



VETERINARY HOSPITAL & HOTEL

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Diabetes Mellitus

Treating diabetes is usually a rewarding endeavor. The information below describes several important concepts that will make this process much more likely to be successful.

1. Consistency: Our goal is to find an appropriate dose of insulin that will last on a long-term basis. In order to do that, we must eliminate as many variables as possible. In other words, the more things that can stay the same from one day to the next, the easier it is to keep a diabetic regulated. Our goal is to give the same dose of insulin at the same times each day, to keep the feeding schedule the same, to keep the activity level/lifestyle the same each day, and to keep your cat's stress level the same.
2. Tight control is not necessary in cats. Human diabetics must maintain blood glucose values very close to normal at all times. If they don't, they will develop some disastrous complications of diabetes, such as loss of fingers, toes, feet, and hands, kidney failure, and cataract formation. These complications do not happen in diabetic cats.
3. Hyperglycemia (high blood glucose) is always better than hypoglycemia (low blood glucose).
4. As the dose of insulin goes up, the blood glucose goes down.
5. Food intake causes a mild increase in the blood glucose. Failure to eat can cause a mild decrease in the blood glucose.

The latter three above principles are applied as such: If you are not sure if you gave a dose of insulin or if it was improperly injected, do not give it again. If your cat does not eat, do not give insulin. If you must miss a dose or two of insulin (occasionally), do not be too concerned. Your cat's blood glucose will get too high for a day or two, but should not cause great problems. Of course, it is always best that your cat receive their medications on time, every day. Boarding at our facility or a referral to an experienced pet sitter are possible options if you need to leave town.

Understanding Diabetes

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. 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. Some 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. However, very few cats respond to these oral drugs because most cats have Type I Diabetes. Most cats with Type II diabetes will eventually progress to Type I anyway and require insulin.

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 and pass into 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:

Weight loss
Ravenous appetite
Increased water consumption
Increased urination

Diagnosing Diabetes

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

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.

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 includes a recommendation for dietary changes.

As for the owner, there are two implications: financial commitment and personal commitment.

When your cat is well regulated, the maintenance costs are minimal. The special diet, insulin, and syringes are not very expensive. However, the financial commitment can be significant during the initial regulation process and if complications arise.

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 only great if your cat is so sick that it has quit eating and drinking for several days. Cats in this state, called ketoacidosis, may require a week or more of hospitalization with quite a bit of laboratory testing. Otherwise, the initial hospitalization may be minimal to get some testing done and to begin treatment. At that point, your cat goes home for you to administer medication. At first, return visits are required occasionally to monitor progress. It may take a month or more to achieve good regulation.

The financial commitment may again be significant if complications arise. We will work with you to achieve consistent regulation, but some cats are difficult to keep regulated. It is important that you pay close attention to our instructions related to administration of medication, to diet, and to home monitoring. Consistency is the key to prolonged regulation. The more you keep the medication, diet, and activity the same from one day to the next, the easier it will be to keep your cat regulated.

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 for an extended time, 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. Cats are obligate carnivores. They have very little requirement for carbohydrates. Diets that are high in protein are preferred because of how cats digest and metabolize their food. If your cat is overweight we will work with you to achieve a proper weight, which will help your cat's tissues respond to insulin more effectively.

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. Fortunately, this is the best way to feed a diabetic cat. However, it is also desirable to monitor how much food is eaten each day. We realize that if you have more than one cat, this may be difficult, but please make an effort, as this is part of the home monitoring that should occur.

Insulin injections 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 for reasons described below.

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.

Insulin Therapy and Administration

About Insulin

Insulin comes in an airtight bottle that is labeled with the insulin type and the concentration. Some insulins (those which look like white powder in water), must be mixed gently prior to each use because it can settle out of suspension and the dosing will be wrong if it is not mixed well. Insulin is a fragile hormone and it can be destroyed if shaken hard. Therefore, to mix insulin, roll in your hands or invert the bottle gently several times. Be sure that you do not mix it hard enough to create foam.

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.

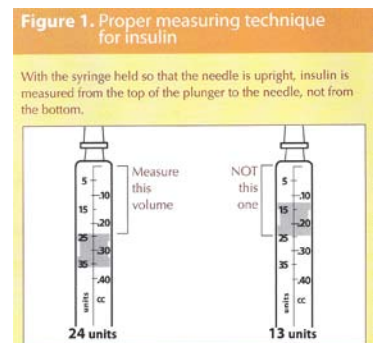
Several types of insulin are used in cats. Some are made for use in humans and obtained from regular pharmacies, others are made for pets and obtained through your veterinarian. The current recommended insulin in cats is called glargine (brand name Lantis). It is a human insulin. Recent studies indicate that newly diagnosed diabetic cats have a higher likelihood of eventually going into remission (and no longer require insulin) if started on human derived glargine. Glargine is a U100 insulin (referring to its strength) and it is important to use syringes that are U100 to get accurate dosing.

