



O A K B A Y A N I M A L H O S P I T A L

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DIABETES MELLITUS IN CATS

Diabetes mellitus, commonly called “sugar diabetes” or just “diabetes,” is a disease caused by failure of the pancreas to produce adequate amounts of insulin.

What does insulin do in my cat's body?

Insulin has been called the cells' gatekeeper. It attaches to the surface of cells and permits glucose (blood sugar) to enter the cells from the blood. When insulin is absent or present in insufficient amounts, glucose builds up in the blood resulting in high blood glucose levels.

Glucose is one of the body's primary energy sources. When insufficient amounts of glucose are available to the cells, the body looks for alternate sources of energy (primarily fat and protein). Eventually, these energy demands lead to weight loss. This weight loss causes the cat to eat more in an attempt to make up for the “energy drain.” Also, the body attempts to remove excess blood glucose by spilling it into the urine. Since glucose attracts water, tremendous amounts of water follow this glucose into the urine. This loss of water causes dehydration and the cat must drink more to counteract it.

Therefore, high blood glucose levels result in the four typical signs of diabetes: 1) **weight loss**, 2) a **ravenous appetite**, 3) **increased urination**, and 4) **increased thirst**. Not all of these signs are readily seen in every diabetic cat, but we expect that you will have seen at least two of them.

How is diabetes diagnosed?

The four clinical signs of diabetes are also present in other feline diseases. Therefore, clinical signs alone are not sufficient to make a diagnosis. The two most important laboratory tests are the blood glucose level and a urinalysis. The normal blood glucose level is 80-120 mg/dL (4.4-6.6 mmol/L). Diabetic cats often have levels over 400 (22), or even 600 mg/dL (33 mmol/L). Diabetic cats also have glucose present in the urine. The combination of these two findings in a cat with at least two of the clinical signs of diabetes is sufficient evidence to make a diagnosis of diabetes.

A cat's blood glucose level can be influenced by excitement. “Stress hyperglycemia” can result from a ride in an automobile and a visit to the veterinary hospital, especially in an excitable cat. This can confuse the testing process for diabetes. When this is suspected, another test, the serum fructosamine, can be used. This test gives an average blood glucose reading for the last two weeks. It will be clearly elevated in diabetic cats.

What does a diagnosis of diabetes mean to my cat?

There are two forms of diabetes: 1) Uncomplicated Diabetes, the most common form, and 2) Ketoacidosis, the life-threatening form. If ketoacidosis is present, the cat is in a crisis and must be treated quickly. Intravenous fluids are given, and very quick-acting insulin is administered. Generally, 1-3 days of hospitalization are required to stabilize the cat and convert it to the uncomplicated form. The uncomplicated form of diabetes needs treatment, but it is not necessary to achieve regulation of the blood glucose level immediately. As long as the cat is eating and drinking and is not dehydrated, insulin can be gradually worked up to the proper level over several days or even weeks.

The first phase of treatment of the uncomplicated form is called regulation. This means that insulin is given until the proper dose is found to keep the blood glucose in the range of 100-300 mg/dL (5.5-16.5 mmol/L) throughout the day and night. When this occurs, the signs of diabetes are relieved. The cat quits losing weight and begins to gain weight; this results in the appetite returning to normal. The cat's urination and water consumption also return to normal levels.

The second phase of treatment is called maintenance. This means that the cat has been regulated and has the appearance and behavior of a normal cat. Hopefully, the cat stays in this phase the rest of its life. However, some cats' need for insulin changes with time and new circumstances, so occasional re-regulation may be needed.

Diabetic cats are best regulated when as many factors as possible are consistent from one day to the next. For this reason, keeping your cat indoors is preferred. However, there is no doubt that not all cats will adapt to this lifestyle. But the benefits are substantial in keeping your cat regulated. It is worth the effort to see if your cat can adapt to indoor-only living.

What does a diagnosis of diabetes mean to me?

