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**Research Article**

# CANINE DIABETES AND ITS SUCCESSFUL MANAGEMENT

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## ABSTRACT

Diabetes has evidence in ancient literature, though recently is being considered as most emerging disease condition in both human and companion animals. Diabetes mellitus is a common endocrine disorder in dogs, presenting with persistent hyperglycemia and clinical signs such as polyuria, polydipsia, polyphagia, and weight loss. The present study was undertaken to evaluate the blood glucose level alterations in canine diabetes mellitus and compare therapeutic management strategies with special reference to blood glucose as a diagnostic tool. Out of 642 dogs screened, 12 were diagnosed as diabetic and randomly divided into two groups. Group-I (n=6) received an alternative therapy comprising activated zinc, arginine, calcium pantothenate, L-carnitine and lettuce extract, while Group-II (n=6) was treated with recombinant insulin @ 0.5 IU/kg intramuscularly, twice daily. Dogs were monitored clinically and through haemato-biochemical parameters, including random, fasting, and post-prandial blood glucose, over 21 days. Both groups showed improvement, but insulin therapy produced more consistent and significant reductions. In Group-II, random glucose decreased from 278.33±28.93 mg/dl to 146.00±11.10 mg/dl, and fasting glucose from 230.22±17.27 mg/dl to 116.83±5.59 mg/dl, approaching normal values by day 21. Post-prandial glucose levels also improved markedly. In conclusion, canine diabetes can be effectively diagnosed and managed with proper monitoring and recombinant insulin remains the most reliable treatment for achieving normoglycemia.

**Keywords:** Diabetes mellitus, Dogs, Glucose

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Diabetes mellitus (DM) is one of the most common metabolic diseases affecting middle-aged to geriatric dogs, characterized by hyperglycemia, glycosuria, polyphagia, polydipsia and weight loss, resulting from an absolute or relative deficiency of insulin. The syndrome, commonly referred to as diabetes, is a frequently occurring disease in humans as well as companion animals, especially dogs. The reported incidence in dogs ranges between 0.2-1.3% of the canine population worldwide (Guptill *et al.*, 2003; Hess *et al.*, 2000).

DM exerts a significant impact on canine health, with complications that substantially reduce quality of life and survival. Common clinical manifestations include persistent polyuria, polydipsia, polyphagia, weight loss and reduced immunity (Feldman & Nelson, 2004; Nelson, 2015). Secondary complications are frequent, with bilateral cataracts reported in up to 75% of diabetic dogs within one year of diagnosis (Beam *et al.*, 1999; Kooistra and Galac, 2012). Other sequelae include peripheral neuropathy, recurrent urinary tract infections, hepatopathy, and diabetic ketoacidosis, the latter being potentially life-threatening (Feldman and Nelson, 2004; Catchpole *et al.*, 2005). Many cases progress insidiously and dogs are often presented only after significant complications have developed (Rand *et al.*, 2004).

Although insulin therapy remains the cornerstone of treatment and is generally life-saving, its limitations include the requirement for lifelong daily injections, close monitoring of blood glucose levels, risk of hypoglycemia, and variable owner compliance (Nelson, 2015; Behrend *et al.*, 2018). Alternative and adjunctive therapies, such as dietary modification and oral hypoglycemic agents, have been investigated, such as zinc and arginine help to stimulate the secretion of insulin while the lettuce extract helps to reduce gastrointestinal glucose absorption (Cheta and Trifan, 2010) but the efficacy of these agents are limited compared with insulin (Eigenmann *et al.*, 1985; Catchpole *et al.*, 2005). This underscores the importance of early diagnosis, careful monitoring, and comprehensive long-term management to optimize prognosis in canine diabetes.

Diagnosis of DM has evolved significantly over time (World Health Organization, 2011). Historically, diabetes was suspected through the sweet taste of urine and later confirmed primarily by glycosuria (Banting *et al.*, 1922). Today, diagnosis and treatment are largely based on measurement of blood glucose concentrations blood glucose concentrationsand associated biochemical parameters.

## MATERIALS AND METHODS

The study was carried out at the Teaching Veterinary Clinical Complex (TVCC) and Department of Veterinary Clinical Medicine, Ethics and Jurisprudence, Nagpur Veterinary College, Nagpur on diagnostic and therapeutic management of diabetes mellitus in canine. The dogs presented at TVCC with symptoms of polyuria, polydipsia, polyphagia and obesity of 5 years or and above, irrespective of breed and sex were screened for random blood glucose. Those having random blood glucose more

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than 150 mg/dl (Rucinsky *et al.*, 2010) were included in the study and recently whelped bitches, bitches in estrus or cases of pseudo-pregnancy and pyometra were excluded. Complete clinical examination of the dogs was carried out proceeding with the owner's complaint, history of the patient, signalment of the patient. Further, a thorough clinical examination was undertaken by considering the relevant points like polyuria, polydipsia, polyphagia and obesity. Haemato-biochemical estimations viz. Random blood glucose, Fasting blood glucose and Post-prandial blood glucose was carried out in each group.

