Regulating & Monitoring a Diabetic Cat Using Insulin

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Not all cats with diabetes will need to be treated with insulin (some cats with mild diabetes may respond to and dietary change), but a majority of them will. The goal of treatment is to resolve the signs of the disease, maintain proper body weight, eliminate or reduce the likelihood of any complications, and provide the cat with a good quality of life. This can be accomplished by maintaining the blood glucose at an acceptable level (100-290 mg/dL; normal is 55-160 mg/dL).

In addition to treating the diabetes, any other concurrent diseases such as pancreatic exocrine insufficiency, hyperthyroidism, Cushing's disease, and infections need to be treated as well.

What should an owner know before trying to 'regulate' a cat with diabetes?

Before treatment is started, it is important that the owner be well-informed and have the time necessary to make the correct decision since regulating a diabetic cat requires commitment. Owners should know:

- The cat will need to be hospitalized for a number of days and one or more blood glucose profiles (described below) will need to be performed. The initial regulation of a cat on insulin generally takes 2-8 weeks.
- The process of getting a cat regulated can be costly.
- Insulin must usually be given twice a day, every day at specific times, probably for the life of the cat.
- Insulin must be handled properly (refrigerated, not shaken, etc).
- There is a proper technique for administering insulin to a cat that must be followed.
- The type of insulin and insulin syringe that are used should not be changed unless under guidance by the veterinarian.
- The type and amount of food and when it is fed must be consistent. In most cases, foods high in protein and low in carbohydrates are recommended. These are usually canned foods.
- The cat will need to be carefully monitored at home on a daily basis; when to seek veterinary advice and return for rechecks will depend on what signs the cat may be showing.
- Insulin requirements often change over time and the dose of insulin may need periodic adjustments based upon blood glucose monitoring.
- Emergency conditions of low blood sugar (hypoglycemia) can be seen if too much insulin is given in relation to food intake. The owner must be aware of when this could occur, the signs of the condition, and how to manage it.
- A blood sugar level that is too high is better than one that is too low.
- Diseases or procedures the cat may have in the future (e.g., surgery, teeth cleaning) may need to be managed differently because of diabetes.
- Heat cycles can affect insulin requirements, so it is suggested that female diabetic cats be spayed. Diabetic cats should not be bred, since pregnancy and lactation will greatly affect blood glucose levels and insulin requirements.

Why are diabetic cats more difficult to regulate than other animals?

Cats are more difficult to regulate for a number of reasons including:

- Cats develop stress hyperglycemia in which their blood glucose levels can greatly exceed normal levels when the cat is stressed, e.g., in the veterinarian's office. This can make the diagnosis more confusing, as well as the regulation with insulin. Because of stress, a cat hospitalized for a blood glucose profile may have a much different result than if the profile was performed in the cat's own home.
- Cats, because of their size, generally need very small doses of insulin which can be difficult to measure accurately.
- Cats can be finicky eaters. If they do not eat consistently from day to day, their insulin needs will vary from day to day.
- Cats are more prone to rebound hyperglycemic (Somogyi effect), as discussed below.
- The insulin needs of an individual cat can vary considerably from month to month. In addition, some cats develop transient diabetes, which may only last for several months and then have spontaneous remission in which it appears to be 'cured,' only to come back months later (in some cats). Once obese cats reach their ideal weight, they may lose their need for supplemental insulin.
- Cats have an extreme variability in their response to insulin. The insulin doses per pound of body weight vary much more between cats than between dogs or between humans.

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What are the characteristics of insulin?

There are several types of insulin used in the treatment of cats with diabetes mellitus. The characteristics differ as to source, duration of action, concentration, and the frequency of administration.

Source: Insulin for treatment of cats may be derived from the pancreas of pigs (pork insulin), pancreas of cattle (beef insulin), or combinations of the two; or it can be genetically engineered to be identical to human insulin. The insulin of various mammals differs by only one or several amino acids.

Duration: Insulin preparations can be short-acting (regular insulin), intermediate (Lente, NPH), or long-acting (glargine, Ultralente, protamine zinc insulin - PZI).

Concentration: Insulin is available in concentrations of 40, 100, and 500 units/ml.

There are corresponding syringes to use for the measurement of the three concentrations of insulin. If using insulin with 40 U/ml, you must measure and administer it with a U-40 syringe; using a U-100 or U-500 syringe would result in the wrong amount of insulin being given, with perhaps a fatal outcome. The measurements marked off on those syringes designed for giving a low dose are often easier to read. Find out from your veterinarian (or pharmacist) what syringes are available for you to use with the concentration of insulin your cat is receiving.

Dose and frequency of administration: Based upon results of the blood glucose profile and the type of insulin which is used, the dose and frequency of administration of insulin will vary. Generally, insulins which are short- or intermediate-acting are given twice daily; long-acting insulins may need to be given once or twice a day depending upon the response. The number of units of insulin your cat receives depends upon the type of insulin used, and your cat's response.