There are some definite financial obligations involved in treating a diabetic cat; however, the majority of expenditure occurs during the regulation phase. The cost is especially great if the cat is ketoacidotic, but this occurs in less than 10% of diabetic cats. Once the cat is stable, the costs for insulin, syringes, and rechecks are minimal.

However, the financial aspect is not the only factor. This disease also requires a substantial amount of involvement on your part to keep the cat regulated. You will be giving insulin injections daily, often twice daily. You will also need to monitor the cat's progress and be aware of signs that it is not well regulated. These will be discussed in detail in the following sections.

If you are not dedicated to keeping your diabetic cat regulated, you will be disappointed with the results and the expenses associated with poor regulation. However, most diabetic cats can be regulated and continue to be a pleasant part of your family. But, your commitment and involvement are critical.

How is diabetes treated?

There are four steps in treatment. Each is of equal importance, but all contribute to a common goal - consistency. The best way to keep a cat regulated is to keep as many things the same as possible. The more things vary from day to day, the more likely the cat is to have regulation problems.

Understanding

The more you know about the diabetic cat, the better you will be at keeping your cat regulated. There are many important points presented in this document. Read and re-read it several times so you are intimately familiar with all of it. If there are sections that you do not understand, call our office and get clarification. Every concept is important.

Diet and Feeding Schedule

The ideal diet for a diabetic cat is one that is low in sugar and high in fiber. Semi-moist diets are typically high in sugar. You will recognize them because they have the consistency of hamburger meat and are packaged in sealed foil packets. These should be avoided. High-fiber diets are specially formulated for certain medical conditions; they are one of the prescription diets sold by veterinarians. These diets slow the movement of food through the stomach and intestines. The sugar in these foods is relatively low in quantity and is absorbed over a much longer period of time. This means that the blood sugar surge that follows eating is much less.

If your cat will not eat one of the prescribed high fiber diets, fiber can be added to regular cat food. Psyllium is the preferred type. It is available as a powder that can be mixed with canned food or as a chewable tablet.

Because of the importance of consistency, it is better for your cat to eat the same quantity of a less desirable food every day than to eat a preferred food on an inconsistent basis.

In the past, specific feeding times have been strongly recommended. Most of these schedules recommended feeding with each insulin injection or before and four hours after each insulin injection. Newer evidence says that specific feeding times are not as important as we once thought. In fact, leaving food in the bowl at all times for free-choice feeding means that the blood glucose level is likely to be more consistent throughout the day. Therefore, either method is acceptable. Again, the key is consistency from one day to the next.

Infection Control

The presence of a high level of glucose in the blood and urine creates ideal environments for infection in several body tissues. Infection prevents insulin from working consistently and makes regulation and long-term control very difficult. The mouth is a common source of infection, especially when the teeth are covered with tartar. If this is a problem in your cat, its teeth may need to be cleaned before good regulation can be achieved.

Tests will be performed before treatment begins to determine if infections are present. However, tests are not available or practical to detect every possible type of infection. Therefore, your cat may be placed on 1-2 weeks of antibiotics in an attempt to eradicate any undetected infection.

Insulin

Insulin is given by injection to replace the insulin that your cat's pancreas cannot produce. The injections are made with a tiny needle, so most cats do not find them unpleasant. They are given just under the skin in areas in which there is no chance of injuring vital organs. The technique is much better tolerated by cats than most owners expect. Most cats require that injections be given twice daily, as close to a 12 hour interval as is feasible for you to do on a consistent basis.

There are several types of insulin available. The specific type, dose, and injection interval will be determined with a glucose curve. This is a test in which insulin is injected early in the morning and blood glucose levels are determined every 1-2 hours throughout the day. The purpose is to determine how long it takes for the blood glucose to reach its lowest level. This is called the peak time. Another purpose is to determine how low and how high the blood glucose levels are throughout the day. Determinations on specific dosing will be made based on this information.

