

FEED RESPONSIBLY.

Nutrition can greatly affect the way dogs and cats with diabetes live. Consider all the factors before prescribing a diet regimen.

NUTRITION NOTES

Nutrition and Diabetes Mellitus

Cynthia R. Ward, VMD, PhD, DACVIM

University of Georgia College of Veterinary Medicine, Athens, Ga.

Diabetes mellitus (DM) is a metabolic disorder that results from impaired glucose handling (lack of insulin production or lack of response to insulin) such that the animal experiences persistent hyperglycemia and glucosuria. As it is for many diseases, an essential part of therapy for DM is nutrition. This article reviews the role of nutrition in the management of dogs and cats with DM.

DOES DM AFFECT DOGS AND CATS DIFFERENTLY?

In veterinary medicine, DM is divided into 2 types, which affect dogs and cats at different frequencies. The 2 types are based on pathophysiology and risk factors, which have been more fully described in human medicine.

- **Type 1 DM** occurs primarily in dogs. It results from destruction of the insulin-secreting beta cells in the endocrine portion of the pancreas, as a result of either immune-mediated (presumably autoimmune) mechanisms or pancreatitis.
- **Type 2 DM** is more prevalent in cats and results from insulin resistance. Receptors on target cells become less responsive to insulin, requiring increased insulin synthesis and secretion to maintain euglycemia. Initially, the beta cells can compensate by secreting

more and more insulin; however, over time and consistent exposure to a hyperglycemic environment, the beta cells begin to fail (beta cell burnout). This process is accompanied by amyloid deposition in the failing pancreas, and type 2 DM ensues.

In cats, a unique feature of DM is the possibility of remission (previously referred to as transient DM). Cats experiencing remission might resume a euglycemic state, such that treatment can be discontinued for some time; however, for most of these cats, the diabetic state returns. In the veterinary literature, the definition of remission is not consistent, which has caused confusion over which treatment options result in remission.

WHAT ARE THE RISK FACTORS FOR DM?

Among humans, type 2 DM has reached epidemic proportions, and the prevalence is rapidly increasing. It is estimated that by the year 2025, as many as 300 million people worldwide will have type 2 DM. Significant risk factors for type 2 DM in people center on unhealthy lifestyles, including inactivity and obesity. Similarly, for cats, inactivity and obesity are significant risk factors for DM and type 2 DM is also on the rise. As companion animals, cats' lifestyles often reflect



those of the people they live with, enabling the cats to enjoy a sedentary life with access to excess calories. Many cats are kept indoors and lack access to activity. In addition, because cats often prefer to graze—eating small amounts of food throughout the day—many people keep dry food available for their cats to consume *ad libitum*. This combination of a sedentary lifestyle and constant access to calorie-dense dry food contributes to obesity in cats, which can then result in the development of type 2 DM.

WHAT DIET REGIMEN SHOULD I RECOMMEND FOR MY DIABETIC PATIENTS?

After a diagnosis of DM has been made, affected dogs and cats should be fed twice a day, when they receive their insulin injection. This regimen helps ensure that the animal eats enough to use the exogenous insulin. At 4 to 8 hours after injection, when the insulin is working, the animal may have a snack; however, clients should control the animal's calorie consumption to avoid weight gain. The daily caloric requirement, especially for overweight animals, should be divided into the requisite meals and snacks. For cats, rather than trying to change their preference for grazing (an exercise in futility), work with the client to develop an optimal feeding strategy. Most diabetic cats can do well with insulin injections and food left out for grazing. If possible, the cat's caloric requirements should be divided into 2 meals per day and the cat should be allowed to nibble on the food throughout the day.

WHAT FOOD SHOULD I RECOMMEND FOR MY DIABETIC PATIENTS?

