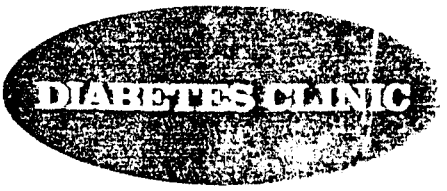

Recent Revisions in Dietary Recommendations to Diabetic Patients

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Dietary considerations are an important component of management of both insulin-dependent and non-insulin-dependent diabetes mellitus. Significant changes in dietary recommendations for the diabetic have recently been made based on findings of clinical research, which suggest that the traditional dietary recommendations are outmoded. Food-particle size, viscosity, and other factors that affect the rate of assimilation of glucose are among those factors that have influenced changes in dietary recommendations. In this article, the author reviews recent provisions in dietary recommendations, the basis for them, and how they can be used in a program of dietary modification for the diabetic patient.

DIABETES HETEROGENEITY AND NUTRITIONAL MANAGEMENT

Most diabetics (more than 95 percent[1]) in developed and developing countries do not need insulin to prevent acute diabetic complications and can therefore be regarded as having non-insulin-dependent diabetes mellitus (NIDDM). In developed countries, such diabetics are now classified according to World Health Organization (WHO) criteria as type II, of whom most are obese (80 to 90 percent) and the remainder are lean. Patients with insulin-dependent, or type I, diabetes mellitus (IDDM) actually constitute a minority of diabetics, and yet much thinking about nutritional management is based on IDDM.

Despite the heterogeneity of diabetes, from a management point of view, grouping into NIDDM, IDDM, and alcohol-induced diabetes is useful. With NIDDM, management depends on attention to food intake, physical inactivity, and emotional stress, all of which influence blood glucose, and on the use of oral medication (sulfonylureas and biguanides). To make the best use of available endogenous insulin is to stave off the need for exogenous insulin.

In IDDM, insulin is necessary, and optimization of insulin sensitivity is not as critical for blood-glucose control. Provided several insulin peaks can be generated over 24 hours (by multiple injections and the use of insulins of different duration of action), insulin dosage can be tailored to a variety of different meal

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patterns. These might include a range of macronutrients or a variety of distributions of energy intake throughout the day, such as larger or smaller breakfasts or evening meals. Above all, it means that general nutritional considerations, such as nutritional adequacy, can be managed first, and control of blood glucose can then be treated by adjusting insulin dosage.

When diabetes is alcohol-induced, avoidance of alcohol in order to prevent further pancreatic and hepatic damage is important if insulin dependence is to be avoided. Otherwise, modest alcohol consumption (an average of one to two standard drinks per day and with meals) can be included in the diabetic diet.

For all diabetics, regardless of type, the hallmark of their food-intake pattern is its regularity.

Much of the revision of thinking about nutritional management of diabetes is occurring in Western countries,[2] and it should not be presumed that these approaches can be extrapolated to developing countries. Indeed, we already know that Asian communities have a relatively greater contribution to energy intake from carbohydrate (60 to 80 percent), of the order now thought desirable by Western diabetologists. We may also need to be realistic about the extent to which diet alone can improve blood-glucose control.

INDIVIDUALIZATION

Loss of physiological reserve, in the way insulin secretion and peripheral action relate to a glucose load, is intrinsic to NIDDM. Nevertheless, this does not mean dietary inflexibility, as evidenced by the clinical experience of patient-determined changes in food intake without significant change in blood-glucose control and by unavoidable retention of different cultural food patterns in multicultural societies, such as the United States and Australia, but with similar levels of control from diabetics of one culture to diabetics of another culture.

Factors that make individualization of nutritional management inevitable include variations in level of physical activity and differences in cultural, social, and economic background. When risk-factor profiles for chronic complications of diabetes are synergistic with hyperglycemia, greater attention to nutritional management of the hyperglycemia will be necessary.

The method of instruction about nutritional management will also depend on the patient's educational background. Even in countries with compulsory education, degrees of print literacy vary greatly.

Given the considerable need for individualization, it would seem preferable not to prescribe diets, but rather to elicit the food-intake pattern of the individual and modify it step by step. Greater collaboration between health professionals and patient can be expected in this way.

NUTRITIONAL PRIORITIES

Good clinical management almost always involves the weighing of risk-benefit ratios and assignment of priorities. Nutritional management is no exception and includes such considerations as (1) the adequacy of essential-nutrient intake; (2) weight control; (3) maintenance of as near-normal blood glucose as possible; (4) minimization of risk factors for macrovascular disease; and (5) the sociocultural role of food. The nutritional management of blood glucose itself is multifaceted (Table I).

