Diabetes Mellitus

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Definition

Diabetes mellitus is a condition in which the level of sugar (glucose) in the blood is abnormally high because the body does not release or use the hormone insulin properly.

Introduction

More than 29 million individuals (9.3% of the population) in the United States have diabetes. In 2012 the direct and indirect cost of diabetes to our society was 245 billion dollars (up from 98 billion in 1997)!

Diabetes occurs when the body fails to produce enough insulin to maintain normal blood sugar levels (usually between 70-110 mg/dl) or when cells do not respond normally to insulin. Normally after eating a meal the body absorbs nutrients including sugar, and the blood sugar level rises. This rise stimulates the pancreas to secrete insulin, a hormone whose job it is to allow glucose (a simple sugar) to enter the cells of the body. Glucose is the main fuel for energy metabolism within the cell. Without insulin the sugar remains in the blood stream and the cells literally starve.

There are two main types of diabetes. Type-1 diabetes (also called insulin dependent diabetes or IDDM) accounts for about 10% of the cases of diabetes. It usually presents in childhood. At the present time scientists think that something (maybe a virus or nutritional factor) causes the body’s immune system to permanently destroy the cells in the pancreas that produce insulin. As a result, they produce little or no insulin of their own. Individuals with Type-1 diabetes are completely dependent on injected insulin for their survival.

Type-2 diabetes (also called non-insulin dependent diabetes or NIDDM) accounts for nearly 90% of the cases of diabetes. Type-2 diabetes can present in childhood or adolescence but the risk increases with age and by age 65 years over 26% of the population has diabetes. Obesity is a risk factor. African American, Hispanic and Alaskan/ Native American, and Asian American peoples have an increased risk of developing Type-2 diabetes. In Type-2 diabetes the pancreas continues to produce insulin, but the body develops resistance to the effects of insulin so there is a relative deficiency of the hormone. At least a third of individuals with Type-2 diabetes do not know they have the disease. It can lead to serious complications and is a silent killer. Serious complications of diabetes include:

1. Blindness
2. Kidney Disease
3. Stroke
4. Heart Disease
5. Nerve Disease and Amputations
6. Impotence
7. Increased susceptibility to infections.

Other causes of diabetes include abnormally high levels of corticosteroids, pregnancy (also called gestational diabetes), drugs and poisons.

Symptoms of diabetes are related to the direct effects of high blood sugar levels. Once the blood sugar level rises above 160-180 mg/dl glucose spills into the urine. The kidneys excrete extra water to dilute the sugar in the urine so the volume of urine increases and the individual needs to go to the bathroom more frequently (polyuria.) To make
up for the lost water, the individual develops increased thirst (polydipsia), and to make up for the lost calories develops increased hunger (polyphagia.) Some people may lose weight. Fatigue, dizziness, headaches, blurry vision and infections are common. Untreated Type 1 diabetes can progress rapidly to diabetic ketoacidosis – a condition in which fat breaks down to produce ketones that are used for energy instead of sugar. Ketones make the blood acidic. Signs of diabetic ketoacidosis include deep, rapid breathing, and breath that smells like nail polish remover. It can lead to coma and even death if untreated. It is unusual for people with Type 2 diabetes to develop ketoacidosis. Sometimes if the blood sugar becomes very high (it can even go over 1,000 mg/dl) they may develop a condition called nonketotic (not ketotic) hyperglycemic (very high sugar)-hyperosmolar (high molecular pressure in the blood stream) coma. Signs of this condition are related to severe dehydration and include confusion, drowsiness, and even seizures.

**Diagnosis**

The diagnosis of diabetes is made when the level of glucose in the blood is above the normal levels on two separate occasions. Usually the blood test is drawn in the morning before the person has eaten anything. This is called a fasting blood glucose. A two-hour postprandial glucose test is when the blood sugar level is checked two hours after a meal is eaten that has 75 grams of glucose in it. Sometimes the doctor will order a test called an oral glucose tolerance test. For this test the individual fasts overnight, a blood sample is taken and then the individual drinks a special solution containing a known amount of glucose. More blood samples are taken over the next several hours. Other tests that are sometimes done include insulin levels and hemoglobin A1C.

