

Getting to grips with diabetes: canine and feline approaches

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Jennifer Cartwright RVN, A1, discusses the diagnostic tools and treatments for this ever-increasing condition of small animals

Summary

DIABETES is a condition that requires input from the veterinary surgeon and veterinary nurses to ensure the client is given the best support to manage their pet's condition. This article gives a summary and recap on the testing, treatment and monitoring protocols available in canine and feline diabetes. It is set out in a way that means it can be used as a quick reference or as a reminder to nurses in the practice. Testing using glucometers increases owner compliance and makes completing glucose curves easier. Dietary management of the condition is also discussed, giving some thought to new ideas relating to diet types. Research has indicated that the diet fed to a diabetic cat is of importance and, by changing on to a high-protein diet the diabetes should be more manageable. The reader may familiarise his or herself with the testing tools available and when best to use each type. The article will be of interest to nurses looking at setting up diabetic clinics and student nurses/nurses wishing to gain a better understanding of the condition.

Key words

diabetes, monitoring, diets, insulin, glucose testing

THE nurse's role in managing and treating diabetes is ever increasing. Nurses are able to run clinics to provide help and support for owners with diabetic animals. Client understanding and monitoring of the illness is one of the major factors in treatment

success.

The pancreas secretes two hormones from the islets of Langerhans ([Figure 1](#)) that are essential in the maintenance of the body's blood glucose: insulin and glucagon. Type-1 diabetes, which is the most common type in dogs, causes destruction of the pancreatic beta cells, leading to insulin deficiency. It has been recognised that middle-aged dogs are at more risk of diabetes, but other factors may also affect insulin production, as below.

- **Progesterone levels.** Progesterone stimulates growth hormone production that is diabetogenic, thus causing insulin resistance.
- **Cushing's disease.** Where cortisol levels lead to an increase in blood glucose levels.
- **Obesity.** This can cause insulin resistance.

Cats more commonly suffer from type-2 diabetes. The prevalence of diabetes in cats has risen in the past few years, probably due to a rise in feline obesity. Obesity increases the risk of diabetes four-fold. At least 60 per cent of obese cats will become diabetic over time (Hoenig, 2006a,b). Male cats are thought to be more prone to diabetes, along with animals more than 12 years old. It is possible to reverse insulin resistance caused by obesity through correction of bodyweight and, therefore, cessation of insulin therapy can eventually occur.

Clinical signs of diabetes include polyuria, polydipsia, polyphagia and, in later stages, anorexia, vomiting, diarrhoea, weakness, dehydration and lethargy. It is important to ensure a definitive diagnosis of diabetes mellitus before treatment starts. A high blood glucose rating alone is not enough to diagnose the condition. Diagnostic tools used during diabetes diagnosis and management are described below.

Blood glucose measurements

The best way to assess glycaemic control is with blood glucose measurements. These are relatively simple, relatively noninvasive tests that allow us to periodically check glucose levels.

Single glucose measurements are more useful in humans, and one-off tests provide limited use in animals apart from indicating a low result, which may suggest insulin overdose. However, a high reading should not be used to change insulin doses, as this may be elevated due to a Somogyi overswing.

Cats can also get fasting hyperglycaemia as a stress response (up to 20mmol/L), so a high blood glucose measurement is not a reliable diagnostic tool.

It may be useful to check glucose levels in the morning, before insulin is given and approximately

once weekly – or more frequently if owners are worried about their pet. The glucose results would determine whether insulin should be given, whether the patient needs feeding, and so on. Guidelines are offered below, dependent on the test results.

