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Diabetes Mellitus

Your cat has been diagnosed with diabetes mellitus (DM). This paper will teach you about DM so that you can effectively treat and monitor your cat's diabetes. Keep this paper accessible and refer to it as questions arise. Please do not hesitate to call *The Cat Doctor* if you are confused or uncertain about the care of your diabetic cat.

An excellent supplemental source of information on diabetes in cats can be found online at www.FelineDiabetes.com.

What is Diabetes Mellitus?

Diabetes mellitus is an endocrine disease caused by lack of the hormone insulin or failure of insulin to work properly. Without insulin, your cat cannot use carbohydrates, fats, and proteins normally. Glucose (sugar) cannot get into body tissues where it is used for energy. Glucose builds up in the blood stream causing high blood sugar (hyperglycemia). High blood sugar leads to increased urine sugar, and loss of fluids and electrolytes in a large volume of urine. Without glucose available for energy, your cat uses other fuels to sustain body functions and begins to metabolize fats and proteins to take the place of glucose energy. This abnormal energy cycle causes weight loss, fatty liver, and production of ketone acids. If dangerous levels of ketone acids build up, your cat can develop a complicated form of DM called ketoacidosis.

What causes DM?

We don't completely understand the causes of DM in cats. Damage to the pancreas, the organ that produces insulin, can cause DM. Inflammation of the pancreas (pancreatitis) and deposits of a protein called amyloid in the pancreas have been implicated. Toxoplasmosis, a protozoan infection that cats can contract by hunting and eating prey, can damage the pancreas and cause DM. Conditions of hormone excess, such as excess adrenal hormones and growth hormones, can interfere with insulin function and lead to DM. Risk factors for developing DM are obesity and drug treatments, such as corticosteroids or progesterones.

Signs of DM

Early signs of diabetes mellitus are increased thirst and increased urine volume. Cats often have a good appetite early in the disease, but still lose weight. They develop a rough, oily coat and dandruff, and may appear weak and listless. Some cats with more advanced diabetes will walk with their hocks (ankles) dropped down (called a plantigrade stance) due to a diabetic neuropathy (nerve degeneration). Cats with diabetes complicated by ketoacidosis will stop eating, become very depressed, dehydrated, and shocky. Diabetic ketoacidosis is life-threatening, and requires immediate and intensive care to reverse the condition.

Demographics and Risk Factors

About 1 in 300 cats will get DM. While diabetes can hit cats at any age, most are 10 years or older at the time of diagnosis. More males than females get DM, and any breed of cat can develop the disease. Overweight cats are more prone to develop DM than lean cats. Recent research suggests that cats eating high carbohydrate diets, especially dry foods, may be more susceptible to DM. Cats that have medical problems requiring the use of corticosteroid medications are predisposed to developing DM.

Diagnosis

The diagnosis of DM is based on a complete physical examination, blood testing, and urinalysis. Additional tests may be needed to complete the medical evaluation, such as abdominal radiographs, abdomi-

nal ultrasound, toxoplasmosis titers, and tests for pancreatic and intestinal disease (a PLI, TLI, cobalamin, and folate panel). If other diseases are discovered at the time diabetes is diagnosed, they must be addressed in order to provide the best possible outcome for your cat.

Treatment of Uncomplicated DM

Diet Change, Oral Medication, or Insulin Injections? The choice of treatment for diabetes will depend on severity of signs and the presence of concurrent illnesses. The options include a change to a low-carbohydrate diet, oral hypoglycemic drugs, and insulin injections. Low carbohydrate diets are usually used along with oral hypoglycemic drugs and insulin injections. Most diabetic cats will need insulin injections to achieve effective control of their disease.

For uncomplicated diabetic cats, outlook for a normal life span is good if we diagnose DM early and are able to treat it consistently. Managing DM requires owner commitment of time and energy. Frequent veterinary visits are needed to monitor your cat's progress, especially in the early stages of treatment.

Diet Change.

Recent research indicates that a key quality of a diabetes diet is low carbohydrate content. Consequently, a good diabetes diet for cats has a normal to high protein content and is low in carbs. Most canned foods are meat (protein) based diets while most dry foods are cereal (carbohydrate) based foods. As a rule, meat-based canned foods are better than most cereal-based dry foods. Exceptions to this rule are meat-based diets that contain gravies or sauces. Gravies and sauces are high in carbohydrates and should be avoided.

