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FELINE DIABETES

Definition:

Diabetes mellitus is an endocrine disease in which the blood sugar level rises because of failure of insulin to control it. This situation occurs either because the pancreas has lost its ability to manufacture insulin (known as Type I diabetes) or that mechanisms of insulin release and tissue responsiveness are dysfunctional (Type II diabetes). Without proper insulin regulation, the body is unable to transport glucose (a simple sugar obtained from digested food) into cells. Because glucose remains trapped in the bloodstream, the tissues of the body are deprived of the energy needed to function normally.

Risk factors:

Many times we are unable to determine why a cat has developed diabetes. However, it is known that obesity is one of the most important conditions which puts a cat at risk for diabetes (especially Type II). Other causes or factors include: damage to the pancreas caused by inflammation, infection, attack by the immune system, or tumors; genetic predisposition; and exposure to certain drugs.

Symptoms:

The most common symptoms of diabetes are weight loss (often in spite of a healthy appetite), excessive water consumption and excessive urine output. Because so much urine is being produced, some diabetic cats will urinate in unusual places (i.e., outside of the litter box). Some cats will also show weakness, lethargy, vomiting, and changes in behavior.

Diagnosis:

Our examination may detect physical changes such as poor body condition, dehydration, jaundice, and an enlarged liver. Laboratory testing is essential to diagnose diabetes. Blood tests show hyperglycemia (high blood sugar, usually above 300 mg/dl), and often there are liver enzyme abnormalities. In complicated cases, there may be electrolyte imbalances and acidosis (acidic blood). Urine samples will show high levels of glucose. These tests are required for several reasons: 1.) the common symptoms of diabetes are similar to those of other diseases, especially kidney disease, hyperthyroidism and cancer; 2.) to detect other illnesses which may complicate management of the diabetes; and, 3.) the severity of the diabetes will influence initial treatment options and success (prognosis).

Treatment:

Successful management of the diabetic cat is a challenge to both you as owners and to us as veterinarians. Recommendations regarding the proper treatment of the feline diabetic are constantly evolving, and there is no standard protocol by which all cats can be treated. Treatment requires a time and financial commitment on your part: your cat will require daily medication and feeding at consistent times, there will be frequent visits to our office, and you will need to monitor changes in your cat's behavior to help guide us in the management of the disease.

Modes of treatment:

1. Insulin injections - Insulin is the cornerstone of treatment of most diabetic cats. Although your cat may not be placed on insulin injections (shots) immediately, many diabetic cats will eventually require insulin to successfully manage their condition. Currently, insulin can only be given by injection. Details on giving insulin injections are provided later in this handout.

2. Nutritional supplements - We are currently treating some cats who have early Type II diabetes with a nutritional supplement called Vanadium. Vanadium is a transitional metal that plays a role in normal metabolic processes.

When given at higher doses, it is thought to increase the body's sensitivity to its own insulin. It is given as a pill or mixed in with food.

3. Oral medications (pills) which lower blood glucose - These medications, which include Glucotrol and Acarbose, may help certain diabetic cats who do not need insulin yet. They may also be used in conjunction with insulin in some cats. These drugs have different actions, including boosting insulin release, blocking carbohydrate absorption from the intestine, and decreasing glucose release from the liver.

4. Dietary therapy - What food a diabetic cat should eat has become a very controversial issue in recent months. While high fiber diets have been traditionally recommended for diabetic animals, we know that for thin cats, a diet high in fiber will not contain enough calories during the recovery phase. Recent work is showing that even overweight diabetic cats may benefit more by increasing dietary protein rather than by increasing fiber. Therefore, our recommendations for almost all diabetic cats are now to feed a canned (canned food has more protein than dry) food which contains at least maintenance protein content (such as Hill's Science Diet) or actually has increased protein content (such as canned kitten foods or the new CNM-DM prescription diet). Obese cats with a marginally elevated blood sugar (displaying a diabetic tendency) may be managed with diet alone, especially if a healthy weight can be achieved. More information is contained under the heading "Feeding the Diabetic Cat".