From this discussion, you can see there are many combinations of insulin, dose and frequencies of administration to be considered when attempting to regulate a cat with diabetes. Successful regulation is determined by the results of a blood glucose profile, glucose level monitoring, and the response of the cat (eating well, alert, normal water consumption, and urine production, etc.).

In general, long-acting insulins are most appropriate for cats. Glargine insulin is a human recombinant insulin. It's formulation results in a constant release of small amounts of insulin. This keeps the blood glucose level far more stable. Glargine is considered to be better than PZI or lente insulins in newly-diagnosed diabetic cats. In some cats, it can even result in remission when used in combination with a low-carbohydrate-high-protein diet. For those cats that have been on long term therapy with other insulins, the results for remission are less likely, though better control is often achieved.

What is insulin resistance?

Insulin resistance is said to occur when the blood glucose level of a cat cannot be regulated with an insulin dosage lower than 2 U/pound of body weight per day. There are many causes of insulin resistance and 'apparent' insulin resistance. Causes of 'apparent' insulin resistance include:

Improper insulin administration: Inadequate mixing of insulin, improper measurement of the dose (misreading the syringe, using the wrong type of syringe), and errors in injecting the insulin can result in the cat not receiving the dose of insulin we think she is. If insulin resistance is suspected, this is the first area to review. Have your veterinarian check your technique.

Inactive insulin: If insulin is improperly stored, used after the expiration date has lapsed, has been shaken or been exposed to higher temperatures, it may lose its potency. The easiest way to determine if inactive insulin is the problem is to use a new bottle of insulin.

Changes in food or feeding schedule: If the feeding schedule, type of food, or access to food has changed, apparent insulin resistance could occur. An example: A dog we were trying to regulate on insulin was needing increasingly larger doses of insulin to keep the blood glucose level in a somewhat normal range. The insulin and its administration all checked out OK. There were no other disease processes that we could identify, yet the dog's insulin requirements continued to rise. One day the owner of the dog came into the veterinary hospital and happily told us the problem had been solved. The dog had been eating the candy canes off the Christmas tree!

Somogyi effect: The Somogyi effect, also called insulin-induced hyperglycemia, or rebound hyperglycemia, is somewhat difficult to understand. Basically, if too much insulin is given, the blood glucose level goes so low it stimulates the production of other hormones in the body such as epinephrine, which promote the breakdown of glycogen (the chemical compound which the body uses to store glucose) and increases the blood glucose level above normal. If this rebound hyperglycemia is suspected, the insulin dose is reduced 50-75%, and after three days, a blood glucose profile is performed.

If the above causes of an inadequate response to insulin have been eliminated, true insulin resistance may be occurring. It is sometimes difficult to determine the cause and it may require multiple laboratory tests to make the determination. Causes of true insulin-resistant states include:

Interference by medications: The long term administration of glucocorticoids such as dexamethasone, or progesterone-like hormones such as megestrol acetate can result in diabetes mellitus and insulin resistance.

Poor absorption of insulin: In some cats, even though active insulin is administered correctly, it is not well absorbed from the

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site of injection. These cats generally respond well to insulin given intravenously or intramuscularly.

Other diseases: Infections, ketoacidosis, pancreatitis, liver disease such as hepatic lipidosis, kidney disease, or hormonal disorders such as Cushing's disease, hyperthyroidism, and acromegaly (condition resulting from an increased production of growth hormone) can affect the metabolism and effectiveness of insulin in the body. Many of these diseases can change the levels of other hormones in the body which affect the glucose level such as glucocorticoids.

Obesity: In humans, obesity is more commonly related to insulin resistance. It has been suggested that obesity in cats can also result in insulin resistance. We do know that as obese cats lose weight, their need for insulin therapy decreases and sometimes is eliminated.

Production of antibodies against insulin: Insulin and other components added during the manufacture of injectable insulin can be considered 'foreign' by the body and cause the body to produce antibodies to destroy them. This is generally quite rare and more likely to occur in cats if pork or human recombinant insulin are used, since when compared to beef insulin, they are less like cat insulin.

How should a diabetic cat be managed and monitored at home?

Accurate and consistent monitoring of a diabetic cat at home can sometimes provide more accurate information as to the response to therapy than attempting to perform blood glucose tests in the veterinarian's office. As an owner of a diabetic cat you should:

Store, handle, and administer insulin properly: The proper method of storing, handling, and administering insulin were discussed in detail above. Remember, if a cat receives only a partial dose of insulin, do NOT give another dose. Wait until the next scheduled dose.

Keep a record of insulin administrations: Record each insulin administration. It is best to have one family member responsible for administration, so missed doses and 'double' doses do not occur as a result of miscommunication.

Monitor for signs of hypoglycemia: Signs of hypoglycemia (discussed in detail below) include lethargy, depression, weakness, seizures, and coma. Administer corn syrup if these signs occur, and contact your veterinarian.

Maintain a proper feeding schedule and access to food: Provide your cat with her recommended diet at the scheduled feeding times. Monitor her appetite and food consumption; this is especially important for cats who 'nibble.'

