



DIABETES MELLITUS **(Sugar Diabetes)**

What is Diabetes Mellitus?

Commonly called “sugar diabetes,” it is a disorder of carbohydrate, fat, and protein metabolism caused by an absolute or relative insulin deficiency. There are two types of diabetes mellitus. Type I (insulin-dependent diabetes mellitus [DM]) is characterized by very low to absent insulin secretory ability. These patients die if not treated with insulin and are prone to develop a toxicity called ketoacidosis.

Type II (noninsulin-dependent DM) is characterized by inadequate or delayed insulin secretion relative to the needs of the patient. Many of these patients can live without additional insulin and are less prone to ketoacidosis. Type II diabetes is often associated with underlying diseases or obesity.

What Happens in Diabetes Mellitus?

The pancreas gland produces insulin. With continued damage to the beta cells that secrete insulin, a deficiency of insulin in the blood causes an impaired ability of tissues, especially muscle cells, fat tissue, and liver cells, to utilize carbohydrates, fats, and proteins. Impaired glucose (sugar) utilization and ongoing glucose production cause hyperglycemia (excess blood sugar levels). Glucosuria (glucose in the urine) develops, causing copious dilute urine (osmotic diuresis), increased thirst and drinking, and compensatory weight loss. Mobilization of fats to the liver causes both hepatic lipidosis (“fatty liver”) and ketogenesis (production of blood ketones).

Systems affected include: Endocrine/metabolic (blood salts depletion and blood shift toward acidity); Liver (hepatic lipidosis, liver failure may develop—particularly in cats); Eyes (cataracts in dogs); Kidney (urinary tract infection and osmotic diuresis); and Nervous (peripheral neuropathy in cats’ rear legs). The prevalence in both dogs and cats varies between one in 400 to 500 animals. There is a higher risk in some breeds of dogs than others (especially the keeshond, puli,

miniature pinscher, and Cairn terrier) and possible higher risk in poodle, dachshund, miniature schnauzer, and beagle.

No breed differences in cats have been reported. Mean age in dogs is about 8 years; range, 4-14 years (excluding rare juvenile form), and in cats about 75% are 8-13 years; range, 1-19 years. Oddly there is a predominance according to sex. In dogs, the female is more likely to develop diabetes, while in cats it is the male more likely.

What Symptoms are Typical of Diabetes Mellitus?

Dogs show signs are more often in the early stages of the disease than in cats. Early signs include: increased thirst and urine production, more frequent eating, and weight loss. Later on, the pet may show loss of appetite, lethargy, depression, and vomiting. An overweight pet with recent weight loss is typical. Back muscle wasting and an oily coat with dandruff is common in cats. Enlarged livers may be present in both dogs and cats, but jaundice is more prevalent in cats.

Less commonly cataracts may be seen in dogs and a weakness in the rear legs in cats (diabetic neuropathy).

What Causes this Disease?

This is open to conjecture but a number of factors have an influence. Genetic susceptibility sets the stage in some dog breeds. Infectious (viral) diseases have been implicated as is immune-mediated beta cell destruction. Pancreatitis (infection or inflammation of the pancreas), predisposing diseases (e.g., hyperadrenocorticism and acromegaly), and certain drugs (e.g., glucocorticoids and progestagens) have been implicated.

How is It Diagnosed?

The combination of sugar in the urine, increased thirst and urine production, and loss of weight is very suggestive of diabetes mellitus. Blood glucose



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levels greater than 200 mg% in dogs and greater than 250 mg% in cats are typical. Other tests may show liver pathology, ketones in the urine, blood pH moving toward acidity, and electrolytes (blood salts) may be deficient.

Radiography (x-rays) may be useful to evaluate for concurrent or underlying disease (e.g., urinary stones, liver pathology, and pancreatitis).

Ultrasonography (ultrasound) is indicated in selected patients, particularly those with jaundice, to evaluate for liver pathology and pancreatitis.

Liver biopsy may be indicated in some jaundiced patients.

How is Diabetes Mellitus Treated?

INPATIENT vs. OUTPATIENT: Dogs and cats that are alert, hydrated, and eating and drinking without vomiting can be managed as outpatients.

ACTIVITY: Strenuous activity may lower the daily insulin requirement. So, a consistent amount of activity each day is helpful.

DIET: Avoid soft, moist foods because they cause severe hyperglycemia after eating. Normal weight dogs and cats should be fed a consistent diet that the pet will reliably eat. Keep daily calorie intake constant. Obese dogs and cats need a gradual weight reduction to improve insulin sensitivity (and reverses diabetes in some cats with type II DM). Techniques to aid in weight loss under your veterinarians supervision:

Technique 1: Reduce the calorie intake to 70% (cats) or 60% (dogs) of the caloric requirement for the animal's ideal body weight.

