

Diabetes Lecture

How would you define Diabetes? Diabetes is a condition where the body has trouble balancing the amount of glucose (sugar) that is in the bloodstream.

The Objectives of this talk is for us to learn the following three things.

1. Understand the regulation of glucose homeostasis between the bloodstream and cells
2. Identify the effects of diabetes on standard glucose regulation
3. Compare and contrast Type 1 and Type 2 diabetes

After a meal, glucose is broken down in the stomach, absorbed by the intestines and distributed all over the body through the bloodstream. Glucose is very important because our bodies use glucose to provide energy to our cells. The problem is, glucose cannot get into our cells on its own. It needs help! That help comes in the form of a hormone called insulin. When there are high levels of glucose in the blood the body sends signals to the pancreas to secrete the hormone, insulin. Insulin helps move glucose from the bloodstream into the cells by functioning as a key that unlocks receptors on the cell. Insulin and glucose travel to cells all over the body. There is a receptor site on the cell membrane for the insulin. When insulin is on that site it opens a channel for glucose so glucose can go into the cell. Insulin is like a key that unlocks a door. Once this happens, glucose molecules are able to enter the cell and provide energy. This reduces blood glucose levels, which causes the pancreas to stop secreting insulin.

Answer the following four questions based on what we just learned.

1. After a meal, what is the primary molecule used to provide energy to the cells of the body?
2. Directly after a meal, do glucose levels increase or decrease?
3. After blood glucose levels rise, what hormone does the pancreas release to reduce blood glucose levels?
4. How does insulin help stabilize blood glucose levels?

Insulin-regulated glucose transport is not the only process that assists the body in reducing blood glucose levels; the liver has a special job- like a “warehouse” for excess glucose. When blood glucose levels are high, the liver also responds by absorbing glucose and packaging the glucose into bundles called glycogen.

Can you think of a time when blood glucose levels decrease in our body’s bloodstream? When a person is between meals or sleeping, the blood glucose drops below standard level. Then, the body signals the pancreas to release the hormone, glucagon. Glucagon converts the glycogen that is stored in the liver back to glucose. Glucose is then released back into the bloodstream to stabilize (increase) blood glucose levels.

Answer the following four questions based on what we just learned.

1. If the cells have enough glucose to provide energy to the body, where are the “extra” glucose molecules stored? Once stored what are they called?
2. During sleep or between meals blood glucose levels drop. What hormone does the pancreas release to increase blood glucose levels?
3. How does glucagon increase blood glucose levels?
4. The newly released glucose enters the bloodstream and signals the release of which hormone?

The three G of diabetes are glucose, glycogen and glucagon.

Glucose is a simple sugar that provides energy to the cells in our bodies.

Glycogen is a long chain of glucose molecules that can be stored in the liver and then released when the glucose levels in the blood are low.

Glucagon is a hormone formed in the pancreas that helps raise blood glucose levels by converting glycogen back to glucose.

Homeostasis is maintained by either insulin or glucagon. Both bring the level of glucose in your blood back to normal range.

Type 1 diabetes, occasionally referenced as insulin-deficient diabetes, is a form of diabetes that results from an autoimmune destruction of the insulin-producing cells of the pancreas. In Type 1 diabetes, the pancreas makes little to no insulin. Do you remember the lock and key analogy? Without

insulin present to un-lock the receptors on the cells, glucose cannot enter the cells to provide energy and glucose builds in the bloodstream. Without insulin-regulated glucose transport, the body must find alternate ways to remove glucose from the blood and stabilize blood glucose levels. Type 1 is usually found in children or young adults. Ten percent of diabetes cases are of this type.

Type 2 diabetes is when the body still produces insulin but may make less than average or there may be a decrease in the number and or the responsiveness to receptors on the cell. Let's revisit our trusty lock and key analogy! In our first example, the body makes limited insulin (the key) and while the insulin molecule matches the insulin receptor on the cell (the lock), allowing glucose to move into the cell; the insufficient amount of insulin reduces the overall rate at which the glucose can enter the cell to provide energy. The glucose molecules build up in the bloodstream as they slowly wait to enter the cell. The second way glucose builds up is a result of insulin that does not accurately match the insulin receptor (the lock). The insulin molecule is simply not a match for the insulin receptor or the insulin receptor has accumulated fat tissues at the receptor site altering the initial shape of receptor. With the second example, even though insulin is present, it cannot be used as effectively as it should; resulting in extremely high levels of glucose and insulin in the blood.

The following is a list of symptoms of diabetes.