Alternative Treatments

There are several oral drugs that are effective for diabetes in humans. Some of these have been used on diabetic cats. In some cases, the response is good for several weeks to months. However, most cats do not respond at all and those that do have a fairly short-term response. There are times in which oral drugs are appropriate, but these times are limited.

How is my cat's condition monitored?

One of the most important aspects of controlling a diabetic cat is monitoring that you do at home. If the cat is monitored closely, the early signs of loss of improper regulation can be detected early and appropriate adjustments made. Monitoring should occur in two ways: 1) Detection of glucose in urine, and 2) Observation of the signs of diabetes.

Detection of Glucose in Urine

A properly regulated cat should not have glucose in its urine on a consistent basis. However, finding it occasionally at a low level is not necessarily bad. Urine glucose can be detected in the following manner:

1. Put a clay-type litter in your cat's litter box. (Clumping litters do not work for this method.)
2. Place about 1 tablespoonful of wet litter in a small paper cup.
3. Add about 1 tablespoonful of tap water to the cup and stir.
4. Place a urine dip stick (available at pharmacies) into the liquid in the cup and read the color change according to the instructions on the package.
5. Interpret the color reading as being half of the actual glucose level.

If you get a 3+ or 4+ reading on the urine dip stick three days in a row, schedule your cat for an appointment to have a blood glucose level determined. Do not change your cat's insulin dose unless specifically instructed to do so.

Clinical Signs of Diabetes

A well-regulated diabetic cat should no longer have the four signs of diabetes: 1) **weight loss**, 2) a **ravenous appetite**, 3) **increased urination**, and 4) **increased thirst**. You should be actively looking for these signs at all times.

Weight Loss

The ideal way to determine weight loss is with a scale at your home. Using the same scale every time is the most accurate way to do this. A baby scale is best, but you can also weigh yourself and yourself plus your cat and take the difference using a regular bathroom scale. It is recommended that you obtain your cat's weight at least twice each month and keep the readings in a log for easy reference. If you prefer, you can bring your cat to the hospital for us to weigh it.

Urine Output

This is a feasible exercise if your cat stays indoors all of the time. Place wet kitty litter in a container such as a glass or plastic jar or a plastic bag. Collect wet litter for a fixed amount of time (until trash collection day, for example), noting the amount that accumulates. A marked increase in this amount correlates with increased urine output. This is reasonably accurate even in multi-cat households as long as there is consistent use of the litterbox by all cats. If some cats urinate indoors and outdoors on an inconsistent basis, this method is not accurate.

Food Consumption

Ideally, you should measure your cat's food each time it is added to the bowl, noting the amount of uneaten food from the previous filling. This is feasible in some situations, but the presence of several cats in the household makes this difficult.

Water Consumption

Measuring the amount of water added to your cat's bowl is another desirable exercise. The multicat household problem is also present as with food consumption.

Of all the methods listed, monitoring weight is the most accurate in multicat households. It also correlates very well with poor regulation. However, regardless of the method used, if any of the signs of diabetes return, make an appointment for blood testing.

Blood Testing as a Means of Monitoring

There are two tests that are used to monitor the level of regulation of diabetic cats: 1) **blood glucose** and 2) **serum fructosamine**. Ideally, blood glucose determinations should be made just before insulin is given (the highest level of the day) and at the peak time (the lowest level of the day). If both tests are not feasible, the same testing time should be used consistently. Although this test is typically performed at the hospital, rare cases exist in which the owner is able to get blood from the cat and perform the test at home. Cats that are unduly stressed by riding in the automobile or being at the veterinary hospital can be tested using the serum fructosamine test. This gives an average blood glucose reading for the last two weeks. It is also being used routinely by some veterinarians.

Blood testing should be performed any time the home monitoring methods reveal abnormalities. It should also be performed every 3-4 months on a routine basis.