Technique 2: Feed a high-fiber, low-calorie food in a quantity similar to which the pet is accustomed. Try to achieve the target weight over 2-4 months.

Rapid weight loss is inadvisable, especially in obese cats with diabetes because they are prone to hepatic lipidosis ("fatty liver"). With thin dogs and cats, you should avoid a reduced calorie diet.

Starvation exacerbates a toxic condition called ketoacidosis and leads to poor immune function. The role of fiber in the diet is mainly in weight loss and obesity prevention. Another beneficial effect may be improved sugar control. The recommended diet is high in fiber, low in fat, and high in complex carbohydrates (Canine or Feline W/d are good examples). In cats a diet with moderately high protein and fat and decreased carbohydrates has proven helpful in decreasing insulin requirements and stabilizing the blood sugar levels (Feline M/d).

When feeding the diabetic patient, feed the pet half its daily food every 12 hours to coincide with twice-daily insulin injections or orally administered hypoglycemic agent. For animals on once-daily insulin injections, half the food is given with the injection and the remainder in 8-10 hours or at the time of peak insulin activity, if that has been determined. For nibblers, dry food can be fed ad libitum, and two small meals of canned food given as described.

SURGICAL CONSIDERATIONS: Intact females should have an ovariohysterectomy ("spay") when stable. Progesterone secreted between heat periods makes management of diabetes difficult.

MEDICATIONS: Insulin is the treatment of choice for all dogs and most cats. Beef, pork, beef/pork, and human recombinant insulin are options, but animal-origin insulins are being phased out. Keep your pet on the same type and species of insulin if possible. Oral administration of a hypoglycemic agent (eg. glipizide) is useful with dietary therapy in some cats with type II DM. The cat should have uncomplicated DM and no history of ketoacidosis. Potential side effects are hypoglycemia (low blood sugar), hepatic enzyme alterations, icterus, and vomiting.



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How Can I Tell if the Insulin is Working?

PATIENT MONITORING

The glucose curve test is the best method of monitoring the response to insulin. Here's how the test works: You feed your pet, inject the insulin, and then bring the patient to the hospital for serial blood glucose testing every 1-2 hours, beginning about an hour after the injection. The goal is to maintain blood glucose between 100 and 200 mg% for at least 20-22 hours per day in dogs, and between 100 and 300 mg% in cats. The curve is performed every few weeks until the disease is regulated, and then every few months or whenever a problem arises. Urine glucose monitoring: There are a number of methods of monitoring the diabetic patient. Urine can be tested for glucose and ketones before the meal and insulin injection. To use this as a regulatory method, the pet must be allowed to have trace to 1/4% glucosuria to avoid hypoglycemia.

Animals regulated by urine alone may be more hyperglycemic than ideal, and insulin overdose with rebound hyperglycemia is an inherent risk with this method. It is most useful to combine urine monitoring with intermittent glucose curves. Owners should seek veterinary attention if ketonuria is detected. The fructosamine test may be helpful in determining the long-term level of regulation.

Clinical signs are an excellent way an owner can assess degree regulation, by monitoring water consumption and urine production, appetite, and body weight. If these are normal, the disease is well regulated.

POSSIBLE COMPLICATIONS

- Cataracts (dogs) and diabetic neuropathy (cats) with poor glycemic control.
- Seizure or coma with insulin overdose.
- Anemia and red blood cell breakdown with severe low levels of blood phosphorus, which can occur after initial insulin therapy.

EXPECTED COURSE AND PROGNOSIS

Some cats recover to become non-diabetic, but may relapse at a later time. Dogs have permanent disease. Prognosis with treatment is good. Most animals have a normal life span when regulated correctly.

PREGNANCY

Diabetes mellitus can develop during pregnancy, in which case the pregnancy is difficult to maintain. Exogenous insulin administration may cause fetal oversize and difficult birth. Insulin resistance may develop, making hyperglycemia difficult to control. The pregnant dog is prone to ketoacidosis. An emergency ovariohysterectomy may be necessary. Dogs with DM should not be used for breeding.

Special instructions: _____

Notify the Doctor if Any of the Following Occur:

- You cannot give the insulin as directed, or urine-sugar levels increase.
- Your pet's thirst and urination increase.
- Your pet has diarrhea, loss of appetite, or vomits frequently.
- Your pet acts weak or depressed.

Thank you for this opportunity to serve you!