

Hypoglycemia in IDDM

A recent article in *Diabetes* contains a summary of the Juvenile Diabetes Foundation workshop on hypoglycemia that was held in November 1988 (1). This study and others relating to the ongoing Diabetes Control and Complications Trials show the increased prevalence of severe hypoglycemia among patients practicing intensive insulin therapy.

This contradicts the experiences of my insulin-dependent diabetes mellitus (IDDM) patients, all of whom are treated with preprandial regular insulin and longer-acting insulins in the morning and at bedtime. Most of these patients describe their lives before intensive therapy as "roller coaster rides," with blood glucose undulating between very high and very low levels. They are usually grateful for the reduced rate of severe hypoglycemia that they now experience.

Why is there such a contrast between our experience and the reports of other investigators? Perhaps a clue lies in a basic principle that I learned when I studied engineering 36 yr ago. For many mechanical and electrical systems, small inputs yield small uncertainty in the outputs, and large inputs cause greater uncertainty or distortion in the outputs. For many IDDM patients, the most significant common inputs, in terms of blood glucose effect, are dietary carbohydrate (CHO) and injected insulin. If both inputs are kept small, the likelihood of wide swings in blood glucose is minimized.

In practice, we try to lower the CHO content of IDDM diets to the point where the basal (long-lasting) and prandial (short-acting) insulin doses approximate the amounts usually produced by nondiabetic patients. For most nonpregnant nonobese adults, this is typically ~5–6 U/insulin dose (2). The amount of CHO that we recommend is typically 6 g for breakfast and 12 g for lunch

and dinner. Enough protein and associated fat is added to each meal to fulfill calorie requirements.

As in studies of non-insulin-dependent diabetes mellitus patients reported from Texas (3) and California (4), we find that reduction of dietary CHO also reduces HbA_{1c}, 24-h urinary glucose, serum triglycerides, cholesterol–high-density lipoprotein ratio, and apolipoprotein B-100–apolipoprotein A-I ratio (5). Furthermore, there is reason to believe that the reduction in periprandial serum insulin levels can independently lower blood pressure and reduce vascular disease risk (6,7).

The purpose of this letter is to suggest that others investigate the effects of low CHO and insulin on the overall well-being of IDDM patients.

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Individualized Goal Setting for Diabetic Control

There is increasing evidence that hyperglycemia is a major cause of complications of diabetes and that achieving normal or near-normal glucose levels (tight control) in diabetic patients will reduce or eliminate these complications. This hypothesis is generally accepted by most diabetologists and is increasingly accepted by primary-care physicians (general internists and family physicians) who treat diabetic patients. Tools such as self-monitoring of blood glucose (SMBG) and glycosylated hemoglobin have clearly shown that "conventional" treatment of diabetes (1 injection of insulin/day, monitoring of urine glucose, and occasional laboratory blood glucose determinations) rarely results in tight control of glucose levels. The quest for normal or near-normal glycemia usually requires frequent and regular monitoring of blood glucose by the patient and multiple doses of insulin or continuous insulin infusion. There must be a committed partnership between patients and health-care professionals that involves a great deal of motivation, education, and support.

Tight control of blood glucose is not appropriate for all diabetic patients. Currently, there are few guidelines for identifying patients who should be encouraged to achieve tight control and how to best prepare those patients. Also, the desirable level of glucose control for patients who are not candidates for tight control is arbitrary. Often, the goal that is set for the patient depends as much or more on the resources available than on what is truly best for the patient. The diabetes specialist, realizing that tight control is a desirable goal and having resources available to help with the hard work of achieving that goal, may start all patients on the road to tight control, with much effort expended working toward a goal of tight control that may be inappropriate or unattainable. Alternatively, the primary-care physician, unclear about the benefits of tight control and unable to meet the needs of the patient to work toward that end, may deprive patients of the opportunity to reach their full potential.

FUNDAMENTAL QUESTIONS

There are several issues that should be considered when deciding the target level of glucose control and the

amount of effort from the patient and health-care professionals to achieve that goal. Before a patient is considered a candidate for tight glucose control, three questions should be asked. First, will tight glucose control benefit this patient? The theoretical benefits of tight glucose control are unlikely for older patients, particularly for patients who have serious underlying diseases. Second, is tight glucose control safe for this patient? The risks of serious sequelae from severe and unsuspected hypoglycemia in a patient who lacks hypoglycemia awareness or has impaired counterregulatory hormone responses almost always outweigh the possibility that tight glucose control will prevent complications. Third, is the patient able to participate actively in treatment? (Does he/she have the financial resources for frequent blood glucose monitoring and the intellectual capacity and motivation to use the information obtained from SMBG to make adjustments in treatment?) Full participation by the patient is imperative for the attainment of tight control.

CANDIDATES FOR TIGHT CONTROL

If the answer to any of the three fundamental questions is no, tight control is not advisable. The target glucose level and the amount of effort expended to reach that target should be determined based on individual circumstances. For these patients, a minimum level of patient effort for monitoring and frequency of insulin injections should be instituted to determine whether a satisfactory glucose level results. Almost all patients should be taught to perform SMBG, and most patients will accept and benefit from more than one daily injection of insulin. Compared with conventional treatment, this compromise is sometimes surprisingly easy; reasonable glucose control can often be achieved by the use of premixed insulins and a light schedule of SMBG, reinforced by fructosamine or glycosylated hemoglobin determinations, in conjunction with periodic visits to health-care professionals.

Patients who answer "yes" to the three fundamental questions should be strongly considered for tight glucose control. At this juncture, it is advisable to determine the best level of glucose control that the patient can accomplish with maximal effort. This requires a team effort, with a program to provide knowledge to the patient and to ensure that the patient uses their knowledge to best advantage.

The best glucose level that can be achieved for an individual patient is determined by 1) the patient's biochemical milieu (some patients are truly brittle and cannot achieve tight control despite all efforts), 2) the patient's motivation, 3) the patient's knowledge of diabetes management, and 4) proper application of that knowledge. While the best possible level of glucose control is being sought, the patient should be encouraged to focus on control of their diabetes as a primary goal and to put aside other major life issues temporarily.