Section 1

Purpose

Section I explains how the glucose enters the cell, hyperglycemia (or high blood sugar), and the three types of diabetes. This information is necessary for individuals

Equipment and Materials Needed

- Reserve the computer lab. You will need one computer for each student.
- Earphones are recommended.

Procedure

- **Before class:** Make sure the computers are functional and the website is open for the students to login.
- **During class:** Use the supplemental content to answer any questions that the students may have about the content.
- **At the end of class:** Help the students successfully log off and answer any queries they may have.

Supplemental Content

A. Why Do Some People Have High Blood Glucose Levels?

Insulin is secreted by the beta cells of the pancreas into the blood in response to rising blood glucose. The main function of insulin is glucose homeostasis, which only happens when the insulin is bound to the cell’s receptor. This in turn stimulates the effect of insulin on the metabolism, storage and use of glucose. Insulin mainly acts on three target tissues the liver, skeletal muscle, and adipose tissue. Insulin promotes the removal of excess circulating glucose into the muscle and adipose tissue. In adipose tissue, glucose is converted to alpha-glycerol phosphate, which is the source of the glycerol for triglyceride synthesis. Most of the glucose is taken up by the liver. When more carbohydrates are eaten than can be used, fatty acid synthesis occurs in the liver cells. The fatty acids are released in lipoproteins and are transported to the adipose tissue for storage. At this time, insulin also inhibits lipoprotein lipase in the adipose tissue to cause a decrease in triglyceride hydrolysis. Insulin response to food is a biphasic one. The first phase is the rapid release of insulin that lasts several minutes. The second phase is a prolonged one, in which insulin is released steadily, until the blood glucose levels return to a normal level.

In obese individuals, the insulin levels are higher than normal, which predisposes them to insulin resistance and development of Type 2 diabetes. There are many causes of insulin resistance, which include a genetic defect in insulin receptors, a decreased number of insulin receptors, a lack of substrates to make insulin, a
decrease in the number of glucose transporters, or impaired insulin clearance from the bloodstream. Declining beta cell insulin secretion and insulin resistance lead to hyperglycemia of Type 2 diabetes.

B. What Is Diabetes?

The diagnosis of diabetes in children or adults must be made by a blood test. Symptoms of diabetes plus a random (non-fasting) blood glucose level of 200 mg/dl or greater; fasting plasma glucose level of 126 mg/dl or greater; or a 2-hour plasma glucose level of 200 mg/dl or greater during an oral glucose tolerance test are all diagnostic of diabetes. However, these criteria should be repeated on a different day to confirm results (American Diabetes Association, 2005). Recently another test, called the hemoglobin A1c test, is also endorsed by the American Diabetes Association. A hemoglobin A1c test result ≥ 6.5% is diagnostic of diabetes, but should also be confirmed with a repeat test (American Diabetes Association, 2009).

C. The Three Main Types of Diabetes

Although most people think of the two main types of diabetes, type 1 and type 2, gestational diabetes is also common.

Classification of Diabetes

The American Diabetes Association has classified diabetes into four main types: Type 1 diabetes (insulin-dependent diabetes mellitus), Type 2 diabetes (non-insulin-dependent diabetes mellitus), impaired glucose homeostasis, and gestational diabetes mellitus (GDM).

Type 1 Diabetes

In the United States, more than 150,000 children have type 1 diabetes. About 10,000 to 15,000 new cases are diagnosed in children each year (Centers for Disease Control and Prevention, 2005). Type 1 diabetes incidence peaks in children both between 5 and 7 years of age and at puberty (Haller et al, 2005). Environmental triggers seem involved in the autoimmune destruction of the beta cells of the pancreas.

The prevalence of Type 1 diabetes is approximately 5-10% of all known cases of diabetes and approximately 75 percent of individuals develop this disease before 30 years of age. People with Type 1 diabetes produce little or no insulin, and need exogenous insulin to prevent ketoacidosis and death. The symptoms of Type 1 diabetes are polydipsia (excessive thirst), polyuria (excessive urination), hyperglycemia, weight loss, dehydration, electrolyte disturbance, and ketoacidosis. The etiology of Type 1 diabetes is threefold and include genetic predisposition, immunological destruction of the islet beta cells that produce insulin, and insulin deficiency.
Type 2 Diabetes

Type 2 diabetes is a chronic condition that affects the way the body metabolizes sugar (glucose), which is the body’s main source of fuel. In Type 2 diabetes, the body is resistant to the effects of insulin, a hormone that regulates the movement of glucose into your cells, or the body doesn't produce enough insulin to maintain a normal glucose level. Insulin resistance is often thought of as the pre-cursor to Type 2 diabetes.

The prevalence of Type 2 diabetes is 90-95 percent of all cases of diabetes. It mostly occurs in obese people but can occur in non-obese people, especially the elderly. It is more commonly diagnosed after age 30 but can occur at any age. People with Type 2 diabetes have defects in both insulin secretion and action. About 40 percent of the patients will need exogenous insulin to bring their blood sugar levels under control. People with Type 2 diabetes may or may not exhibit the classic symptoms of diabetes (polyphagia-excessive hunger, polydipsia-excessive thirst, polyuria-excessive urination, weight loss) and are not prone to developing diabetic ketoacidosis like Type 1 diabetes. People can remain asymptomatic for years with Type 2 diabetes and then present with diabetic complications including retinopathy, nephropathy, neuropathy, or cardiovascular disease.

Gestational Diabetes

Pregnant women are normally screened for gestational diabetes between the twenty-fourth and twenty-eighth week of pregnancy. The babies of women with gestational diabetes are often larger at birth. This can increase problems at delivery. About four percent of all pregnant women develop gestational diabetes. Gestational diabetes also increases the risk of the mother and child to subsequently develop Type 2 diabetes.

Impaired Glucose Tolerance/Insulin Resistance

This state is considered to be an intermediate between normal glucose homeostasis and diabetes. Impaired glucose tolerance is a risk factor for future diabetes and cardiovascular disease.

Insulin resistance often manifests during puberty, although diagnosis of Type 2 diabetes may occur in later years.

How To Reduce Type 2 Diabetes Risk?

Type 2 diabetes develops as a result of complex interactions between genetic predisposition and environmental factors. The environmental factors can be modified to a certain extent. The risk factors include:

- Family history of diabetes
• Physical inactivity
• Overweight and obesity
• African American, Hispanic, Asian American, or Pacific Islander descent
• Previous abnormal fasting blood glucose or impaired glucose tolerance
• Hypertension
• Blood values for low high density lipoprotein (< 35 mg/dl and/or high triglycerides (< 250 mg/dl)
• History of cardiovascular disease
• Polycystic ovary syndrome
• History of gestational diabetes or delivery of a baby weighing more than nine pounds
• Other clinical symptoms of diabetes, such as acanthosis nigricans that look like brown patchy areas on the skin where skin touches skin (under the arms, and the folds of the neck or groin.

Lifestyle factors, namely diet and physical activity, are modifiable risk factors and should be addressed to decrease the risk for Type 2 diabetes, especially if one or more of the other risk factors are already present.

**Supplemental Activity Online:** Have students visit the Fun Place for games and activities to re-enforce concepts, especially HOT Review 3 for type 1 and type 2 diabetes.

**Supplemental Discussion Offline:** Discuss with students what “risk” means. Having a risk factor does not mean you will get a disease or condition. It means “more likely than if you didn’t have that risk factor”. Have students come up with other risk factors and conditions, such as not wearing a seat belt and being harmed if there is an accident.