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Comparison of Glucose Levels in Blood Samples Taken from Coccygeal, Jugular and Mammary Vein of Cows in Lactation

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Abstract

Blood glucose level is one of the most commonly used parameters in assessing the energy metabolism in dairy cows. The presented study aimed to compare the glucose concentrations in blood samples taken from the coccygeal vein, jugular vein, and mammary vein from the same animals at the same time. Healthy Holstein-Friesian dairy cows (n=25) in their second and third lactation were selected for the study. The blood samples were taken from the coccygeal vein, jugular vein, and *V. subcutanea abdominis* (mammary vein) at the same time from each animal. To analyze blood glucose, Free Style Optium Blood Glucose Test Strip (Abbott, Istanbul, TURKIYE) was used. In comparison to the blood taken from both the jugular vein and coccygeal vein, glucose levels in blood samples taken from the mammary vein were significantly low (P<0.001). As a result, the determination of glucose levels in blood samples taken from the mammary veins may cause erroneous interpretations. Therefore, the mammary vein for blood glucose must not be used as a sampling site.

Key Words; Cow, Coccygeal vein glucose, Jugular vein, Mammary vein

Introduction

The incidence of metabolic diseases increased concurrently with the increased number of large dairy farms. Especially, primary clinical ketosis, subclinical ketosis, and yield losses that occur as a result of negative energy balance are one of the major health problems that large dairy farms are facing. To determine the negative energy balance in dairy cattle, it is important to assess the blood glucose concentration along with beta-hydroxybutyrate (BHB) and non-esterified fatty acids (NEFA).[1] Glucose must be assessed absolutely in the differential diagnosis of Type-1 and Type-2 ketosis.[2] Briefly, the blood glucose level is one of the basic parameters of the metabolic profile test.

Glucose is the principal source of energy for vital processes of all mammalian cell types.[1] Certain cell types and tissues such as the brain, erythrocytes, kidney medulla, and mammary tissue have an obligatory requirement for glucose as a substrate.[3] Glucose is mainly taken up by the mammary gland and plays an important role in regulating milk volume through lactose synthesis in dairy cows.[4] Also, glucose is one of the most important biochemical parameters that play a role in the physiological regulation of the ovarian cycle.[5] For the activation of many metabolic functions, the relative glucose level must be maintained at physiological limits.

The presented study aimed to compare the glucose levels in blood samples taken from the coccygeal vein, jugular vein, and mammary vein from the same animals and the same time.

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Materials And Methods

This study was performed on a dairy farm in Denizli, Turkiye. Healthy 25 Holstein-Friesian dairy cows (3-5 years old) on postpartum days 14 to 21 were selected for the study. Housing, feeding, and management conditions were the same for all cows. The average daily milk production in cows was determined as 32.2±2.14 kg.

All blood samples were taken in the morning, approximately 2 hours before the morning feed. Blood samples were taken from coccygeal, jugular, and mammary veins, respectively, at the same timeframe from each of the animals in the study. New sterile 25x8 mm needles were used to take blood samples from each animal and each vein.

To analyze blood glucose, a blood glucose test strip (Free Style Optium Blood Glucose Test Strip, Abbott® Inc, Istanbul, Turkiye) was used. Blood samples taken from the animals were directly installed on the test strips for glucose measurement. Glucose levels were measured using a Free-Style Precision electrochemical meter (Abbott®Inc, Istanbul, Turkiye) without waiting based on the manufacturer's recommendations.

Values are presented as means ± standard error of the mean (SEM). Data were used Shapiro–Wilk normality test for determining normal distribution. All groups showed normal distribution. T-test was used to determine any difference among groups. Tukey test was used as a post hoc analysis. The result was considered statically significant at $p<0.05$. All statistical analyses were performed using the Sigma Stat 3.1 for Windows statistical package (Systat Software®, Inc, Point Richmond, California, USA). The Local Ethical Committee approved the study design for Animal Experiments of Bursa Uludag University (No:2022-03/05).

