Diabetes Mellitus: Current Understanding and Treatment Alternatives

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Diabetes is a group of metabolic diseases characterized by prolonged high blood glucose. *Diabetes mellitus* is derived from the Greek word *diabetes* meaning "to pass through" and the Latin word *mellitus* meaning "honeyed." It is believed that the term *diabetes* was coined by Greek physician Apollonius of Memphis (circa 250 BC) when he observed excessive urination in patients. The term *mellitus* was added by English physician Thomas Willis in 1675 when he noticed that the urine of diabetic patients had a sweet taste.

Type 1 diabetes, previously called insulin-dependent diabetes, occurs when beta cells, the insulin-producing cells of the pancreas, are destroyed by the immune system. Type 2 diabetes, previously called noninsulin-dependent diabetes, occurs when cells lose their sensitivity to insulin.

If untreated, diabetes can lead to serious conditions such as blindness, heart disease, kidney disease, nerve disease and stroke.

Diagnosed and Undiagnosed Diabetes in the United States, 2012

All Ages
- Total: 29.1 million people or 9.3% of the population have diabetes.
- Diagnosed: 21.0 million people.
- Undiagnosed: 8.1 million people

(27.8% of people with diabetes are undiagnosed.)

By Age
- 20–44: 4.1%
- 45–64: 16.2%
- 65+: 25.9%

By Sex
- Men: 13.6%
- Women: 11.2%

(CDC, 2014)

Epidemiology and medical statistics

Prevalence in the US

As of 2012, 9.3% of the United States population suffered from diabetes. Diabetes in seniors over the age of 65 had a staggering prevalence of 25.9% or 11.2 million people. In people under the age of 20, only 1 in 3 cases of diabetes is type 2 versus 91% encountered in older ages.

When ethnicity is taken into consideration, 7.6% of Non-Hispanic Whites, 9% of Asian Americans, 12% of Hispanics, 13.2% of Non-Hispanic Blacks and 15.9% of American Indians/Alaskan Natives suffer from diabetes.

Based on death certificate data, diabetes was the 7th leading cause of death in the United States in 2010. In 2012, the cost of diabetes including reduced productivity and medical costs was estimated at $245 billion (CDC, 2014).

Pathophysiology

In order to understand diabetes, we first need to understand carbohydrate metabolism and the action of insulin. After the consumption of food, carbohydrates are broken down into glucose molecules in the gastrointestinal (GI) tract which then pass into the bloodstream elevating their concentration in the blood. This glucose rise stimulates the pancreas to secrete insulin from its beta cells. Once secreted, insulin activates glucose transporters that allow glucose to enter cells. Much like a key in a lock, the activation happens through a receptor in the cell membrane that is specific for insulin molecules. Once glucose has entered the cells, dropping its concentration in the blood, insulin secretion is inhibited.

Hormones such as glucagon, catecholamines, growth hormone, thyroid hormones and corticosteroids participate in raising blood glucose. By contrast, insulin is the only hormone known to reduce blood glucose.

Diabetes is a metabolic disease that occurs either because the pancreas doesn't produce enough insulin or the cells fail to properly respond to insulin. Depending on the reason, diabetes is divided in type 1 and type 2.

Type 1 diabetes

Type 1 diabetes is an autoimmune condition with unknown cause, although a viral infection is usually blamed. The immune system attacks and destroys the beta cells of the pancreas halting the production of insulin. The onset is usually before the age of 30. Patients are generally slim to normal weight. The lack of insulin results in the inability of glucose to enter the cells, and cellular energy requirements fail to be met. The starving cells utilize a process called lipolysis to break fats into glycerol which further metabolizes into glucose and fatty acids. The fatty acids metabolize into ketones which in turn drop the metabolic pH. This condition called diabetic ketoacidosis (DKA) is usually the first symptom of type 1 diabetes.

Type 2 diabetes

Type 2 diabetes is vastly different than type 1 diabetes. Autoimmunity is not responsible, and fortunately the beta cells are not destroyed allowing the pancreas to still produce insulin. In addition to genetic factors, type 2 diabetes is caused by obesity, dietary and lifestyle factors, and advanced age. The pathology behind this type is a result of one or a combination of the following factors: peripheral resistance to insulin, altered insulin secretion, and increased production of glucose by the liver. The reason cells become resistant to insulin is quite complex. While not yet fully understood, staggering evidence points toward obesity and a diet rich in simple carbohydrates and fats. When cells become resistant to insulin, the pancreas compensates by increasing insulin production causing hyperinsulinemia. Over time, the secretion of insulin drops to subnormal levels. Because our body is remarkably able to adapt, diabetes can remain undiagnosed for years.