5. Antibiotics - infections in the pancreas may decrease insulin production, and infections in other parts of the body may cause insulin resistance (inability of cells to use insulin). Antibiotics may be prescribed if it is suspected that an infection is playing a role in the development of diabetes or is complicating the treatment of your diabetic cat.

6. Intensive Care - occasionally a diabetic cat will be sick enough to require hospitalization with intravenous fluids, medications, injections, and sometimes even feeding tubes to correct metabolic abnormalities associated with diabetes.

Prognosis:

We are often asked how long a cat will live if it has become diabetic. Because of the extreme variability among diabetic cats, this question is difficult to answer. In general, our impression is that diabetic cats have a shorter life span than average. However, many cats will live several years (as many as 3 or 4 years) following diagnosis if appropriate therapy is given. In addition, there is a small percentage of cats that will "recover" temporarily and sometimes permanently from diabetes.

Complications of Diabetes:

In general, diabetic cats suffer fewer secondary problems than humans and dogs. They *do not* develop kidney failure, skin infections, cataracts, or circulation problems requiring limb amputation. Most complications encountered are the result of inadequate control of the disease (or its treatment) and include:

1. Peripheral neuropathy (a condition affecting the nerves to the legs, head and tail):

A relatively common problem which often first appears as weakness in the hind legs, and a sinking in the hocks so that the cat walks on its hocks instead of on its toes. The nerves in the front legs may also be affected so that the carpus (the "wrist" joint) sinks toward the ground as well. Nerves to the head, neck and tail may also be affected so the the cat appears weak all over. Neurologists believe this condition does result in some discomfort, especially of the extremities (lower legs and paws). Cats with well-regulated diabetes are less likely to develop this condition, and cats that have developed the condition may improve once the diabetes is controlled.

2. Ketoacidosis:

This condition develops in uncontrolled diabetic cats (usually those with type I diabetes), especially those who have lost a lot of weight quickly or those that have long-standing insulin deficiency. It occurs when the body, deprived of sugar as an energy source, begins breaking down fat instead. The by-products include ketones, which are acids that create toxic effects on the brain and other tissues. These cats are typically quite sick and symptoms include lethargy, poor appetite, vomiting and even coma. Electrolyte imbalances that can occur with this condition are often severe and potentially life-threatening.

3. Pancreatic digestive enzyme deficiency:

Although not a consequence of diabetes, this condition often is present in diabetic cats. Symptoms include diarrhea, frequent or large bowel movements, pale-colored stool, and vomiting. Even when the insulin dose is adequate, these cats will not gain weight well until they are supplemented with pancreatic enzymes. We usually mix this supplement in the food.

4. Hypoglycemia (low blood sugar):

This is almost always associated with an overdose of insulin, and sometimes occurs in cats on oral hypoglycemic agents. See the section on giving insulin injections for information on how to spot and avoid hypoglycemia.

5. Side effects from medications:

Most likely to occur with oral hypoglycemic medications (see the following section).

Using Oral Hypoglycemic Agents for Diabetes Management

Which cats can be given oral hypoglycemics?

These supplements or medications can be used in the diabetic cat instead of (or with) insulin injections *only* if the cat fulfills the following criteria:

- he or she is healthy otherwise
- has no evidence of ketoacidosis
- is a normal weight or above, and has not lost more than 10% of his/her original body weight
- is not jaundiced and has no significant elevations in certain liver enzymes

Depending on the type of oral hypoglycemic chosen, you will need to give your cat a pill at least every 24 hours (and usually twice a day). Most are given with food or mixed in the food. These drugs offer a conservative approach to diabetes management but often do not provide adequate control.