Results

In comparison to the blood taken from both the jugular vein and coccygeal vein, glucose levels in blood samples taken from the mammary vein were significantly low ($p<0.001$) (Table 1). Although glucose levels in blood samples taken from the jugular vein were slightly higher compared to the sample taken from the coccygeal vein, there was no statistical significance.

Table 1. Glucose levels in blood samples taken from three different veins of the same animals at the same time frame (n=25).

Parameter	Jugular Vein (n=25)	Coccygeal Vein (n=25)	Mammary Vein (n=25)
Blood Glucose (mg/dl)	65.2 ±11.1^{A}	62.4 ± 13.5^{A*}	51.2 ± 9.3^{B}

Data are expressed as means ± SEM. *p< 0.05.

A, B: significant difference between groups' measurements at the same time.

Discussion

It is important to assess the blood glucose level along with BHB and NEFA to determine the negative energy balance in dairy cattle. Also, blood glucose should be evaluated in disorders characterized by hyperglycemia, such as rumen acidosis, insulin resistance, severe stress, and diabetes mellitus. Blood glucose is one of the most important parameters of the metabolic profile test. Moreover, it is used to determine the type and degree of ketosis. Briefly, glucose is commonly used as an indicator of energy metabolism.[2,6] There are some studies on the suitability of the glucose meter used in our study for cattle.[7,8] Mair et al.[7] reported that the glucose levels analyzed with the FreeStyle Precision (FSP, Abbott) in the capillary blood and the coccygeal blood were smaller than laboratory results in plasma. Similarly, Panousis et al.[9] determined that the mean glucose concentration resulting from the laboratory method was significantly higher compared to that obtained from the FreeStyle Precision hand-held meter. Oetzel and McGuirk[10] indicate that there is no agreement between laboratory plasma glucose and blood glucose measured using a hand-held meter. However, Zakian et al.[11] reported that the meter was sensitive and specific and had good agreement with the reference methods for detecting subclinical ketosis and hypoglycemia. Also, they determined that the performance of the meter in measuring blood glucose using glucose oxidase as the reference method was better than that reported in other studies that used hexokinase as the reference method. However, our study did not evaluate the sensitivity and specificity of the device used, as in the studies described above.

Blood samples are generally taken from the jugular or coccygeal vein for assessment of glucose and other biochemical parameters. However, mammary veins are sometimes used for blood sampling due to the easy approach site and quicker collection. This situation may give erroneous results in the assessment of blood glucose because of the high glucose uptake of the mammary glands for lactose synthesis.[4]

In the present study, in contrast with both jugular and coccygeal veins, glucose levels in blood samples taken from the mammary vein were significantly low ($p<0.001$) (Table 1). Šamanc et al.[12] reported that mammary vein glucose concentrations were significantly lower in all lactating groups than in the group of dry cows. Similar to our results, Šamanc et al.[12] determined that jugular glucose concentration was a higher level than mammary glucose concentration in the high-yielding cow. In addition, Šamanc et al.[12] found that the jugular vein / mammary vein ratios for

glucose concentrations were above 1.0 in all cows. However, they did not compare the glucose concentration of the tail vein. In the present study, in comparison to the blood taken from coccygeal veins, glucose levels in blood samples taken from the mammary vein were found to be significantly low ($p<0.001$). Although glucose levels in blood samples taken from the jugular vein were slightly higher compared to the sample taken from the coccygeal vein, there was no statistical significance.

The glucose requirements of the dairy cow are dominated by the requirements of the mammary gland for milk synthesis. Concordantly, glucose utilization can be higher in mammary glands due to milk yield by comparison with other tissues such as muscle and adipose tissue.[13] Some researchers have reported that the high priority of the mammary gland for glucose utilization is supported by endocrine changes during peak lactation.[13] A decreased insulin concentration after calving reduces glucose uptake into insulin-sensitive organs such as muscle and adipose tissue. However, mammary glands are not affected by insulin action. Therefore, glucose uptake into the mammary glands consists of privilege.[14] Due to the mentioned reasons, glucose levels in blood samples taken from the mammary vein may be determined as low compared to the jugular or coccygeal vein.