For dogs with DM, the optimal diet is high in insoluble fiber. This diet controls glucose absorption from the gut and minimizes postprandial hyperglycemic peaks. For optimal DM control, clients are instructed to feed and give the dog insulin twice daily. As the insulin begins to be absorbed after injection, it should allow the glucose absorbed from the food to be used or stored appropriately. A high-fiber diet also helps the dog lose weight, which can have a beneficial impact on DM control. Food choices for diabetic dogs are much less important than those for cats. For dogs, it is more important that they eat regularly than be strictly limited to certain foods.

For cats with DM, diet is much more important and can significantly affect DM control. For these obligate

carnivores, the optimal diet contains 12% metabolizable energy (ME) of carbohydrates. In addition, to prevent loss of lean body mass, a high-protein diet with at least 40% ME protein is recommended. There are many prescription diets on the market that have a low carbohydrate load and are formulated especially for cats. If clients will not purchase prescription low-carbohydrate diets, they can feed nonprescription canned foods; besides being generally less calorie dense, canned cat food also tends to be lower in carbohydrates. For diabetic cats in whom DM is stable and serum blood glucose is less than 300 mg/dL, a low-carbohydrate diet may be tried initially before insulin therapy to determine if remission can be achieved. However, if diet alone does not lead to euglycemia in 2 to 4 weeks, insulin therapy should be started. Insulin therapy should also be initiated if the cat is ketotic, even if eating and drinking normally.

WHAT IF THE DIABETIC PATIENT WILL NOT EAT?

Anorexia can lead to ketosis, which is an emergency situation. Ketosis is a metabolic condition resulting from an increased concentration of ketone bodies, which cause hyperosmolality and acidosis and can lead to a rapid decline in clinical condition. Ketosis occurs when the body's balance of insulin and glucagon is altered, either from decreased insulin or increased glucagon in the bloodstream. Because one cannot remove glucagon from the system, supplementing with insulin is the best way to reverse the abnormal insulin:glucagon ratio and treat ketosis. The rule of thumb is that ketosis indicates that the patient needs more insulin. Conversely, abrupt withdrawal of insulin can alter the insulin:glucagon ratio and result in development of ketone bodies. Therefore, if a diabetic animal will not eat, it should be given half its normal insulin dose to prevent ketosis. Doing so will usually *not* result in hypoglycemia. If the animal continues to not eat well, it should be taken to the veterinarian to check for ketosis, hypoglycemia, or concurrent disease.

WHAT IS THE OPTIMAL FOOD FOR THE DIABETIC ANIMAL WITH A COMORBID CONDITION?

Some DM patients have a concurrent disease and would benefit from feeding recommendations other than those for DM alone. For these patients, the food choice should be based on which disease would benefit the most from nutritional intervention.

For instance, what is the appropriate food choice for a dog with inflammatory bowel disease (IBD) and DM? For a dog with IBD, a limited-antigen or hydrolyzed diet can significantly decrease gut inflammation and may reduce or eliminate the need for medical therapy; however, for a dog with DM, a diet high in insoluble fiber is ideal for slow glucose absorption. For a dog with both of these diseases, the need to control the IBD outweighs the need to control the DM, so the dog should be fed to manage the IBD.

Another example is a cat with DM and stage 2 chronic kidney disease (CKD). Dietary therapy plays an important role in preventing progression of CKD. Therefore, although a low-carbohydrate/high-protein diet can significantly affect glucose control in diabetic cats, it is more beneficial to feed to prevent CKD progression. Therefore, a cat with these comorbidities should be fed a renal diet, and the insulin dose should be increased to compensate for lack of glucose control. **TVP**

Suggested Readings

- Behrend E, Holford A, Lathan P, et al. 2018 AAHA diabetes management guidelines for dogs and cats. *JAAHA* 2018;54(1):1-21.
- Hamper B. Current topics in canine and feline obesity. *Vet Clin North Am Small Anim Pract* 2016;46(5):785-795.
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- Kimmel SE, Michel KE, Hess RS, Ward CR. Effect of dietary insoluble fiber versus dietary soluble fiber on glycemic control in dogs with naturally occurring insulin-dependent diabetes mellitus. *JAVMA* 2000;216:1076-1081.
- Sparkes AH, Cannon M, Church D, et al. ISFM consensus guidelines on the practical management of diabetes mellitus in cats. *J Feline Med Surg* 2015;17:235-250.
- Verbrugghe A, Hesta M. Cats and carbohydrates: the carnivore fantasy? *Vet Sci* 2017;4(4):55.