Potential Side Effects:

Vanadium (sold under the name Super Vanadyl Fuel, manufactured by TwinLab) is currently an attractive oral hypoglycemic agent because there are no known side effects and it is not too costly. It is less a medication and more a nutritional supplement. As with all oral hypoglycemic agents, the biggest drawback is that it may not offer adequate control of blood glucose levels for many cats. The quantity needed can also be difficult to give if the cat is not willing to eat it mixed in canned food (which is the ideal way to administer it).

Glucotrol (the most commonly used medication) has the potential to cause liver toxicity. If the liver becomes very damaged, the cat may develop loss of appetite, jaundice, vomiting and eventual liver failure. Elevations in the liver enzymes usually precede these more severe symptoms. If liver enzyme (especially the ALT) elevation is detected, by stopping the medication, we can usually avoid any long-term problems with the liver. This medication may also cause excessively low blood sugar (hypoglycemia). Veterinary researchers are currently looking in to the possibility that Glucotrol may actually increase amyloid (a substance similar to scar tissue) deposits in the pancreas.

Problems associated with other oral hypoglycemic agents (such as Acarbose) include diarrhea, poor appetite, and vomiting. Again, the most common complication resulting from using oral medications alone to control diabetes is that the disease progresses and the cat ultimately needs insulin.

Monitoring:

Cats not on insulin that are being managed with diet and/or vanadium are usually checked within 1-2 weeks of starting therapy. An examination and blood glucose measurement will evaluate whether this therapy is helping. When to perform re-check exams and blood glucose measurements will be determined at that time.

Because of the possible side effects described above, cats on Glucotrol must be examined and have a blood screen (a urinalysis may also be recommended) performed one week after starting the medication. If no problems are noted at that time, they are checked every two weeks for the first 6 - 8 weeks of therapy. By that time, we will be able to determine if the drug is controlling the diabetes or if insulin therapy is needed.

Monitoring of cats on other hypoglycemic agents is highly individualized.

Managing Diabetes with Insulin Injections

If insulin injections (shots) have been prescribed to treat your cat's diabetes, this guide will help you understand how to give the injections, how to care for the insulin, and problems that may occur while your cat is on insulin therapy. We want to make you as comfortable as possible with the treatment, and will address all of your questions and concerns.

Demonstration of insulin injections:

When it has been decided that your cat should receive injections, we will schedule a time for one of our veterinary technicians to show you how to give injections. Information provided during this session (which lasts 10-20 minutes) will include how to measure the dose of insulin, where and how to give the injection, and how to care for your insulin.

Timing of the insulin injections:

You will be giving insulin either once or twice a day (most cats will need morning and evening doses). If your cat has been prescribed injections only once a day, it is best to give it when the cat eats the most. For most people, this is in the morning when fresh food is put down. If you have been instructed to give injections twice a day, the injections should be as close to 12 hours apart as possible, and no sooner than 10 hours apart unless your veterinarian has instructed you otherwise.

Where to buy insulin and insulin syringes:

It is our preference to use full-strength insulin (100 units of insulin per ml, U-100), which we or any pharmacy can dispense to you. You can also buy the insulin syringes from us or the pharmacy (we will give you a prescription for the insulin and the syringes). If you will be using less than full-strength (diluted insulin, or PZI U-40) you will need to buy the insulin from our hospital.

According to our state pharmacy laws, a prescription for insulin or insulin syringes is not required for purchase. Therefore, if you run out of syringes when we are closed (e.g., nights/weekends) a pharmacy can sell supplies to you. If you buy insulin in an “emergency” situation, make sure the type and strength of insulin is identical to what you have been using. (Again - the regular pharmacy will not be able to dispense diluted insulin or PZI insulin to you!)

Storage and care of insulin:

Insulin should be kept in a cool, dark place such as the refrigerator. Prolonged exposure to direct light (especially sunlight) or excessive heat will inactivate the insulin. A few hours at room temperature in room light (e.g., being left on the kitchen counter) is unlikely to change the insulin activity. The insulin bottle should be gently rolled and inverted several times before it is given to the cat. It should never be vigorously shaken or it may become less effective. Failure to gently mix the insulin before giving could result in over- or under-dosing. Diluted insulin except for PZI has a shelf life of only 1 month. Undiluted insulins typically have very long shelf lives (see the expiration date on the box).

