

Diabetes Mellitus in Cats

There are two forms of diabetes in cats: diabetes insipidus and diabetes mellitus. Diabetes insipidus is a very rare disorder that results in failure to regulate body water content. Your cat has the more common type of diabetes, diabetes mellitus, or “sugar diabetes”. This disease is seen on a fairly regular basis, usually in cats 5 years of age or older. Simply put, diabetes mellitus is a failure of the pancreas to regulate blood sugar.

The pancreas is a small but vital organ that is located near the stomach. It has two significant populations of cells. One group of cells produces the enzymes necessary for proper digestion. The other group, called beta cells, produces the hormone called insulin.

Types of Diabetes

In cats, two types of diabetes mellitus have been discovered. Both types are similar in that there is a failure to regulate blood sugar, but the basic mechanisms of disease differ somewhat between the two groups.

1. Type I, or Insulin Dependent Diabetes Mellitus, results from total or near-complete destruction of the beta cells. This is the most common type of feline diabetes. As the name implies, cats with this type of diabetes require insulin injections to stabilize blood sugar.

2. Type II, or Non-Insulin Dependent Diabetes Mellitus, is different because some insulin-producing cells remain. However, the amount produced is insufficient, there is a delayed response in secreting it, and the tissues of the cats body are relatively resistant to it. These cats may be treated with an oral drug that stimulates the remaining functional cells to produce or release insulin in an adequate amount to normalize blood sugar. Alternatively, they may be treated with insulin. Cats with NIDDM may ultimately progress to total beta cell destruction and then require insulin injections.

What Insulin does for the Body

The role of insulin is much like that of a gatekeeper. It stands at the surface of body cells and opens the door, allowing glucose to leave the blood stream pass inside the cells. Glucose is a vital substance that provides much of the energy needed for life, and it must work *inside* the cells. Without an adequate amount of insulin, glucose is unable to get into the cells. It accumulates in the blood, setting in motion a series of events that can ultimately prove fatal.

When insulin is deficient, the cells become starved for a source of energy. In response to this, the body starts breaking down stores of fat and protein to use as alternative energy sources. As a consequence, the cat eats more; thus, we have weight loss in a cat with a ravenous appetite. The body tries to eliminate the excess glucose by eliminating it in the urine. However, glucose (blood sugar) attracts water; thus, urine glucose takes with it large quantities of the body's fluids, resulting in the production of a large amount of urine. To avoid dehydration, the cat drinks more and more water. Thus, we have the four classical signs of diabetes:

CLASSICAL SIGNS OF DIABETES MELLITUS:

Weight loss
Ravenous appetite
Increased water consumption
Increased urination

Diagnosing Diabetes

The diagnosis of diabetes mellitus is based on several criteria: the four classical clinical signs, the presence of a persistently high level of glucose in the blood stream, the presence of glucose in the urine and high levels of fructosamine in the blood.

The normal level of glucose in the blood is 80-120 mg/dl. It may rise to 250-300 mg/dl following a meal or when the cat is very excited. However, diabetes is the only common disease that will cause the blood glucose level to rise above 400 mg/dl. Some diabetic cats will have a glucose level as high as 800 mg/dl, although most will be in the range of 400-600 mg/dl.

To keep the body from losing its needed glucose, the kidneys do not allow glucose to be filtered out of the blood stream until an excessive level is reached. This means that cats with a normal blood glucose level will not have glucose in the urine. Diabetic cats, however, have excessive amounts of glucose in the blood, so it will be present in the urine.

The diagnosis of diabetes seems rather simple, and in most cats it is. However, some diabetic cats do not meet all the criteria. For these, another test is performed called fructosamine. This test represents the average blood glucose level for the past two weeks. It minimizes the influence that stress and eating have on blood glucose levels and can be very helpful in understanding difficult cases. This test must be sent to a laboratory to be performed and may take several days for the results to be reported.