Conclusion

As a result, the determination of glucose levels in blood samples taken from the mammary veins may cause erroneous interpretations, as well as it can lead to wrong treatment practices. Therefore, the mammary vein must not be used as a sampling site, especially for the measurement of glucose. Our study results may be enlightening to further studies on the assessment of biochemical parameters such as BHB, NEFA, and insulin, which are associated with glucose metabolism in blood samples taken from the mammary vein.

References

1. McArt JA, Nydam DV, Oetzel GR, Overton TR, Ospina PA. Elevated non-esterified fatty acids and beta-hydroxybutyrate and their association with transition dairy cow performance. The Veterinary Journal 2013;198,560-570.
2. Şentürk S, Mecitoğlu Z, Temizel M, Cihan H, Kasap S, Demir G. Clinical and biochemical evaluation of cows occurring severe weight loss after calving. Journal of Research in Veterinary Medicine 2010;29:43-49.
3. Baraille F, Planchais J, Dentin R, Guilmeau S, Postic C. Integration of chREBP-mediated glucose sensing into whole body metabolism. Physiology 2015;30:428-437.
4. Lin Y, Sun X, Hou X, Qu B, Gao X, Li Q. Effects of glucose on lactose synthesis in mammary epithelial cells from dairy cow. BMC Veterinary Research 2016;12:2-11.
5. Oikonomou G, Arsenos G, Valergakis G, Tsiaras A, Zygoyiannis D, Banos G. Genetic relationship of body energy and blood metabolites with reproduction in Holstein cows. Journal of Dairy Science 2008;91:4323-4332.
6. Senturk S. Which laboratory parameters should be considered in which clinical findings in the practical laboratory for cattle? Ozsan Press: Bursa, 2017; pp.259-260.
7. Mair B, Drillich M, Klein-Jöbstl D, Kanz P, Borchardt S, Meyer L, Schwendenwein I, Iwersen M. Glucose concentration in capillary blood of dairy cows obtained by a minimally invasive lancet technique and determined with three different hand-held devices. BMC Veterinary Research 2016; 12:34.
8. Voyvoda H, Erdogan H. Use of a hand-held meter for detecting subclinical ketosis in dairy cows. Research in Veterinary Science 2010;89:344-351.
9. Panousiıs N, Kritsepi M, Karagiannis I, Kalaitzakis E, Lafı E, Brozos C. Evaluation of precision exceed for on-site monitoring of blood B-hydroxybutyric acid and glucose in dairy cows. Journal of Hellenic Veterinary Medical Society 2011;62:109-117.
10. Oetzel G, McGuirk S. Fact sheet - Cowside blood BHBA testing with a hand-held 'ketometer'- version 4, 3/5/09, School of Veterinary Medicine, University of Wisconsin-Madison, USA. http://www.vetmed.wisc.edu/dms/fapm/fapmtools/tci/BHBA-Testing- Update-090305.pdf [Accessed 2 May 2011].
11. Zakian A, Tehrani-Sharif M, Mokhber-Dezfouli M, Nouri M, Constable P. Evaluation of a point-of-care electrochemical meter to detect subclinical ketosis and hypoglycemia in lactating dairy cows. Australian Veterinary Journal 2017;95:123-128.
12. Šamanc H, Kirovski D, Lakić N, Celeska I, Bojković-Kovačević, S, Sladojević Ž, Ivanov I. A comparison of the concentrations of energy-balance-related variables in jugular and mammary vein blood of dairy cows with different milk yield. Acta Veterinaria Hungarica 2014;62:52-63.
13. Hammon HM, Metges CC, Schulz A, Junghans P, Steinhoff J, Schneider F, Pfuhl R, Bruckmaier R, Weikard R, Kühn C. Differences in milk production, glucose metabolism, and carcass composition of two Charolais 3 Holstein F2 families derived from recipro-

cal paternal and maternal grandsire crosses. Journal of Dairy Science 2010;93:3007-3018.

14. Komatsu T, Itoh F, Kushibiki S, Hodate K. Changes in gene expression of glucose transporters in lactating and nonlactating cows. Journal of Animal Science 2005;83:557-564.