1. Frequent urination: People with diabetes have excess sugar (glucose) built up in their blood due to the absence or lack of properly functioning insulin. The kidneys are forced to absorb and filter excess sugar. Glucose is excreted into the urine along with fluids drawn from cell tissues. The constant removal of glucose from the body triggers frequent urination.
2. Excessive thirst: Frequent urination removes essential fluids from the body contributing to excessive thirst in people with diabetes.
3. Extreme hunger: Frequent urination causes diabetics to lose essential calories. Since the body has trouble transporting glucose to the cells for energy, fat cells are often used as a replacement.
4. Tiredness or fatigue: Because the body cannot properly use glucose for energy, people with diabetes often suffer from fatigue. Increased blood glucose levels affect blood thickness and contributes to poor circulation. Poor circulation decreases the rate that the body delivers energy to the cells.
5. Changes in vision: Increased blood glucose levels affect blood viscosity and contributes to poor circulation. The retinal nerve of the eyes degenerate slowly because of the inadequate supply of nutrients to the eyes. This lack of nutrient supply and degeneration leads to blurred vision and occasionally blindness in people with diabetes.
6. Numbness or tingling in hands or feet: When blood vessels are damaged by excess glucose in the blood; they no longer carry enough blood to the extremities to provide essential oxygen and nutrients.
7. Abnormally high frequency of infection and slow healing wounds or sores: Glucose itself is a rich medium which promotes the growth of bacteria and viruses; in fact, it is used in all laboratories as a culture medium to grow bacteria. High blood glucose levels make diabetics prone to a variety of infections throughout the body.

Treatment includes the following four ways.

1. Insulin injections (Type 1 and Type 2). Because the body is not producing a sufficient amount of insulin, people with diabetes inject insulin to help transport glucose to the cells to provide energy. People with type 1 diabetes use insulin to control their blood sugar. Sometimes people with type 2 diabetes need to use insulin, too.
2. Oral Drug Therapy (Type 2). There are many medications available to help people with type 2 diabetes achieve better glucose control. These medications work in many different ways. Some increase insulin production. Some increase the cell's sensitivity to insulin, helping the body to use its own insulin more efficiently. Some help the liver metabolize sugar. Some alter the absorption of sugar. Some newer medications can also alter satiety (how the body feels "full") and can alter other hormones such as glucagon, which also affect how the body uses food.
3. Exercise (Type 1 and Type 2). Exercise can lower glucose levels in the body because cells use more energy when you exercise than when you rest. Whenever you actively use a muscle, you burn both

fatty acids and glucose. During and after periods of activity, your falling glucose level is sensed by the beta cells in your pancreas, and they relax their output of insulin.

4. Controlled diet (Type 1 and Type 2). By closely monitoring food choices, people with diabetes can help regulate the amount of insulin required to break down the food.

Both types have abnormally high levels of glucose in the blood, they both have the same symptoms and both can manage the disease by eating healthy foods, exercising, maintaining a healthy weight and checking blood glucose levels often.

The cause of Type 1 diabetes are an auto-immune disease. This means your own body attacks itself. Cells in the pancreas that produce insulin are destroyed so you can not make insulin or make very little. A patient's habits or behaviors did not contribute to their diagnosis. The following causes may contribute to the development of Type 2 diabetes: Obesity, physical inactivity, family history, race and age.

The following complications can come from diabetes. **EYE Cataracts:** A cataract is a thickening and clouding of the lens of the eye. Doctors think that people with diabetes are more likely to develop cataracts if they have high blood sugar levels over a long period of time. **Diabetic retinopathy** involves changes in the retina, the light-sensitive layer at the back of the eye. These changes happen because of damage or growth problems in the small blood vessels of the retina. A person with diabetes may be able to slow or reverse the damage caused by retinopathy by improving blood sugar control.

Glaucoma: People with diabetes also have a greater chance of getting glaucoma. In this disease, pressure builds up inside the eye, which can decrease blood flow to the retina and optic nerve and damage them. **KIDNEY Diabetic nephropathy:** when blood sugar is high, it can cause damage to the blood vessels in the kidneys, leading to kidney disease. **NERVE Diabetic neuropathy** can affect nerves in many different parts of the body. The most common early symptoms of the condition are numbness, tingling, or sharp pains in the feet or lower legs. If it's not treated, nerve damage can cause a number of problems. **HEART AND BLOOD DISEASE** People with diabetes have a higher risk of developing certain problems with the heart and blood vessels; these are called cardiovascular diseases. Some of these problems include: heart attack (caused by a blockage of the blood vessels supplying blood to the heart), stroke (caused by a blockage of the blood vessels supplying the brain) and blockage of blood vessels in the legs and feet, which can lead to foot ulcers, infections, and even amputation of a toe, foot, or lower leg. **GUM** People with diabetes are more likely than others to develop gum disease (also called periodontal disease) because they may have: more plaque and less saliva (too much plaque on the teeth and not enough saliva can contribute to tooth decay), some loss of collagen (a protein that's in gum tissue) and poor blood circulation in the gums.

If you have a patient that is Pre-Diabetic, what recommendations would you provide to assist them with making healthy lifestyle choices?