

**Assessment of two portable glucometer and automated
hematology analyzer for the monitoring of diabetes in
Dog and Cat.**



**A Clinical Report Presented in Partial
Fulfillment of the Requirement for the
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List of abbreviation

SYMBOLS	ABBREVIATION
CVASU	Chattogram Veterinary And Animal Sciences University
SAQTVH	Shahedul Alam Quadary Teaching Veterinary Hospital
FVM	Faculty Of Veterinary Medicine
%	Percentage
<	Less than
>	Greater than
Et al.	And his associated

: ABSTRACT :

Diabetes is a common chronic disease of human that can also affect animals like dogs, cats, pigs and horses. Among other species except human, diabetes mellitus is more prevalent in dog and cat. It is incurable disease associated with abnormally high levels of sugar; however it can be controlled successfully with good care of livelihood and food. The aim of this study was to find out the status of diabetes mellitus among the dogs and cats in Chattogram Metropolitan area and it runs at Shahedul Alam Quadary Teaching Veterinary Hospital (SAQTVH) of Chattogram Veterinary and Animal Sciences University (CVASU), Bangladesh. Total 30 dogs and 30 cats were tested for presence of diabetes. All necessary information were collected through questionnaire and blood samples were collected two times (fasting and after feeding) using insulin syringe from cephalic vein. Glucotest prime and Accu-Check glucometer with strips and auto-hematology analyser were used to detect the blood glucose level. Pets were detected with sugar levels that indicate diabetes. However, variation of blood glucose level according to different physiological status and habits like sex, age, body weight, breed and feeding habit/diet were detected. Significant relations were found between the occurrence of diabetes and age of animal. In case of dog, the prevalence of diabetes in local dog is higher than exotic breed. In gluco test prime it is 11%, in accu-check and hematological analyser around 13%. Dogs aged more than 27 months is more prone to diabetes by gluco test prime (P-value = 0.001) and by hematological analyser (P-value = 0.06). Female are at more risk to diabetes by gluco test prime 90%, by accu-check 28% and by hematological analyser 73%. In case of cat, aged more than 15 months and more than 4 kg weight is more prone to diabetes by gluco test prime (P-value = 0.001), by accu-check (P-value = 0.02) and by hematological analyser (P-value = 0.01).

Finally these studies recommend that, diabetes in dogs and cats has impact on their health in this area and needed further study for clear understanding.

Keywords: Diabetes, Glucotest prime, Accu-Check, Hematology analyser.

: Introduction:

Diabetes is a complex modern disease in human and similarly in dog and cat. The precise etiology of diabetes in dogs and cats is uncertain but different in two species. In case of dog, it is mostly found middle aged and older dogs (Marmor et al.,1982). Like human beings, diabetes is a multifactorial disease, involving both genetic and environmental factors. In human beings, polymorphisms in the major histocompatibility complex (MHC) genes play an important role in susceptibility of diabetes and this might also be true in case of dogs (Kennedy et al.,2003).The most common environmental factors that play role in diabetes include diet, and infectious organisms such as Cocksackie B virus, Epstein-Barr virus, enterovirus and rotavirus (Jun and Yoon, 2004). It is unclear that obesity is a risk factor for diabetes in the dog, but insulin secretion increases according to the degree of obesity (Mattheeuws et al., 1982). Several risk factors have also been identified responsible for diabetes in cats: age, obesity, neutering, and gender (Panciera et al., 1990; Scarlett and Donoghue, 1998). Diabetes typically occurs in dogs between 5 to 12 years of age, and is uncommon under 3 years of age (Catchpole et al., 2005). Older male cats are more susceptible to diabetes especially those who have been neutered (Panciera et al., 1990). Three main form of diabetes seen in dogs and cats. Dogs mostly suffer from type 1 diabetes which is thought to be caused by autoimmune mediated destruction of beta cells and they need insulin for survival (Lendrum et al., 1976; Palmer et al., 1983). Type 2 or noninsulin dependent diabetes occurs when pancreas is producing some insulin, but body cannot utilize as it should (Rand et al., 2004). Another form of diabetes is related to endocrinopathies which is commonly seen both in dog and cats (Panciera et al., 1990).