What causes hypoglycemia, how do I recognize it, and what do I do about it?

Hypoglycemia means low blood glucose level. If the level is below 80 mg/dL (4.4 mmol/L) it is considered too low. If it is below 40 mg/dL (2.2 mmol/L), it is life-threatening. A well-regulated cat's blood glucose level should not be below 100 mg/dL (5.5 mmol/L) at any time. Because hypoglycemia can be life-threatening, **it is always better for the blood glucose level to be too high than too low.**

Causes

- 1) A dose of insulin that is too high.
- 2) A double dose of insulin (by two family members).
- 3) Too little food intake or vomiting of its food.
- 4) Too much exercise or activity.
- 5) Spontaneous remission of diabetes (discussed below).

Signs

The cat experiencing mild hypoglycemia is very weak. It may be totally unresponsive to your attempts to arouse it; it may try to walk and be very uncoordinated. When severe hypoglycemia is present, it may become comatose or have a seizure.

Treatment

A mildly hypoglycemic cat should be given 1 tablespoon of corn syrup orally. If dramatic response does not occur within 20 minutes, a second dose should be given. If that does not cause response, intravenous glucose will need to be given. Cats showing signs of severe hypoglycemia should be rushed to the veterinary hospital immediately for intravenous glucose. If the cat responds to oral corn syrup, it should not be given insulin again until the cause of the problem is determined. The list of causes above should be considered carefully. If the answer is not apparent, your veterinarian should be consulted.

Tell me more about spontaneous remission of the disease.

Spontaneous remission means that a diabetic cat becomes no longer diabetic. Its pancreas resumes normal function so that insulin injections are no longer needed. This phenomenon is peculiar to the cat and is not uncommon. It is thought to occur in about 20% of diabetic cats.

The first signs of spontaneous remission is hypoglycemia. At the peak time (determined by the glucose curve), the cat is very unresponsive; however, a few minutes to a few hours later it appears normal. The cat has the ability to respond to hypoglycemia by converting glycogen (stored in the liver) to glucose. However, after a few days of this response, glycogen stores are depleted and the cat becomes seriously hypoglycemic. It may die without immediate intravenous glucose.

The key to detecting spontaneous remission is to observe your cat at the peak time. Since this time may occur during the night or when you are at work, you should observe for it on weekends or other days when you are at home.

What are the things I need to know about handling insulin?

Insulin is sold in sterile, air-tight bottles. It should be refrigerated at all times. Persistent warm temperatures and direct sunlight will inactivate it.

The active insulin crystals settle out of suspension in a few hours. When you are ready to use it, all or most of the crystals will be stuck to the bottom of the bottle. The label instructs you to roll it gently in your hands. However, gentle rolling may not be adequate to properly put the insulin crystals back into suspension with the liquid. If that happens, consistent dosing of insulin is very unlikely. You may draw up the correct volume of insulin in the syringe, but the amount of active insulin crystals will probably not be correct. This means that your cat will not get the proper dose and is one of the common causes of regulation difficulties.

Extremely vigorous shaking can damage the insulin crystals, but shaking also makes foam in the bottle. When you draw the foam into your syringe, you will have difficulty getting the correct amount of insulin. Therefore, reasonable shaking is needed to properly resuspend the insulin crystals, but shaking too vigorously can create foaming problems. Be sure that you shake the bottle until all of the white material is off of the bottom of the bottle and is well mixed with the liquid.

How do I get insulin into the syringe?

- 1) Shake the insulin bottle to properly resuspend the insulin crystals.
- 2) Remove the plastic cap from the needle.
- 3) Fill the syringe about one-fourth with air.
- 4) Push the needle through the rubber stopper and into the bottle.
- 5) Inject the air into the bottle.
- 6) Draw twice as much insulin into the syringe as you need.
- 7) Remove the needle from the bottle.
- 8) Hold the syringe so the needle is pointed upward.
- 9) Tap the side of the syringe so that any air bubbles go toward the needle.
- 10) Push the plunger upward to expel all air from the syringe.
- 11) Push the needle back into the bottle and inject the excess insulin into the bottle.
- 12) You should have the correct amount of insulin (but not air) in the syringe.

