

## **Diabetes in Dogs**

### **Affected Animals:**

Diabetes can occur at any age, but it is most likely to begin at seven to nine years of age. Female dogs are twice as likely to be affected by the diabetes, compared to males. Diabetes is more common in a number of dog breeds, including Keeshond, Pulik, Cairn terrier, miniature pinscher, dachshund, miniature schnauzer, poodle, and beagle. However, any dog can develop diabetes mellitus, or “sugar diabetes.”

### **Overview:**

Why is insulin so important? 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 dog eats more; thus, we have weight loss in a dog with a ravenous appetite. The body tries to eliminate the excess glucose by excreting it in the urine. However, glucose (blood sugar) attracts water resulting in the production of a large amount of urine. To avoid dehydration, the dog drinks more and more water.

Characterized by high concentrations of sugar (glucose) in the blood and urine, diabetes mellitus is one of the more common hormonal disorders of the dog, and the disease almost always requires lifelong insulin treatment. Chronic high glucose in the blood and urine can cause severe complications including infections, cataracts, nervous system disorders, pancreatitis, kidney disease, and even diabetic coma. If left untreated, diabetic dogs will suffer from complications and an early death. The good news is that when monitored and treated properly, most diabetics can do well for long periods of time (many years), and can enjoy an excellent quality of life.

Diabetic dogs are treated with insulin injections, dietary modification and exercise. Some people with diabetes can use oral hypoglycemic drugs (pills), but these medications typically are not helpful in dogs. In order to regulate their blood glucose levels, diabetic dogs require frequent veterinary office visits in the initial stages of treatment, followed by periodic examinations for proper maintenance thereafter.

Initially, it may seem difficult for some owners to imagine give daily insulin injections, but the majority of dog owners have no trouble learning to do this, once they decide to do so. The needles we use to give insulin injections are tiny, and many pets seem to barely feel them. Giving insulin injections while the pet is distracted by eating seems to work very well for many pets – most hardly notice it. With a little careful instruction from the veterinary staff, most owners become “insulin injection experts” in short order.

### **Clinical Signs (Symptoms):**

Commonly reported symptoms of diabetes include drinking large amounts of water (polydipsia), urinating large volumes (polyuria), increased appetite (polyphagia), and weight loss (often despite eating more). Depending on the stage of the disease, physical findings may also include weight gain/obesity, cataracts, dehydration, tiredness, weakness, and acetone-like smell of the breath (ketone halitosis). Other complaints that can be caused by underlying diabetes mellitus include frequent infections (especially urinary tract infections), non-healing wounds, urination accidents in the house, hair loss, weakness in the joints, etc.

The normal level of glucose in the blood is 80-120 mg/dl (4.4-6.6 mmol/L). However, diabetes is the only common disease that will cause the blood glucose level to rise above 400 mg/dl. Some diabetic dogs will have a glucose level as high as 800 mg/dl, although most will be in the range of 400-600 mg/dl when diagnosed.

### **What Causes Diabetes Mellitus:**

Diabetes usually results from decreased production of insulin by the pancreas, impaired insulin function within the body tissues, or both. With either lack of insulin production or lack of insulin effectiveness (or both), the dog's system becomes unable to regulate the glucose that is circulating in the bloodstream, and blood sugar becomes very, very high. If the condition is left undiagnosed and untreated, it can progress to severe illness and possibly death.

A list of things that can cause diabetes mellitus includes:

- *Pancreatitis* – inflammation in the pancreas, causing vomiting, diarrhea, abdominal pain, possibly diabetes mellitus and other problems. Inflammation in the pancreas can shut down production of insulin, and cause diabetes mellitus. Sometimes the diabetes is temporary, resolving when the pancreas heals. And sometimes diabetes after pancreatitis (especially chronic pancreatitis) is permanent – it all depends on how much damage is done to the pancreas.
- *Degeneration of the pancreas*. We do not yet understand very well what causes this, but think that genetics play a role. This type of diabetes is usually not reversible.
- *Female hormonal imbalance*. Diabetes mellitus sometimes can be reversible when noted in the intact female dog, when she is spayed.
- *Drugs* – there are a few drugs (including cortisone) which can make borderline diabetics require insulin.
- *Obesity* – can make borderline diabetics require insulin, just as in people.
- *Low thyroid function (hypothyroidism)* – usually won't cause diabetes by itself, but if present and undiagnosed and untreated, can make diabetes very hard to regulate.
- *Cushing's Disease* – another hormonal disease, of overactive adrenal glands, which also can make diabetes difficult to regulate, if present, undiagnosed, and untreated.

No matter the cause, there are two types of diabetes mellitus in dogs: insulin-dependent and non-insulin-dependent (the latter occurs exceedingly rarely). This discussion is limited to insulin-dependent diabetes mellitus (IDDM). Just like humans with IDDM, dogs affected by this form of the disease will usually require lifelong administration of insulin in order to keep their blood glucose levels under control.