Each macronutrient can have its own effects on blood glucose, whereas, in the past, the focus has been exclusively on carbohydrate composition. It has been presumed that a knowledge of the carbohydrate content of a food would allow prediction of blood-glucose response. In fact, the way in which carbohydrate behaves depends on the proportion of energy contributed by it,[3] absolute amount of carbohydrate,[4] monomeric components, such as glucose, fructose, and galactose,[5] food preparation,[6,7] relation to other nutrients,[8-10] the time course of change in relative contribution of carbohydrate to energy intake,[3] and the frequency of ingestion of carbohydrate.

It is thus clear that from the standpoint of

TABLE I

NUTRITIONAL MANAGEMENT OF BLOOD GLUCOSE

Macronutrient Considerations

Carbohydrate
- Percentage energy
- Chain length
- Monomeric components
- Food preparation
- Relation to other nutrients
- Time course of change in carbohydrate intake
- Quantity of carbohydrate
- Frequency of ingestion

Fat
Protein
Ethanol
Dietary Fiber

Micronutrient Considerations

Vitamin B_6
Dehydroascorbic acid[20]
Zinc
Chromium

Food Toxins

Ethanol
Microorganism (e.g., streptozotocin)
Cyanogenetic glycosides (e.g., cassava)

carbohydrate alone, it would be necessary to know, for example, the proportions of glucose, fructose, and galactose, the particle size of the food, and its viscosity. These factors and others will affect the rate of assimilation of glucose and its rate of increase and decrease in the blood after a meal. One factor that does not appear to be important (provided exocrine pancreatic function is intact) is the chain length of the carbohydrate.[11] Insulin sensitivity is also influenced by the background carbohydrate intake, whether low or high, and it is therefore not enough to know the acute effects of a particular carbohydrate load. Changing insulin sensitivity evolves over days and weeks. Nevertheless, at a given insulin sensitivity, where, in NIDDM, insulin secretion cannot match the glucose load, the greater the dose of administered carbohydrate, the greater the increase in blood glucose. Therefore, although it can be said that a higher proportion of energy from carbohydrate will lead to greater insulin sensitivity, on a particular occasion a greater carbohydrate load will lead to a relatively greater blood glucose concentration. The way to cope with this problem is to encourage the ingestion of carbohydrate in smaller quantities throughout the day.

The "glycemic index"[5] has been developed to allow a food rather than a carbohydrate macronutrient approach to nutritional management of diabetes. It is an advance on former thinking, inasmuch as it considers the effect of a food or meal on blood glucose, but it does not allow for the evolution of changing assimilation of carbohydrate or of insulin sensitivity with time, nor does it allow for other nutritional consequences of the intake of that food or meal.

The acute effects of fat in delaying gastric emptying[12] (and therefore blood-glucose

TABLE II

NUTRITIONAL MANAGEMENT OF RISK FACTORS FOR MACROVASCULAR DISEASE

Hyperglycemia
Hyperinsulinemia
Hyperlipidemia
Hypertension (sodium, potassium, magnesium, energy, ethanol, fat, dietary fiber)
Free fatty acids
Platelet function
Coagulation factors

response[13,14]) have been known for a long time. The longer-term effects of an increase in fat intake through relative hyperinsulinemia,[15,16] however, need closer scrutiny. Moreover, the quality of the fat (whether it is polyunsaturated and whether the essential fatty acids are of the $omega_3$ or $omega_6$ series) may also be important in the determination glucose tolerance.

It may well be that an increase in carbohydrate contribution to energy is not the only way to improve blood-glucose control. Some evidence now suggests that a higher protein intake may also assist blood-glucose control.[16-19] The difficulty with these studies is that for Japanese and for Aboriginal Australians, for example, an increase in protein intake may be accompanied by a change in the quality of fat toward $omega_3$ fatty acids, in contrast to the increase in saturated fat intake that generally accompanies an increase in protein intake in European developed societies.

The effects of ethanol increasing the likelihood of hypoglycemia through a reduction in gluconeogenesis are well known. Carbohydrate, which accompanies the ingestion of ethanol, will modify the blood-glucose response. It is for this reason that the use of ethanol by diabetics is generally recommended in moderation and with meals.