Cynthia R. Ward

Dr. Ward received her VMD and PhD degrees from the University of Pennsylvania. She was on faculty at the University of Pennsylvania until 2005, when she moved to the University of Georgia, where she is currently a Professor of Small Animal Internal Medicine. Dr. Ward has an active research program in clinical and basic endocrinology, has authored numerous journal articles, book chapters, and research abstracts, and has been honored by receiving numerous teaching awards, including the University of Pennsylvania Alumni Teaching Award, the Norden/Pfizer Distinguished Teaching Award (twice), and the National SCAVMA Teaching Award. Dr. Ward is also a Diplomate of the American College of Veterinary Internal Medicine (SAIM).



Heartgard® Plus

(ivermectin/pyrantel)

CHEWABLES

CAUTION: Federal (U.S.A.) law restricts this drug to use by or on the order of a licensed veterinarian.

INDICATIONS: For use in dogs to prevent canine heartworm disease by eliminating the tissue stage of heartworm larvae (*Dirofilaria immitis*) for a month (30 days) after infection and for the treatment and control of ascarids (*Toxocara canis*, *Toxascaris leonina*) and hookworms (*Ancylostoma caninum*, *Uncinaria stenocephala*, *Ancylostoma braziliense*).

DOSAGE: HEARTGARD® Plus (ivermectin/pyrantel) should be administered orally at monthly intervals at the recommended minimum dose level of 6 mcg of ivermectin per kilogram (2.72 mcg/lb) and 5 mg of pyrantel (as pamoate salt) per kg (2.27 mg/lb) of body weight. The recommended dosing schedule for prevention of canine heartworm disease and for the treatment and control of ascarids and hookworms is as follows:

Dog Weight	Chewables Per Month	Ivermectin Content	Pyrantel Content	Color Coding On Foil Backing and Carton
Up to 25 lb	1	68 mcg	57 mg	Blue
26 to 50 lb	1	136 mcg	114 mg	Green
51 to 100 lb	1	272 mcg	227 mg	Brown

HEARTGARD Plus is recommended for dogs 6 weeks of age and older.

For dogs over 100 lb use the appropriate combination of these chewables.

ADMINISTRATION: Remove only one chewable at a time from the foil-backed blister card. Return the card with the remaining chewables to its box to protect the product from light. Because most dogs find HEARTGARD Plus palatable, the product can be offered to the dog by hand. Alternatively, it may be added intact to a small amount of dog food. The chewable should be administered in a manner that encourages the dog to chew, rather than to swallow without chewing. Chewables may be broken into pieces and fed to dogs that normally swallow treats whole.

Care should be taken that the dog consumes the complete dose, and treated animals should be observed for a few minutes after administration to ensure that part of the dose is not lost or rejected. If it is suspected that any of the dose has been lost, redosing is recommended.

HEARTGARD Plus should be given at monthly intervals during the period of the year when mosquitoes (vectors), potentially carrying infective heartworm larvae, are active. The initial dose must be given within a month (30 days) after the dog's first exposure to mosquitoes. The final dose must be given within a month (30 days) after the dog's last exposure to mosquitoes.

When replacing another heartworm preventive product in a heartworm disease preventive program, the first dose of HEARTGARD Plus must be given within a month (30 days) of the last dose of the former medication.

If the interval between doses exceeds a month (30 days), the efficacy of ivermectin can be reduced. Therefore, for optimal performance, the chewable must be given once a month on or about the same day of the month. If treatment is delayed, whether by a few days or many, immediate treatment with HEARTGARD Plus and resumption of the recommended dosing regimen will minimize the opportunity for the development of adult heartworms.