Whenever possible, cats with DM should be transitioned to a low-carbohydrate diet. Prescription low-carbohydrate diets available at *The Cat Doctor* are Purina D/M and Hill's M/D. These come in canned and dry formulations but the canned varieties are better for your cat because of their lower carbohydrate content. If your cat won't eat D/M or M/D, try a kitten formulation such as canned Science Diet Growth or canned IAMS kitten food. Again, meat-based canned foods are preferred to most dry foods.

Avoid treats and try to keep your cat on a regular feeding schedule. When giving twice-a-day insulin injections, feed a portion of the daily calories preceding each injection. Observe that your cat has its usual appetite for food. Many cats prefer to "graze" on food left down at all times. This is acceptable for diabetic cats, but for some obese patients, we may recommend gradual decreases in food volumes.

A few diabetic cats will normalize their blood sugar levels after changing to a low-carbohydrate diet without having to use insulin injections or oral hypoglycemic drugs.

Oral drugs.

Oral hypoglycemic drugs stimulate the pancreas to produce more insulin. Glipizide may be used if you want to avoid giving insulin injections to your cat. Some diabetics respond to glipizide, but for most cats it doesn't work adequately. Glipizide is given two times daily with a meal. Cats must be examined weekly during the first month of treatment. Blood tests and urinalyses will help evaluate response to treatment and monitor for adverse reactions to the drug. Potential side effects of glipizide therapy include damage to the liver, vomiting, hypoglycemia, and decreased white blood cell counts. It may take up to 16 weeks to normalize the blood glucose with oral agents.

We sometimes use glipizide in conjunction with low-carbohydrate diets in some patients who have less severely elevated blood glucose levels, have not suffered much weight loss, do not have ketoacidosis, and do not have other complicating diseases.

Insulin Injections.

Most diabetic cats will need insulin injections for effective control of their blood sugar. Subcutaneous injections are given every 12 to 24 hours, depending on the type of insulin used and your cat's unique response to the insulin. Injections are given with a very fine needle which most cats tolerate quite well. A detailed description of handling insulin and giving injections follows. Our veterinary technicians will meet with you and review this procedure. They'll make sure you are completely comfortable with the process



At *The Cat Doctor*, we use 2 types of insulin, glargine (Lantus®) and PZI. Glargine, an insulin used to treat human diabetics, must be given to cats twice daily. PZI, a long-acting veterinary insulin, can be given once daily to some cats, but most cats require twice daily injections.

The most serious potential side effect of insulin injections is insulin overdose, which can cause low blood sugar (hypoglycemia). Hypoglycemia is discussed in detail below.

Monitoring Response to Treatment

While it may take several weeks to reach optimum control of diabetes, most cats will have more energy, drink less water, and produce less urine once treatment is started. Close observation of your cat is especially important in the early phases of treatment. We recommend keeping a written daily log noting appetite, water intake, attitude, insulin dosage, and Glucotest results. (See below.)

At *The Cat Doctor*, we recheck our diabetic patients frequently during the first weeks of treatment. At these visits, we'll review the history, examine and weigh your cat, and take blood glucose readings. Some visits may require more thorough testing. Based on these evaluations, we can fine-tune the insulin dose.

Blood Glucose Curves for Cats Receiving Insulin Injections

After the first 1-2 weeks of treatment, cats on insulin injections come to *The Cat Doctor* for the day for a blood sugar curve. Blood glucose curves tell us how your cat handles the particular insulin we've selected and when the insulin has its peak effect. We will ask you to feed your cat that morning and bring your cat and the insulin to *The Cat Doctor*. We first check a blood glucose level to determine the residual effect of the previous insulin injection. Then we administer an insulin injection and take serial blood glucose samples throughout the day. When the insulin has its peak effect, your cat's blood glucose will be at its lowest level of the day. By studying the blood glucose curve we can adjust the insulin dose and determine the best time of day for future blood glucose checks.

Fructosamine Test

This blood test reflects how well your cat's diabetes has been controlled over the past 3-4 weeks. It is not affected by immediate blood sugar levels which can be influenced by acute stress, meals, and other interfering factors. We occasionally find fructosamine levels helpful when evaluating our diabetics.

