

## Nutrition and Diabetes

### 1. What are the symptoms of diabetes mellitus?

General: always tired, polyuria, sudden wt. loss (Type 1), wounds won't heal, polyphagia, blurry vision, tingling in hands or feet, polydipsia

Type 1: hyperglycemia  
excessive thirst

freq. urination  
significant weight loss  
electrolyte disturbances.

Type 2: hyperglycemia  
excessive thirst

freq. urination  
weight loss  
polyphagia

### 2. What are the metabolic and physiological impacts of insulin, glucagon, and what happens if there is excess or deficiency of either of these hormones?

**Insulin** - a hormone released from the beta cells of the pancreas that enables cells to metabolize and store glucose and other fuels. Persons with diabetes have bodies that do not produce or respond to insulin, a hormone necessary for the use or storage of body fuels. Without effective insulin, hyperglycemia (excessive glucose in blood) occurs, which can lead to both the ST and LT complications of DM. Insulin is both anticatabolic and anabolic and facilitates cellular transport.

**Glucagon** - a hormone, produced by the alpha cells of the pancreas, which causes an increase in blood glucose levels by stimulating the release of glucose from liver glycogen stores. In general, the counter-regulatory hormones (glucagon, growth hormone, cortisol, epinephrine, and norepinephrine) have the opposite effect of insulin.

### 3. What are the major components of the management of diabetes mellitus?

The management of diabetes includes **MNT, medications, exercise, blood glucose monitoring, and self-management education**. An important goal of treatment is to provide the individual with the necessary tools to achieve the best possible glycemic control to prevent, delay, or arrest the microvascular and macrovascular complications of diabetes while minimizing hypoglycemia and excess weight gain.

### 4. What is the DCCT and what is the significance of this?

Diabetes Control and Complications Trial (DCCT) - a 10-year study (ended in '93), sponsored by the National Institutes of Health, in which more than 1400 people with Type 1 diabetes were treated with either conventional therapy (usually, two insulin injections per day) or intensive therapy (multiple insulin injections or an insulin pump); follow-up evaluations proved that tight blood glucose control reduces the risk of diabetic complications. Decreased risk of complications by 70% if blood glucose as near normal as possible.

### 5. What are the goals of medical nutrition therapy for diabetes mellitus?

The overall goal is to assist individuals with diabetes to make necessary life-style changes that lead to desired metabolic outcomes, not just increased knowledge.

- Maintenance of as near-normal blood glucose levels as possible.

- Achievement of optimal lipid levels.
- Provision of adequate calories
  - For maintaining or attaining reasonable weight for adults.
  - For normal growth and development in children & adolescents.
  - For meeting pregnancy and lactation needs.
  - For recovery from catabolic illness.
- Prevention and treatment of the acute complications of insulin-treated diabetes.
  - Hypoglycemia
  - ST illnesses
  - Exercise-related problems
- Prevention and treatment of the LT complications of diabetes
  - Renal disease
  - Autonomic neuropathy/(gastrointestinal)
  - Hypertension
  - Cardiovascular disease
- Improvement of overall health through optimal nutrition.

6. What differences are there in medical nutrition therapy between Type 1 and Type 2 diabetes mellitus?

**Strategies for Nutrition Therapy and Type 1 Diabetes:**

Day-to-day consistency in the timing and amount of food eaten is important for persons receiving conventional insulin therapy (i.e., two injections of insulin per day). It is recommended that individuals (1) eat at consistent times synchronized with the action of insulin; (2) monitor blood glucose levels; and (3) adjust insulin doses for the amount of food usually eaten and required. People with Type 1 diabetes require insulin injections; thus, they rarely use oral glucose-lowering medications. They can be taught to adjust their premeal insulin doses to compensate for departures from their meal plan, to delay premeal insulin for late meals, and to administer insulin for snacks that are not part of their plan. Even with intensive insulin therapy, consistency in food intake and an individualized meal plan facilitate improved glycemic control.