Dietary fiber in isolation and used in pharmacological doses undoubtedly can have a favorable effect on the blood-glucose response following a carbohydrate load. Some doubt does exist, however, about the extent to which these effects of dietary fiber can be realized acutely when it comes in food.[20] Nevertheless, the longer-term effects of changes in dietary-fiber intake may allow lower insulin responses.[21,22]

It seems likely that some micronutrients can also modify blood glucose. For example, in gestational diabetes, vitamin B_6 has been shown to improve control.[23] Dehydroascorbic acid, derived from ascorbic acid, may actually impair glucose tolerance.[24] In malnutrition diabetes, zinc deficiency and chromium deficiency may be contributory.[25,26]

Among those food toxins that may adversely affect blood-glucose control are ethanol, because abuse may lead to pancreatic damage; toxic products of soil microorganisms, such as streptozotocin; and cyanogenetic glycosides derived from cassava.[27]

The nutritional management of risk factors for macrovascular disease must be considered in its own right (Table II). Although it is clear that hyperglycemia (even as impaired glucose tolerance short of definite diabetes mellitus by WHO criteria) constitutes a risk factor for macrovascular disease, it is not certain that this represents a cause-and-effect relationship.[28] Often this hyperglycemia will be accompanied by hyperinsulinemia, and evidence exists that this may be important independently.[29-33] Hypercholesterolemia, hypertriglyceridemia, and low concentrations of high-density-lipoprotein (HDL) cholesterol also require nutritional management.[34-37]

Numerous nutritional factors now appear to be important in the management of, at least, mild hypertension.[38-51] Elevation of free fatty acids in their own right may also be important.[52] Platelet function and coagulation factors can also be influenced by diet.[34,53,54]

NUTRITIONAL-MANAGEMENT ORIENTATION

It should now be clear that for the overall nutritional management of the diabetic, and even for the management of blood glucose alone, it is insufficient to take a nutrient or even a food or meal orientation. It is necessary to bear in mind the overall food-intake pattern.

NUTRITION AND OTHER METHODS OF MANAGEMENT

For NIDDM, it seems likely that regular physical exercise will be as important (or at least the corollary of) nutritional management.[55] This is because appetite is more appropriate with a greater level of physical activity, excess adiposity is better controlled, muscle mass is preserved, and insulin sparing is achieved.

Those involved in the management of diabetes are also well aware that situations of emotional stress not uncommonly lead to elevations in blood glucose, and these should not be confused with the effects of diet. Nevertheless, it must also be said that at times of emotional stress, attention to diet may be less good.

Insofar as improvement of control through nutritional means, physical exercise, and stress management decreases the use of oral agents, this would appear a good thing. There is no certainty that oral agents will improve life expectancy or decrease complication rates. What they do accomplish is a reduction in blood glucose, glycosuria, osmotic diuresis, and associated polyuria and polydipsia. For the elderly, nutritional management is preferred to oral agents, because adverse drug effects are more common in this age group. Oral agents also interact with other medications, such as warfarin. In those who abuse alcohol, significant interactions between oral agents and alcohol occur. It so happens that the emphasis on foods high in carbohydrate and dietary fiber (currently practiced by diabetologists in developed countries) attends also to the problem of the adequacy of essential-nutrient intake and the reduction in risk for atherosclerotic vascular disease. To this extent, the currently advocated nutritional management of diabetes corresponds to the prudent diet recommended for the population at large. This, however, does not preclude subtle therapeutic manipulation of the diabetic diet, with further improvement in blood-glucose control, which should be possible as a greater understanding develops in relation to food-intake patterns and overall diabetic control. In the meantime, with blood-glucose monitoring more accessible, exploration of different dietary alternatives in the individual diabetic should allow considerable progress in the nutritional management of diabetes.

CONCLUSION

Diabetes represents a heterogeneous group of conditions but management requires particular emphasis on nutritional optimization of carbohydrate control. Nevertheless, the first nutritional priority is that essential-nutrient intake be adequate, and the second is that the desirable weight-for-height relationship be achieved and maintained.

Nutritional modification of risk factors (other than hyperglycemia) for macrovascular disease in diabetes—putative hyperinsulinemia, hyperlipidemia, hypertension, elevated free-fatty-acid concentrations, platelet function, and coagulation factors—is also necessary. The nutritional management of blood glucose requires attention to total macronutrient and micronutrient composition. As far as carbohydrate is concerned, it is not simply percentage contribution to energy but also absolute amount of carbohydrate, monomeric components, physical changes brought about by food preparation, relation to other nutrients, frequency of consumption, background food intake, and rapidity of any change in food intake. Pharmacological effects of dietary fiber may be different from the effects of fiber naturally occurring in food, and dietary fiber may serve as a useful marker for desirable food in the diabetic diet, regardless of intrinsic activity. Improvement in blood-glucose control may be achieved not only through an increase in high-carbohydrate and high-di-

etary-fiber food intake but also through a reduction in relative fat intake, alteration in quality of ingested fat, or relative increase in protein intake. In the final analysis, nutritional advice on food-intake pattern, rather than on nutrient, food, or even meal orientation, is necessary for the diabetic. Above all, change must be effected within the individual's food culture, and exercise should be encouraged for nutritional flexibility. •

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