Monthly treatment with HEARTGARD Plus also provides effective treatment and control of ascarids (*T. canis*, *T. leonina*) and hookworms (*A. caninum*, *U. stenocephala*, *A. braziliense*). Clients should be advised of measures to be taken to prevent reinfection with intestinal parasites.

EFFICACY: HEARTGARD Plus Chewables, given orally using the recommended dose and regimen, are effective against the tissue larval stage of *D. immitis* for a month (30 days) after infection and, as a result, prevent the development of the adult stage. HEARTGARD Plus Chewables are also effective against canine ascarids (*T. canis*, *T. leonina*) and hookworms (*A. caninum*, *U. stenocephala*, *A. braziliense*).

ACCEPTABILITY: In acceptability and field trials, HEARTGARD Plus was shown to be an acceptable oral dosage form that was consumed at first offering by the majority of dogs.

PRECAUTIONS: All dogs should be tested for existing heartworm infection before starting treatment with HEARTGARD Plus which is not effective against adult *D. immitis*. Infected dogs must be treated to remove adult heartworms and microfilariae before initiating a program with HEARTGARD Plus.

While some microfilariae may be killed by the ivermectin in HEARTGARD Plus at the recommended dose level, HEARTGARD Plus is not effective for microfilariae clearance. A mild hypersensitivity-type reaction, presumably due to dead or dying microfilariae and particularly involving a transient diarrhea, has been observed in clinical trials with ivermectin alone after treatment of some dogs that have circulating microfilariae.

Keep this and all drugs out of the reach of children.

In case of ingestion by humans, clients should be advised to contact a physician immediately. Physicians may contact a Poison Control Center for advice concerning cases of ingestion by humans.

Store between 68°F - 77°F (20°C - 25°C). Excursions between 59°F - 86°F (15°C - 30°C) are permitted. Protect product from light.

ADVERSE REACTIONS: In clinical field trials with HEARTGARD Plus, vomiting or diarrhea within 24 hours of dosing was rarely observed (1.1% of administered doses). The following adverse reactions have been reported following the use of HEARTGARD: Depression/lethargy, vomiting, anorexia, diarrhea, mydriasis, ataxia, staggering, convulsions and hypersalivation.

SAFETY: HEARTGARD Plus has been shown to be bioequivalent to HEARTGARD, with respect to the bioavailability of ivermectin. The dose regimens of HEARTGARD Plus and HEARTGARD are the same with regard to ivermectin (6 mcg/kg). Studies with ivermectin indicate that certain dogs of the Collie breed are more sensitive to the effects of ivermectin administered at elevated dose levels (more than 16 times the target use level) than dogs of other breeds. At elevated doses, sensitive dogs showed adverse reactions which included mydriasis, depression, ataxia, tremors, drooling, paresis, recumbency, excitability, stupor, coma and death. HEARTGARD demonstrated no signs of toxicity at 10 times the recommended dose (60 mcg/kg) in sensitive Collies. Results of these trials and bioequivalency studies, support the safety of HEARTGARD products in dogs, including Collies, when used as recommended.

HEARTGARD Plus has shown a wide margin of safety at the recommended dose level in dogs, including pregnant or breeding bitches, stud dogs and puppies aged 6 or more weeks. In clinical trials, many commonly used flea collars, dips, shampoos, anthelmintics, antibiotics, vaccines and steroid preparations have been administered with HEARTGARD Plus in a heartworm disease prevention program.

In one trial, where some pups had parvovirus, there was a marginal reduction in efficacy against intestinal nematodes, possibly due to a change in intestinal transit time.

HOW SUPPLIED: HEARTGARD Plus is available in three dosage strengths (See DOSAGE section) for dogs of different weights. Each strength comes in convenient cartons of 6 and 12 chewables.

For customer service, please contact Merial at 1-888-637-4251.