

# Uncomplicated Diabetes Mellitus in Dogs

## Basics

### OVERVIEW

- Increased levels of glucose (sugar) in the blood (known as “hyperglycemia”) when the dog has been fasted, combined with the presence of glucose (sugar) in the urine (known as “glucosuria”)
- Disorder of carbohydrate, fat, and protein metabolism caused by an absolute or relative insulin deficiency
- The pancreas is an organ of the body, located near the upper small intestine; the pancreas produces insulin to regulate blood sugar
- Diabetes mellitus in dogs generally is characterized by loss of insulin-secreting ability through presumed destruction of pancreatic  $\beta$ -cells by the body's own immune system (that is, it is an autoimmune destruction of the  $\beta$ -cells) and results in a dependence on insulin treatment (also known as “insulin-dependent diabetes mellitus” or “IDDM”)
- Far less frequently, diabetes mellitus in dogs can develop as a result of the combination of a relative insulin deficiency (that is, inadequate insulin secretion) at the same time that the body has a lack of response to insulin (known as “insulin resistance”); this combination of relative insulin deficiency and insulin resistance may result in “insulin-dependent diabetes mellitus” or IDDM; “non-insulin dependent diabetes mellitus” or NIDDM; or both through the course of the disease
- Insulin-dependent diabetes mellitus or IDDM patients are prone to developing diabetic ketoacidosis (condition in which levels of acid are increased in the blood due to the presence of ketone bodies secondary to diabetes)
- Non-insulin dependent diabetes mellitus or NIDDM patients may respond to treatment with medications administered by mouth to decrease blood glucose (known as “oral hypoglycemic agents”); dogs treated with oral hypoglycemic agents must be monitored very carefully as diabetes mellitus in dogs generally is a progressive disease
- “Uncomplicated” diabetes mellitus is a designation that indicates the dog has diabetes mellitus, but does not have secondary problems (such as ketoacidosis, vomiting, or diarrhea) that makes the dog “more sick” and requires more aggressive treatment
- Diabetes mellitus also is known as “sugar diabetes”



## GENETICS

- Certain breeds have much higher likelihood of developing diabetes mellitus than expected, while other breeds have much lower likelihood than expected; these findings suggest an inherited component in the development of immune-mediated destruction of the pancreatic  $\beta$ -cells

## SIGNALMENT/DESCRIPTION OF PET

### Species

- Dogs

### Breed Predilections

- The Samoyed, Tibetan terrier, Cairn terrier, and golden retriever (in the United States only) are at higher risk than other breeds
- The Keeshond, poodle, dachshund, miniature schnauzer, and beagle possibly are at higher risk than other breeds
- The boxer, German shepherd dog, and golden retriever (in the United Kingdom only) may be at lower risk than other breeds

### Mean Age and Range

- Mean, approximately 8 years of age; range, 4–14 years (excluding rare juvenile form)

### Predominant Sex

- Female

## SIGNS/OBSERVED CHANGES IN THE PET

- Increased urination (known as “polyuria”) and increased thirst (known as “polydipsia”), increased appetite (known as “polyphagia”), and weight loss
- Enlargement of the liver (known as “hepatomegaly”)
- Cataracts—common finding in more long-term (known as “chronic”) cases or in dogs that have had poor control of their diabetes mellitus
- Sluggishness (lethargy), depression, decreased appetite (inappetance), lack of appetite (known as “anorexia”), and vomiting may occur in pets with marked ketoacidosis (a condition in which levels of acid are increased in the blood due to the presence of ketone bodies secondary to diabetes)

## CAUSES

- Immune-mediated pancreatic  $\beta$ -cell destruction
- Various disorders that could lead to secondary immune-mediated destruction of pancreatic  $\beta$ -cell destruction, such as inflammation of the pancreas (known as “pancreatitis”) or various viral diseases

## RISK FACTORS

- Diestrus (time period following the end of standing heat [when the female is receptive to breeding] and when the female hormone, progesterone, is being secreted by the yellow body of the ovary) in the female dog (known as a “bitch”)
- Genetic susceptibility to immune-mediated isletitis
- Medications (such as steroids and progestins [substances capable of producing the effects of the female hormone, progesterone])

## Treatment

### HEALTH CARE

- Most dogs with uncomplicated diabetes mellitus can be managed as outpatients; they are alert, hydrated, and eating and drinking without vomiting
- General management of the stable diabetic patient is best achieved through regular interaction between the owner and trained veterinary nursing staff
- Fluid therapy may be needed in some cases

### ACTIVITY

- Strenuous activity may lower insulin requirements
- Consistent amount of activity each day is helpful

## DIET

- The most important principle when feeding a diabetic dog is the diet **MUST BE CONSISTENT**; the dog should consume the same caloric intake morning and night and from day to day; feed a consistent diet that the pet will eat reliably and in a short amount of time The second important principle is to match the glucose-lowering effects of insulin with the glucose-raising effects of the meal; due to the timing of greatest activity of insulin after administration and absorption of food after eating, diabetic control generally is improved if the dog is fed 60–90 minutes **AFTER** insulin dosing
- Diabetic dogs should be fed a diet that provides appropriate calories for the pet's ideal body weight; your pet's veterinarian can provide feeding recommendations
- Obese diabetic dogs—reduce the caloric intake to achieve the desired target, ideal body weight over 2–4 months; a high-fiber, low-calorie diet will help in achieving restricted caloric intake (this type of diet helps in weight control, but has no role in improving diabetic control)
- Feed the pet half its daily food every 12 hours if it is receiving twice-daily insulin injections or medications administered by mouth to decrease blood glucose or sugar (oral hypoglycemic agents); feed pets on once-daily insulin injections their total daily diet divided into two to three meals within the first 6–8 hours after insulin dosing; talk to your pet's veterinarian about feeding and insulin administration daily schedule Those dogs that “graze” throughout the day can be fed free-choice dry food (that is, dry food is available throughout the day) and given two small meals of canned food every 12 hours for pets receiving twice-daily insulin injections or oral hypoglycemic agents; “grazers” on once-daily insulin injections should receive two small meals of canned food within the first 6–8 hours after insulin dosing
- No snacks should be given to the pet, unless the snack has no calories
- Discuss the dietary needs and feeding protocol with your pet's veterinarian

