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Evaluation of a new portable glucose meter designed for the use in cats

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Summary

Portable blood glucose meters (PBGMs) are useful in the management of diabetes mellitus in cats. In the present study we compared the performance of two PBGMs: the AlphaTRAK® (Abbott Animal Health, Maidenhead, England) specifically developed for dogs and cats, and the Ascensia ELITE® (Bayer HealthCare, Zurich, Switzerland) developed for humans. Quality parameters, including precision and accuracy, were better for the AlphaTRAK® meter compared to Ascensia ELITE®. While the AlphaTRAK® meter results did not differ from the reference method, results from the Ascensia ELITE® were significantly ($P < 0.001$) lower. The superior performance of the AlphaTRAK® meter supports its use to monitor blood glucose levels in cats.

Keywords: diabetes, cat, glucose, portable blood glucose meter

Portable blood glucose meters (PBGMs) are small pocket-sized devices for rapid and easy measurement of blood glucose concentrations. Their introduction into veterinary medicine has facilitated diabetic monitoring to a great extent (Wess and Reusch, 2000a; Casella et al., 2002; Casella et al., 2003; Reusch et al., 2006). Numerous PBGMs have been developed during the last decade, the vast majority of which is designed for use in humans. A few years ago, Wess and Reusch (2000b) have validated 5 PBGMs for use with feline blood. It has been shown that accuracy varies and blood glucose measured by PBGM often differs slightly from those measured by a reference method. Among the 5 PBGMs the Glucometer Elite® (currently marketed as Ascensia ELITE®, Bayer HealthCare, Zürich, Switzerland) was chosen for further use in the hospital and for home monitoring. The major advantage of this particular device is its easy use without buttons to press and turning on automatically when the test strip is inserted. Another main advantage is that this PBGM mostly underestimates true concentrations, whereas other PBGMs arbitrarily under- or overestimate true values, which is considered a drawback for clinical purposes (Reusch et al., 2006).

Several companies are now marketing PBGMs for veterinary use claiming that they give more accurate results than the PBGMs for humans. So far, independent investigations have only been presented for the AlphaTRAK® used in dogs; the meter was more precise and accurate than the Ascensia ELITE® (Cohen et al., 2008). Because no data are available for the AlphaTRAK® in cats, the aim of this study was to compare its performance with that of the Ascensia ELITE® against a laboratory reference method in this species.

Animals, Material and Methods

Animals

Thirty-nine client-owned cats admitted at the Clinic for Small Animal Internal Medicine, University of Zürich, were included in the study (animal experiment permission: 90/2007).

Blood glucose meters and reference method

Blood glucose was measured with the PBGMs AlphaTRAK® and Ascensia ELITE® (Fig. 1) and results were compared against the reference method of our laboratory (i.e., hexokinase method). For quality assessment a control solution and test strips, both provided by the manu-

Figure 1: AlphaTRAK® (left) and Ascensia ELITE® (right) portable meter to measure blood glucose concentrations in cats.

facturers, were used for the AlphaTRAK® meter and Ascensia ELITE®, respectively. Quality tests were performed every morning.

Precision and accuracy of the glucose meters

To evaluate precision, EDTA-blood samples were col-lected from two clinically healthy (Glucose: 5–9 mmol/l) and two diabetic cats (Glucose > 9 mmol/l). An aliquot of the two samples collected from healthy cats was left at room temperature for 6 hours to lower blood glucose levels (< 5 mmol/l). Precision was determined by calculating the average coefficient of variation of the blood samples analyzed 10 times each within 15 minutes for normal, high and low glucose concentrations.

Accuracy of the PBGMs was measured in two groups each of 10 cats with normal and high blood glucose concentrations, and in another group of 15 cats with low glucose levels. In each cat capillary samples were collected from the inner pinna as described by Reusch et al. (2006) and glucose was measured from the same drop of blood with the AlphaTRAK® and Ascensia ELITE® meters at random order. At the same time a peripheral blood sample was collected and serum glucose measured with the reference method.

Coding the AlphaTRAK® meter

Because mistakes can erroneously be done by coding the AlphaTRAK® meter for dogs instead for cats, three feline EDTA-blood samples with normal, high and low glucose concentrations were measured five times with both codes. Median difference and range were calculated.

Statistical analysis

Accuracy between the PBGMs and the reference method was evaluated with repeated measures ANOVA. Significance was considered $P < 0.05$. Accuracy was also examined by error grid analysis (Clarke et al., 1987; Wess and Reusch, 2000b). The grid system assigns predicted glucose values (measured with the PBGM) versus actual glucose values (measured with the reference method) to five zones (A through E). Measurements in zones A and B are clinically accurate in that they lead to clinically correct treatment decisions. The PBGM readings in zone A deviate from the reference value by no more than 20 %, and in zone B represent benign errors and deviate from reference values by > 20 %; however, they either would not lead to a change in treatment. Values in zones C, D and E would lead to treatment errors or failure to initiate treatment.

Results and Discussion

Similar to previous data in dogs (Cohen et al., 2008), our study showed that the AlphaTRAK® meter in cats is more precise and accurate at normal, high and low glucose levels (Tab. 1 and Fig. 2). Measurements with the AlphaTRAK® were similar to the reference method whereas with the Ascensia ELITE® were significantly lower. Accuracy of the two PBGMs varied among glucose concentrations. For either device the difference between PBGM readings and reference values increased from the low to the high glycemic range. Both PBGM predominantly yielded underestimation at low and normal glucose concentrations. In the hyperglycemic range the AlphaTRAK® meter tended to overestimate glucose levels whereas the Ascensia ELITE® underestimated them. The tendency of the two PBGMs to underestimate readings at low glucose concentrations may be appropriate for owners of diabetic cats who adjust dosage of insulin according to PBGM reading. With PBGM measurements that are slightly less than the actual blood glucose values, hypoglycemia would be more likely avoided by injecting less insulin or by treating potential hypoglycemia earlier.

