



# Diabetes Mellitus in Dogs

There are two forms of diabetes in dogs: diabetes insipidus and diabetes mellitus. Diabetes insipidus is a very rare disorder that results in failure to regulate body water content. Your dog has the more common type of diabetes, diabetes mellitus. This disease is seen on a fairly regular basis, usually in overweight dogs 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. Diabetes occurs when the pancreas no longer produces enough 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 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**

**Increased 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. It is common for cats with diabetes to also have urine infections.

The normal level of glucose in the blood is 75-140 mg/dl. Diabetes Mellitus is the only common disease that will cause the blood glucose level to rise above 400 mg/dl. Some diabetic dogs may 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. Dogs with a normal blood glucose level will not have glucose in the urine. Diabetic dogs, 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 dogs, it is. However, some diabetic dogs do not meet all the criteria. For these, another test may be 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.

Occasionally there are other serious problems detected when the blood tests are done. For most dogs, controlling the blood sugar is the key to good health. However, additional treatments are occasionally needed

**What It Means for Your Dog to be Diabetic:** While a dog can live (albeit somewhat uncomfortably) for many months with diabetes, eventually they will succumb this disease if not treated appropriately. Most can be successfully treated and with appropriate treatment, many dogs can live relatively normal lives.

For the diabetic dog, one reality exists. Blood glucose cannot be normalized without treatment. Although the dog can go a few days without treatment and not get into a crisis; **treatment should be looked upon as part of the dog's daily routine** (see page 7). Effective treatment almost always requires some dietary changes. **The vast majority of dogs will require twice daily insulin injections.**

**Goals of Treatment:** The goal of treatment is to regulate your dog's food, insulin, and exercise so the patient has a *relatively normal* blood sugar level throughout the day. There are two possible degrees of regulation:

1. **Loose Regulation:** With loose regulation, the blood sugar maintained at a level where the classic symptoms of excess thirst, excess urination, extreme hunger, and weight loss are absent. This does not mean that its blood sugar levels are constantly at a normal. It does mean that the blood sugar levels are low enough to alleviate the symptoms and prevent most of serious problems associated with sugar diabetes. For most dogs and their owners, we believe this is the most practical level of treatment and regulation.
2. **Tight Regulation:** With tight regulation, the goal is to constantly have the patient's blood sugar in the normal range. This is sometimes difficult to achieve and usually requires significantly more expense and effort. Also, with tight regulation, the potential for dangerously low blood sugar is greater.

**What it means to be the owner of a diabetic dog:**

**For you as the owner, there are two implications: financial commitment and personal commitment.**

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

In some cases, your dog may need to 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 dog is so sick that it has quit eating and drinking for several days. Dogs in this state, called ketoacidosis, may require a week or more of hospitalization with quite a bit of laboratory testing. Otherwise, the initial hospitalization not be needed or required for a day or two to get some testing done and to begin treatment. At that point, your dog goes home for you to administer medication. The need for return visits depends on how things are going with the regulation. Some dogs are regulated 2-4 weeks, but many take 1-2 months while others can take several months.

The financial commitment may again be significant if complications arise. We will work with you to achieve consistent regulation, but some dogs 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 day to day, the easier it will be to keep your dog regulated.**

Another complication that can arise is hypoglycemia or low blood sugar; if severe, it may be fatal. This usually occurs due to inconsistencies in treatment, diet or exercise.

Your personal commitment to treating your dog is very important in maintaining regulation and preventing crises. Most diabetics 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 dog should receive proper treatment while you are gone. These factors should be considered carefully before deciding to treat a diabetic dog.

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

One of the first step in treatment is to alter your dog's diet. Diets that are high in fiber and / or high in protein and low in fat and carbohydrates are preferred because they are generally lower in sugar and slower to be digested. This means that the dog does not have to process a large amount of sugar at one time. If your dog is overweight, a reducing-type diet is fed until the proper weight is achieved, then we switch to a high fiber maintenance food.

**\*Your dog's feeding routine is also important.** It is important to monitor how much food is eaten each day & to regulate your dog's weight. If you have more than one dog, this may be difficult, but please make an effort, as this is part of the home monitoring that should occur. In most cases your dog should get two meals daily. Dog treats are best eliminated. 2<sup>nd</sup> best is to use the prescribed diet as a treat. \*

The second step in treatment is to use a drug to control (lower) control blood glucose levels. Although many people are initially uncomfortable with the thought of giving injections, giving insulin by injection is the only way diabetes can currently be successfully treated in dogs.

**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 dog 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 dog 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. You will get your dog's insulin and insulin syringes at the pharmacy of your choice (it is a prescription medication, so we will call it in).

Several types of insulin are can be used. If we are not getting the desired response from this insulin, we may need to try a different type of insulin.

**For your dog, we recommend \_\_\_\_\_ insulin. Use U-\_\_\_ syringes.**

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 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.

