Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

Diabetes Mellitus

Treating a diabetic cat can be a challenge. Some cats just never seem to stay regulated. However, there are several important concepts that make this process much more likely to be successful.

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 the same times each day, to feed the same food in the same quantities each day, to keep the activity level the same each day, and to keep your cat's stress level the same.

Control: 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 to diabetic cats. Therefore, as stated above, it is better for the blood glucose to be too high than too low.

Blood Sugar Levels: (high blood glucose) is always better than hypoglycemia (low blood glucose).

Dose Changes: As the dose of insulin goes up, the blood glucose goes down.

Eating Habits: Food intake causes the blood glucose to rise. Failure to eat allows the blood glucose to fall below normal.

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 properly 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 concerned. Your cat's blood glucose will get too high for a day or two, but that will not cause great problems.

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.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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 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.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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 requires some dietary changes. Whether an individual cat will require oral therapy or insulin injections will vary.

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, the oral medication, insulin, and syringes are not 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 only for a day or two 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 every 5-7 days 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, 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.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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.

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.

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. Either is acceptable, and both have advantages and disadvantages.

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

This is generally our preferred way to treat diabetic cats, especially if they are as follows:

1) Cats that do not take tablets well.
2) Cats belonging to owners who cannot give tablets.
3) Cats that fail to respond to the oral drugs.
4) Cats that have been ketoacidotic (because Type II diabetics rarely become ketoacidotic).
5) Cats belonging to owners who find injections easier to give than tablets. (Most cats are in this category. This is not because pills are hard to give but because injections are very easy to give.)

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

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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 are 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. 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.

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.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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 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.

Home Monitoring

Your part can be performed in one or both of 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

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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 method** of home monitoring is to determine the presence of glucose in the urine. If your cat is properly regulated, there should be no glucose present in the urine.

There are several ways to detect glucose in urine. You may purchase urine glucose test strips in any pharmacy. They are designed for use in humans with diabetes, but they will also work in the cat. The use of special non-absorbing kitty litter permits you to dip the test strip into urine in the litter box. Aquarium gravel, Styrofoam packing "peanuts," and commercial non-absorbing litter can be used. Since these are not ideal litter materials, they are best used on a periodic basis.

Another method is as follows:

1. Put about 1 tablespoon of wet litter in a small cup. (A clay type litter is required; clumping litter will not work.)
2. Add about 1 tablespoon of tap water to the litter and stir.
3. Dip a urine glucose test strip into the liquid and read it according to the directions on the bottle.
4. The results will be about half of the actual urine glucose amount because of the dilution of the added water.

If glucose is detected by either method, the test should be repeated the next two days. If it is present each time, we should see your cat for a blood test.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

Monitoring of Blood Glucose

Determining the level of glucose in the blood is the most accurate means of monitoring. This should be done about every 3-4 months if your cat seems to be well regulated. It should also be done at any time the clinical signs of diabetes are present or if glucose is detected in the urine for two consecutive days.

Timing is important when the blood glucose is determined. Since eating will elevate the blood sugar for several hours, it is best to test the blood at least 6 hours after eating.

When testing the blood we want to know the highest and lowest glucose readings for the day. The highest reading should occur just before an injection of insulin is given. The lowest should occur at the time of peak insulin effect. This is usually 5-8 hours after an insulin injection, but it should have been determined during the initial regulation process. Therefore, the proper procedure is as follows:

1) Feed your cat its normal morning meal then bring it to hospital immediately. If you cannot get it to the hospital within 30 minutes, do not feed it. In that situation, bring its food with you.
2) Bring your cat to the hospital early in the morning without giving it insulin.
3) A blood sample will be taken immediately, and then we will give insulin and feed your cat if it did not eat at home.
4) A second blood sample will be taken at the time of peak insulin effect.

If your cat gets excited or very nervous when riding in the car or being in the hospital, the glucose readings will be falsely elevated. If this occurs, it is best to admit your cat to the hospital the morning (or afternoon) before testing so it can settle down for testing the next day. Otherwise, the tests give us limited information.

Hypoglycemia

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

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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 (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

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

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

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.

Pearland
ANIMAL HOSPITAL

1601 N. Main, Pearland, Texas 77581
Phone: (281) 485-2496
Fax: (281) 485-0681
www.pearlandanimalhospital.com

SUMMARY OF INSTRUCTIONS FOR CATS RECEIVING INSULIN INJECTIONS

1) Read and reread this material so that you understand the specifics of proper regulation and how to recognize and treat hypoglycemia.

2) Give the first injection of insulin of _____units at about _____ AM/PM.

3) Return for a glucose curve at about the same time as you normally give insulin in 5-7 days. Allow your cat to eat through the night or feed it that morning and immediately bring it to the hospital. Do not give insulin, but bring it with you. (If it will take more than 30 minutes to drive to the hospital, call for instructions on feeding.)

4) Feed your cat one of the foods mentioned above.

SUMMARY OF INSTRUCTIONS FOR CATS RECEIVING GLIPIZIDE OR GLYBURIDE TABLETS

1) Have the prescription filled at any pharmacy.

2) Read and reread this material so that you understand the specifics of proper regulation and how to recognize and treat hypoglycemia. If hypoglycemia occurs, discontinue glipizide or glyburide until consulting us.

3) Give _____ tablet (_____ mg) twice daily (about every 12 hours) for 1 week. Return for a blood test about 6-8 hours following tablet administration.

4) Feed your cat one of the foods mentioned above.