

Blood glucose level as an insufficient indicator of feline diabetes mellitus: a case report

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ABSTRACT: In several European countries (e.g., Poland) blood glucose level is the main indicator of feline diabetes mellitus. We describe a case of an adult domestic cat (*Felis catus*) that exhibited no symptoms of diabetes except high glucose level in blood (≈ 200 mg/dl) that indicated a possibility of early stage of this disease. However, further investigations including serum fructosamine level determination, systematic urine monitoring as well as comparative analyses of glucose level in blood samples collected at the veterinary clinic and at home revealed that the cat was suffering from stress-induced hyperglycaemia brought on by the car ride and visit to the veterinary clinic. This case highlights the fact that determining blood glucose level alone is insufficient in feline diabetes mellitus diagnosis and can lead to unnecessary treatment with potential adverse effects on feline health.

Keywords: felines; blood glucose; diabetes mellitus; behaviour

Diabetes mellitus, a group of disorders that share a defect in the control of carbohydrate metabolism, are becoming increasingly common in domestic animals. Immune-mediated type I diabetes appears to be very rare in cats. The most typical feline diabetes mellitus bears close clinical and pathological resemblance to human type II diabetes (especially due to the occurrence of islet amyloidosis) and is characterised by inadequate insulin secretion and impaired insulin action (Rand 1999; O'Brien 2002). It is suggested that the increasing frequency of predisposing factors such as obesity and physical inactivity are responsible for the increasing incidence of diabetes in domestic cats (McCann et al. 2007; Prahll et al. 2007). Other risk factors can include age, neutering and gender (Hoening 2002). The most common clinical symptoms include polyphagia, polyuria, polydipsia, unkempt coat, muscle wasting, progressive weakness and loss or gain of weight (Rios and Ward 2008). Persistent hyperglycaemia and glucosuria are typical demonstrations of feline diabetes mellitus. Therefore, blood and urine glucose are among the most common laboratory analyses conducted in order to confirm this disease in cats. It is also suggested that serum fructosamine concentration can provide insight into the scale of diabetes (Rios and

Ward 2008). However, in countries such as Poland blood glucose analyses accompanied with sugar determination in urine are usually the only methods conducted in order to confirm this disease and to prescribe further treatment (insulin injections or nourishment). We describe a case of the domestic cat clearly demonstrating that this approach can be insufficient and can lead to incorrect diagnosis followed by unnecessary treatment with potential adverse health effects.

Case description

An adult (seven years old, weight 3.7 kg) domestic cat (*Felis catus*) demonstrated no symptoms of diabetes mellitus or any other disease. However, the owners decided to perform a periodic health examination at the veterinary clinic (29.05.2012). The car ride to the clinic lasted for 30 min, queue for examination – 15 min. A standard examination along with complete haematology and clinical biochemistry (Reflovet Plus, Roche) was conducted. The only recorded abnormality was a high blood glucose level – 254 mg/dl.

Repetition of these analyses was performed three days later (01.06.2012), the duration of the car ride

and queuing time was similar. Blood glucose concentration (164 mg/dl) again exceeded the level for healthy cats (90 to 120 mg/dl). On that day urinalysis was also conducted (Uryxxon Relax, Macherey-Nagel), although no trace of sugar was detected. Based on the obtained results the veterinary physician suggested potential diabetes mellitus in its initial phase (an explanation for no visible symptoms of disease and no trace of sugar in urine) but concluded that there was no need for insulin injections at that point. However, a moderate carbohydrate and high fibre diet (protein 46%; arginine 2.49%; fat 12%; starch 17.1%; digestible fibre 11.4%; raw fibre 5.6%) was recommended for the following two weeks (twice a day, at the same time). The owners were also instructed to monitor sugar in *matutinal* urine using test strips (Multistix 10 SG, Siemens, United Kingdom), twice a week. However, during the entire described period no trace of sugar in urine was observed when using this method. On 03.07.2012 the cat was again transported to the veterinary clinic and blood glucose was analysed. Based on the obtained result (185 mg/dl) no change in diet for the next three weeks was recommended and again insulin was not prescribed.