By using error grid analysis (Tab. 2), we also showed that the AlphaTRAK® meter is more accurate. Even though both PBGM provided all readings in the clinically acceptable zones A and B, the AlphaTRAK® meter had more values in zone A at any glucose concentration. The error grid is helpful to identify devices that provide readings closest to the reference method, which would not lead to any change in treatment (Clarke et al., 1987). This analysis is considered the most useful for clinical evaluation of PBGMs in humans, and has also been used previously to validate PBGM in dogs and cats (Wess and Reusch 2000b; Wess and Reusch 2000c).

Differently from the Ascensia ELITE® meter, which has no button to press and is automatically started with the test strip, the AlphaTRAK® requires turning on and coding for the appropriate species. Of note, if this PBGM is accidentally coded for dogs instead for cats, glucose levels are overestimated of approximately 1–4 mmol/l (median 3.0 mmol/l), possibly leading to wrong therapeutic decisions. Before using the instrument, the attending veterinary personnel or pet owner should be adequately trained to avoid this important error.

In conclusion, the superior performance of the AlphaTRAK® meter supports its use for glucose monitoring in cats with diabetes or with any disorder where glucose levels need to be readily available. The AlphaTRAK® is now used at our hospital as the standard PBGM in dogs and cats.

Table 1: Precision of measurements obtained with the AlphaTRAK® and Ascensia ELITE® meters compared to the hexokinase reference method.

Glucose concentration	Method	Coefficient of variation (%)
Normal (5–9 mmol/l)	AlphaTRAK®	4.7
	Ascensia ELITE®	8.6
	Reference	1.2
High (> 9 mmol/l)	AlphaTRAK®	2.3
	Ascensia ELITE®	3.5
	Reference	0.9
Low (< 5 mmol/l)	AlphaTRAK®	5.3
	Ascensia ELITE®	6.0
	Reference	2.4

Table 2: Error grid analysis for results of blood glucose measurements obtained with AlphaTRAK® and Ascensia ELITE® meters.

Glucose concentration of samples	Meter	Zone A	Zone B	Zone C, D and E
Normal (5–9 mmol/l; n = 10)	AlphaTRAK®	7	3	0
	Ascensia ELITE®	1	9	0
High (> 9 mmol/l; n = 10)	AlphaTRAK®	5	5	0
	Ascensia ELITE®	2	8	0
Low (< 5 mmol/l; n = 15)	AlphaTRAK®	11	4	0
	Ascensia ELITE®	4	11	0

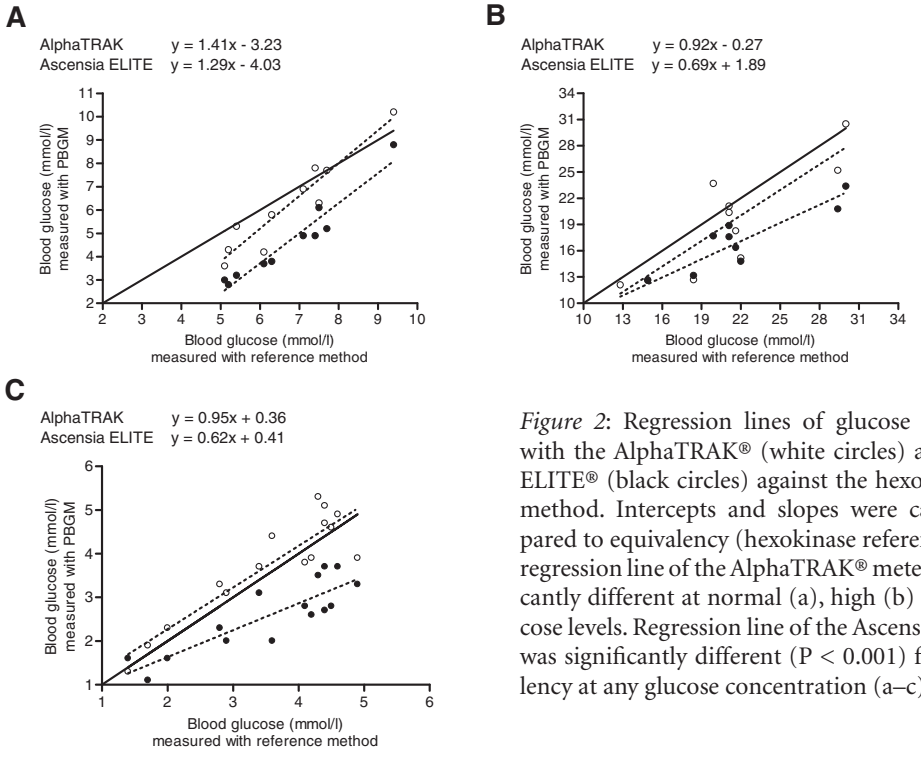

Figure 2: Regression lines of glucose levels measured with the AlphaTRAK® (white circles) and the Ascensia ELITE® (black circles) against the hexokinase reference method. Intercepts and slopes were calculated. Compared to equivalency (hexokinase reference method) the regression line of the AlphaTRAK® meter was not significantly different at normal (a), high (b) and low (c) glucose levels. Regression line of the Ascensia ELITE® meter was significantly different ($P < 0.001$) from the equivalency at any glucose concentration (a–c).

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