What It Means for Your Cat to be Diabetic

For the diabetic cat, one reality exists. Blood glucose cannot be normalized without treatment. Although the cat can go a few days without treatment and not get into a crisis, treatment should be looked upon as part of the cat's daily routine. Treatment almost always requires some dietary changes. Whether an individual cat will require oral therapy or insulin injections will vary.

In some cases, your cat will be hospitalized for a few days to deal with the immediate crisis and to begin the regulation process. The "immediate crisis" is when your cat is so sick that it has quit eating and drinking. Cats in this state, called ketoacidosis, may require several days to a week of hospitalization with quite a bit of laboratory testing. Once your cat's glucose level is regulated in the hospital, it will be sent home on insulin injections. You will then follow up with your regular veterinarian in several days to a week to be sure the dose is correct at home.

Another complication that can arise is hypoglycemia or low blood sugar; if severe, it may be fatal. This may occur due to inconsistencies in treatment or because some cats can have a spontaneous remission of their disease. This will be explained in subsequent paragraphs.

Your personal commitment to treating this cat is very important in maintaining regulation and preventing crises. Most diabetic cats require insulin injections twice daily, at about 12-hour intervals. They must be fed the same food in the same amount on the same schedule every day. If you are out of town, your cat must receive proper treatment while you are gone. These factors should be considered carefully before deciding to treat a diabetic cat.

Treatment

As mentioned, the key to successful treatment is consistency. Your cat needs consistent administration of medication, consistent feeding, and a stable, stress-free lifestyle. To best achieve this, it is preferred that your cat lives indoors. Although that is not essential, indoor living removes many uncontrollable variables that can disrupt regulation.

The first step in treatment is to alter your cat's diet. Diets that are high in fiber are preferred because they are generally lower in sugar and slower to be digested. This means that the cat does not have to process a large amount of sugar at one time. If your cat is overweight, a reducing-type diet is fed until the proper weight is achieved, then your cat is switched to a high fiber maintenance food. There are several prescription foods formulated specifically for diabetic cats.

Your cat's feeding routine is also important. The average cat prefers to eat about 10-15 times per day, one mouthful at a time. This means that food is left in the bowl at all times for free choice feeding. Unlike dogs and people with diabetes, eating a set amount at set times is difficult to impossible to do with cats. As such, diabetes control in cats is different than in people or dogs.

The second step in treatment is to use a drug to control (lower) control blood glucose levels. The choices are to give insulin injections or to give an oral drug. Both have advantages and disadvantages and one may be more appropriate for your cat than the other.

Insulin injections are usually the first choice because this approach is to replace the hormone that is missing or made in inadequate amounts. Although many people are initially uncomfortable with the thought of giving injections, for most cats, insulin injections are easier than giving tablets.

Many people are initially fearful of giving insulin injections. If this is your initial reaction, consider these points.

- 1) Insulin does not cause pain when it is injected.
- 2) The injections are made with very tiny needles that your cat hardly feels.
- 3) The injections are given just under the skin in areas in which it is almost impossible to cause damage to any vital organ. Please do not decide whether to treat your cat with insulin until we have demonstrated the injection technique. You will be pleasantly surprised at how easy it is.

The second option for treatment is the use of a tablet that lowers blood glucose. It is estimated that as many as 25% of diabetic cats have Type II diabetes. This means that they may be treated with oral medication instead of insulin injections. There is no reliable, practical test to know if your cat is one of these. Therefore, we must place your cat on an initial dose of glipizide or glyburide, the oral hypoglycemic drugs, for about 1 week. This is usually done at home if your cat is eating well. Weekly blood glucose levels are checked for about one month until it is determined whether or not response is occurring. If response occurs and blood sugar declines, this treatment is continued until it is no longer effective. That may be for many years or for only a few months, depending on the progression of destruction of the beta cells in the pancreas.

One disadvantage to treating with tablets is that some cats only have a temporary response. The tablets function by stimulating the existing beta cells so they work more efficiently. Many diabetic cats have a gradual decline in the number of functioning beta cells as time passes. This means that a time will come with the tablets are no longer effective.

