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Poor Glycemic Control in

An 11-year-old, 4.5-kg neutered male Yorkshire terrier with diabetes mellitus was presented for evaluation.

History. The dog had been diagnosed with diabetes mellitus 3 months previously; treatment with porcine lente insulin was begun at an initial dose of 2 U Q 12 H. No dietary modifications were made. Due to unresolved clinical signs, persistent glucosuria, and consistently high blood glucose concentrations (measured at varying times of day), the insulin dose was gradually increased to the present dose of 8 U Q 12 H.

Physical Examination. Physical examination findings included a grade 2/6 left systolic heart murmur, significant dental disease, and a distended urinary bladder. There were no other remarkable findings.

Initial Diagnostics. A CBC, serum biochemical profile (including serum fructosamine concentration), and urinalysis were performed to investigate causes of potential insulin resistance. The CBC results were normal; abnormal results from the serum biochemical profile and urinalysis are provided in the **Table.**

Additional Diagnostics. The high concentrations of glucose in the blood and urine and the high serum fructosamine concentration were taken as evidence of poor glycemic control. Mild increases in serum alkaline phosphatase activity and mild hypercholesterolemia were not considered diagnostically significant. The owner was questioned thoroughly about storage, handling, and administration of insulin; no problems were identified.

▶ Table. Abnormal Laboratory Results

	Result	Reference Range
Serum Biochemical Profile		
Glucose (mg/dL)	468	65–127
Alkaline phosphatase (U/L)	112	12–110
Gamma glutamyltransferase (U/L)	0	1–11
Cholesterol (mg/dL)	346	109–315
Fructosamine (mcmol/L)	685	170–338
Urinalysis (Cystocentesis)		
Glucose (mg/dL)	1000	Negative

a Diabetic Dog

The dog was admitted to the hospital the following day for a blood glucose curve. He was fed his regular food and given 8 U of insulin at 8 am; blood glucose concentrations were measured every 1 or 2 hours for 10 hours. Results are shown in the **Figure.**

Figure. Baseline Blood Glucose Curve
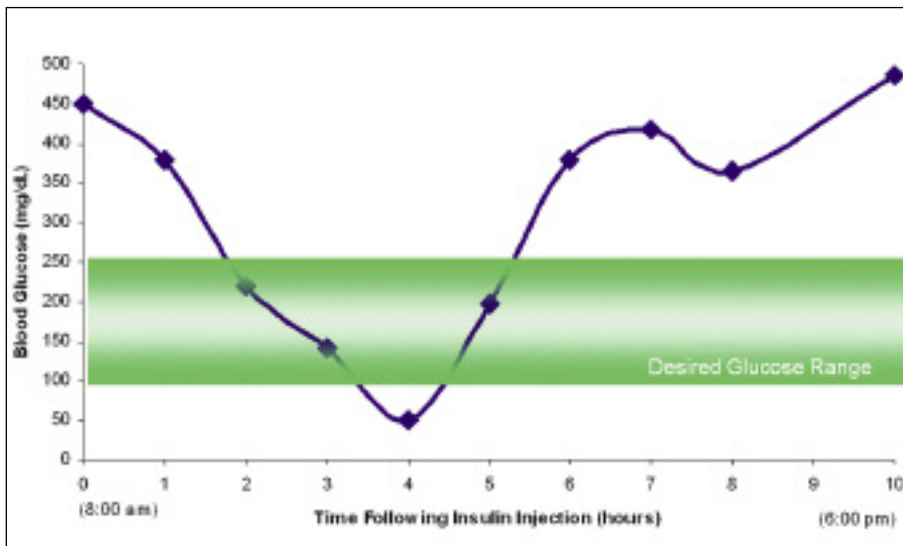
ASK YOURSELF...

On the basis of clinical history, physical examination findings, laboratory analysis, and blood glucose curve results, which of the following is the most sensible course of action?

A. Increase the dose of insulin
B. Change to a longer-acting insulin
C. Decrease the dose of insulin
D. Increase the dosing of insulin to Q 8 H

CONTINUES

CORRECT ANSWER:
C. DECREASE THE DOSE OF INSULIN

This case illustrates a rare occurrence referred to as the Somogyi phenomenon,[1] which is more descriptively termed "insulin-induced hyperglycemia" or "rebound hyperglycemia."

The Somogyi phenomenon is considered rare in human diabetic patients and may occur more commonly in children with undetected nocturnal hypoglycemia. This phenomenon is also considered rare in veterinary patients,[2,3] but the true incidence is unknown, in part because hypoglycemia induced by insulin overdose can be difficult to detect in dogs and cats.

Pathophysiology. Inappropriately high doses of insulin result in hypoglycemia, and the body responds by engaging a system of physiologic mechanisms that causes an exaggerated rebound in blood glucose. This response results in hyperglycemia, which can be interpreted as resistance to insulin. Had the hypoglycemia in this dog not been documented, the persistent clinical signs, hyperglycemia, and glucosuria could have been interpreted as grounds to increase the insulin dose further, thereby worsening the hypoglycemia.

Management. Some experts do not believe the Somogyi phenomenon is relevant to diabetes management, and the routine use of blood glucose curves to guide adjustments in insulin therapy is also controversial. Studies have shown day-to-day variation in responses to equal doses of insulin in diabetic dogs and blood glucose curves do not always yield reliable data on which to base insulin recommendations.[4,5]

Despite the variability seen when dogs are hyperglycemic, however, marked hypoglycemia detected during a curve does tend to be reliable. In this case, decreasing the insulin dose is likely to result in less marked hypoglycemia, thereby eliminating or blunting the hyperglycemic rebound response and leading to better overall glycemic control.

Outcome. For this patient, the dose of insulin was reduced to 4 U Q 12 H (0.9 U/kg). Six weeks later, clinical signs had improved and serum fructosamine concentration had decreased to 440 mcmol/L.

See Aids & Resources, back page, for references and suggested reading.

TAKE-HOME MESSAGES
- Inappropriately high doses of insulin result in hypoglycemia that triggers an exaggerated rebound in blood glucose known as the Somogyi phenomenon.
- Hypoglycemia induced by insulin overdose can be difficult to detect in dogs and cats.
- Use of a blood glucose curve may be helpful in detecting marked hypoglycemia.
- Reducing the insulin dose in these patients blunts the rebound response and produces better overall glycemic control.