Disposal of insulin syringes:

Because of public health concerns, used insulin syringes should not be thrown away in your regular garbage. Purchase a hazardous waste container from our hospital. When full, you may bring it in and we will take care of the disposal of the container.

Insulin overdose:

This problem is occasionally encountered when managing diabetic cats. It may occur in the following ways:

- failure of the cat to eat at the time insulin is given
- accidental overdose - for example, 2 family members giving the dose without each other's knowledge, or improper measurement of the dose in the syringe
- sudden decline in the cat's need for insulin - this can occur if the cat is sick from other conditions, however, there is also the potential for this in a cat that seems to be doing well. This circumstance is highly unpredictable and is one reason why frequent evaluation of the diabetic cat is so important.

An insulin overdose may result in life-threatening hypoglycemia (low blood sugar). Hypoglycemia usually occurs 2-6 hours after the last insulin dose was given, however, in some cases it occurs at other times. Initial symptoms of hypoglycemia include:

- lethargy (low energy)
- weakness or wobbliness
- either a loss of appetite or an unusual eagerness to eat

More severe symptoms are:

- disorientation
- excessive vocalization/meowing
- stumbling
- dilated pupils, sometimes apparent blindness
- agitation / irritability / anxiety
- muscle tremors which may progress to seizures
- coma which may progress to death

If you observe any of the symptoms, it is important to provide a source of glucose to the cat. If the symptoms are mild, feeding your cat may be enough to counteract the effects of the overdose. If the cat will not eat, you may have to syringe-feed several teaspoons of a sugar source such as Nutrical (a high-calorie veterinary supplement) or Karo syrup. If the cat lacks the ability to swallow, rubbing these sugar solutions on the gums may help to raise blood sugar levels temporarily.

After a sugar source has been provided, it is essential to contact our hospital or, if after hours, the local emergency clinic. Examination and measuring blood glucose levels will be necessary to confirm that hypoglycemia is occurring. This is important because other conditions of the diabetic (particularly ketoacidosis), can have similar symptoms to hypoglycemia. The following are guidelines to follow to avoid insulin overdose:

- a. always keep in mind that it is better to miss a dose of insulin than to give it improperly, so if there is any doubt as to whether your cat should receive its insulin, do not give it.
- b. feed your cat immediately before you give the insulin - if your cat eats several times throughout the day (this is the preferred feeding schedule), make sure fresh food is available before giving the insulin.
- c. if your cat is acting normally but does not eat its normal amount or at its regular time (this depends on the cat), give only half the dose or phone us if you are unsure what to do.
- d. if your cat is acting sick and not wanting to eat according to its regular pattern, do not give any insulin and contact our office.
- e. make clear who is to give the insulin on any given day, or write schedules or charts so that the cat is not accidentally double-dosed.
- f. schedule blood-glucose curves (see section on monitoring) at least every 3 to 6 months, even if your cat seems well.

Monitoring Recommendations for Cats on Insulin

Your cat will need frequent examinations, blood and urine tests during the first few weeks once treatment is started. The dose of insulin will be fine-tuned during this time. The type or timing of insulin injections may also need adjustment. To establish the correct of insulin, your cat will stay in the hospital for at least 10 hours so that we can perform a blood glucose curve. In addition, any diabetic cat that is showing any symptoms of illness should be examined immediately.

The Blood Glucose Curve:

In the morning, the cat is fed normally at home but no insulin is given - after eating, the cat is immediately transported to the hospital and we will then give the insulin after first determining the blood glucose level. Blood samples are drawn every 1-3 hours thereafter. By the end of the day, we are able to generate a "curve" of insulin activity - we can see if the insulin dose is appropriate, how long the insulin has an effect on the blood glucose level, and determine if the insulin should be given once or twice a day.