**Prevention and Treatment**

Medical researchers are actively seeking a strategy for the prevention of Type 1 diabetes. It is known that both genetic and environmental factors play a role in the development of IDDM. Several prevention trials are “in the works” but so far no specific intervention has been shown to be effective.

While no one can change the genes with which one is born, certain environmental factors that increase the risk for the development of Type 2 diabetes can be changed. Diet and exercise are the cornerstones. Type 2 diabetes is associated with obesity, decreased physical activity, high blood pressure and abnormal blood lipid (fat) levels. A sensible diet and daily exercise program is the best way we know to eliminate these risk factors at the present time.

The goal of treatment of diabetes is to maintain blood sugar levels as close to the normal range as possible. Weight control, diet and exercise are important for the treatment of both Type 1 and Type 2 diabetes. A dietitian will be able to outline the best food choices and the best times to eat for each individual with diabetes. In general we recommend that an individual with diabetes not eat too many sweets and limit the amount of saturated fat and cholesterol in the diet. Mealtimes and snacks need to be on a regular schedule.

In Type 1 diabetes the body does not produce insulin, so insulin must be replaced. Usually insulin is injected into the subcutaneous tissue (just below the skin) one or more times a day. Insulin may also be used as a treatment for Type 2 diabetes.

There are four basic types of insulin:

1. Rapid acting insulin (i.e. lispro/Humalog, aspart/Novolog, or glulisine/Apidra) begins to work within 20 minutes of injection but only works for 2-4 hours.
2. Short acting insulin (i.e. Regular) starts to work within 30-60 minutes of injection, peaks at 2-4 hours and may continue to lower blood sugar for as long as 6-8 hours.
3. Intermediate acting insulin (i.e. NPH) starts to work 1-3 hours after injection, peaks in 6-10 hours and lasts for 18-26 hours.
4. Long acting insulin (i.e. insulin glargine/Lantus, detemir/Levemir) begins to work after 2 hours and lasts for about 24 hours.

Deciding which kind of insulin to use and how much to give can be complicated and must be done with the
Everyone with diabetes must have an individual treatment plan in place that addresses:

1. Diet
2. Diabetes medications which may include an insulin regimen
3. Method and schedule of testing blood sugar levels and monitoring treatment
4. Exercise program
5. How to anticipate and manage emergencies.

Not all individuals with Type 2 diabetes require insulin. Many obese diabetics can be treated with diet and exercise alone if they lose weight. However, this can be hard to do. When these methods do not meet the goal, the Primary Care Provider may decide to add an oral hypoglycemic agent to control blood sugar. There are many classes of these medications, each class targets different organ systems responsible for blood sugar control.

1. Sulfonylureas/Secretagogues: Glucotrol, Glipizide, Glimiperide
2. Biguanides: Metformin
3. Alpha-Glucosidase Inhibitors: Precose
4. Thiazolidinediones: Pioglitazone (Actos)
5. DPP4 Inhibitors: Sitagliptin (Januvia), Saxagliptin (Onglyza), Linagliptin (Tradjenta)
6. SGLT2 Inhibitors: Canagliflozin (Invokana), Dapagliflozin (Farxiga), Empagliflozin (Jardiance)
7. Incretin Mimetics: Exenatide (Byetta), Bydureon (once weekly Byetta), Liraglutide (Victoza)
And new ones continue to be in development.

When first-line drug therapy does not meet blood sugar goals, other classes of drugs may be added in combination. When combination therapy is not successful insulin is indicated.

Monitoring Treatment

In the past individuals with diabetes were required to check urines for sugar and ketones. This is not as accurate as checking blood levels and can be very difficult to do for individuals with a developmental disability who cannot always co-operate with obtaining urine samples. Fortunately it is now possible to measure blood sugar very easily at home. A tiny lancet is used to stick the finger. It is nearly painless. A drop of blood is put on a reagent strip. A small, hand held machine is used to read the changes on the test strip and the test result (level of blood sugar) appears on a digital display. Every individual with diabetes should have a treatment plan provided by the physician that describes in detail when blood sugar should be checked. The results should be written down and taken with the individual to physician appointments and to the emergency room everytime.

Emergency Situations – What can go wrong?