Insulin Therapy and Administration

About Insulin

Insulin comes in an airtight bottle that is labeled with the insulin type and the concentration. Before using, mix the contents. It says on the label to roll it gently, not shake it. The reason for this is to prevent foam formation, which will make accurate measuring difficult. Some of the types of insulin used in cats settle out of suspension in a few hours. If it is not shaken properly, it will not mix well, and dosing will not be accurate. Therefore, the trick is to shake it vigorously enough to mix it without creating foam. Since bubbles can be removed (as described later), it is more important to mix it well than to worry too much about foam formation.

Insulin is a hormone that will lose its effectiveness if exposed to direct sunlight or high temperatures. It should be kept in the refrigerator, but it should not be frozen. It is not ruined if left out of the refrigerator for a day or two as long as it is not exposed to direct sunlight. However, we do not advise this. Insulin is safe as long as it is used as directed, but it should be kept out of reach of children.

Several types of insulin have been used in cats. Some are made for use in humans and obtained from regular pharmacies. Protamine zinc insulin (PZI) is made specifically for cats and obtained from veterinarians but is difficult to get on a regular basis. PZI has a concentration of 40 units of active insulin crystals per milliliter of fluid. Thus it is called U40 insulin. Insulins made for humans have a concentration of 100 units per milliliter and are called U100 insulins. This is important to know because there are two types of insulin syringes, U40 syringes and U100 syringes. They are made to be used with their respective types of insulin and must not be interchanged or improper dosing will occur. The 2 human insulins used are Humulin N and Lantus. Your veterinarian will discuss which is best for your cat.

Drawing up Insulin

Have the syringe and needle, insulin bottle, and cat ready. Then, follow these steps:

- 1) Remove the guard from the needle, and draw back the plunger to the appropriate dose level.
- 2) Carefully insert the needle into the insulin bottle.
- 3) Inject air into the bottle; this prevents a vacuum from forming within the bottle.
- 4) Withdraw the correct amount of insulin into the syringe.

Before injecting your cat with the insulin, verify that there are no air bubbles in the syringe. If you get an air bubble, draw twice as much insulin into the syringe as you need. Then withdraw the needle from the insulin bottle and tap the barrel of the syringe with your finger to make the air bubble rise to the nozzle of the syringe. Gently and slowly expel the air bubble by moving the plunger upward.

When this has been done, check that you have the correct amount of insulin in the syringe. The correct dose of insulin can be assured if you measure from the needle end, or "0" on the syringe barrel, to the end of the plunger nearest the needle.

Injecting Insulin

The steps to follow for injecting insulin are:

- 1) Hold the syringe in your right hand (switch hands if you are left-handed).
- 2) Have someone hold your cat while you pick up a fold of skin from somewhere along your cat's side with your free hand (pick up a different spot each day). Do not use the scruff of the neck.
- 3) Quickly push the very sharp, very thin needle through your cat's skin. This should be easy and painless. However, take care to push the needle through only one layer of skin and not into your finger or through two layers of skin. The latter will result in injecting the insulin onto your cat's hair coat or onto the floor. The needle should be directed parallel to the backbone or angled slightly downward.
- 4) To inject the insulin, place your thumb on the plunger and push it all the way into the syringe barrel.
- 5) Withdraw the needle from your cat's skin. Immediately place the needle guard over the needle and discard the needle and syringe.
- 6) Stroke your cat to reward it for sitting quietly.
- 7) Be aware that some communities have strict rules about disposal of medical waste material so don't throw the needle/syringe into the trash until. You can purchase special red containers at your pharmacy for needle and syringe disposal.