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 back with your free hand (pick up a different spot each day).
- 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 know if this is permissible. If it is not, we can dispose of them for you.

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 seconds. In most cases, a reward of stroking results in a fully cooperative cat that eventually may not even need to be held.

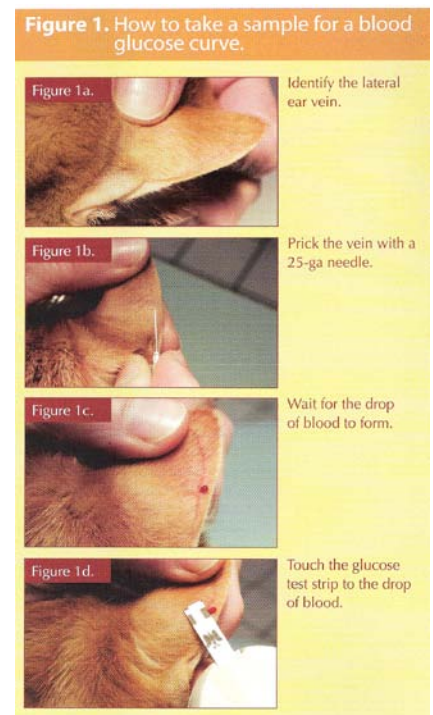
Home Monitoring

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. Your part can be performed in two ways.

The **first way** is to monitor your cat for signs of diabetes. To do this, you need to be constantly aware of your cat's appetite, weight, water consumption, and urine output. You should be feeding a constant amount of food each day, which will allow you to be aware of days that your cat does not eat all of it or is unusually hungry after the feeding. You should weigh your cat at least twice monthly. It is best to use the same scales each time. A baby scale works well for this. If you have several cats that eat together and use the same litter box, monitoring weight is the best because it is specific to this one cat.

If possible, you should develop a way to measure water consumption. The average 10 pound (4.5 kg) cat should drink no more than 7 1/2 oz. (225 ml) of water per 24 hours. Since this is highly variable from one cat to another, keeping a record of your cat's water consumption for a few weeks will allow you to establish what is normal for your cat. Another way to measure water consumption is based on the number of times it drinks each day. When properly regulated, it should drink no more than four times per day. If this is exceeded, you should take steps to make an actual measurement.

Urine output can be measured by determining the amount of litter that is scooped out of the litter box. This is a little less accurate if you have more than one cat that uses the litter box, but it can still be meaningful. The best way to measure litter is to use a clumping litter and scoop it into a sealable container. After a few weeks you will be able to know the normal rate at which the jar fills. Too rapid filling will indicate that your cat's urine production has increased.



Any significant change in your cat's food intake, weight, water intake, or urine output is an indicator that the diabetes is not well controlled. We should see the cat at that time for blood testing.

The **second** way to monitor your cat at home is to determine the level of glucose in the blood. This is the most accurate way of determining if your cat is regulated. This should be done about every 1-3 months if your cat seems to be doing well. It should also be done at any time the clinical signs of diabetes are present.

Many human glucometers work well in cats. Your veterinarian can advise you on appropriate brands available and how to obtain samples from your cat at home.

Timing is important when the blood glucose is determined. The number of times you check your cat's blood glucose and when during the day you check it should be determined by your veterinarian. It will partially depend on which type of insulin is being used.

In-Clinic Monitoring

If you are uncomfortable learning how to use a glucometer, your cat will need to have its blood glucose periodically measured at the veterinary clinic.

Occasionally, a cat that is having problems with its regulation will have to stay an entire day in the hospital for what is called a glucose curve. This is a series of blood glucose measurements that help us determine exactly what the insulin is doing throughout the day.

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 double 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 (about 4 hrs. after injection with glargine). 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 karo 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 karo 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 as they contain a lot of sugar*).

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

Spontaneous remission means that a diabetic cat is no longer diabetic. This is a phenomenon that happens in about 15-20% of diabetic cats. Unfortunately, it can happen rather suddenly so a hypoglycemic crisis may be created because the owner does not realize remission has occurred and continues to give the normal amount of insulin.

For a few days after remission occurs, the cat is able to make emergency amounts of glucose as the blood glucose level falls to dangerously low levels. It does so by converting glycogen, a product stored in the liver, to glucose and releasing it into the blood stream. However, at some point in time the glycogen stores are depleted and it can no longer respond; a hypoglycemic crisis then occurs.

When it occurs, the cat may be normal for a few weeks or for many months. However, diabetes will almost always return because these cats have limited ability to make insulin. Therefore, you should watch for the typical signs of diabetes then contact us for insulin instructions.

For more information on feline diabetes, visit www.felinediabetes.com