## SURGERY

- Intact females (that is, capable of reproducing) should have their ovaries and uterus removed surgically (known as a “spay” or “ovariohysterectomy”), when stable
- Progesterone (a female hormone) secreted during diestrus (time period following the end of standing heat [when the female is receptive to breeding] and when progesterone is being secreted by the yellow body of the ovary) makes management of diabetes mellitus difficult

## Medications

Medications presented in this section are intended to provide general information about possible treatment. The treatment for a particular condition may evolve as medical advances are made; therefore, the medications should not be considered as all inclusive

- Insulin—required for treatment of insulin-dependent diabetes mellitus; frequently utilized as part of management of non-insulin dependent diabetes mellitus; various types, including Vetsulin® (porcine origin lente insulin); Humulin N®; Novolin N®; PZI VET® (Protamine Zinc Insulin—beef/pork insulin)
- Insulin is administered by injection; your pet's veterinarian will explain proper handling, storage, and administration of insulin
- Glargine and detemir insulins are synthetic insulins; rarely used in canine diabetics
- Oral administration of medications to decrease blood glucose (hypoglycemic agents) generally is not recommended in canine diabetes

## Follow-Up Care

### PATIENT MONITORING

- All diabetic dogs need to be managed with regular contact between the owner and the pet's veterinary team; the pet should be checked every 3–4 months if stable and the signs of diabetes are controlled; more frequent evaluation will be necessary if the pet's diabetes is controlled poorly
- The owner can monitor the degree of excess urination (polyuria) and thirst (polydipsia) as well as the pet's appetite and body weight—if they are within acceptable limits, the diabetes probably is under good control
- Measurement of urine glucose levels is not particularly useful in monitoring diabetes
- Glycated proteins—“fructosamine” or “glycosylated hemoglobin”; glucose binds irreversibly to albumin (a

protein in the blood) producing fructosamine or to hemoglobin (the oxygen-carrying component of the red blood cell) producing glycosylated hemoglobin; extent of binding or glycosylation directly related to blood glucose concentration over lifespan of protein in blood (normally about 10–20 days for fructosamine and 4–8 weeks for hemoglobin); not affected by stress of hospitalization or dietary intake on the day of obtaining blood samples for testing; requires single blood draw, best used for ongoing management of stable diabetic patient

- Glucose curve—can provide information on insulin effectiveness, duration of action, and nadir (that is, the lowest blood glucose level achieved during dosing interval); used most frequently when establishing initial control, changing insulin type, dose, or frequency, or problem solving the diabetic that is difficult to control
- Home-glucose monitoring—using serial blood glucose estimations with home-glucose monitoring kits requires significant owner commitment and compliance; most useful as early indicator of need for reduction in insulin dose in pets with well-controlled signs; should never be used as the sole basis for adjustment of insulin
- The owner should consult with the pet's veterinary team prior to adjusting the insulin dosage; the results of home-glucose monitoring provide useful information for the veterinary team in managing the diabetic pet

## PREVENTIONS AND AVOIDANCE

- Intact females (that is, capable of reproducing) should have their ovaries and uterus removed surgically (known as a “spay” or “ovariohysterectomy”)
- Avoid unnecessary use of megestrol acetate in treating various medical conditions
- Currently no evidence exists to suggest that obesity increases the risk of diabetes mellitus in female and male dogs that have been neutered

## POSSIBLE COMPLICATIONS

- Cataracts can occur, even with good glycemic control of the diabetes
- Weakness, especially with exercise
- Seizures or coma with insulin overdose
- Low red-blood cell count (known as “anemia”) and presence of excessive hemoglobin in the plasma (known as “hemoglobinemia”) with severe low levels of phosphorus in the blood (known as “hypophosphatemia”) are extremely rare complications that are more likely seen in a diabetic ketoacidotic dog; “hemoglobin” is the compound in red-blood cells that carries oxygen to the tissues of the body; “diabetic ketoacidosis” is a condition in which levels of acid are increased in the blood due to the presence of ketone bodies secondary to diabetes

## EXPECTED COURSE AND PROGNOSIS

- Dogs generally have permanent disease, unless diabetes is related to “heat” or “estrous cycle” in female dog (bitch), where surgical removal of the ovaries and uterus may resolve the diabetes for a time
- Prognosis with treatment using twice daily insulin and aligned feedings is excellent

## Key Points

- The most important principle when feeding a diabetic dog is the diet **MUST BE CONSISTENT**; the dog should consume the same caloric intake morning and night and from day to day; feed a consistent diet that the pet will eat reliably and in a short amount of time
- General management of the stable diabetic patient is best achieved through regular interaction between the owner and trained veterinary nursing staff
- Discuss daily feeding and medication schedule, home monitoring, signs of low levels of glucose (sugar) in the blood (known as “hypoglycemia”), and what to do if hypoglycemia develops with your pet's veterinarian
- Understand when it is necessary to call or visit your pet's veterinarian
- Keep a chart of pertinent information about the pet, such as daily insulin dose, attitude, appetite, and weekly body weights