**Strategies for Nutrition Therapy and Type 2 Diabetes:**

The primary nutrition goals for persons with Type 2 diabetes are to achieve and maintain normal blood glucose and lipid levels. Learning new life-style behaviors and attitudes are essential. Caloric restriction and moderate weight loss (10 to 20 lb) have been shown to improve diabetes control, even if a desirable body weight is not achieved. Weight loss appears to improve glucose uptake, increase insulin sensitivity, and normalize hepatic glucose production. Weight loss may be most beneficial soon after Type 2 diabetes is diagnosed, when insulin secretion is still adequate. When calories are restricted, hyperglycemia improves more rapidly than with weight loss. Caloric intake is more important than weight. Emphasis should be on blood glucose control, a nutritionally adequate intake, and moderate restriction (250-500 kcal less than the average daily intake as calculated from nutrition assessment), rather than weight loss. Exercise, behavior modification of eating habits, and psychological support are also important. Other nutrition related strategies include making better food choices, especially reducing fat intake; adequately spacing meals; and spreading nutrient intake throughout the day. Blood glucose monitoring provides the feedback to adjust nutrition and medications.

Frequent follow-up with a dietitian as outlined in nutrition practice guidelines for Type 2 diabetes can provide the problem-solving techniques, encouragement, and support that life-style changes require.

7. How to determine appropriate kcal level of the diet and carbohydrate, protein and fat amounts in the diet of a person with either type of diabetes mellitus? Why might the amounts of the 3 energy nutrients vary from client to client?

- CHO provides 60-79% kcal
- Fiber as gen pop 25-30g
- PRO provides 15-20% kcal
- FAT <30% kcal
- Sat FAT <10% kcal (some recommend <7%)
- Cholesterol <300 mg/d

Diets are individualized. For instance, if obesity and weight loss pre primary concerns, a reduced dietary fat intake should be considered. If LDL cholesterol is the primary concern, the NCEP Step II Diet guidelines should be implemented. If triglyceride and VLDL cholesterol levels are the primary concerns, one approach is a moderate increase in MUFAs, consumption of <10% kcal from sat fats, and moderate CHO intake. Another option is a low-fat, low-calorie diet.

8. What is the affect of different medications used to help control blood glucose in diabetes mellitus? ( insulin and oral hypoglycemic agents)

#### Insulin

- Enables cells to metabolize and store glucose and other fuels.
- Too little insulin ---> hyperglycemia - an excessive amount of glucose in the blood (>180 mg/dL) caused by too little insulin, insulin resistance, or increased food intake; symptoms include frequent urination, increased thirst, and weight loss.
- Too much insulin ---> hypoglycemia (or insulin reaction) - low blood glucose level (<70 mg/dL), which can be caused by the administration of excessive insulin or oral medications, too little food, delayed or missed meals or snacks, increased amounts of exercise or other physical activity, or alcohol intake without food.

#### Sulfonylureas

- Stimulate pancreas to make insulin
- Can result in hypoglycemia
- Do not take with alcohol
- Wt gain
- Orinase, Tolinase
- DiaBeta, Amaryl, Glucotrol

#### Biguanides

- Antihyperglycemic in effect
- Not at risk for hypoglycemia
- Enhances peripheral glucose uptake
- Do not take with alcohol
- Metallic taste

- Glucophage

### Thiazolidinedione

- Helps cells to take in more glucose
- Monitor liver function
- Gain wt.
- Risk of anemia & edema
- Actos
- Avandia

### Meglitinides

- Repaglinide
- Helps pancreas make more insulin right after meals
- Can get hypoglycemia
- Gain wt.

### Alpha-glucosidase inhibitors

- Gas, bloating, diarrhea if dose too high
- Take with first bite or 30 min before meal
- Glyset
- Precose

9. What is the relationship among food intake, blood glucose lowering medication, and exercise in diabetes mellitus and the impact of each on blood glucose control? How does the client with diabetes mellitus juggle all of these to maintain blood glucose as close to normal as possible? What role does the RD play as part of the treatment team?

When the nondiabetic person exercises, insulin levels decline while counterregulatory hormones (primarily glucagon) rise. In this way, increased glucose utilization by the exercising muscle is matched precisely with increased glucose production by the liver. In persons with Type 1 diabetes, the glycemic response to exercise varies depending on overall diabetes control, plasma glucose and insulin levels at the start of exercise, intensity and duration of the exercise, previous food intake, and previous conditioning. An important variable is the level of plasma insulin during and after exercise. Excessive insulin levels can potentiate hypoglycemia because of insulin-enhanced muscle glucose uptake by the exercising muscle. In persons with Type 2 diabetes, blood glucose control can improve with exercise, largely because of decreased insulin resistance and increased insulin sensitivity, which results in increased peripheral use of glucose not only during but also after the activity. Repeated periods of exercise at regular intervals are needed to reduce the glucose intolerance associated with Type 2 diabetes. This exercise-induced enhanced insulin sensitivity occurs without changes in body weight. Exercise also decreases the effects of counterregulatory hormones; this, in turn, reduces the hepatic glucose output, contributing to improved glucose control. Exercise performed later in the day reduces overnight hepatic glucose output and fasting glycemia. Exercise after eating can also be beneficial, reducing postprandial hyperglycemia, which is common in Type 2 diabetes.

Hypoglycemia is a potential problem associated with exercise in persons taking insulin or oral medications. Hyperglycemia and worsening ketosis can result from insulin deficiency if exercise is started when blood glucose levels are higher than 250-300 mg/dL. Exercise of high intensity can also result in hyperglycemia owing to the effects

of counterregulatory hormones. SMBG, both preexercise and postexercise, is the key to safety and understanding how exercise affects diabetes control. Frequent postexercise testing may be especially important. Blood glucose monitoring provides feedback that can be used to guide insulin and carbohydrate adjustments. The choice between increasing carbohydrate or decreasing medication depends on the individual and his or her diabetes management goals. In general, 1 hour of increased exercise requires an additional 15g of CHO, either before or after exercise. It is often necessary to adjust the insulin dosage (moderate decrease in insulin) to prevent hypoglycemia.

Diabetes management is a team effort. Persons with diabetes must be at the center of the team because they have the responsibility for day-to-day management. Dietitians, nurses, physicians, and other health care providers contribute their expertise to developing therapeutic regimens that help the person with diabetes achieve the best metabolic control possible. The goal is to provide the individuals with the knowledge, skills, and motivation to incorporate self-management into their daily life-styles. Nutrition education must be an ongoing component of diabetes care. Continued nutrition education is essential. Successful behavioral change requires comprehensive education, skill development, and motivation. This is best accomplished through a coordinated team effort in which the dietitian must be an active participant.

10. What can lead to diabetic ketoacidosis? What is the metabolic and physiological impact of diabetic ketoacidosis? What are symptoms of diabetic ketoacidosis and how does this relate back to the metabolic and physiological events going on?

Diabetic ketoacidosis (DKA) - severe, uncontrolled diabetes, resulting from insufficient insulin, in which ketone bodies (acids) build up in the blood; if left untreated (with immediate administration of insulin and fluids), can lead to coma and even death. Hyperglycemia can lead to diabetic ketoacidosis, a life-threatening but reversible complication characterized by severe disturbances in carbohydrate, protein, and fat metabolism. DKA is always the result of inadequate insulin for glucose utilization. As a result, the body depends on fat for energy, and ketones are formed. Acidosis results from increased production and decreased utilization of acetoacetic acid and 3-beta-hydroxybutyric acid from fatty acids. These ketones spill into the urine, hence the reliance on urine testing for ketones. DKA is characterized by elevated blood glucose levels (>250 mg/dL) and the presence of ketones in the blood and urine. Symptoms include polyuria, polydipsia, hyperventilation, dehydration, the fruity odor of ketones, and fatigue. SMBG, testing for urine ketones, and medical intervention can all help prevent DKA. If left untreated, DKA can lead to coma and death. Treatment includes supplemental insulin, fluid and electrolyte replacement, and medical monitoring. Acute illnesses, such as flu, colds, vomiting, and diarrhea, if not managed appropriately, can lead to the development of DKA. Patients need to know the steps to take during acute illness to prevent DKA.

