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Diabetes mellitus is not a rare disease in the dog. It results either from an inability of the pancreatic beta cells to synthesize and release adequate amounts of insulin or from a peripheral antagonism to the effects of insulin. Most of the time the cause is idiopathic, but some associated known predisposing factors include pancreatitis, glucocorticoid abuse, prolonged use of megestrol acetate, and acromegaly.

Diagnosis is made on the basis of history and clinicopathologic abnormalities as will be described in further sections. The practitioner should be aware that the cat often shows a transient hyperglycemia during times of stress where the blood glucose levels can elevate to 200-300 mg/dl, but this rarely happens in the dog. Therefore it is important to interpret the laboratory values within the context of the patient. When the significance of the hyperglycemia is questionable, the clinician should repeat the test and check for the presence of glycosuria. This discussion will pertain to only the non-ketoacidotic patient that is being treated as an out-patient.

History and Physical Examination Findings
The history usually denotes polyuria, polydipsia, and gradual weight loss over a period of weeks to months. Polyphagia is sometimes evident. The physical examination abnormalities include evidence of weight loss and slight hepatomegaly. Dogs can get a rapid onset of diabetic cataracts.

Diagnosis
Persistent hyperglycemia and glycosuria are the classic clinicopathologic abnormalities. Occasionally the liver serum enzyme tests (ALT, AST, and alkaline phosphatase) are elevated due to hepatic lipidosis.

Treatment
Most of the time, these patients are initially treated as outpatients following a special consultation session with the owner that provides specific instructions regarding insulin injection technique, feeding, insulin dosage adjustments, and the actions needed to counter any hypoglycemic reactions.

NPH (Humulin N) or Vetsulin insulin (if available) are the initial drugs of choice in the compensated dog. They are initially dosed for the dog at ½ unit/kg, and it should only be given subcutaneously on a divided dose basis BID. In man, the activity of NPH insulin is characterized as follows: onset of action - 3 to 4 hours, peak action - 8 to 12 hours, and duration of action 18-24 hours. In the cat and most dogs, however, experience has shown that the onset and peak action times of NPH can occur as early as a few hours following the injection thereby predisposing the animal to episodes of hypoglycemia. To circumvent this misfortune, the insulin dose should be split where one-half of the total is given in
the morning, and the other half is given 8-12 hours later. This split-dose method provides the patients with most of its total daily insulin requirement yet lessens the risk of hypoglycemic reactions. In situations where the animal is receiving only one dose of insulin per day, the clinician should suspect the need for splitting the dose when the following signs are present: (a) symptoms of hypoglycemia in the late morning or early afternoon accompanied by minimal glycosuria and (b) hyperglycemia and excess glycosuria on the following morning’s blood and/or urine sample(s). The reasons explaining this reaction include the Somogyi reaction, shortened duration of insulin effect, and possibly the owner’s administration of excessive carbohydrates on the preceding day to counter the hypoglycemic episode.

I now recommend to all of my diabetic pet owners that they purchase glucagon injection at the drug store and give it IM at a dose of 0.03 mg/kg for any hypoglycemic coma or seizure event. Oral glucose substitutes will adequately treat hypoglycemia so long as the patient is conscious.

There are several different ways a pet owner can monitor his/her diabetic dog. Each technique offers certain advantages and disadvantages that I will provide in this brief presentation.

**SPOT BLOOD GLUCOSE CHECKS**

**Advantages.** Ease in having to collect one blood sample. Might reflect accurate patient status on the most stable diabetic.

**Disadvantages.** That particular sample might not reflect the varying blood glucose levels in that patient. The stress of the office visit and blood collection might give a falsely high result. Sample collection can be difficult in the fractious animal.

**BLOOD GLUCOSE CURVES IN THE HOSPITAL.**

**Advantages.** Provides a more spread out time assessment of the patient’s response to the insulin injection for a more accurate interpretation.