**Drawing up Insulin:** Have the syringe and needle, insulin bottle, and dog 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 dog 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) It may be helpful to have someone hold your dog while you pick up a fold of skin from somewhere along your dog's back with your free hand (pick up a different spot each day). After a little experience, this is usually be done by one person.
- 3) Quickly push the very sharp, very thin needle through the 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 on 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 dog's skin. Immediately place the needle guard over the needle and discard the needle and syringe.
- 6) Stroke / praise your dog 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.
8. It is neither necessary nor desirable to swab the skin with alcohol to "sterilize" it.

Although the above procedures may at first seem complicated and somewhat overwhelming, they will very quickly become second nature. Your dog 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 dog's progress be checked on a regular basis. Monitoring is a joint project on which owners and veterinarians must work together.

**Home Monitoring:** Ideally you can do all of the below items. Realistically you may need to make compromises, especially if there is more than one pet in your home. Your part can be performed in one or both of two ways.

**The first and most important way** is to monitor your dog for signs of diabetes. To do this, you need to be constantly aware of your dog'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 dog does not eat all of it or is unusually hungry after the feeding. You should weigh your dog at least once monthly. It is best to use the same scales each time.

If possible, you should develop a way to measure water consumption. Another way to measure water consumption is based on the number of times it drinks each day. When properly regulated, your dog should drink about 3-6 times per day. If this is exceeded, you should take steps to make an actual measurement.

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 dog is properly regulated, there should be only a trace or 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 also work for dogs. Simply collect a morning urine sample in a clean, dry container when you dog urinates.

If more than a trace of glucose or no glucose is detected, the test should be repeated the next two days. If the readings do not return to "trace" levels, please call us. It may be necessary to do some blood tests.

If the urine glucose test is greater than a trace for 3 consecutive days, call us.

#### **Monitoring of Blood Glucose: There are two tests that are used for monitoring blood sugar in dogs:**

1. **Fructosamine.** This test gives a rough average of what the blood sugar level has been for the previous two weeks. It requires only a single test and timing is not critical. For dogs that seem to be well regulated, this test is often reasonably accurate and therefore appropriate. Usually it is done every 3-4 months.
2. **Blood sugar levels:** Determining the level of glucose in the blood is the most accurate means of monitoring. This should be done about at least once a year. It should also be done at any time the clinical signs of diabetes are present, if your dog appears to have a hypoglycemic reaction, or if glucose is detected in the urine for 3-5 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 is 6 – 8 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.

Under certain circumstances it is best to perform a **blood glucose curve.** The proper procedure is as follows:

- 1) Feed your dog 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 dog to the hospital early in the morning without giving it insulin; but bring your insulin to the hospital.
- 3) A blood sample will be taken immediately, then we will give insulin and feed your dog if it did not eat at home.
- 4) Several blood samples will be taken throughout the day to help us determine the peak time of insulin effect.

If your dog 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 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:

- 1) *If the insulin dose is too high.* The most common causes such a 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 dog does not eat, skip that dose of insulin. If only half of the food is***

**eaten just give a half dose of insulin. It is better for the blood sugar to be too high temporarily to 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.

The most likely time that a dog 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 or may have seizure. You may call it and get no response. Within a few hours, the blood glucose will rise, and your dog will return to normal. Since many dogs 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 this, please bring in your dog for blood testing.

If your dog is slow to recover from this period of lethargy, acts disoriented, confused, weak, you should give it corn syrup (1 tablespoon by mouth). If there is no response in 15 minutes, repeat the corn syrup.

If severe hypoglycemia occurs, a dog may get extremely weak and may 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.

#### **SUMMARY OF INSTRUCTIONS FOR DOGS 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) **Get the supplies for treatment.** Your prescription will specify the type of insulin and syringes. It has been placed at \_\_\_\_\_ Pharmacy.

If you will be using urine glucose tests strips, they should be purchased at a pharmacy.

#### 3). **Daily Routine:**

- See note on page 3 regarding feeding your dog (this information is flanked by asterisks \* )
- Feed your dog in the morning. After it eats, give it the first injection of insulin starting with \_\_\_\_\_units. See below for what to do if you dog will not eat.
  
- Feed 2 meals daily, preferably the low calorie high fiber diet we recommend.
  
- Give the second dose of insulin 8-12 hours later (9 -10 hours is ideal), with a meal.
  
- **If you dog does not eat, it should not get the normal dose of insulin.**
  - If it skips one meal, skip the insulin dose.
  - If it eats half a mean, give half the normal insulin dose.
  - If it skips two meals, discontinue the insulin and call us.

4). **Watch for signs of decrease in thirst, urination, and excess appetite.** Increase the dose of insulin by \_\_\_\_\_ units every 3 days until one of the following occurs:

- You notice decreased symptoms. Once you see this, continue at the same dose of insulin for 2 weeks and then make an appointment for a Fructosamine test.
- If your dog's total insulin dose (per injection) exceeds 1/2 unit per pound or it has a hypoglycemic reaction, call and arrange for a glucose curve to be done in our hospital. (review the important details for this test under monitoring blood sugar levels on page 6).

**Even if your dog seems to be doing fine, blood testing & urine testing need to be done every 3- 6 months!**

**If you have questions or problems, please call Fairhaven Veterinary Hospital @ 360-671-3903**