Dogs having blood sugar more than 150mg/dl were divided into two groups comprising of six dogs in each group. Group I dogs were treated with alternate therapy consisting combination of Syrup Activated Zinc, Activated Arginine, Calcium Pantothanate L carnitine and lettuce extract @ 1 ml/5 kg body weight. Group-II Dogs were treated with recombinant insulin, @ 0.5 IU/kg, i/m, after feeding at every 12 hrs interval.

Observations of various parameters recorded during the experiment period were tabulated and the data was statistically analysed using one way classification and student t-test by Snedecor and Cochran (1994).

## RESULTS AND DISCUSSION

In the period of study, total 642 dogs were screened having polyuria, polydipsia, polyphagia and obesity. Out of which 12 dogs had random blood glucose more than 150 mg/dl and therefore were considered and evaluated for further biochemical parameters. The prevalence in this study was found to be 1.86 per cent. These findings are in accordance with Fracassi *et al.* (2004) who reported 1.33% of prevalence of Diabetes mellitus in dogs and Nelson and Reusch (2014) accounted hospital prevalence rate of 0.4 to 1.2%. Whereas Shruthi *et al.* (2017) revealed incidence of Diabetes mellitus to be 0.14% in dogs.

The blood glucose concentration was measured and the average ± S.E. of Random Blood Glucose was found to be 287.57±43.97 mg/dl in Group-I and 278.33±28.93 mg/dl in Group-II at $0^{th}$ day, 257.50 ±37.89 mg/dl in group-I whereas 241.50 ±24.12 mg/dl in group-II at $3^{rd}$ day, 230.67 ±32.97 mg/dl in group-I and 211.00 ±22.13 mg/dl in group-II at $7^{th}$ day, 195.17±25.47 mg/dl in group-I whereas 181.67±16.36 mg/dl in group-II at 14th day of treatment which reduces to 157.50±20.35 mg/dl and 146.00±11.10 mg/dl on $21^{th}$ day of treatment, respectively. Qadri *et al.* (2015) suggested that blood glucose level may go up to 700-800 mg/dl although most remain in the range of 400-600 mg/dl.

The average ± S.E. of Random Blood Glucose was found to be 287.57±43.97 mg/dl on day 0 in Group-I whereas 278.33±28.93 mg/dl in Group-II which gradually reduced to 157.50±20.35 mg/dl and 146.00±11.10 mg/dl on $21^{th}$ day of treatment, respectively. There was no significant difference between the days as well as between the groups for Random Blood Glucose. It indicated that the Random Blood Glucose does not significantly change during $3^{rd}$ day to $21^{th}$ day for both groups. In the present study persistent hyperglycaemia was recorded random which may be because of combination of resistance to the actions of insulin in liver and muscle together with impaired pancreatic β-cells function leading to relative insulin deficiency. However, in susceptible individuals it is likely that pancreatic β-cells are unable to sustain the increased demand for insulin. In the present subject it is likely that the excessive production of glucose in the liver and skeletal muscle result from resistance to the action of insulin.

Medicament of Group-I consisted of zinc which is an essential component of many enzymes. Zinc deficiency has been observed secondary to energy metabolism derangement. Another component of this is activated arginine as we know that proteins from main structural components of body cells and an adequate intake is essential for health. Arginine is a conditionally essential amino acid. However, incorporation of this did not appear to restore post treatment blood glucose level to physiological value.

The average ± S.E. of fasting Blood Glucose was found to be 248.67 ±44.97 mg/dl in Group-I whereas 230.22 ±17.27 mg/dl in Group-II at $0^{th}$ day, 219.17±34.41 mg/dl in group-I and 203.50 ±18.65 mg/dl in group-II at $3^{rd}$ day, 191.83±26.94 mg/dl in group-I whereas 175.17±18.96 mg/dl in group-II at $7^{th}$ day, 166.33±23.65 mg/dl in group-I and 147.17±11.11 mg/dl in group-II at $14^{th}$ day, of treatment which reduces 133.67±12.96 mg/dl in group-I whereas 116.83 ±5.59 mg/dl in group-II at $21^{st}$ day, respectively. Kumar *et al.* (2014) reported that in insulin treated dogs, concentration of fasting blood sugar varies between 100 and 300 mg/dl which is in accordance with the present findings of the study.

