

Flight Surgeon Notes # 9

DIABETES

History: The role of the pancreas in diabetes was first discovered in 1889 by Joseph von Mering and Oskar Minkowski in dogs that developed diabetes when the pancreas was removed. **Insulin** was discovered by Sir Frederick G Banting, Charles H Best and JJR Macleod at the University of Toronto in 1921. On **11 January 1922** insulin was first used in the treatment of diabetes in a human. On a personal note, I had the privilege of meeting Dr. Best when I began medical school at Northwestern in 1959.

The pancreas is a gland, approximately the size of your hand, located in the abdomen, behind the stomach. It produces **Enzymes** and **Hormones**. **Enzymes** include **Lipases** that combine with bile from the liver to digest fats and fat-soluble vitamins. **Proteases** are enzymes that digest proteins, while **Amylase** is the enzyme that breaks starches down into sugar. **Enzymes** are secreted directly into the digestive system.

In addition to enzymes, the pancreas contains **Hormones**, which are released *into the blood* and carry messages to other parts of your digestive system. **Pancreatic hormones** include:

- **Insulin.** This hormone is made in *beta cells* of the pancreas. *Beta cells* make up about 75% of pancreatic hormone cells. **Insulin** is the hormone that helps your body use sugar for energy. Without enough insulin, sugar levels rise in the blood and you develop **diabetes**.
- **Glucagon.** 20% of the hormone cells are *Alpha cells* that produce **Glucagon**. If the blood sugar gets too low, glucagon helps raise it by sending a message to your liver to release stored sugar.
- **Gastrin** and **Amylin** are also made in the pancreas. **Gastrin** is primarily made in the stomach, but some is made in the pancreas. It stimulates the stomach to make gastric acid. **Amylin** is made in beta cells of the pancreas to help control appetite and stomach emptying.

Insulin is a critical hormone created by the pancreas to regulate the body's metabolism of carbohydrates, fats, and proteins. It controls the amount of glucose in the bloodstream and also helps store glucose in the liver, fat, and muscles. Without proper insulin function, the body can't store glucose in your muscles or liver, nor can it make fat. Instead, the fat breaks down and produces, among other things, keto acids. When the level of keto acids increases, the imbalance can trigger *diabetic ketoacidosis*, a potentially fatal condition.

When a person eats, the blood glucose levels rise, and this leads the person's pancreas to release insulin, so that the sugar can be stored as energy for later use.

Diabetic Types: Pancreatic production of insulin determines whether a person has either **Type 1 Diabetes** or **Type 2 Diabetes**.

Type 1 Diabetes is an autoimmune disease that destroys beta cells and **no insulin** is produced. It can occur at any age and in any race, but commonly occurs in young people. The CDC estimates that 1.6 Americans have it, including 187,000 children and adolescents. Insulin replacement is required for therapy, without which death usually results.

Type 2 Diabetes is the more common form of diabetes. In this form, insulin is not used properly. For some persons, blood sugar levels may be controlled by diet and exercise. Others require oral medications or insulin for control.

Gestational Diabetes is confined to pregnancy and is not discussed here.

No less than any other disease, it is **better not to have Diabetes**. But, with therapy and effort, a relatively normal life is possible.

Diabetes is more than simply “too much sugar!” Life is a flame that requires fuel to keep burning. For the human body, food is the fuel. *Metabolism* is the process of converting food into fuel. **Insulin** is the most critical factor to participate in metabolism. *Diabetes, without insulin, is equivalent to starvation.*

Symptoms and Risk Factors of Diabetes:

The age-old symptoms of Diabetes are 1. **Polyuria** (increased frequency and amount of urination), 2. **Polydipsia** (Increased thirst) and 3. **Polyphagia** (Increased hunger). Other symptoms are weight loss, blurry vision, numbness or tingling in hands or feet, increased fatigue, very dry skin, sores that heal slowly and more infections than usual.