### **Diagnosis:**

Diabetes is usually diagnosed by finding very high levels of glucose in the blood and in the urine. A more advanced and critical stage of diabetes is sometimes denoted by the presence of ketones in the urine. This complicated form of diabetes is called diabetic ketoacidosis (DKA). If DKA is untreated, it can lead to diabetic coma.

Your veterinarian may run tests, including:

- *CBC (complete blood count)* – too look for evidence of infection or anemia, which can be associated with untreated diabetes.
- *serum biochemical profile* – to look for problems with the liver, kidneys and blood lipids (cholesterol and triglycerides) which can be related to diabetes; and to rule out other disease which can look like diabetes.

- *Electrolytes* – many diabetics lose potassium, and it may need to be supplemented until the proper insulin dose is determined. Occasionally potassium needs to be supplemented long term in diabetics.
- *Urinalysis* – to look for urinary tract infection, which is present in about 50% of all untreated diabetics. Your vet also may want to do a urine culture, to completely rule out urinary tract infection.
- *Abdominal ultrasound* – this may be suggested if your diabetic pet is seriously ill, to look for problems such as pancreatitis, kidney infection, etc., which will need to be treated if your pet is to get well as soon as possible.
- In some cases, the initial test results may indicate the need to do more specific tests.

The veterinarian also may schedule in-hospital stays for the dog to allow for serial blood glucose checks every one to two hours over a 12 to 24 hour period. This series of tests is called a blood glucose curve, and ideally will provide information about the effectiveness of the insulin dose, and how long each injection remains active. Depending upon the results of the glucose curve, the veterinarian will adjust the insulin type, dose, and frequency of administration so that the dog's blood glucose level remains within a close-to-normal range.

Once your pet is relatively "well regulated," glucose curves may no longer be necessary. There is a test called fructosamine which provides an average of blood glucose over the past 10-14 days. If fructosamine is in normal range, then we know insulin therapy is ideal, and no glucose curves are necessary. If fructosamine is high, it may mean that insulin dose is too high or too low, or that we are using the wrong kind of insulin. When fructosamine is high, it means we need to schedule a glucose curve, to find out how to adjust insulin therapy.

If you are willing, it can help a great deal to learn to check your own pet's blood sugar at home. This may sound intimidating at first, but many owners learn to do with this with a little practice, and a little help from us. You certainly don't need to do this daily, and probably won't need to do it on a regular basis as long as everything is going well. However, having the ability to check blood sugar at home can be extremely valuable if and when your diabetic pet becomes ill. You can know within a few minutes whether you need to decrease insulin dose and feed (low blood sugar), or whether you need to see your veterinarian for control of high blood sugar. Because ill diabetic dogs can be ill either because they are not getting enough insulin or they are getting too much, it can be difficult to tell the difference at home, if you can't check blood sugar. Having a blood glucose meter at home to use can sometimes allow your veterinarian to give advice over the phone or in the office, which might prevent any problems your diabetic has from becoming worse. Because stress can increase blood sugar, testing blood sugar at home is considered more accurate than testing at the clinic, as blood glucose values may be falsely high at the clinic, causing us to overdose insulin in some cases. If you are interested in learning to test blood sugar at home please let us know – we are happy to spend as much time as is necessary to teach you.

### **Treatment:**

The goals of treatment are to return the dog to normal health and to prevent complications that can arise from a high blood glucose level. Some possible complications which need treatment include infections of the urinary tract, respiratory system, and skin; ketoacidosis or severe metabolic disturbance; cataracts which result in vision loss; pancreatitis or inflammation of the pancreas; and other less common disorders. Treatment protocols include proper insulin administration, diet and exercise plans, and control of concurrent disease. Intact female patients need to be spayed as soon as their diabetes is stable to prevent disruption of diabetic control due to fluctuating reproductive hormones. Some unspayed diabetic dogs will have complete resolution of their diabetes after being spayed.

Some dogs accept and respond to treatment successfully, and are doing very well within a few days to weeks of starting insulin. Others will not respond with even the most aggressive treatment, especially if

multiple disorders are present, which make treatment of the diabetes more complicated. And there are many possibilities in between.

Your veterinarian will choose the appropriate type of insulin for your dog. The dose of insulin the veterinarian selects will be based on several factors, including body weight and type of insulin. The goal is not to achieve perfect control from the outset, but rather to allow the dog and owner to get used to the new routine of insulin injections and dietary changes, while the body adjusts to introduction of insulin. Arriving at the proper dose of insulin (called "regulation") will occur over weeks to months.