The average ± S.E. of Fasting Blood Glucose was found to be 248.67±44.97 mg/dl on day 0 in Group-I and 230.22±17.27 mg/dl in Group-II and reduced to 133.67±12.96 mg/dl in group-I and 116.83±5.59 mg/dl in group-II at $21^{st}$ day, respectively. There was no significant difference between the days as well as between the groups. It indicated that the fasting blood glucose does not significantly change during 3 days to 21 days for both groups. In Group-II when compared with the Group-I, the values at $21^{st}$ day were found within the normal reference value. Hence the effectiveness of treatment in Group-II appears to be better.

The Average±S.E. of Post-prandial Blood Glucose

**Table 1. Average ± S.E. of Random Blood Glucose in dogs suffering from diabetes mellitus**

| Days | 0 (mg/dl) | 3 (mg/dl) | 7 (mg/dl) | 14 (mg/dl) | 21 (mg/dl) |
|---|---|---|---|---|---|
| GROUP-I | 287.57±43.97 | 257.50±37.89 | 230.67±32.97 | 195.17±25.47 | 157.50±20.35 |
| GROUP-II | 278.33±28.93 | 241.50±24.12 | 211.00±22.13 | 181.67±16.36 | 146.00±11.10 |
| Result | NS | NS | NS | NS | NS |

NS - non significant

**Table 2. Average ± S.E. of Fasting Blood glucose in dogs suffering from diabetes mellitus**

| Days | 0 (mg/dl) | 3 (mg/dl) | 7 (mg/dl) | 14 (mg/dl) | 21 (mg/dl) |
|---|---|---|---|---|---|
| GROUP-I | 248.67±44.97 | 219.17±34.41 | 191.83±26.94 | 166.33±23.65 | 133.67±12.96 |
| GROUP-II | 230.22±17.27 | 203.50±18.65 | 175.17±18.96 | 147.17±11.11 | 116.83±5.59 |
| Result | NS | NS | NS | NS | NS |

NS- non significant

**Table 3. Average ± S.E. of Post-Prandial Blood Glucose in dogs suffering from diabetes mellitus**

| Days | 0 (mg/dl) | 3 (mg/dl) | 7 (mg/dl) | 14 (mg/dl) | 21 (mg/dl) | CD (1%/5%) |
|---|---|---|---|---|---|---|
| GROUP-I | 303.00±46.66$^{a}$ | 252.50±35.54$^{a}$ | 222.50±31.16$^{a}$ | 198.17±27.54$^{b}$ | 160.83±16.80$^{c}$ | 94.25 |
| GROUP-II | 289.28±7.31$^{a}$ | 233.50±17.78$^{b}$ | 197.17±15.74$^{c}$ | 178.83±10.84$^{cd}$ | 149.50±5.32$^{d}$ | 48.68 /35.98 |

* = Significant at 5% level, NS- non significant

Different Column-wise superscripts indicate significance

**Note:** Rows indicate significance between the different days and it indicates using small alphabet symbol. Column indicates significance between two groups, it indicates using ** (1%) and *(5%) level of significance.

level in Group-I was 303.00±46.66, 252.50±35.54, 222.50±31.16, 198.17±27.54 and 160.83±16.80 mg/dl on 0$^{th}$, 3$^{rd}$, 7$^{th}$, 14$^{th}$ and 21$^{th}$ day of treatment period where as 289.28±7.31, 233.50±17.78, 197.17±15.74, 178.83±10.84 and 149.50±5.32 mg/dl on respective days in Group-II.

The post-prandial blood glucose values in Group-I were 303.00±46.66 on day 0, whereas 160.83±16.80 mg/dl on 21$^{th}$ day of treatment period. Similarly, they were 289.28 ±7.31 mg/dl on day 0 and 149.50±5.32 mg/dl on day 21 in Group-II. The decreasing trend of post-prandial blood glucose level in both the treatment group was noticed. The difference between the intervals was significant in Group-I after 7$^{th}$ day. Similarly, in Group-II Post-prandial Blood Glucose level decreased consistently during 3$^{rd}$ to 21$^{st}$ day post treatment, but did not returned to normal physiological limit. These findings are in accordance with Feldman and Nelson (2004) and the Rucinsky *et al.* (2010) where insulin therapy is considered as the gold standard in canine diabetes management and effective in reducing both fasting and post-prandial glucose levels within weeks.

From the investigation, following conclusions have been drawn that the common symptoms exhibited by diabetic dogs are polydipsia, polyuria and polyphagia. There was no significant effect of treatment on fasting blood glucose levels, however, the post-prandial blood glucose levels significantly decreased between the intervals. Treatment of diabetic dogs with injections of recombinant insulin @ 0.5 IU/kg, intramuscularly twice a day resulted in significant decrease in blood glucose levels over the period of time.

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