Symptoms of Type 1 Diabetes:

Nausea, vomiting, or stomach pains. Symptoms may develop in a few weeks or months and can be very severe. Type 1 diabetes usually begins in childhood, teen-age years and young adulthood. But, it can occur at any age. **Without insulin therapy, it is fatal.**

Symptoms and Risk Factors of Type 2 Diabetes

The symptoms of **Type 2 Diabetes** often develop over several years and initially may escape notice. Because symptoms can be hard to spot, it’s important to know these and to see your doctor to get your blood sugar tested if you have any of them. You’re at risk for developing type **2 Diabetes** if you:

- Have prediabetes
- Are overweight
- Are 45 years or older
- Have a parent, brother, or sister with type 2 diabetes
- Are physically active less than 3 times a week
- Have ever had gestational diabetes (diabetes during pregnancy) or given birth to a baby who weighed more than 9 pounds
- Are African American, Hispanic/Latino American, American Indian, or Alaska Native (some Pacific Islanders and Asian Americans are also at higher risk)
- If you have non-alcoholic fatty liver disease you may also be at risk for type 2 diabetes.

In **Type 2 Diabetes**, cells don’t respond normally to insulin; this is called *insulin resistance*. To compensate, the pancreas makes more insulin. Eventually the pancreas can’t keep up, and your blood sugar rises, setting the stage for **Prediabetes** and **Type 2 Diabetes**.

Diabetes is an autoimmune disease, no less than Rheumatoid Arthritis and Lupus. As such, it directly and indirectly involves many organs of the body. Involvement of other organ systems is termed **comorbidity**. **Blindness** is a type of comorbidity for diabetes. **Diabetic retinopathy** is the most common cause of blindness in this country.

Several medical studies link 97% of diabetic patients with a **comorbid condition**, while other studies link approximately 90% of diabetics with at least 2 comorbid conditions. **Common comorbid conditions are:**

- Hypertension-82%
- Obesity-78%
- Chronic Kidney Disease-24-25%
- Hyperlipidemia-62%⁺
- Hypertension and Hyperlipidemia-63%
- Hypertension with Cardiovascular Disease-20%⁺
- Obesity-Hypertension-Cardiac Disease-20%⁺

Rarely does diabetes occur in isolation. The comorbid conditions increase with age, just as they increase in non-diabetic patients. Their severity, however, is worse in diabetics. Diabetes causes hardening of the arteries. Cigarette smoking also causes hardening of the arteries. Combining diabetes with cigarettes is a disaster. The mainstays in diabetic therapy are **dietary management** and **exercise**. Diabetic dietary management is a highly specialized field and should be administered by a specialist in Diabetes and/or Endocrinology. Skeletal muscle contains the receptors that interact with insulin. This is why physically conditioning is important. An endocrinologist whom I have consulted for diabetic management routinely treats both men and women with testosterone to build muscle tissue.

Pertinent to questions raised by our Vietnam Veterans is: “What role does *Agent Orange* play in provoking this autoimmune disease?” For a discussion of this, refer to the two following paragraphs:

Veterans with **Type 2 Diabetes** who were exposed to herbicides during service may be eligible for disability compensation and health care. Veterans who served in **Vietnam**, the Korean demilitarized zone or another area where **Agent Orange** was sprayed may be eligible for a free **Agent Orange Registry health exam, May 4, 2016**

The Institute of Medicine of the National Academy of Sciences published a report “**Veterans and Agent Orange: Herbicide/Dioxin Exposure and Type 2 Diabetes**” in 2000. This report, and its 2002 and 2004 updates, found evidence of an association between exposures to herbicides and **Type 2 Diabetes**.

A final word is indicated! Diabetes can be successfully treated. It is a complex disease, with many associated problems, that requires specialized care through a Specialist in Internal Medicine, Diabetologist or Endocrinologist.

Guy S. Clark, M.D., Flight Surgeon

Future columns will note other issues of aging. Suggestions are welcome!