If your cat needs a dosage adjustment or is being switched to another type of insulin, we will need to perform another curve fairly soon after that change. Sometimes we will need to keep your cat overnight and perform another curve the next day.

Many owners feel their cat will experience too much stress by been hospitalized and are reluctant to do a blood glucose curve. We understand this concern and do everything possible to minimize anxiety felt by the cat. However, there is no substitute for a curve and the valuable information it provides. Urine glucose strips (for home use) are a very crude indicator and we could be putting your cat in danger if we rely on the results. If you board your cat at our hospital, sometimes coordinating a blood glucose curve during a boarding stay reduces the effects of stress. For boarding cats, we typically allow the cat to adjust to his/her surroundings for a day or two, then perform the curve. When you return to town, we will discuss the results of the curve during your discharge appointment.

The Fructosamine Level:

A new blood test, called the fructosamine level, may help us reduce the number of blood glucose curves needed to achieve good regulation of a diabetic cat. This test gives us a window on the past 3 weeks, as the value correlates with how high the cat's average blood sugar level has been during that time. This test is of most use when used in conjunction with a measurement of the blood glucose when it is expected to be the lowest (this time is usually determined by the blood glucose curve). It does not require a hospital stay and is cost-effective in cases where a blood glucose curve may not be needed.

Even if your cat seems to be doing well, it is strongly recommended that your cat is evaluated using either a blood glucose curve or a fructosamine level every 3-6 months.

Feeding a Diabetic Cat

In general, diabetic cats will have more stable blood sugar levels if they eat small amounts several times a day (ad lib feeding). However, some cats will overeat when allowed constant access to food, which may worsen the diabetic condition. If your cat eats all the food that is offered at mealtimes (meal feeding), feed the cat twice a day in conjunction with the insulin or oral hypoglycemic dose. As mentioned previously, current recommendations are to feed all diabetic cats canned foods with moderate to high protein content. If your cat refuses to eat canned foods, then provide dry instead.

Cat on Vanadium:

Many cats accept the dose mixed in with a palatable canned food. Feed twice a day. One can of maintenance or kitten food per 24 hours is a general guideline to follow.

Cats on Glucotrol:

The medication works better if it is given with a meal. If your cat is not a meal feeder and prefers to nibble all day, sometimes feeding a small snack at medication times will ensure that the cat eats something at this time. Feed twice a day. One can of maintenance or kitten food per 24 hours is a general guideline to follow.

Cats on Insulin:

Diabetic cats that are placed on insulin immediately are often cats who are thin or losing body condition rapidly. In addition to insulin, intensive nutritional management is needed to reverse the negative energy balance which could predispose them to other problems. These cats should be fed anything they will eat, as often as they want. High calorie, high-protein foods such as canned kitten food, prescription diets such as Hill's p/d, a/d, and Eukanuba Nutritional Recovery Formula are useful for very debilitated or thin cats.

If a cat is overweight or normal weight it should be fed as described above.

Cats that need weight control:

Because of the apparent beneficial effects of canned, high protein foods for diabetic cats, we will try to achieve weight loss on such a diet. In some cases, it will not be possible and another dietary approach will need to be used. Those cats will likely be placed on lower calorie diets.

Note: a diabetic cat should not be fed soft-moist foods or treats from the grocery store (eg, Tender Vittles or Pounce) because these foods are extremely high in sugar.

Home Care Checklist

Please make sure we have answered all your questions about the following:

1. If you will be giving insulin:
 - the starting dose of insulin
 - how to give and care for the insulin
 - how to dispose of insulin syringes
 - how to avoid and identify signs of an insulin overdose

2. If you will be giving vanadium, glucotrol or other oral hypoglycemics:
 - the dose
 - how to give a pill
 - side effects to watch for
 - where to buy vanadium (certain health food stores, we use NatureWay)

3. The type of food recommended for your cat and when and how much to feed

4. When you should schedule your next appointment.

Still have questions? Call us for assistance. GOOD LUCK!