Monitoring Your Cat at Home

Please keep in mind that other concurrent disease states may also alter the following signs.

Water Intake. As the insulin dose increases and your cat's diabetes is better controlled, the water intake will noticeably decrease. If you have only one cat, you can measure water intake accurately. Measure the ounces of water you pour it into the water bowl, and then measure the ounces remaining 24 hours later. The difference between the two measurements is your cat's daily water intake. Please record the ounces of water consumed daily so we can review this with you at our rechecks. Well controlled diabetic cats typically drink less than 4-6 ounces per day.

Urine Volume will decrease, although it may not decrease to pre-diabetes level.

Hunger. Excessive appetite subsides to a more normal appetite.

Energy and Strength. Activity levels increase and mobility is improved as the diabetes is controlled. Most cats have a complete reversal of their weakness and hind leg neuropathy. Diabetic neuropathies can resolve quickly or take weeks to months to resolve. Some cats have residual "neuropathy" and persistently walk with dropped hocks, suggesting less than ideal regulation.

Glucotest. This is a packet of small chips that are placed on top of your cat's litter. Glucotest chips change color when coming in contact with glucose in the urine. The darker the color reaction, the greater the sugar in the urine. Compare the color to the chart in the package insert and record the urine glucose value in your log. If you observe two different color changes on one or more Glucotest chips, use the lower glucose level for that recording. Any extreme reaction, either no color change (beige) or a dark red color change should be reported to *The Cat Doctor* right away. No color change (beige) is especially a concern because it suggests your cat's blood sugar is too low. If you see no color (beige), stop giving insulin injections and consult your veterinarian as soon as possible.

Please read the entire package insert carefully before using this monitoring system. We suggest a couple modifications to the package instructions. Instead of mixing the chips into the kitty litter, sprinkle them on the surface of the litter. If your cat is in the habit of urinating in one part or corner of the litter box, you can sprinkle a partial package on the litter surface in that part or corner of the box. This will allow you to stretch the number of uses per Glucotest package. Finally, although the Glucotest is helpful in home monitoring diabetic cats, this system should not be used to self-regulate your cat's insulin dose. Please consult your veterinarian before making insulin dosage adjustments.

Glucometer Blood Test. Accurate, inexpensive, and easy-to-use blood glucose monitors are available at pharmacies. Many of our clients have learned to take blood sugar levels by obtaining a drop of blood from an ear vein. Our veterinary technicians can show you this technique if you wish to perform blood glucose monitoring at home. We ask that you keep careful records of the time of day and blood sugar level so we can help you in making adjustments in the insulin dosage. A good description of the use of the home monitor can be seen at

www.FelineDiabetes.com.

Owners can discuss glucometer readings with our veterinarians over the phone and get advice on insulin dose adjustments. We charge a phone consultation fee for this service.

Insulin Treatments

Handling Insulin

Insulin is a fragile protein suspended in liquid. Handle insulin vials gently. Keep the insulin refrigerated between uses. (Don't worry if you leave your kitty's insulin out once overnight—it will still be effective.)

Before drawing up the insulin, gently roll the bottle of insulin in your hands for about 10 seconds to mix and warm the insulin. Vigorous shaking can damage the insulin protein and create air bubbles that make measurement more difficult.

Because insulin can deteriorate even when handled properly, we recommend that you replace glargine and PZI insulin bottles every 3 months. (Note: drug store pharmacists will recommend that you replace glargine insulin bottles every 1 month. Studies in cats have shown that a single bottle of glargine insulin delivers reliable diabetes control for up to 3 months.).

Giving Insulin Injections

- When using glargine insulin, you will be given a written prescription to purchase the insulin and U-100 insulin syringes at a human pharmacy. We prescribe syringes with tiny needles, labeled *3/10 cc for 30 units or less with microfine needle*.
- You may purchase PZI insulin, manufactured only for cats, and special U-40 insulin syringes at *The Cat Doctor*.