- **Blood glucose extremely low: less than 4.4mmol/L.** Do not provide insulin. Feed the animal or provide syrup. Retest in 15 minutes. If normal, provide insulin and recheck the day after. If still low, then contact the veterinary surgeon.
- **Blood glucose low: 4.4-5.4mmol/L.** Feed and if the patient eats, provide insulin. Recheck in 30 minutes. If still low, report to a vet. If normal, recheck the day after.
- **Blood glucose normal: 5.5-11.1mmol/L.** Provide a glucose retest in one week.
- **Blood glucose high: 11.2-16.6mmol/L.** Provide insulin and monitor for clinical signs. Test the following day and if it is still high, contact the vet. If normal, retest in one week.
- **Blood glucose extremely high: more than 16.7mmol/L.** Provide insulin and observe symptoms. Recheck in one hour. If still high, report to a vet. If lower, recheck the following day.

Glucose curves

Glucose curves are an essential tool for monitoring diabetic patients – especially unstable ones – and provide the confidence to alter insulin doses. It is a relatively simple technique that provides a true indication of stability and estimates the true nadir level. When conducted using a glucometer, minimum amounts of blood can be used – only 0.5-4µl.

Glucose curves should be carried out in various situations, such as when a diabetic patient is first diagnosed, if hypoglycaemia is suspected, if a fructosamine level is high, 10 days after a change in insulin, and routinely every three months as a monitoring aid in stable patients.

A glucose curve should also answer questions, such as:

- is the insulin working? and
- how long is it lasting?

If a patient is on once-daily insulin, ideally the glucose curve should be conducted over 24 hours, with samples taken every two hours. With twice-daily insulin, a 10-hour curve is sufficient. Hourly samples should be taken if a Somogyi effect is suspected or if levels are too low to ensure hypoglycaemia does not occur.

Glucometers ([Figure 2](#)) are the ideal tool for running a glucose curve, but it is important to ensure the

one used is species-specific. Using a human glucometer is not ideal, as this will tend to provide lower than true results due to humans having a higher percentage of blood glucose in red blood cells and lower percentage blood glucose in the plasma than cats and dogs. Numerous animal-specific glucometers are available that have been calibrated specifically for cats, dogs, ferrets or horses.

Sites that can be used to obtain a sample for glucometers are the marginal ear vein, paw pad, leg callus (in the dog) and the inner/outer lip (in the dog).

Urine sampling

Glucose in the urine is not a diagnosis of diabetes. However, it may be a good initial indicator of onset and means other diagnostics should be carried out. Normally, glucose molecules are filtered by the kidneys and passed back into the blood stream. In patients with diabetes, blood glucose levels are so increased the kidneys become overwhelmed and they cannot infiltrate glucose back into the blood stream. This is known as the renal threshold and in the dog is 10-12mmol/L, and 14mmol/L in the cat.

Urine sampling can quickly indicate whether a patient is suffering from ketoacidosis by identifying ketones in the urine.

Fructosamine

Fructosamine is a good diagnostic tool in diabetes. It confirms hyperglycaemia and assesses overall glycaemic control. It should not be used to decide whether insulin levels need to be altered, although it will give an indication of whether a glucose curve should be carried out.

Fructosamines are formed when the carbonyl group of glucose reacts with an amino group of a serous protein, such as albumin. Serous proteins have a short half life – therefore, fructosamine levels reflect blood glucose over a two to three-week period. The disadvantage of this test is a larger blood sample is required, and it usually needs to be sent to an external laboratory; therefore, results can be delayed.

Other tests

Glycated haemoglobin is rarely used but, like fructosamine, it measures glycaemic levels over a length of time.

Intravenous glucose tolerance tests are available to assess glucose metabolism and assesses glucose half-life in plasma.

Treatment

The treatment of diabetes generally follows two routes.

- **Ketoacidotic patients.** Untreated diabetic animals need to gain energy from somewhere and, as they cannot use energy from glucose, they will start to break down fat and protein. This results in metabolic acidosis and a build up of ketones in the blood. Treatment with intravenous fluids – usually Hartmann’s – to correct the acidosis and 0.9 per cent saline for maintenance is our usual course of action, plus treatment with intravenous soluble bovine insulin. Strict monitoring on an hourly basis is essential in these patients.