It is neither necessary nor desirable to swab the skin with alcohol to "sterilize" it. There are four reasons:

- 1) Due to the nature of the thick hair coat and the type of bacteria that live near the skin of cats, brief swabbing with alcohol or any other antiseptic does not really kill all the bacteria.
- 2) Because a small amount of alcohol can be carried through the skin by the needle, it may actually carry bacteria with it into the skin
- 3) The sting caused by the alcohol can make your cat dislike the injections.
- 4) If you have accidentally injected the insulin on the surface of the skin, you will not know it. If you do not use alcohol and the skin or hair is wet following an injection, the injection was not done properly.

Although the above procedures may at first seem complicated and somewhat overwhelming, they will very quickly become second nature. Your cat will soon learn that once or twice each day it has to sit still for a few minutes. In most cases, a reward of stroking results in a fully cooperative cat that eventually may not even need to be held.

Monitoring

It is necessary that your cat's progress be checked on a regular basis. Monitoring is a joint project on which owners and veterinarians must work together.

The easiest way is to monitor your cat for signs of diabetes. The most obvious and often easiest to monitor is your cat's thirst and amount of urination. A well regulated diabetic is not overly thirsty and does not have to urinate excessively. The average 10 pound cat should drink no more than 1 cup of water per 24 hours. When properly regulated, it should drink no more than four times per day. If you notice your cat is drinking more than you think it should or the litter pan is wetter than normal, contact your veterinarian regarding checking the cat.

Any significant change in your cat's food intake, water intake, or urine output is an indicator that the diabetes is not well controlled and you should take your cat to your veterinarian.

Hypoglycemia

Hypoglycemia means low blood sugar. If it is below 40 mg/dl, it can be life threatening. Hypoglycemia occurs under three conditions:

1) *If the insulin dose is too high.* Although most cats will require the same dose of insulin for long periods of time, it is possible for the cat's insulin requirements to change. However, the most common causes for change are a reduction in food intake and an increase in exercise or activity. The reason for feeding before the insulin injection is so you can know when the appetite changes. *If your cat does not eat, skip that dose of insulin.* If only half of the food is eaten just give a half dose of insulin. *Always remember that it is better for the blood sugar to be too high than too low.*

2) *If too much insulin is given.* This can occur because the insulin was not properly measured in the syringe or because two doses were given. You may forget that you gave it and repeat it, or two people in the family may each give a dose. A chart to record insulin administration will help to prevent the cat being treated twice.

3) *If your cat has a spontaneous remission of the diabetes.* This is a poorly understood phenomenon, but it definitely occurs in about 20% of diabetic cats. They can be diabetic and on treatment for many months, then suddenly no longer be diabetic. Since this is not predictable and happens quite suddenly, a hypoglycemic crisis ("insulin shock") is usually the first indication.

The most likely time that a cat will become hypoglycemic is the time of peak insulin effect (5-8 hours after an insulin injection). When the blood glucose is only mildly low, the cat will be very tired and unresponsive. You may call it and get no response. Within a few hours, the blood glucose will rise, and your cat will return to normal. Since many cats sleep a lot during the day, this important sign is easily missed. Watch for it; it is the first sign of impending problems. If you see it, please bring in your cat for blood testing.

If your cat is slow to recover from this period of lethargy, you should give it corn syrup (1 tablespoon by mouth) or feed one packet of a semi-moist cat food. If there is no response in 15 minutes, repeat the corn syrup or the semi-moist food. If there is still no response, contact us immediately for further instructions. (Note: *Diabetic cats should not be fed semi-moist foods except for this situation.*)

If severe hypoglycemia occurs, a cat will have seizures or lose consciousness. This is an emergency that can only be reversed with intravenous administration of glucose. If it occurs during office hours, come in immediately. If it occurs at night or on the weekend, call our emergency phone number for instructions.

Spontaneous Remission

This is a poorly understood phenomenon that only happens in a few cats. Unfortunately, it can happen rather suddenly so a hypoglycemic crisis may be created when the normal amount of insulin is given. When it occurs, the cat may be normal for a few weeks or for many months. However, diabetes will almost always return. Therefore, you should watch for the typical signs of diabetes then contact us for insulin instructions.