Three weeks later (24.07.2012) another glucose examination was performed at the veterinary clinic and revealed a value of 184 mg/dl. However, the glucose level in a blood sample collected two days later (26.07.2012) at home (exactly at the same time of day), was 75 mg/dl and did not exceed the norm for non-diabetic cats. On the same day another blood sample was collected and sent to IDEXX GmbH (Ludwigsburg, Germany) for fructosamine determination. Its level (263 $\mu\text{mol/l}$) also did not exceed the norm (reference value 190–365 $\mu\text{mol/l}$). These results suggested that the high glucose levels may have been induced by stress due to the car ride, queuing at the clinic and the examination itself. It was decided to maintain the moderate carbohydrate and high fibre diet for six to eight weeks until repetition of the blood collection at the clinic and at home.

The glucose level in the blood sample collected at home (10.09.2012) was 74 mg/dl while in the sample collected two days later at the clinic (same time and nourishment conditions) – 184 mg/dl (12.09.2012).

A comparison of the results showed that the glucose level was highly affected by visit to the veterinary clinic (Table 1). The mean glucose level in blood collected at the vet clinic was 194 mg/dl, while at home – 74.5 mg/dl. There was no signifi-

Table 1. Comparison of blood glucose levels in samples collected at the veterinary clinic and at home

Date	Place of blood collection	Glucose level (mg/dl)	Mean
29.05.2012	veterinary clinic	254	194.4
01.06.2012		164	
03.07.2012		185	
12.09.2012		184	
26.07.2012	home	75	74.5
10.09.2012		74	

cant change in the cat's weight between the first and the last day of the described period.

Interestingly, the cat demonstrated different types of behaviour depending on the place of blood collection. In the less stressful environment (home) loud vocalisation and struggling was observed during blood collection. Vocalisation, panting and shivering was also observed during the car ride. At the veterinary clinic the cat exhibited none of these behaviours except for minor shivering – probably a result of paralysing stress.

DISCUSSION AND CONCLUSIONS

We have demonstrated that a visit to a veterinary clinic can result in stress-induced hyperglycaemia in cats, manifested by abnormal levels of glucose in blood. The difference between the mean glucose levels in blood collected at the clinic and at home was 119.9 mg/dl. This phenomenon has also been observed previously in some experimental studies. For example Rand et al. (2002) demonstrated that stressful event such as bathing can have a significant impact on blood glucose concentrations in healthy cats with a mean rise of 79 mg/dl and individual increases as high as 194 mg/dl. Subjecting cats to bathing appears to usually be a more stressful event than an ordinary visit to the veterinary clinic although our case indicates that some cats can be more sensitive and stress-susceptible. Stressful events can induce hyperglycaemia that persists for several hours or even an entire day and which can invalidate blood glucose curves (Feldman and Nelson 2004).

The cat described in our case revealed clear symptoms of stress only when blood was collected at home (struggling, shivering, vocalisation) and during a car ride (panting and vocalisation). At the veterinary clinic the cat exhibited only slight shivering. This probably

was an effect of intense and paralysing stress caused by the unknown and insecure environment. It is interesting to consider that Rand et al (2002) observed a strong positive correlation between intensity of struggling (caused by spray bathing) and blood glucose level. Therefore, it seems possible that cats can reveal different reactions to stressful events; this should be taken into account by veterinary physicians.

The possibility that a change in diet was successful in decreasing blood glucose content was excluded by comparative analyses of blood samples collected at two environments differing in stress induction. Fructosamine determination was the final confirmation that the cat did not suffer from diabetes mellitus. Fructosamine is a glycosylated protein that results from an irreversible, non-enzymatic reaction that binds glucose to amino acid residues, especially albumin, in circulation. The concentration of fructosamine in serum is a reflection of mean blood glucose level over the preceding one to three weeks. The reliability of the fructosamine assay has been documented in several studies (Crenshaw et al. 1996; Elliot et al. 1999; Rios and Ward 2008). However, in some European countries (e.g., Poland) an access to its determination in animal blood samples is very limited and requires often a long-distance dispatch (e.g., to Germany or Switzerland) and significant expense. Therefore, fructosamine levels are unfortunately determined rarely by veterinary physicians despite their clear usefulness in feline diabetes mellitus diagnosis.

The here-described case demonstrates that blood glucose level analyses are insufficient in feline diabetes mellitus diagnosis and should be extended to include at least serum fructosamine determination. A simple solution that can be applied in order to exclude feline stress-induced hyperglycaemia is collection of blood at the veterinary clinic and within a few days at home at the same time of the day and under the same nourishment conditions.

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