- **Standard treatment.** Spaying female patients is essential, as progesterone levels will affect insulin production. A change of diet is probably becoming more important in the treatment of diabetes (see later). Subcutaneous injection of a lente or protamine zinc insulin once or twice daily is needed.

We have experienced major problems with obtaining the bovine insulin lente, and many patients are having to transfer to porcine insulin. This should be done under the strict guidance of a veterinary surgeon and will require additional monitoring. It is also worth noting that the porcine insulin contains 40IU/ml as opposed to 100IU/ml in the bovine type.

Cats will tend to start on 1-2IU of insulin twice daily, with changes of 1IU as necessary. The dose should not be changed more than once every seven days.

Dogs will receive a starting dose of 0.5-1IU/kg daily but can go to twice daily if advocated. This will depend on the results of the glucose curve. The dose rate should not be altered more than every three days, and increments of 10 per cent are usually used.

Monitoring

Monitoring is the area where veterinary nurses play a major role in the well-being of patients, as well as guiding the clients through a transitional period. The basic monitoring tools used will be glucose curves and fructosamine sampling.

Glucose curves should be carried out five to 10 days after the insulin levels have been changed, to assess efficacy. Ideally, this would be done in the animal’s own environment to ensure typical conditions. Ease of sampling with glucometers makes this possible with owner compliance.

Depending on the results, the veterinary surgeon will make changes to the insulin levels.

Feeding

Nutritional management is an important consideration in treating diabetes in cats and dogs. The most appropriate diets for cats and dogs differ greatly and will be looked at separately.

Cats

Opinions about the most suitable diet for diabetic cats have changed greatly over the past few years. It was thought a diet high in carbohydrate and fibre was the better way to achieve good glycaemic control, when, in fact, the introduction of a high-protein and low-carbohydrate diet is now thought more beneficial.

In cats, diabetes tends to be more of a lifestyle disease, so maintaining optimal body condition is most important. This, combined with insulin therapy, could lead to diabetes remission. Overall diet changes in cats should aim to maintain a normal bodyweight, reduce postprandial hyperglycaemia and stimulate normal insulin secretion. It has been shown that a high-protein diet increases insulin sensitivity and can lead to a reduction of up to 50 per cent in the dosing (Pibot et al, 2006).

One study compared a high-protein diet with low carbohydrate and low dietary fibre, to a high-protein diet with moderate amounts of carbohydrate and higher amounts of fibre. The rate of diabetic remission was more than 60 per cent with the former diet versus 40 per cent with the latter, thus proving the benefits of high protein without the carbohydrate content (Pibot et al, 2006).

Cats can be fed ad lib because, as shown, a high-protein diet does not tend to cause postprandial hyperglycaemia, hence the timing of injections in relation to feeding timing is more irrelevant. However, caution must be taken to prevent hypoglycaemia when switching a cat to a higher protein diet, as the cat will be more insulin-sensitive.

Dogs

There is still debate on whether a diet high in fibre is beneficial to diabetic dogs. What is important is that the nutritional and calorific content is kept constant and allows maintenance of good body condition. Meals should be ideally timed so that maximum insulin activity can occur at the postprandial stage.

Carbohydrate levels do, however, play an important role in canine diabetes, and are shown to be of major importance as the dosage of insulin is shown to be linked with the amount of carbohydrate in the diet (Pibot et al, 2006). Carbohydrates with a lower glycaemic index are more beneficial, as postprandial glucose levels are lower. For this reason, foods with high glycaemic indexes (such as bread and rice) should ideally be avoided. Diets with a lower glycaemic index release stable amounts of glucose over a longer period, allowing more glycaemic control.

In summary, diabetic dogs should be fed a consistent, stable diet – the same amounts, the same nutritional content – at the same time every day, and the timing matched to insulin dosing, so that maximum insulin activity corresponds with the glycaemic response.

References and further reading

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