrated a significant reduction in calcium in cows with LDA (Veysi et al., 2003; Zadnik, 2003; Delgado-Lecaroz et al., 2000; El-Attar et al., 2007), but there were no significant differences in phosphorous and magnesium concentrations of cows with abomasal displacement compared to healthy cows. The puerperal hypocalcemia represents a significant risk factor for development of abomasum displacement in cows (Houe et al., 2001). In the cows that developed clinical LDA, decreased values of calcium were detected prior to LDA (Geishauser et al., 2000). Calcium demand is tremendous immediately postpartum and monitoring serum calcium in cows less than a week following calving may have some utility, but before or beyond this time period it makes no sense to measure calcium. Recently, low serum calcium concentrations (subclinical hypocalcemia) have been linked with increased risk of early lactation culling (Duffield et al., 2005).

The blood glucose level in cows with LDA amounted to  $2.27(\pm 0.35)$  mmol/l, whereas in control cows it was  $2.62(\pm 0.17)$  mmol/l ( $p < 0.05$ ). On Day 7, the blood glucose level in cows with LDA was observed to increase to  $2.65(\pm 0.11)$  mmol/l and reached the blood glucose level of cows in the control group, whereas on Day 14 exceeded it (cows with LDA –  $2.89(\pm 0.39)$  mmol/l,

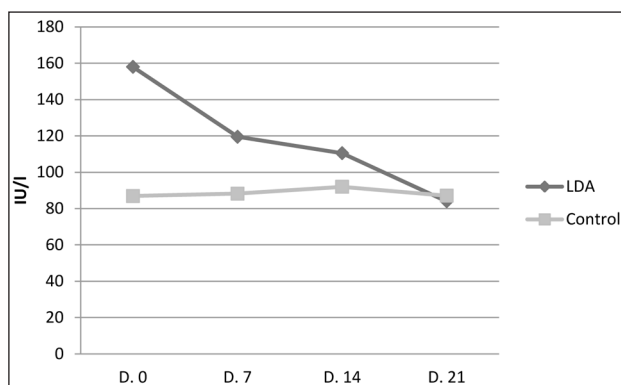


Fig. 2. AST level variation in the blood serum of cows with LDA and the control group

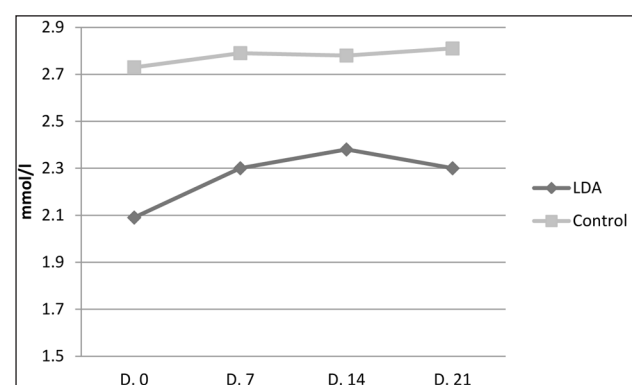
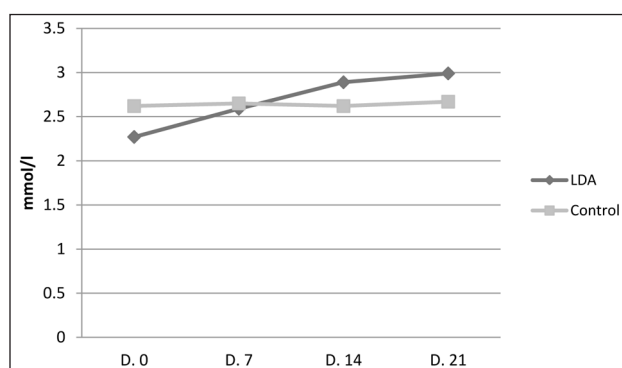


Fig. 3. Calcium level variation in the blood serum of cows with LDA and the control group

control – 2.62(±0.17) mmol/l). Statistically reliable difference ( $p < 0.05$ ) also remained on Day 21 (cows with LDA – 2.99(±0.18) mmol/l, control – 2.67(±0.17) mmol/l) (Fig. 4). Significant increase in the blood glucose level in cows with displaced abomasums is a result that conforms to that of Zadnik (2003) and El-Attar et al. (2007). Holtenius et al. (1998; 2000) reported decreased abomasal motility in cows with high insulin combined with high glucose levels (Holtenius et al., 1998; 2000). On the other hand, Van Winden et al. (2003) found low levels of insulin and glucose in cows that developed abomasum displacement after



**Fig. 4.** The blood glucose level variation in the blood serum of cows with LDA and the control group

10 days. The exact mechanism by which the abomasal displacement leads to hyperglycemia is unknown (Van Winden et al., 2002). Glucose is the primary metabolic fuel and is absolutely required for vital organ function, fetal growth, and milk production. In dairy cows, the massive energy demand to support milk production is partly met through gluconeogenesis. Glucose concentrations are under tight homeostatic control. Therefore, although glucose has a central role in metabolism, it is a poor analyte for monitoring or investigating herd problems (Herdt, 2000).