**Disadvantages.** Requires hospitalization for at least 8 hours. Requires numerous blood collections which might be difficult to procure and expensive. Any stress caused by the hospitalization and the several phlebotomies can give falsely high levels. False results are possible if the animal does not eat. Inserting an indwelling venous catheter is costly and again an added initial stress to the patient.

**BLOOD GLUCOSE CURVES AT HOME.**

**Advantages:** In the ideal world this method can provide accurate serial blood glucose determinations provided that the patient is calm and the owner effective with the technique.

**Disadvantages.** Many will not tolerate the repeated skin pricks. Fibrosis will set into areas of skin that are repeatedly used. Requires owner commitment and the patient’s cooperation. Process might not be able to be continued in the owner’s absence.

**SERUM FRUCTOSAMINE DETERMINATIONS.**

**Advantages.** One blood sample reflects the blood glucose over a 2-3 week time period. Easy technique with minimal stress to the patient and minimal cost to the client. Commonly used today.
**Disadvantages.** Reflects an average value over a period of time. A normal value might be inaccurate if patient is hypoglycemic half the time and hyperglycemic the other half. Conditions such as hypoproteinemia, azotemia, and hyperlipidemia can give erroneous results.

**URINE GLUCOSE MONITORING.**
**Advantages.** Simple to do at home, no stress to the animal, inexpensive, can give “ball-park” impression of the status of the diabetic regulation. Two sample collections (one in the morning and the other in the mid-late afternoon) will increase the accuracy. Time tested with good results in many cases. Sample collection fairly easy.

**Disadvantages.** Time of sample collection might not truly reflect on the insulin’s action in that patient. Gives only a qualitative instead of a quantitative impression of the insulin effect. Sample collection difficult if waiting for fresh catch.

**CLINICAL SIGNS.**
**Advantages.** Easy to do, no equipment necessary. Anyone can do.

**Disadvantages.** Can be inaccurate if owner is a poor observer and bad record keeper. Furry patients might not readily show weight gain and weight loss. Metabolic decompensation might not be detectable until late stage. Owner’s noncompliance with feeding can be a large complicating factor.

So what is the ideal monitoring technique? This is a difficult if not an impossible question to answer because each method has its own advantages and disadvantages. Each pet owner, the patient, and the veterinarian will find what works best in each particular situation.

**Diet:**
The diet should be a balanced ration and fed in such an amount that obesity is avoided. The optimal diet for the diabetic patient is low in carbohydrate and high in protein. This can be found in several commercial prescription and nonprescription products.

**UNIVERSITY OF FLORIDA - COLLEGE OF VETERINARY MEDICINE**
**MANAGEMENT OF THE DIABETIC PET**

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Dear Mr./Mrs. ________________:

Your pet has a disease called Diabetes Mellitus (sugar diabetes). Since your pet does not have enough natural insulin to maintain normal body function, you must provide the insulin by daily injection.

At your pharmacy, you will purchase Humulin N (NPH) insulin (100 units per cc), insulin syringes (100 unit), and needles with the accompanying prescriptions. Other insulin products can be obtained, but these will best be left to your doctor’s discretion. The U-100 syringes are available in the following calibrations 0 to 100, 0
to 50, and 0 to 30 units. They have "painless" 29 gauge needles attached. Note that insulin and insulin syringes can be purchased without prescriptions. Insulin should be refrigerated or kept in a cool and shaded environment at all times, and the bottle must be gently swirled prior to withdrawal of the insulin into the syringe. The injection must be given subcutaneously (beneath the skin). Your doctor or technician will demonstrate the correct injection technique.

If your veterinarian chooses to use VETSULIN, this only comes in a concentration of 40 units per cc. Note that Vetsulin requires U-40 syringes. Should Vetsulin be unavailable, you can use Humulin – N and there should be no problems with this product.