Proper management of diabetic dog or cat depends upon the understanding and interpretation of clinical signs, urine glucose values, and periodic serial blood glucose monitoring. Persistent polyuria and polydipsia, or the development of cataracts will indicate need for a better control (Miller, 1995). Various methods have been developed for measuring blood glucose concentration such as, automated chemistry analyzers that determine glucose concentration by means of hexokinase or glucose oxidase method, enzyme-catalyzed reactions coupled with color detection system, and methods that result in generation of an electrical current (Cohn et al., 2000; Sacks, 1986).Hematological analysis or blood glucose measurement is supposed to be the best means of assessing diabetes but it is not out of problem. For example, many diabetic animals are so stressed in the hospital that release of glucocorticoids and epinephrine may result in insulin

resistance and inaccurate results. Furthermore, many pets don't eat out of their normal environment (Miller, 1995). A number of portable blood glucose meters (PBGGM) have been developed that permit veterinarians to measure blood glucose concentration using only drop of venous blood from dogs and cats. These meters use a number of glucose detection technologies, but most employ a method based on the enzymatic reaction between glucose in blood sample and glucose oxidase. These meters are readily available, inexpensive and can rapidly provide accurate results from small quantities of blood (Cohn et al., 2000).

The problems we are facing with diabetes in veterinary medicine are similar to those in human medicine. Our pet population is becoming more sedentary and obese. The incidence of obesity is increasing and so as diabetes. It is necessary to monitor blood glucose concentration to control the condition save pet lives. The following study is designed to assess two portable glucometer and automated hematology analyzer for the monitoring of diabetes in dog and cat so that

- i) we can compare glucose concentrations from blood samples of dogs and cats, ii) to identify the factors influencing the glucose level in both animals.
- iii) to find out way of management of diabetes affected dogs and cats.

: Materials and Methods :

A total of sixty dogs and cats (30 dogs and 30 cats) were selected for the study from the period of August 2019 to March 2020 at S.A.Q. Teaching Veterinary Hospital, CVASU. All owners permitted collection of blood from their pets. Data were collected by a prescribed questionnaire survey from the owner. Potential risk factors like age, sex, breed, and body weight of the sample population were recorded by direct questioning and physical observation. Glucose concentration of the blood samples, determined by use of the reference method, ranged from 60-120 mg/dl (5.5-13.75 mmol/L) in normal dogs. Most of the diabetic dogs and cats range from 250-600 mg/dl (Marmor et al., 1982).

Dogs and cats were manually restrained while a 22-gauge needle was placed in the cephalic vein. Blood was allowed to drip directly from the needle hub onto the test strip or cartridge of Glucotest prime and Accu-Check and was assayed immediately. For hematological test a 1 ml syringe was attached to the needle and blood was collected and placed in a tube containing EDTA. Blood sample was centrifuged, and plasma was obtained. Plasma glucose concentrations were measured by use of Erba biochemical analyzer by trained laboratory personnel who were unaware of the results obtained from other devices. Owners have been advised to feed their dogs and cats and again blood glucose concentrations were measured with Glucotest prime, Accu-Check (Roche Diabetes Care, Inc.) and hematological test by following the same procedure discussed above.

Statistical analysis: Data obtained from the questionnaire were entered into Microsoft excel 2010 spread sheet. Data were then cleaned for errors and inconsistencies, sorted, coded and checked for integrity in MS Excel 2010. Afterwards, data were exported to STATA-IC-13 (Statacorp, 4905, Lakeway Drive, College station, Texas, USA) for conducting statistical analysis.

Risk factor analysis: Univariable chi-square test was performed to evaluate the association between the independent variables: breed classed in terms of two categories (local/exotic breed), age (<14/>15 months), body weight (<4/>4 kg), and sex (male/female). Individual variable was categorized to make enough frequency number of each class for increasing power of the statistical test. P value 0.05 or less was used to identify the factor as significant. The results were presented as percentages and p value.

: Photo Gallery :



Blood collection from Dog



Blood collection from Cat



Blood-Glucose level in Glucotest prime meter



Blood-Glucose level in Accu-check meter



Hematological test



Hematology Analyser

: Results and discussions:

In dogs, the highest number of diabetes cases were found in local breeds than exotic breeds when analyzed with Glucotest prime (BM= 55.6%, $P=0.5$; AM=66.7%, $P= 0.6$), Accu-Check (BM= 11.2%, $P=0.2$; AM=11.2%, $P= 0.3$) and Hematology analyzer (BM=11.2%, $P=0.3$; AM=55.6%, $P= 0.7$) respectively (Table 1). Whereas, Marmor et al. (1982) and Davison et al. (2005) reported that exotic and crossbreeds like Keeshounds, English Springer Spaniels, Labrador retrievers and Yorkshire terriers have increased risk of diabetes than other breeds. Dogs aged more than 27 months had higher occurrence of diabetes than those aged below 26 months when tested with Glucotest prime (BM= 78.6%, $P=0.05$; AM=100%, $P= 0.001$) and hematology analyzer (BM= 7.1%, $P= 0.1$; AM=71.4%, $P= 0.06$) . But in Accu-Check dogs below 26 months had more number of cases especially after meal (BM= 6.2%, $P=0.9$; AM=18.8%, $P= 0.7$) (Table 1). These findings supports Davison et al. (2005) who also reported higher susceptibility of diabetes in dogs aged between 5 to 12 years due to obesity and glucose intolerance. Dogs weighed more than 23 kg had more percentage of diabetes in Glucotest prime ((BM= 61.6%, $P=0.8$; AM=76.9%, $P= 0.4$) and hematology analyzer (BM= 15.4%, $P=0.8$; AM=61.6%, $P= 0.4$), but with Accu-Check those who are below 22 kg showed higher percentage of cases (Table 1). However, Mattheuws et al. (1982) reported that dogs with higher degrees of obesity (approximately 75% body fat) are more prone to diabetes than others due to hyperinsulinemia and glucose intolerance. Female dogs had found to be more affected with diabetes than male dogs with Glucotest prime (BM= 81.9%, $P=0.06$; AM=90.9%, $P= 0.05$), Accu-Check (BM= 9.1%, $P=0.6$; AM=27.3%, $P= 0.2$), and Hematology analyzer (BM= 27.3%, $P=0.2$; AM=72.8%, $P= 0.1$) respectively (Table 1). This is supported by Davison et al. (2005) who also reported higher cases in females than males. The pathogenesis of diabetes in females is often associated with the progesterone-dominated phase of di-oestrus and the release of growth hormone from the mammary glands into the circulation, leading to insulin resistance (Eigenmann et al., 1983; Selman et al., 1994).

Variable s	Groups	Glucotest prime				Accu-Check				Hematological test			
		BM, n (%)	<i>p</i>	AM, n (%)	<i>p</i>	BM, n (%)	<i>p</i>	AM, n (%)	<i>p</i>	BM, n (%)	<i>P</i>	AM, n (%)	<i>P</i>
Breed	Local	10 (55.6)	0.5	12 (66.7)	0.6	2 (11.2)	0.2	2 (11.2)	0.3	2 (11.2)	0.3	10 (55.6)	0.7
	Exotic	8 (66.7)		9 (75)		0		3 (25)		3 (25)		6 (50)	
Age (month)	<26m	7 (43.8)	0.05	7 (43.8)	0.001	1 (6.2)	0.9	3 (18.8)	0.7	4 (25)	0.1	6 (37.6)	0.06
	>27m	11 (78.6)		14 (100)		1 (7.2)		2 (14.3)		1 (7.1)		10 (71.4)	
Body weight (kg)	<22kg	10 (58.8)	0.8	11 (64.8)	0.4	1 (5.9)	0.8	4 (23.6)	0.2	3 (17.7)	0.8	8 (47.1)	0.4
	>23kg	8 (61.6)		10 (76.9)		1 (7.7)		1 (7.7)		2 (15.4)		8 (61.6)	
Sex	Male	9 (47.4)	0.06	11 (57.9)	0.05	1 (5.3)	0.6	2 (10.6)	0.2	2 (10.6)	0.2	8 (42.1)	0.1
	Female	9 (81.9)		10 (90.9)		1 (9.1)		3 (27.3)		3 (27.3)		8 (72.8)	

Table 1: Association between Glucotest prime, Accu-Chek and hematological test and selected factor of diabetic dogs in Chattogram metropolitan area (N=30).

BM=before meal; **AM**=after meal; **n**= total number of positive case with percentage.

Table 2 represents the association between Glucotest prime, Accu-Check and hematological test and selected factor of diabetic cats in Chattogram metropolitan area.

In cats, both local and exotic breeds showed almost same percentage of diabetes cases with all monitoring devices (Table 2) which do not support Prahl et al. (2007) who reported that Purebred

cats were at decreased risk of diabetes compared with mixed breeds. Cats aged more than 15 months had significantly higher percentage of cases than younger cats when tested with Glucotest prime (BM= 78.6%, $P=0.01$; AM=85.8%, $P= 0.01$), Accu-Check (BM= 71.5%, $P=0.02$; AM=71.5%, $P=0.02$) and Hematology Analyzer (BM= 71.5%, $P=0.02$; AM=78.6%, $P=0.01$) respectively which supports the findings of Root et al. (1995) and Prahl et al. (2007). As age increases, several conditions like insulin resistance, obesity, infection, hyperadrenocorticism, and acromegaly also appears which make cats susceptible to diabetes (Cronshaw and Peterson 1996). Cats those weighed more than 4 kg had significantly higher percentage of cases than cats weighed below 4 kg with all monitoring devices (90.9%, $P=0.002-0.01$) (Table 2) which is supported by Root et al. (1995) and Prahl et al. (2007) who also recognized increasing weight and obesity is related to diabetes in cats. Obese cats develop insulin resistance regardless of gender (Prahl et al., 2007). Both male and female showed almost equal number of diabetes cases with all monitoring devices (Table 2). Whereas, male cats have been reported to have higher cases of diabetes by Root et al. (1995) and Prahl et al. (2007). A recent study shows that male cats are more likely to gain weight than female cats. Male cats gains more weight and has a greater fat mass. In addition, males may be naturally more insulin resistant than female cats (Appleton et al., 2001).