Signs and symptoms of diabetes

Diabetes type 1 and 2 share the same signs which are associated with the inability of glucose to enter the cells: increased thirst (polydipsia), increased hunger (polyphagia) that gets worse after eating, and frequent urination (polyuria). This trio is common to all types of diabetes. Other signs such as slow wound healing, fatigue, headaches, and blurry vision are also very common, but often ignored or misdiagnosed at first.

When high glucose is present in the bloodstream, the kidneys are forced to work excessively in order to filter and absorb it. The capacity for such action however is limited, and excess glucose is secreted in the urine along with water. Polyuria leads to dehydration which triggers a thirst response. Fatigue is also the result of dehydration and the inability of the body to use sugar to produce energy. Weight loss is the result of constant urination as well and the loss of calories through urine. This often manifests in the early stages of diabetes when patients lose weight rapidly. The high concentration of glucose circulating in the bloodstream is also important at a cellular level. The increased osmotic pressure in the extracellular fluids forces water to passively stream from the cells causing inflammation, damage, or even cellular death. Conditions such as diabetic retinopathy, nephropathy and neuropathy are the direct result of this process.

Treating diabetes

The management of diabetes concentrates on keeping blood sugar levels as close to normal as possible. Type 1 diabetes is, of course, treated with insulin injections and in some cases by pancreatic transplantation. Type 2 diabetes is treated with anti-diabetic medications such as Metformin which decrease production of glucose by the liver. Other medications may be used to increase the release of insulin, make cells more sensitive to insulin, or decrease the absorption of sugar from the intestines. Insulin may also be used in type 2 diabetes. Fortunately, a number of medicinal plants have also shown promising results in the management of diabetes. "More than 400 plants and compounds have shown antidiabetic activities *in vitro* and/or *in vivo*" (Chang et al, 2013).

Case study (example)

A 55-year-old man presents with fatigue, chronic headache, chronic thirst, and frequent urination. He has gained 50 pounds over the past year in spite of the fact that he stopped drinking beer when the weight gain started. He admits that he snacks on sugary foods and chips, and drinks one to two liters of soda daily. He works a desk job. He lifts weights once a week and tries to walk once a week, but is otherwise largely inactive. He has a paternal family history of type 2 diabetes. His blood sugar measured 145 six months ago and 150 two weeks ago. His Hemoglobin A1c measures high at 6.8. His total cholesterol is within normal range at 198; however, his HDL cholesterol is mildly elevated at 39. His body mass index (BMI) is 29, and his blood pressure is mildly elevated at 145/95. He currently takes no medications, herbs or supplements. He has refused pharmaceutical treatment and is seeking alternatives.

Analysis

His problem is type 2 diabetes, likely influenced by a genetic component though largely caused by dietary and lifestyle factors. His elevated blood sugar, BMI and blood pressure are increasing his risk for heart disease, stroke and kidney disease.

Treatment

Treatment includes a life-long low-glycemic or other weight-reduction diet and an interval exercise program to promote weight reduction. Botanical support includes anti-diabetic, anti-inflammatory, and hypotensive herbs such as Cinnamon (*Cinnamomum zeylanicum*) (Ranasinghe et al, 2012), Fenugreek (*Trigonella foenum-graecum*) (Neelakantan et al, 2014), Chamomile (*Anthemis nobilis*) (Zhao et al, 2014), Lemon Balm (*Melissa officinalis*) (Weidner et al, 2014), Tarragon (*Artemisia dracunculus*) (Kheterpal et al, 2010), and Geranium (*Pelargonium graveolens*) (Bouhkris et al, 2012). Licorice (*Glycyrrhiza glabra*) herb will be avoided in this case due to his mild hypertension. The client has been directed to keep a journal of his exercise, food intake, blood sugar and blood pressure. He will have a follow-up clinic visit every two months and follow-up labs every three to six months to measure his progress and adjust his treatment plan as needed.