11. What is hypoglycemia? What are the symptoms? What are the recommendations to prevent hypoglycemia? What should the client do when hypoglycemic?

Hypoglycemia (or insulin reaction) - low blood glucose level (usually <70 mg/dL), which can be caused by the administration of excessive insulin or oral medications, too little

food, delayed or missed meals or snacks, increased amounts of exercise, or other physical activity, or alcohol intake without food. Hypoglycemia is a common side effect of insulin therapy. Autonomic symptoms are generally the first signs of mild hypoglycemia, and include shakiness, sweating, palpitations, and hunger. Moderate and advanced hypoglycemic symptoms are related to neuroglycopenia and include headaches, confusion, lack of coordination, blurred vision, anger, seizures, and coma. Common causes of hypoglycemia:

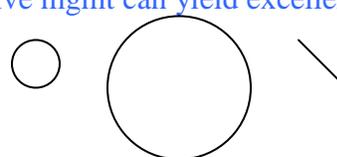
- medication errors
- excess insulin or oral medications
- inadvertent or deliberate errors in insulin doses
- improper timing of insulin in relation to food intake
- intensive insulin therapy
- inadequate food intake
- omitted or inadequate meals or snacks
- delayed meals or snacks
- increased exercise or activity
- unplanned activities
- prolonged duration or increased intensity of use of insulin in relation to food intake
- intensive insulin therapy
- inadequate food intake
- omitted or inadequate meals or snacks
- delayed meals or snacks
- increased exercise or activity
- unplanned activities
- prolonged duration or increased intensity of exercise
- alcohol intake without food

In general, treatment begins with 15g of CHO. Commercially available glucose tablets have the advantage of being premeasured. If patients are unable to swallow, administration of subcutaneous or intramuscular glucagon may be needed. Parents, roommates, and spouses should be taught how to mix, draw up, and administer glucagon for emergency situations. SMBG is essential for prevention and treatment. Changes in insulin injections, eating, exercise schedules, and travel routines warrant increased frequency of monitoring.

12. What are the different meal planning methods used in diabetes mellitus medical nutrition therapy? What method might be better for different clients?

- **Plate Model Approach** - Simplest model. Divide plate into appropriate sections to represent % of meals for CHO, PRO, FAT. Patients with "suboptimal math skills and hectic lives who feel overwhelmed with the reality of day-to-day diabetes management. A frequent complaint is that portion control is too complicated and time consuming." Traditional methods yield tighter control, but few patients are capable of maintaining the required attention to detail in the long run. This plan helps patients make CHO counting and intensive insulin management a workable reality. Simplified intensive mgmt can yield excellent results with much less stress.

1. Identify high CHO foods



2. Generalize portion sizes
  3. Use a visual
- 
- **Food Guide Pyramid/First Step in Diabetes Meal Planning** - general guidelines for meal planning based on FGP to be used for meal planning until an individualized meal plan can be implemented. Emphasizes consistent meal times and coordination with endogenous or exogenous insulin.
  - **ADA Exchange List Method** - Groups foods into lists called exchanges. Each list is a group of measured foods that contribute approximately the same number of calories and the same amount of CHO, PRO, and FAT, therefore foods on each list can be substituted or "exchanged" with other foods on the same list. Persons with diabetes need an individualized meal plan that outlines the number of choices from each list that should be included for each meal and for snacks.
  - **Carbohydrate Counting** - Can be used as a basic meal planning approach or for more intensive management. Several CHO counting educational tools are available, and are based on the concept that, after eating, it is the CHO in foods that is the major predictor of postprandial blood glucose levels. One CHO choice contributes 15g of CHO. Booklets available in three levels of complexity emphasize the relationship of total CHO intake to glycemic control./ Stresses the need for appropriate modifications in activity or medications if CHO intake deviates from the usual meal plan.

### **Implementing Nutritional Self-Management**

1. Assessment and the Nutrition Prescription
2. Behavioral and Medical Goals
3. Implementation and Education
4. Evaluation and Documentation
5. Follow-up and Ongoing Nutritional Therapy