How do I make a proper injection?

- 1) Place the cat so that it can be restrained easily.
- 2) Using your left hand (if you are right handed), lift a roll of skin from an area of loose skin.
- 3) Part the hair (but do not put alcohol on the skin).

- 4) Place the tip of the needle on the skin so the syringe is horizontal to the cat's spine and pointing toward the cat's head.
- 5) Quickly pull the skin over the needle. You may need to slightly thrust the needle forward at the same time.
- 6) Make the injection and remove the needle.
- 7) Rub your hand over your cat's hair at the injection site to be sure it is dry. If it is wet, the needle probably went through the roll of skin, and the injection was made on top of the skin. Since it is not possible to know how much of the insulin was injected incorrectly, it is best not to repeat the injection. However, learn from your mistake so this does not happen again.
- 8) Give your cat some type of reward that can be associated with the injection. Stroking and holding is best, but a small treat is also acceptable.

How should my cat be cared for when I am out of town?

The ideal way to care for your diabetic cat when you are out of town is to have a friend or neighbor come to your house twice daily to give your cat its insulin and to feed it. This approach keeps almost all things consistent. If a neighbor will feed your cat but will not consent to giving insulin injections, your cat will be fine without insulin for 2-3 days. If you will be gone longer than 3 days or if you cannot find in-home care, a boarding kennel or veterinary hospital can be used for boarding. However, be sure to choose a facility that has someone available who understands diabetic cats.

INSTRUCTIONS

Initial Regulation

- 1) Give ____ units of insulin under the skin twice daily for ____ days. Ideally, insulin should be given every 12 hours. However, consistency is more important. Choose times that will be workable for you almost every day.

Make an early morning appointment. Do not give insulin, but feed your cat as close to the appointment time as possible. Plan to leave your cat for the day; however, if the first glucose level is too high, you may be instructed to return home and give a higher dose for several more days.

- 2) Feed your cat a high fiber diet: Feed _____ in the amount of _____ per 24 hours. If specific feedings are used, feed your cat at the time of each insulin injection. If dry cat food is fed, free choice feeding is acceptable.

It is important to feed food that will be eaten consistently, even if it is not a high fiber diet. It is important not to feed a high sugar diet, such as a semi-moist product.

If your cat does not eat, do not give insulin. If only half of the normal amount of food is eaten, give half of the normal insulin dose. Failure to eat can result in hypoglycemia. A high blood glucose level is always better than hypoglycemia.

- 3) Give the antibiotic, _____, _____ times per day for _____ days. Schedule your cat for teeth cleaning, if needed, as soon as it is stable enough for anesthesia.

- 4) Read and reread this document until you are thoroughly familiar with each section.

Monitoring

- 1) Get urine dip sticks from a pharmacy. They are made to test for urine glucose. Test your cat's urine _____ times per week. If the result is 3+ or 4+ positive on three consecutive tests, return your cat to the hospital for a blood test. The preferred times for blood glucose testing are early in the morning (before insulin is given) or at the peak time. There is no time preference when testing for serum fructosamine.

- 2) Monitor as many of the following as possible: 1) **weight**, 2) **appetite**, 3) **amount of urine output**, and 4) **amount of water consumption**. If obvious changes occur in any of them, return your cat to the hospital for a blood test. The preferred times for blood glucose testing are early in the morning (before insulin is given) or at the peak time. There is no time preference when testing for serum fructosamine.

3) Return your cat to the hospital for blood glucose or serum fructosamine testing every _____ months. The preferred times for blood glucose testing are early in the morning (before insulin is given) or at the peak time. There is no time preference when testing for serum fructosamine.