No other statistical reliabilities between other recorded parameters were found.

## CONCLUSIONS

Cows with LDA subject to surgical treatment according to Dirksen and given 0.300 kg of monopropylenglycol for 14 days after the surgical correction showed the following:

### 1. Cows with LDA were observed to develop ketosis and hepatic lesions after surgical correction.

Cows with LDA demonstrated reliably ( $p < 0.001$ ) higher BHB concentration than clinically healthy cows (average BHB of cows with LDA amounted to 1.16 mmol/l, whereas that of healthy cows was 0.8 mmol/l). The average AST concentration in cows with LDA amounted to 158 (IU/l), whereas that in control cows was 86.9 IU/l ( $p < 0.001$ ). The average blood glucose level in cows with LDA amounted to 2.27 mmol/l, whereas that in control cows was 2.62 mmol/l ( $p < 0.05$ ).

### 2. Hypocalcemia is characteristic for cows with LDA.

The average calcium concentration in the blood serum of cows with LDA amounted to 2.09 mmol/l, whereas that of healthy cows was 2.73 mmol/l ( $p < 0.05$ ). The calcium concentration remained low for the entire period of the trial (until Day 21 after the surgical correction).

### 3. Risks of ketosis and hepatic lesions decreased after 21 days following the treatment (when BHB, AST levels decreased and blood glucose level increased).

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### KARVIŲ, SERGANČIŲ ŠLIUŽO DISLOKACIJA, BIOCHEMINIŲ RODIKLIŲ KAITA PO OMENTOPEKSIJOS

#### S a n t r a u k a

Tyrimo tikslas – po gydymo omentopeksijos būdu įvertinti šliužo dislokaciją į kairę pusę (ŠDK) sirgusių karvių kraujo biocheminių rodiklių kaitą. Tyrimas atliktas 2007–2014 m. Lietuvos gyvulininkystės ūkyje, laikančiame 600 melžiamų karvių. Tirta 30 karvių, kurioms buvo diagnozuota ŠDK. Kontrolei (analogų principu) buvo atrinktos 25 kliniškai sveikos karvės. Visoms karvėms, sirgusioms ŠDK, omentopeksijos būdu atliktas operacinis gydymas. Ketozės prevencijai po operacijos 14 dienų karvės buvo girdomos monopropilenglikoliu (po 0,300 kg). Kraujas biocheminiam tyrimui buvo imamas iš *v. coccigea* prieš pat operaciją (0 d.), praėjus septynioms paroms (7 d.), keturiolikai parų (14 d.) ir dvidešimt vienai parai (21 d.). Iš kraujo serumo nustatyta: kalcio (Ca), fosforo (P), magnio (Mg), aspartatamino transferazės (AST), albuminų (Alb), betahidroksibutiratų (BHB), gliukozės koncentracijos. Karvėms, susirgusioms ŠDK, po operacijos stebima ketozė ir kepenų pažeidimai. ŠDK BHB koncentracija buvo statistiškai patikimai ( $p < 0,001$ ) didesnė, nei kliniškai sveikų karvių (vidutinė BHB ŠDK sirgusių karvių – 1,16 mmol/l, sveikų – 0,8 mmol/l). Vidutinė fermento AST koncentracija ŠDK sirgusių karvių – 158 (IU/l), kontrolinių – 86,9 IU/l ( $p < 0,001$ ); sirgusių ŠDK vidutinė gliukozės koncentracija – 2,27 mmol/l, kontrolinės grupės – 2,62 mmol/l ( $p < 0,05$ ). Karvėms, susirgusioms ŠDK, būdinga hipokalcemija. Sirgusių ŠDK karvių vidutinė kalcio koncentracija kraujo serume – 2,09 mmol/l, sveikų – 2,73 mmol/l ( $p < 0,05$ ). Žema kalcio koncentracija išsilaiškė ir viso tyrimo metu (iki 21 d. po operacijos). Ketozės ir kepenų pažeidimų rizika sumažėjo praėjus 21 parai po gydymo (sumažėja BHB ir AST koncentracijos, padidėja gliukozės koncentracija kraujo serume).

**Raktažodžiai:** karvės, ŠDK, operacija, biocheminiai tyrimai