



CERTAIN PATHOLOGIES THAT RESULT IN LONG-TERM (OR "CHRONIC") COMPLICATION FROM DIABETES MELLITUS INCLUDE ULCERATION, INFECTION, NEUROPATHIC

HIGH BLOOD SUGAR (GLUCOSE) INCREASES THE RISK OF EYE PROBLEMS. IN FACT, DIABETES IS THE LEADING CAUSE OF BLINDNESS IN ADULTS AGES 20 TO 74.



A
STEP
INTO



DIABETES

DIABETES HAS BECOME ONE OF THE MAJOR CAUSES OF PREMATURE ILLNESS AND DEATH IN MOST COUNTRIES, MAINLY THROUGH THE INCREASED RISK OF CARDIOVASCULAR DISEASE.



BY
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PATIENTS WITH TYPE 2 DIABETES HAVE INCREASED RISK FOR ACUTE RENAL FAILURE COMPARED WITH PATIENTS WITHOUT DIABETES.



In this installment of our educational series Mr. Mozena distills the epidemiology of diabetes from technical terms down to layman's language providing an easy to understand overview of the disease along with eye-opening statistics regarding the range of the disease and its effects on the lower limb. This article is available for Continuing Education Unit (CEU) credit.

“What spirit is empty and blind, that it cannot recognize the fact that the foot is more noble than the shoe, and skin more beautiful than the garment with which it is clothed.”

—*Michelangelo*¹

“The term ‘diabetes mellitus’ describes a metabolic disorder of multiple etiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both. The effects of diabetes mellitus include long-term damage, dysfunction and failure of various organs.”²

People with diabetes may develop serious complications such as heart disease, stroke, kidney failure, blindness, amputation and premature death.³

“Diabetes comes from Greek, and it means a ‘siphon’. Aretus the Cappadocian, a Greek physician during the second century A.D., named the condition diabainein. He described patients who were passing too much water (polyuria) - like a siphon. The word became ‘diabetes’ from the English adoption of the Medieval Latin diabetes.

In 1675, Thomas Willis added mellitus to the term, although it is commonly referred to simply as diabetes. Mel in Latin means ‘honey’; the urine and blood of people with diabetes has excess glucose, and glucose is sweet like honey. Diabetes mellitus could literally mean ‘siphoning off sweet water’.”⁴

Diabetes is a group of diseases. Four broad categories include Type I, Type II, Gestational Diabetes, and other specific types which are a collection of a few dozen individual causes.⁵ Maturity-onset diabetes of youth, latent autoimmune diabetes in adults, neonatal diabetes mellitus are to name a few.⁶ Type 2 diabetes accounts for around 90% of all diabetes world-wide.⁷

Obesity is a pandemic disease that has increased the incidence and prevalence of diabetes.⁸ “The central nervous system (CNS) plays an important role in the regulation of appetite, energy expenditure, and body weight.” “These responses may have an important role in driving and sustaining energy intake

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To take advantage of the program, thoroughly read the adjacent article, “A Step into Diabetes” and then visit: **www.pedorthics.org** and click on the Continuing Education Opportunities tab to purchase the 10-question quiz associated with this article. CEP quizzes cost \$15 for members and \$25 for non-members. The quizzes are worth 1.0 Scientific or Business CEP, depending on the content. Successful completion of the quiz will result in 1.0 CEP reported directly to ABC and BOC at the end of each quarter.

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over and above pure requirement, contributing to the obesity epidemic.”⁹ Not everyone that is obese acquires diabetes there appears to be a genetic predisposition for diabetes.¹⁰ Type II diabetes starts with insulin resistance but the precise nature of the defects that lead to diabetes are not known.¹¹ Usually Type II diabetes treatment begins with lifestyle changes of diet and exercise and then oral hypoglycemics such as Metformin.

“The pancreas is an abdominal glandular organ, with an digestive (exocrine) and hormonal (endocrine) function. 90% of the pancreas is composed of exocrine cells...”¹² The pancreas secretes pancreatic juice containing digestive enzymes that assist digestion and absorption of nutrients in the small intestine. Digestive enzymes include amylase which aid in carbohydrate digestion, pancreatic lipase that assists in fat digestion and proteases which assist in protein digestion. The pancreas also secretes bicarbonate ions and water that neutralize the acid from the stomach in the small intestine. By volume the overwhelming majority of what the pancreas produces is the digestive pancreatic excretions which are about 1.5L/day.¹³ The endocrine function produces several important hormones, including insulin, glucagon, somatostatin, and pancreatic polypeptide which circulate in the blood. In people who do not have diabetes, the pancreas stores about 200 units of insulin. A 100 units of insulin is 1ml or 1cc in U100. “The average basal rate for adults is one-to-two units per hour. After meals, insulin secretion increases to four-to-six units per hour.”¹⁴ “Approximately 40-50% of the total daily insulin dose is to replace insulin overnight, when you are fasting and between meals. This is called background or basal insulin replacement. The basal or background insulin dose usually is constant from day to day.”¹⁵ “The other 50-60% of the total daily insulin dose is for carbohydrate coverage (food) and high blood sugar correction. This is called the bolus insulin replacement.” A diabetic will often inject a long acting basal dose of insulin and bolus or rapid acting doses. “...1 unit of rapid acting insulin will drop the blood sugar 40-50 mg/dl.”¹⁶ “The American

Diabetes Association suggests the following targets for most nonpregnant adults with diabetes. More or less stringent glycemic goals may be appropriate for each individual.