Hypoglycemia

The most significant complication of insulin and oral hypoglycemic medication therapy is hypoglycemia. Hypoglycemia (low blood sugar) can result when attempts are made to keep blood sugars under very tight control. It can also occur when an individual takes his/her usual dose of medication and then markedly increases his/her exercise or decreases the amount of food usually eaten. Anything that keeps an individual from eating or keeping down the food that is eaten in combination with antidiabetic drugs can cause hypoglycemia. Gastroenteritis, flu, drug toxicity from other medications, and excess alcohol ingestion are some of the things that can cause this problem.

Symptoms of hypoglycemia include sweating, nervousness, faintness, confusion, fatigue, weakness, headaches, inappropriate behavior, visual problems, inability to concentrate, seizures, and coma.

What to do?

1. If the individual with diabetes is sick check the blood sugar and notify the doctor before giving insulin or...
oral hypoglycemic medication.
2. Always have a source of quick available glucose (sugar) available. Candy, juice, milk, glucose tablets, or water with 1-2 tablespoons of sugar in it are some examples.
3. For individuals who have frequent hypoglycemic episodes the doctor may prescribe Glucagon to keep on hand. Glucagon is a hormone that is also secreted by the pancreas. It is given by injection and can raise blood sugar within 5-15 minutes.
4. Check the individual’s blood glucose. If the level is below 60 mg/dl give the individual sugar or administer glucagon.
5. Notify the individual’s physician.
6. If the individual does not respond by an increase in blood sugar to above 60 mg/dl within 10-15 minutes call 911.

**Diabetic Ketoacidosis (DKA)**

DKA is due to insulin deficiency. It can be the presenting event in Type 1 diabetes. It can be caused by failure of the individual with diabetes to take insulin, infection, illness, trauma or emotional stress. It can be dramatic and life threatening. It is often preceded by one or more days of increased drinking (polydipsia) and urination (polyuria,) plus nausea, vomiting and decreased appetite. Abdominal pain (stomachache) is sometimes acute. Deep, rapid breathing, dehydration, disorientation and coma and even death may occur. The breath may smell like nail polish remover. DKA requires immediate and intensive treatment in the hospital setting.

What to do?

1. Check individual’s treatment plan
2. If you suspect DKA check the blood sugar level so you can give this information to the physician.
3. Notify the individual’s PCP or endocrinologist
4. Go directly to the hospital emergency room
5. If transportation is a problem call 911

**Nonketotic Hyperglycemic Hyperosmolar Syndrome**

This is also called nonketotic hyperosmolar coma but not all individuals actually develop coma. In this syndrome the blood sugar levels are extremely high (600-2400 mg/dl.) It usually occurs in elderly individuals with Type 2 diabetes who are not able to keep up with the fluid losses associated with increased urination (polyuria.) They become severely dehydrated and disoriented. The condition may be associated with steroid, diuretic or Dilantin therapy, infections, or cerebrovascular accidents (CVAs.) Like DKA, this can be a life-threatening situation. It requires immediate and intensive treatment in the hospital setting.

What to do?

1. Check the individual’s treatment plan
2. Check the blood sugar level so you can give this information to the physician
3. Notify the PCP or endocrinologist
4. Proceed directly to the hospital emergency room
5. If transportation is a problem call 911

**Conclusion**

Diabetes mellitus is a condition in which the level of sugar (glucose) in the blood is abnormally high because the body does not release or use the hormone insulin properly. There are two main types of diabetes. Type 1 diabetes (also called insulin-dependent diabetes mellitus or IDDM) is present in individuals who produce little or no insulin and are dependent on insulin treatment for their survival. Type 2 diabetes (also called non-insulin dependent diabetes mellitus or NIDDM) is present in individuals who continue to produce insulin, but the body develops
resistance to the effects of insulin so there is a relative deficiency of the hormone. At least a third of individuals with Type-2 diabetes do not know they have the disease. It can lead to serious complications and is a silent killer. Treatment is available for both forms of the disease. Complications of diabetes can be prevented, delayed or slowed down by maintaining good control of blood sugar levels. Every individual with diabetes should have an individual treatment plan designed by the PCP or endocrinologist that can be implemented by the team. The individual treatment plan should address:

1. Diet
2. Medications and/or insulin regime
3. Method and schedule of testing blood sugar levels and monitoring treatment
4. Exercise program
5. How to anticipate and manage emergencies.

References

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