The amount of insulin required each day may be subject to change depending on various factors such as alterations in diet, exercise and certain environmental stresses. The dose is determined by monitoring the amount of sugar in your pet’s urine. This will be measured each morning prior to insulin administration. To measure urine sugar, purchase Diastix® or Ketodiastix® (in the USA) at your pharmacy. Do not confuse these with Ketostix® which does not measure urine sugar. The instructions on these tests are simple to follow.

Split Injection Method – This is my preferred method for dogs and cats when using NPH, Vetsulin, PZI (note that PZI-feline is 40 units/ml concentration and requires U-40 insulin syringes), and glargine (the latter two are used in cats).

(a) In the morning, determine the urine sugar level and determine the necessary insulin dosage adjustment.
(b) Administer ½ of the total dose SQ; then feed ½ of the daily total diet.
(c) In the evening, administer the other ½ dose of insulin and feed the other one half of the daily diet. Allowing free choice food throughout the day is permissible for your cat.

The following chart will guide you in making total daily insulin dose adjustment. Note that the colors are meant to coordinate with the Ketodiastix® or Diastix® reagent tests.

FOR A LARGE OR MEDIUM SIZED DOG:

[above 30 lb (15 kg)]

<table>
<thead>
<tr>
<th>Urine Sugar Level</th>
<th>Insulin Dose Adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>4+ (2%)</td>
<td>increase 2-3 units over previous day’s dose. (brown)</td>
</tr>
<tr>
<td>3+ (1%)</td>
<td>increase 2 units over previous day’s dose. (brown)</td>
</tr>
<tr>
<td>2+ (½%)</td>
<td>increase 1 unit over previous day’s dose. (green/brown)</td>
</tr>
<tr>
<td>Trace (1/10%) or 1+ (1/4%)</td>
<td>repeat previous day’s dose. (green)</td>
</tr>
<tr>
<td>Negative</td>
<td>decrease 2 units from previous day’s dose. (blue)</td>
</tr>
</tbody>
</table>
### FOR A CAT AND SMALL DOG:

<table>
<thead>
<tr>
<th>Urine Sugar Level</th>
<th>Increase/Decrease</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>3+ (1%) or 4+ (2%)</td>
<td>Increase ½-1 unit over previous day’s dose.</td>
<td>(brown)</td>
</tr>
<tr>
<td>2+ (½%)</td>
<td>Increase ½ unit over previous day’s dose.</td>
<td>(green/brown)</td>
</tr>
<tr>
<td>Trace (1/10%) or 1+ (1/4%)</td>
<td>Repeat previous day’s dose.</td>
<td>(green)</td>
</tr>
<tr>
<td>Negative</td>
<td>Decrease 2 units from previous day’s dose</td>
<td>(blue)</td>
</tr>
</tbody>
</table>

The ultimate objective is to maintain the morning urine sugar at the **Trace to 1+ level**. In the small pet, adjustments for dosage increase can be made on an alternate day basis.

Infrequently your pet may experience an insulin reaction due to a marked decrease in its blood sugar. When using NPH (Humulin N) insulin, this reaction is most likely to occur **3-8 hours** following the morning’s injection but may occur as soon as **1-2 hours** after the injection. The signs accompanying such a reaction will mimic a **drunken state**; that is, your pet will be weak and walk with a wobbly incoordinated gait. Should this occur, administer 1-2 tablespoons of Karo Syrup (or 0.25-0.5 ml/lb) orally. If no improvement is seen after 15 minutes or if the signs worsen, seek out veterinary assistance immediately. If you were instructed to purchase Glucagon severe hypoglycemic seizures or coma, the dose is **0.03 mg/kg IM or SQ**. Glucagon can be purchased at the drugstore with a doctor’s prescription.

Dietary changes are unnecessary other than feeding your pet twice daily so long as the diet is nutritionally balanced and avoids obesity. Prescription diets can be used at your veterinarian’s discretion.

Should your pet become ill or acquire any type of trauma, your doctor should be contacted immediately.

### References