Herbs for diabetes © Avosb/iStock

Follow-up

The client returned for a follow-up at five months. He had been compliant with his tincture blend only having missed an occasional weekend dose. He had cut his soda intake to 12 oz per day and snack foods to one per day. He continued to abstain from beer except for Friday or Saturday nights when he socializes with friends. He had added a leafy green salad and whole fruit smoothie to his daily diet. He had switched from white rice to brown rice 50% of the time, and from white bread to whole grain bread 75% of the time. He was limiting bacon and fried foods to one or two servings each per week. He had added a 30-minute treadmill run twice per week and took a walk around the block on his lunch hour most weekdays. He still lifted weights once per week and agreed to try and increase to twice per week. He had lost 10 pounds (reducing his BMI from 29 to 28). His blood sugar had decreased to 138. His LDL cholesterol had decreased from 39 to 38 bringing it within normal range. His Hemoglobin A1c had decreased from 6.8 to 5.9 (normal range 4–5.6%). His blood pressure had decreased to 143/93. He stated that his symptoms had all decreased approximately 50%. The client was satisfied with his progress. He agreed to continue his tincture blend while continuing dietary and lifestyle improvements. He was advised to schedule a follow-up visit in two months and follow-up laboratory tests in six months.

Herbs that may be useful in the treatment of diabetes	
Cinnamon bark (*Cinnamomum zeylanicum*)	Reduces insulin resistance, anti-inflammatory (Ranasinghe et al, 2012)
Fenugreek seed (*Trigonella foenum-graecum*)	Reduces postprandial glucose levels (Neelakantan et al, 2014)
Chamomile, Roman flower (*Anthemis nobilis*)	Hypoglycemic, anti-inflammatory, hypotensive (Zhao et al, 2014; Zeggwagh et al, 2009)
Lemon Balm leaf (*Melissa officinalis*)	Reduces insulin resistance (Weidner et al, 2014)
Tarragon leaf (*Artemisia dracunculus*)	Anti-diabetic (Kheterpal et al, 2010)
Geranium leaf (*Pelargonium graveolens*)	Anti-diabetic (Boukhris et al, 2012)
Licorice root (*Glycyrrhiza glabra*)	Reduces insulin resistance, anti-inflammatory (Sil et al, 2013)

Sample phytotherapeutic diabetes treatment	
Fenugreek (*Trigonella foenum-graecum*) tincture	80 cc
Chamomile (*Anthemis nobilis*) tincture	80 cc
Lemon Balm (*Melissa officinalis*) tincture	80 cc
Cinnamon bark (*Cinnamomum zeylanicum*) essential oil	*3 cc
Tarragon (*Artemisia dracunculus*) essential oil	*3 cc
Geranium (*Pelargonium graveolens*) essential oil	*3 cc
Blend all of the above together in an 8 oz glass bottle. Shake well before use. Take 2 cc with each three meals diluted in a small glass of water. (*Essential oils for oral use should be highly diluted in an appropriate carrier. The amount of essential oil contained in this tincture blend is approximately 0.375 drops of each oil—1.125 drops total per 2 cc dose.)	
Stress a low glycemic, weight-reduction diet and exercise plan.	
Note: This sample phytotherapeutic treatment is intended to be used under the supervision of a qualified healthcare professional. Optimal results are achieved when treatment plans are customized to each patient.	

Diabetes is an extremely common, disabling, and potentially deadly disease. Increasing public awareness of the signs and symptoms of the disease will greatly increase early diagnosis and treatment resulting in a reduction of premature death and disability. For example, reducing Hemoglobin A1c (a laboratory measure of blood glucose control) by just one percentage point can reduce the risk of eye, kidney and nerve diseases by an impressive 40%. Keeping blood pressure under control can reduce the risk of heart disease and stroke by up to 50%. Reducing LDL ("bad") cholesterol, while increasing HDL ("good") cholesterol, can reduce the risk of cardiovascular events by up to 50% (CDC, 2014). While anti-diabetic medications are sometimes unavoidable, anti-diabetic herbs and essential oils in combination with dietary and lifestyle modifications can be valuable tools in reducing the need for prescription medicines while greatly improving the quality of life for diabetic patients.

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Galega officinalis
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Editor's note

French Lilac (*Galega officinalis*) has been used since the Middle Ages as an herbal remedy for the symptoms of diabetes. The plant contains guanadine compounds that lower blood sugar levels. Guanadine itself is too toxic to be used as a drug, but it inspired chemists to make very similar compounds. One of these is now sold as the diabetes drug Metformin. - Royal Botanic Gardens, Kew