- *Lente insulin* – is the insulin needed by most dogs. Years ago, I was available over the counter at human pharmacies, but the manufacturer stopped production of this insulin. More recently, veterinary Lente insulin available through veterinarians and veterinary pharmacies, called "Vetsulin." Vetsulin is a U-40 insulin, which means it has 40 units per cc or ml of fluid. U-40 \*red\* capped syringes must be used to deliver Vetsulin. If U-100 \*orange\* capped syringes are used, insulin will be underdosed by 60%.
- *NPH insulin* – is still available over the counter at human pharmacies, and while probably a second choice to Vetsulin, is often used in diabetic dogs. One of the trade names is "Humulin N" and another "Novolin." NPH is a shorter acting insulin than Lente. NPH is a U-100 insulin, which means it has 100 units per cc or ml of fluid. U-100 \*orange\* capped syringes must be used to deliver NPH. If U-40 \*red\* capped syringes are used, insulin will be overdosed by 2.5 times.
- *Lantus (glargine) insulin* – is fast becoming the most popular insulin for both people and cats. However, dogs often don't absorb this insulin in a consistent manner, making it difficult to arrive at a proper dose. For this reason, Lantus is not ideal for most dogs. Some of the other long acting insulins are being experimented with in dogs, but none is commonly used.
- *Detemir insulin* – as another long acting insulin that seems to work much better in dogs than Lantus. It is at least 4x the cost per vial as compared to NPH, but the lower dose used sometimes offsets this.

There are three phases of treatment of diabetes mellitus.

*Regulation.* The initial period of weeks to months that is required to reach the proper insulin dose is called "regulation." During this time, the dog usually is rechecked weekly, if all is going reasonably well. If your pet becomes ill, more frequent checks or even hospitalization can be required. It is common for the veterinarian to make adjustments in the insulin protocol during these visits. Insulin doses should not be adjusted at home unless the veterinarian has instructed the change. Blood glucose curves and other tests are required throughout treatment to accurately assess the animal's response to treatment.

Some dogs can become regulated with relative ease if they respond well to therapy. Other dogs can take much longer, or never respond, especially if they have a concurrent disease. A "honeymoon period" is noted in some dogs in which they appear to respond initially to the insulin but then lose control within the first six months of therapy.

*Maintenance.* Once regulated, some diabetics remain at the same dose for years, without need for change. Others have changing insulin demands, and need the insulin dose or type adjusted frequently. **Signs of low blood sugar that indicate that insulin dose is too high include lethargy, weakness, incoordination, vomiting, or even seizures or coma if blood sugar becomes dangerously low.** *Signs of high blood sugar include weight loss, increased appetite, increased thirst, increased urination, etc.* Severely high blood sugar for long periods of time can cause severe illness and even diabetic coma. Over time, you will learn to recognize early and subtle signs that your pet needs to consult a veterinarian for insulin adjustment.

Many diabetic dogs are overweight. For optimal glucose control, obesity should be corrected slowly in diabetic patients; it should take several months for the dog to reach the ideal weight recommended by the veterinarian. In addition, the veterinarian may suggest a specific diet type. Commercial diets containing

higher amounts of fiber and digestible complex carbohydrates usually are advised for diabetic dogs, because they help decrease the fluctuations in blood glucose levels after a meal is consumed. The total daily caloric intake should be divided into at least two daily meals.

Exercise is highly encouraged due to its beneficial effects on blood glucose control and weight loss. If the dog has not had a structured routine, then it is recommended to start with short walks and slowly increase to a tolerable level.

*Remission.* In some cases, diabetic dogs can go through short or long periods of not needing insulin, called "remission." Remissions are much more common in cats than in dogs. Remissions in dogs can be brought about by healing pancreatitis, or spaying a female dog with hormonal diabetes.

During maintenance and remission, regular rechecks will help keep your pet in the best health possible. Regular rechecks when your pet is doing well may seem expensive and unnecessary. However, regular rechecks are very effective at preventing illness severe enough to cause hospitalization. In the long run, regular rechecks are usually more cost effective than allowing undetected problems to result in illness requiring treatment and possible hospitalization. We recommend that diabetics be seen at least every 6 months, and often up to every 3-4 months, depending on the case. We will send you a post-card reminder when your pet's recheck is due.

### **Prognosis:**

How your diabetic pet will do long term is dependent on a number of factors, including your willingness to properly monitor and treat the disease, the dog's ability to respond to the insulin, the presence of other concurrent diseases which must also be treated, and the development of complications of diabetes. With dedicated care from the owner, regular recheck appointments with the veterinarian, and a teamwork approach between the owner and the doctor, many diabetic dogs can live healthy lives for many years. For those pets that fail to respond to therapy, or whose owners decline treatment, a shortened life span is expected.

### **Prevention:**

It may not be possible to prevent diabetes mellitus. However, maintaining a dog's ideal weight and initiating regular exercise into its routine may be beneficial. Owners also should pay close attention to the dog's drinking, eating, and elimination habits. If any abnormalities are noted, the owner should seek veterinary care. Early detection may lead to easier control or, at least, avoidance of severe disease complications.

### **References:**

1. <http://vetcentric.com>
2. HomeCare Handouts
3. Ward, Ernest. Lifelearn Handouts.