

Perspectives on Management of Diabetes Mellitus in Dogs and Cats

Written by Nicola Parry

In a series of sessions on diabetes mellitus (DM) in dogs and cats, Andrew C. Bugbee, DVM, Purdue University College of Veterinary Medicine, West Lafayette, Indiana, USA, discussed important screening tools used in dogs and cats with DM, as well as methods used to evaluate the response to insulin in these patients.

DM is a common endocrine disorder in dogs and cats, characterized by an absolute or relative deficiency of insulin, with many patients requiring long-term administration of exogenous insulin as the mainstay of treatment. DM is typically insulin dependent in dogs and non-insulin dependent in cats; the latter condition is similar to type 2 DM in people and is also increasing in incidence in dogs.

GLYCEMIC SCREENING TOOLS FOR SMALL ANIMALS WITH DIABETES MELLITUS

The primary aims of therapy for dogs and cats with DM include alleviation of the clinical signs associated with hyperglycemia and avoidance of insulin-induced hypoglycemia or ketoacidosis. According to Dr. Bugbee, however, there is no gold standard diagnostic tool for monitoring blood glucose control in small animals, and decisions about monitoring options are often influenced by the owner's financial situation and compliance level. The phenomenon of stress-induced hyperglycemia also complicates blood glucose monitoring in cats.

A variety of screening tools are used in veterinary practice to assess whether a patient's DM is relatively well controlled.

Owner-Reported Clinical Signs

Owner-reported clinical signs (in particular those relating to thirst, appetite, weight change, and exercise tolerance) represent an extremely simple means of monitoring glycemic control in small animal patients, and when abnormal they should prompt further diagnostic evaluation to determine their cause. According to Dr. Bugbee, these may even provide information about the patient's glycemic control that is as useful as what would be gained by analysis of some biochemical parameters, such as mean blood glucose level.

Body Weight Evaluation

Because weight gain suggests glycemic control and weight loss suggests unregulated DM, body weight should be recorded each time a patient with diabetes presents for evaluation. Fluctuations can therefore provide important information about the patient's relative glycemic control to help guide therapy, although additional variables must also be accounted for, such as concomitant disease and purposeful attempts at weight loss.

Urine Glucose Evaluation

Urine glucose measurement is another useful screening tool for glycemic control, in particular for home management of patients with diabetes. Because a single urinary glucose concentration reflects all glucose that has spilled into the urinary bladder since the previous urination, however, episodes of hypoglycemia are masked by episodes of hyperglycemia and excess urinary glucose flow. Urine glucose monitoring is helpful when insulin overdosing is a concern or when assessing for diabetic remission in cats, said Dr. Bugbee. Because most clinicians aim for a blood glucose level of 100 to 300 mg/dL during the course of the day in small animal patients with diabetes, most patients should be urine glucose positive. Consequently, he advised that if a patient consistently tests negative for urine glucose, further diagnostic evaluation is necessary to determine whether an insulin dose reduction is indicated.

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Fructosamine

Serum fructosamine concentration provides a quantitative assessment of glycemic control in dogs and cats, correlating with the average blood glucose concentration during the previous 1 to 3 weeks. An elevated fructosamine concentration indicates persistent hyperglycemia during this timeframe, whereas prolonged periods of hypoglycemia are indicated by low levels. Changes in serum protein levels or increased protein turnover, however, can affect the accuracy of this test, such as in cases of reduced protein intake and protein-losing disorders. Serum fructosamine concentrations may also be lower than expected in cats with hyperthyroidism due to their catabolic state.

Serum fructosamine concentration is also a useful monitoring tool. This is especially true in cats if stress-induced hyperglycemia prevents accurate blood glucose measurement. Because this value represents an average throughout time, however, longer episodes of hyperglycemia could eclipse shorter episodes of hypoglycemia.

A low fructosamine concentration suggests insulin overdose, likely due to the onset of diabetic remission in cats. Conversely, in cats and dogs, increased concentrations suggest poor glycemic control but do not indicate the cause. Some patients receiving too much insulin may have high fructosamine concentrations because of the Somogyi effect.

Although screening tools are helpful to determine whether a patient's DM is relatively well controlled, they should not be used as the only source of information to direct therapeutic decision making. In patients with abnormal glucose screening test results, follow-up with more definitive data about glycemic control is required.

EVALUATING THE PATIENT'S RESPONSE TO INSULIN

Blood Glucose Curve

Assessment of glycemic response following insulin administration has historically involved blood glucose determination prior to feeding and insulin administration, and every 1 to 2 hours following insulin injection. The goal of treating patients with diabetes is to have a blood glucose nadir (maximum insulin effect) of approximately 100 to 120 mg/dL with a glucose range during the curve period of approximately 100 to 300 mg/dL. The blood glucose curve is the optimum monitoring tool to direct therapeutic decision making, because it allows determination of pre-insulin blood glucose concentration, time to onset of insulin action, blood glucose nadir, duration of insulin action, and range of blood glucose between the insulin dosing intervals. Accuracy of blood glucose concentrations

varies according to what site on the body the sample is obtained from, and the optimum site also varies among individuals, said Dr. Bugbee, noting that he typically uses the ear tip or inner lip in dogs and the ear tip or paw pad in cats. He also highlighted the need to use a veterinary-specific glucometer, because those calibrated for use in people may underestimate blood glucose concentrations in veterinary patients. The pricking device and operator manipulation of the pricked site can also affect the blood glucose concentration.

By performing blood glucose curves at home, owners and pets can be spared the stress that often accompanies a visit to the veterinary office and its impact on blood glucose readings. Veterinarians, however, should be cautious in advising at-home blood glucose monitoring. Owners should be selected carefully to avoid problems such as excessive and unnecessary blood glucose sampling and adjustment of insulin therapy without veterinary direction.

Continuous Interstitial Glucose Monitoring

Continuous interstitial glucose monitoring (CIGM) is now gaining popularity in veterinary medicine to evaluate glycemic control during a more prolonged period, providing insights into daily glucose changes in dogs and cats. This system uses a sensor to measure glucose concentrations in the interstitial fluid (ISF) of the SC space, which have been shown to correlate with blood glucose concentration. The recording device samples ISF glucose concentration every few seconds and records a blood glucose reading every 5 minutes. Although CIGM can provide more glycemic information and allow a more physiologic assessment of the patient in the home environment, it does not completely prevent the need for blood glucose sampling, because daily calibration of the device is required. It is also an expensive technology.

Dr. Bugbee emphasized that, despite the cost associated with CIGM, it likely represents the way forward for management of complicated cases of DM in veterinary patients. In the meantime, however, he concluded that a monitoring plan comprising a combination of diagnostic tools should be individualized to each patient to account for variables that can complicate blood glucose monitoring.

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