Monitor your cat's weight: If your cat is overweight, the rate of weight reduction is important; we do not want your cat to lose weight too fast, however, we do want her to lose. Establishing and maintaining your cat's weight is one of the major goals of insulin therapy, and an excellent means to monitor the effectiveness of the therapy. You may want to invest in a baby scale (you may find one at a garage sale) or mail scale. As your cat's weight changes, her insulin needs may change. Your cat's weight is an excellent way to monitor the success of insulin therapy.

Observe the cat for improvement of signs of diabetes: Attitude, water consumption, frequency and amount of urination, and appetite are all clues as to how well your cat is responding to therapy. This information will be very valuable in evaluating your cat's progress.

Accurately measure other parameters as advised: Depending on your cat's overall health, weight, difficulty in regulation or other factors, your veterinarian may also ask you to measure water intake or urine glucose (measured using paper strips and watching for a color change). Insulin dosages, however, should NOT be changed based solely on urine glucose levels. A urine glucose test does not tell us what is going on at the time the urine sample was obtained; it is an average of the glucose level in the urine, which was formed since the cat last urinated - that could be 8 or more hours ago.

Keep scheduled appointments and communicate!: Your veterinarian will advise you as to how often your cat will need to be examined and have her blood glucose monitored. Be sure to keep these appointments; the time of day these appointments are scheduled is often critical. Be sure to communicate any concerns or observations to your veterinarian. Working as a team will greatly increase your probability of successfully regulating your cat.

Be patient: Regulating a cat with diabetes is much more difficult than regulating a dog or person. You may be doing everything perfectly at home, but still have difficulty in regulating your cat. Try not to become frustrated, and if you do not understand something, ask. Do not be offended if your veterinarian asks to review your methods of measuring and administering insulin.

Keep the cat indoors or supervised outdoors: Outdoor cats are at much more of a risk of missing their scheduled insulin injections and feeding times. Their exercise may vary tremendously from day to day, which can greatly affect their insulin needs. You will not be able to accurately monitor food intake, water consumption, or urination if your cat is allowed to be unsupervised outside. If your cat would develop hypoglycemia, you would have no way of knowing it. For cats accustomed to going outside, many will learn to walk on a leash or be happy to be outside on a harness and long lead while you are in the

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yard with them.

Monitor glucose levels at home: Many owners are able to monitor their cat's glucose levels at home using an instrument called a glucometer. This allows for 'tighter' glucose control, but also involves much more work by the owner. A small drop of blood is obtained, usually from the cat's ear margin, and tested using the glucometer. This information along with in-hospital glucose curves and the above home management techniques will provide the best regulation of the cat.

What are the causes, signs, and treatment of hypoglycemia in diabetic cats?

Hypoglycemia, or low blood sugar (less than 50 mg/dL; normal is 55-160 mg/dL), is the most common and serious side effect of insulin therapy in cats. It can be life-threatening. It is important that owners of diabetic cats know how to prevent, recognize, and treat this condition.

Causes of hypoglycemia: Most of the causes of hypoglycemia in diabetic cats can be prevented or predicted. Hypoglycemia can result from:

Hyperglycemia is always better than hypoglycemia.

- Administration of too much insulin. This can occur if the wrong insulin or wrong type of syringe is used, or a second dose of insulin is given due to miscommunication between family members or to try to make up for a first dose that was improperly given. Some cats can undergo spontaneous remission of their diabetes, i.e., they suddenly produce enough insulin on their own and do not need supplemental insulin. How or why this occurs is not well-understood, and it may be only a temporary phenomenon.
- Decreased food intake. If insulin was administered but the cat will not eat her meal, the excess insulin in relation to the amount of glucose available to the body will cause the blood glucose to go too low.
- Increased exercise or calorie consumption. If the body is using more glucose for energy, it may pull too much glucose out of the bloodstream.
- Poor regulation. If the cat is poorly regulated, is experiencing the Somogyi effect, or insulin changes are made too rapidly in the regulation process, low blood glucose can occur.
- Metabolism changes caused by other diseases. Heat cycles and other hormonal diseases (or their treatment) can result in a change of the body's insulin requirements.

Signs of hypoglycemia: Cats with hypoglycemia will act depressed and lethargic, may show weakness or incoordination, progress into a stupor or coma, and ultimately develop seizures and die. The earlier the signs are recognized, the easier and more successful the treatment.

Treatment of hypoglycemia: Home management of hypoglycemia depends upon recognizing the signs of hypoglycemia early. If the cat is able to eat, offer her her normal food. If she refuses to eat but can still swallow, have her lick some Karo (corn) syrup. If she is unable to swallow, apply the corn syrup to her gums. Contact your veterinarian who can determine what other treatment or hospitalization may be necessary.

Summary

Regulating a cat with diabetes requires an understanding of the disease process and the complexity of the regulation process, good communication between the owner and the veterinarian, good observational skills, attention to detail, and commitment. A diabetic cat who is properly regulated can enjoy many more years of quality life.

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