- Never confuse glargine (U-100) and PZI (U-40) syringes which have different calibrations and deliver very different doses of insulin.
- After gently mixing the insulin, insert the needle into the insulin bottle, turn the bottle upside down, and slowly draw up slightly more insulin solution than you need. With the needle still in the insulin vial held upside down, tap the syringe barrel gently to make any bubbles in the syringe rise to the top of the fluid. Then slowly depress the syringe plunger to expel the air bubbles and measure the exact number of units desired.
- Remove the needle from the bottle, and give the injection subcutaneously (under your cat's skin) in the flank area (between the hips and the ribcage). Lift the skin upward to make a "tent", insert the needle into the skin at the base of the "tent" with the needle parallel to the surface of your cat's body. Press the plunger downward to inject the insulin. Then remove the needle from the skin. Because insulin needles are very fine, most cats don't feel the injection at all.
- To prevent skin irritation, scar tissue formation, and erratic insulin absorption, rotate injections to different skin sites from day to day.
- Always make sure your cat is feeling well and has a good appetite before giving insulin injections. Feed a portion of its food prior to giving the injection. If you think your cat is ill or it refuses to eat, do not give the insulin and call *The Cat Doctor* for instructions.
- Please use a new insulin syringe each time you give an injection. Used syringes should be stored in a sealable and non-breakable container and can be brought to *The Cat Doctor* for medical waste disposal at no charge.

Transient Diabetes

A word of caution: some cats (estimates vary from 15 to 50%) are transient diabetics. These cats, after a period of treatment, return to a non-diabetic state and do not require treatment. This is good, of course, but these cats are at risk for hypoglycemia if they are being treated with insulin or oral hypoglycemic drugs and no longer need it. Cats that are transient diabetics can become diabetic again especially after an illness or weight gain.

Low Blood Sugar (Hypoglycemia)

If more insulin is given than is needed or if your cat fails to eat properly after his insulin has been given, he may develop hypoglycemia. Signs of hypoglycemia include mild disorientation, "acting drunk," lethargy, weakness, and, in more serious cases, seizures and coma.

While this is relatively uncommon in well-monitored patients, you should know the signs of hypoglycemia and be prepared to give emergency treatment at home. Purchase Karo syrup (corn syrup) and pre-load the syrup into several 3 cc syringes provided by *The Cat Doctor*. Keep Karo Syrup syringes at room temperature and replace them with freshly loaded syringes every 6 months.

If you suspect your cat has signs of low blood sugar, give 3 cc of Karo syrup by mouth using a preloaded syringe. Repeat Karo syrup treatments every 30 minutes until a good response is seen or emergency veterinary care is found. If your cat will eat, offer food (regular diet or a special treat) after administering Karo syrup. If your cat will not swallow, rub Karo syrup on the gums. Be extremely careful working around the mouth, you can get bitten while your cat is disoriented by hypoglycemia. If your cat is having seizures or is excitable do not have your fingers near its mouth!

After initiating emergency treatment, IMMEDIATELY call *The Cat Doctor* (253-874-2012) or after hours, the *Animal Emergency Clinic* located in Tacoma (253-474-0791). This is a life-threatening emergency!



To minimize risk of hypoglycemia, please do not increase your cat's insulin dose without consulting a veterinarian. We may request an examination and blood glucose test before adjusting the insulin dosage.

Keep in mind that there are other causes of increased thirst. If your cat suddenly becomes thirstier, he may be developing other medical problems, such as kidney disease. Do not assume that his blood glucose is too high and he needs more insulin! Please contact *The Cat Doctor* for a recheck.

What If?

- If you have not yet given the insulin injection and your cat won't eat, is vomiting, or is otherwise seriously ill, DO NOT GIVE THE INSULIN. Schedule an immediate examination at *The Cat Doctor*.
- If you gave the insulin injection and you are concerned your cat may not eat or is seriously ill, be on guard for hypoglycemia. Have your cat examined immediately at *The Cat Doctor* or an emergency clinic.
- If your cat moved during the injection, and you're not sure the injection went under the skin, do not give a second injection. Wait until the next scheduled time and give the injection as usual.
- If your day's schedule isn't cooperating, it's OK to give the insulin injection as much as 2 hours early or 2 hours late on occasion. Otherwise, try to keep an every 12 (or 24) hour schedule.

Check List for Your Cat

- Food:
Canned Dry _____
- Oral medication: _____
- Insulin type:
Give _____ units, every _____ hours
- Review insulin handling.
- Demonstrate and practice insulin injections.
- Review signs of low blood glucose. (hypoglycemia)
- Review emergency treatment of hypoglycemia.
- 3 cc syringes of Karo syrup.
- Prescriptions:

