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Relationship between HbA1c, Fructosamine and Clinical Assessment of Glycemic Control in Dogs

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Veterinary Chemistry Analyzer

The study aimed to evaluate the relationship between HbA1c, fructosamine, and clinical assessment in monitoring glycemic control in diabetic dogs. A total of 28 diabetic dogs were enrolled, and their glycemic control was assessed using a clinical score tool (CST), serum fructosamine levels, and blood HbA1c concentrations. The clinical score tool was based on owner observations and physical examination. The current study employed a clinical assessment (CST) as the gold standard for evaluating the usefulness of test results for identifying dogs with various levels of diabetes control.

Clinical assessment consisted of physical examination and a Clinical Survey Tool (CST) that was completed during an interview with the dog owner. The CST consisted of 12 items with binary responses (shown as Figure 1) and concerned the 4-week period that preceded the interview. The CST was similar to a CST used previously to evaluate diabetic control in dogs[1]. Nine items required direct answers provided by dog owners to questions posed by the veterinarian completing the CST. These items recorded owners' responses to questions about presence/ absence of clinical signs, complications, and of treatment compliance. The remaining three items were independent of owner input and were recorded by the veterinarian supervising the evaluation and assessed specific parameters from the physical examination. Each item was assigned equal weight and scored either 0 or 1 for a maximal score of 12. The CST score classified diabetic control according to the scale: 11–12 = GOOD control, 7–10 = FAIR control, 0–6 = POOR control.

EVALUATION OF DIABETES CONTROL – Make any additional notes on reverse

Patient history (All refer to changes over previous 4 weeks)

|	
1. Need for insulin adjustment	Yes/ No
2. Change in water consumption	Yes-increased water consumption/ No
3. Change in urine frequency/amount	Yes/ No
4. Change in appetite/food intake	Change in appetite (increased)/ No change in appetite
5. Change in activity level	Change in activity level (decreased)/ No change in activity level
6. Increase in body weight	Yes/ No (no change/decrease)
7. Signs of hypoglycemia noticed	Yes/ No
8. Required treatment for hypoglycemia	Yes/ No
9. Compliant with recommended insulin dosing	Yes/ No

Physical examination

10. Change body weight >5%	Yes/ No
11. Body condition score	Unacceptable (poor body condition)/ Acceptable (good body condtion)
12. Hydration status	Dehydrated/ Normal hydration

▶ **Figure 1:** The CST content

The Results showed the agreement between the CST and both fructosamine and HbA1c tests ranged from poor to fair, but HbA1c showed better agreement with the clinical assessment than fructosamine when classifying glycemic control as acceptable or unacceptable. Also, there was a moderate correlation between HbA1c and fructosamine levels (R=0.58). The author mentioned HbA1c ≤8.5% was suggested to indicate fair glycemic control in insulin-treated diabetic dogs based on the clinical assessment. Nonetheless, further research is still needed to establish optimal HbA1c cut-off values for dogs. In conclusion, while HbA1c showed better alignment with clinical assessment compared to fructosamine, both tests had misclassifications. Therefore, HbA1c and fructosamine should not be used in isolation but rather as part of a combined approach with other clinical monitoring methods.
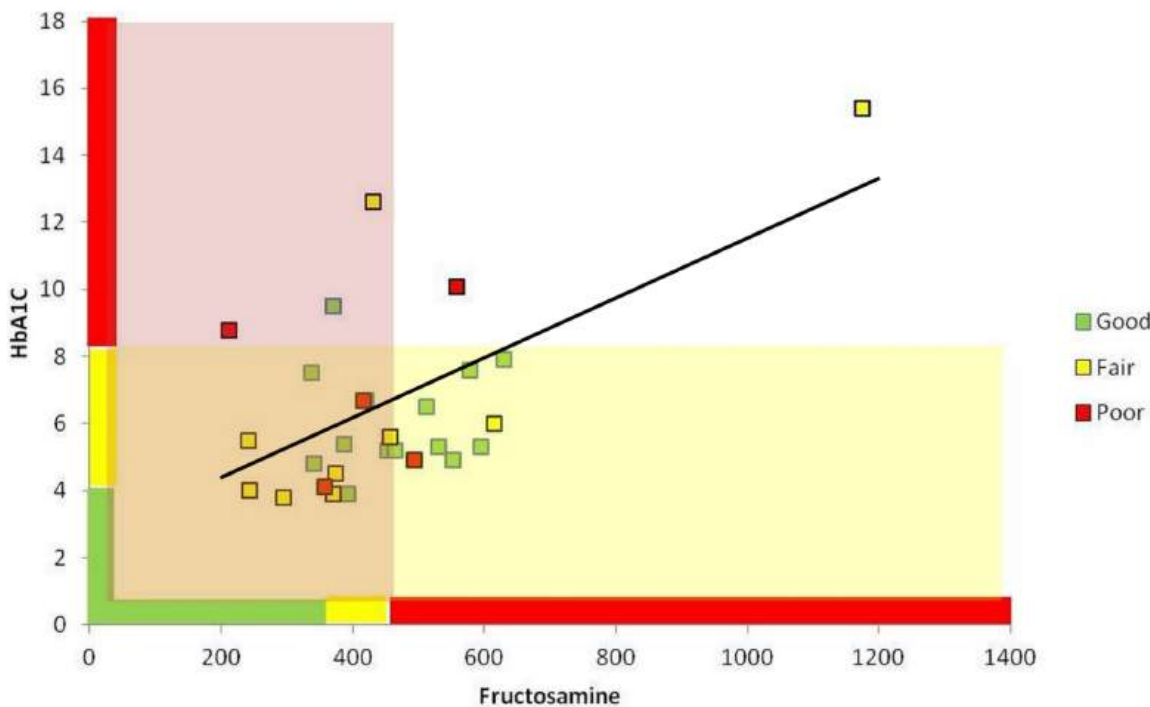
► **Figure 2:** Relationships between classifications of glycemic control in study dogs by CST, blood HbA1c, and serum fructosamine. Individual dogs are represented by colored squares. The color of each square indicates glycemic classification determined using the gold standard (CST) assessment: GOOD–green, FAIR–yellow, POOR–red. The position of each square on the graph is determined by the dog's serum fructosamine concentration (x-axis) and blood HbA1c concentration (y-axis). Respective cut-offs and ranges for classification using fructosamine and HbA1c are indicated by the color-coded bars along each axis (GOOD–green, FAIR–yellow, POOR–red). The pale red area indicates dogs classified as having ACCEPTABLE control by the serum fructosamine test. The pale-yellow area indicates dogs classified as having ACCEPTABLE control by the blood HbA1c test. Dogs that fall into the area of overlap (pale orange) were classified as having ACCEPTABLE control by both tests. Blood HbA1c (%) and serum fructosamine (μmol/l) concentrations showed a significant correlation among the study group (n = 28 dogs). Pearson's R = 0.578; p = 0.001.

Note: This figure is adapted from "Relationship between HbA1c, fructosamine and clinical assessment of glycemic control in dogs", by Olga Norris and homas Schermerhorn, 2022, PLoS ONE 17(2): e0264275. https://doi.org/10.1371/journal.pone.0264275

♦ **Reference**

1. Rankin AJ, KuKanich KS, Schermerhorn T, et al. Evaluation of diabetes mellitus regulation in dogs treated with ophthalmic preparations of prednisolone acetate versus diclofenac sodium. Am J Vet Res. 2019; 80(12):1129–1135. https://doi.org/10.2460/ajvr.80.12.1129 PMID: 31763946

2. Norris O, Schermerhorn T. Relationship between HbA1c, fructosamine and clinical assessment of glycemic control in dogs. PLoS One. 2022 Feb 25;17(2):e0264275. doi: 10.1371/journal.pone.0264275.

AmiShield HbA1c Disc and Fructosamine Disc

AmiShield HbA1c disc provides quantitative determinations of HbA1c in canine EDTA or lithium heparinized whole blood. It can help veterinarians monitor the blood sugar status of canine patients over a period of time (2-3 months) to diagnose whether they have diabetes or to determine the effectiveness of insulin in diabetic dogs.

Here is the dynamic range and the reference ranges for canines.

Canine HbA1c(%)	
Pre- Diabetic	4 - 6.5
Diabetic	> 6.5
Treated diabetic dogs	
Excellent Control	4 - 4.9
Good Control	5 - 5.9
Fair Control	>= 6

Dynamic Range (Common Units / SI Units)	
HbA1c	2 - 13.0%

HbA1c Disc

1 Item 60 µL

REF 001-21LR — For Veterinary Use Only

HbA1c (Glycated Hemoglobin)

* Use the provided capillary-dropper to transfer 2 µl of EDTA whole blood to the enclosed dilution tube and mix well.
* Then transfer 60 µl of mixed sample to the reagent disc using the provided pipette.
* Use disc within 20 minutes after opening the pouch.

Made In Taiwan

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AmiShield

AmiShield Fructosamine disc provides quantitative determinations of Fructosamine in lithium heparinized whole blood, plasma, or serum. It can help veterinarians monitor blood glucose status of diabetic dogs over a period of time (1-3 weeks).

Here is the dynamic range and the reference ranges for canines.

Canine Fructosamine(µmol/L)	
Normal non-diabetic	177 - 314
Newly diagnosed diabetic	> 320
Treated diabetic dogs	
Excellent Control	< 350
Good Control	350 - 400
Fair Control	400 - 450
Poor Control	> 450

Dynamic Range (Common Units / SI Units)	
Fructosamine	100 - 1000 µmol/L

Fructosamine Disc

1 Item 60 µL

REF 001-21LQ — For Veterinary Use Only

Fructosamine

* Only lithium heparinized whole blood, lithium heparinized plasma or serum can be injected into this disc.
* Use disc within 20 minutes after opening the pouch.

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* AmiShield Fructosamine Disc is available for canine and feline patients.