Variables	Groups	Glucotest prime				Accu-Chek				Hematological test			
		BM, n (%)	<i>p</i>	AM, n (%)	<i>p</i>	BM, n (%)	<i>p</i>	AM, n (%)	<i>p</i>	BM, n (%)	<i>p</i>	AM, n (%)	<i>P</i>
Breed	Local	8 (53.3)	1.0	9 (60)	0.70	8 (53.4)	0.7	8 (53.3)	0.7	8 (53.3)	0.7	8 (53.4)	1.0
	Exotic	8 (53.3)		10 (66.7)		7 (46.7)		7 (46.7)		7 (46.7)		8 (53.4)	
Age (month)	<14m	5 (31.3)	0.01	7 (43.8)	0.01	5 (31.3)	0.02	5 (31.3)	0.02	5 (31.3)	0.02	5 (31.3)	0.01
	>15m	11 (78.6)		12 (85.8)		10 (71.5)		10 (71.5)		10 (71.5)		11 (78.6)	
Body weight (kg)	<4kg	6 (31.6)	0.002	9 (47.4)	0.01	5 (26.3)	0.01	5 (26.3)	0.01	5 (26.3)	0.01	6 (31.6)	0.002
	>4kg	10 (90.9)		10 (90.9)		10 (90.9)		10 (90.9)		10 (90.9)		10 (90.9)	
Sex	Male	9 (56.3)	0.7	10 (62.5)	0.9	8 (50)	1.0	8 (50)	1	8 (50)	1.0	9 (56.3)	0.7
	Female	7 (50)		9 (64.3)		7 (50)		7 (50)		7 (50)		7 (50)	

Table 2: Association between Glucotest prime, Accu-Chek and hematological test and selected factor of diabetic cats in Chattogram metropolitan area. (N=30)

BM=before meal; **AM**=after meal; **n**= total number of positive case with percentage

The study was conducted only in TVH, CVASU and therefore the sample size was not big enough. Any statistical assumptions were not considered to calculate sample size which is a

limitation of the study. As some of the variables were highly correlated with each other, we were not able to conduct a multivariable logistic regression model to determine potential risk factors on the occurrence of diabetes. The sensitivity and specificity of glucometers and hematological analyzer was not out of question. Although structured questionnaire was used to obtain required information we could not completely rule out the recall bias, for example if the owner could not recall the age of the dogs and cats.

In conclusion, the incidence of diabetes in dogs and cats related with several factors like breed, older age, obesity and gender. Diabetes in dogs and cats are similar concern like diabetes in human and it can be tested by using portable glucometers and hematology analyzer. Owners should be more careful of their pet health and maintain regular exercise and balanced diet to prevent diabetes. In future, more portable glucometers can be assayed to measure diabetes in dogs and cats and make them available to the owners so that they can test their pets staying home.

: CONCLUSION :

Globally Canine and feline diabetes has emerged as an important endocrinopathy in middle to old ages pet. Diabetes is an assorted disorder with several pathological mechanisms leading to hyperglycemia and complication of abnormal metabolism. The life expectancy of a diabetic animal can be the same as healthy one's with proper care. Diabetic pets are more likely to die of kidney diseases, liver disorders than of diabetes itself. So with proper care and treatment, they survive happily. Both in human and cats, type 2 diabetes is more common. Diet is a major component of the illness's cause and treatment. But for dogs, type 1 diabetes occur more. Here no special diet are not recommended. Food must contain low fiber as it slows the release of glucose, blunting its postprandial rise (less blood sugar increases after meals). Daily exercise and routine deworming also very important for controlling diabetes in pets. The result from this study may boost up the importance of proper diet, regular exercise and check-up of the pets.

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: Biography :

I am Rony Chowdhury, son of Mr. Tapan Kanti Chowdhury and Mrs. Suvra Chowdhury. I passed Secondary School Certificate examination in 2011 (G.P.A-5.00) followed by Higher Secondary Certificate examination in 2013 (G.P.A-5.00). Now I am an intern Veterinarian under the Faculty of Veterinary Medicine in Chattogram Veterinary and Animal Sciences University. As an upcoming veterinarian ,I would like to work as a veterinary surgeon in Bangladesh and to dedicate my rest of life for welfare of animals.