A1C: 7%

A1C may also be reported as eAG: 154 mg/dl

Before a meal (preprandial plasma glucose): 70–130 mg/dl

1-2 hours after beginning of the meal (postprandial plasma glucose)*: Less than 180 mg/dl”¹⁷

“Definition: The A1c test (also known as HbA1c, glycated hemoglobin or glycosylated hemoglobin) is a blood test that correlates with a person’s average blood glucose level over a span of a few months. The A1c test measures how much glucose is stuck to your hemoglobin, or more specifically, what percent of hemoglobin proteins are attached to glucose. So if you have a 7% A1c, that means that 7% of your hemoglobin proteins are glycated.”¹⁸

“The eAG test is actually not a test. It is another way of referring to the HbA1c or A1c test. The term eAG stands for estimated Average Glucose. The American Diabetes Association has recommended the term as a way for physicians to provide HbA1c results in units that patients are more familiar with. The eAG units correspond more closely to readings provided via self-monitoring by at-home glucometers.”¹⁹

FACTS AND STATS ABOUT DIABETES INCLUDE:

- 29.1 million people in the US have diabetes or about 9.3% of the population.
- 13.6% of men and 11.2% of women over the age of 20 years have diabetes.
- Ethnicity and diabetes – the highest percentages a diabetics are seen in American Indians & Alaska Natives, then Non-Hispanic blacks, then Hispanics, then Asian Americans, then Non-Hispanic whites.

- In 2010 there were about 73,000 non-traumatic lower-limb amputations in the US with about 60% occurring in diagnosed diabetics over 20 years of age.
- 2012 estimated cost of diabetes in the US is 245 billion dollars with 176 billion dollars as direct medical costs.²⁰
- Diabetes is the 7th leading cause death and it is probably underreported.
- Lifetime chance of developing a foot ulcer is from 15% to 75%.
- Ulcer recurrence rate over 5 years is 50% to 70%.
- A foot ulcer precedes lower limb amputation 85% of cases.
- The one year amputation of foot ulcer diabetics is 15%.
- The presence of diabetes increases the risk of non-traumatic amputation; 20x.
- Lower limb loss is associated with a 50% 5 year mortality rate.²¹
- People with diabetes have a greater risk of depression than people without diabetes.²²
- Depression is more than three-times higher in people with type 1 diabetes and nearly twice as high in people with type 2 diabetes.²³
- African-Americans are up to four times more likely to have an amputation than white Americans.²⁴
- Every 20 seconds a lower limb is lost to diabetes somewhere in the world.
- Every 7 minutes a limb is lost in the USA.²⁵
- About half of lower limb amputees are unable to utilize their prosthesis.²⁶
- Diabetes has become one of the major causes of premature illness and death in most

countries, mainly through the increased risk of cardiovascular disease(CVD).²⁷

The stages of the diabetic have been described as the normal foot, the high risk foot, the ulcerated foot, the infected foot, the necrotic foot, the unsalvageable foot.²⁸ An effort has been made to reduce ulcerations and amputations by addressing risk factors. The following risk factors are noted for diabetic foot ulceration, plantar foot ulcer recurrence in neuropathic diabetic patients, diabetic foot infection and diabetic amputation.

RISK FACTORS FOR DIABETIC FOOT ULCERATION

Uncontrolled hyperglycemia
 Duration of Diabetes
 Peripheral Vascular disease
 Blindness or visual loss
 Chronic renal disease
 Older age

Peripheral neuropathy
 Structural foot deformity
 Trauma and improperly fitted shoes
 Callus
 History of prior ulcer/amputation
 Prolonged elevated pressures
 Limited joint motions²⁹

RISK FACTORS FOR PLANTAR FOOT ULCER RECURRENCE IN NEUROPATHIC DIABETIC PATIENTS

Unrecognized repetitive trauma
 Presence of minor lesions
 In-shoe peak pressure <200 kPa with footwear adherence >80% Barefoot peak pressure
 Day-to-day variation in stride count.

“The presence of a minor lesion was clearly the strongest predictor, while recommended use of adequately offloading footwear was a strong protector against ulcer recurrence from unrecognized repetitive trauma. These outcomes define clear targets for diabetic foot screening and ulcer



prevention.”³⁰ The tensile strength of scar tissue is about 80% of original tissue strength.³¹

RISK FACTORS FOR DIABETIC FOOT INFECTION

Almost always follows trauma
Wounds that penetrate to bone
Recurrent wounds
Wounds of long duration(30 days)
Peripheral vascular disease³²

RISK FACTORS FOR DIABETIC AMPUTATION

Peripheral Neuropathy
PVD
Foot ulcers (particularly if they appear on the same side as the eventual LEA) former amputation treatment with insulin.³³

Also in addition to the above risk factors the following factors for risk are noted:

Infection
History of prior ulcer
Structural foot deformity
Trauma
Charcot foot
Impaired vision
Older age
Male sex
Ethnicity (greatest rates in Blacks & Hispanics)³⁴

“Several ‘steps’ take place prior to the loss of a limb. The six steps are diabetes, neuropathy, ulceration, vascular disease, infection and amputation. Each of these steps is preventable and one can take action to prevent the patient from escalating to the next step.”³⁵

CONCLUDING REMARKS

“Foot complications are one of the most serious and costly complications of diabetes.³⁶ However, through a care strategy that combines: prevention; the multi-disciplinary treatment of foot ulcers; appropriate organization; close monitoring, and the education

of people with diabetes and healthcare professionals, it is possible to reduce amputation rates by between 49% and 85%.”³⁷ Diabetes is a vast subject. Note that insulin dosing is highly individualized and proper blood glucose control is dependent on many factors and is difficult to achieve. Much is known about the care of the diabetic foot and now proper implementation of this knowledge is necessary. Preventative care may lead the patient through orthotics and footwear, patient education, diet and exercise, and the reasons for unhealthy eating habits and the management of their eating.

Pedorthists are part of the medical team in the care of people with diabetes. **PFA**

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