



## Diabetes mellitus

is a group of metabolic disorders characterized by elevated blood sugar and abnormalities in insulin secretion and action. As a result of these abnormalities, carbohydrate, fat and protein metabolism is altered.

These nutrients remain in the bloodstream rather than being incorporated into cells to provide nourishment and act as structural components. Buildup of these substances eventually results in micro and macrovascular damage and organ system failure. It is a case of cellular starvation in the face of plenty.

Diabetes is the seventh leading cause of death in the United States. Approximately 24 million people are afflicted. Prevalence is rising. Globally, there have been over a million new cases annually since 2002. Epidemiologic predictions suggest that by the year 2025 there will be a 57% increase in the prevalence of diabetes in North America, 108% in Southeast Asia and 111% increase in Africa. This can be considered a true epidemic.

Development of diabetes may be secondary to immune-mediated mechanisms, trauma, genetic predisposition, pregnancy, drug or viral-induced, or association with other disorders such as acromegaly, Cushing syndrome or pheochromocytoma. Individuals at risk for developing diabetes include those with a positive family history of diabetes; ethnic ties to American Indian/Alaska Native/Hispanic/African American/Asian or Pacific island peoples; history of gestational diabetes; obesity; hypertension; hyperlipidemia and those suffering from other autoimmune disorders.

Type 1 diabetes mellitus is an immune-mediated disorder. Insulin is absent due to destruction of the insulin-producing  $\beta$  cells in the pancreas. Five to ten percent of diabetics are of the type 1 classification. Therapy requires exogenous insulin administration. Type 2 diabetes results from environmental influences superimposed on genetic predisposition. There is both a relative deficiency of total insulin production and insulin resistance. Type 2 diabetes mellitus is more prevalent than type 1, with over 90 percent of diabetics having type 2. Therapy is multifaceted and includes exercise, weight loss, lifestyle changes and a variety of medications. Onset of type 1 diabetes is usually sudden, with little interval time between loss of  $\beta$  cell function and overt symptomatology. On the other hand, type 2 diabetes may generate metabolic abnormalities for up to 15 years before an individual becomes symptomatic. During this time, significant damage to blood vessels and tissues can occur. For this reason, diabetes specialists have developed profiles of individuals at risk for developing diabetes and early screening is recommended before a person becomes symptomatic and suffers irreparable tissue damage.

Both type 1 and type 2 diabetes can irreversibly harm blood vessels and nerves throughout the body. Common adverse events in diabetics include stroke, eye damage, heart attack, kidney failure, impotence, recalcitrant infections, numbness and vascular insufficiency. If the blood vessels of the legs are damaged, loss of sensation, recurrent infection and amputation may result. Involvement of the larger cardiovascular structures is associated with heart, brain, and kidney damage. No vessels are immune to the untoward effects of uncontrolled diabetes.

The literature is limited regarding the effect of diabetes on hearing loss. However, knowledge of the anatomy and physiology of the ear suggests the association should be obvious. Anatomic dissection of all compartments of the ear reveals a rich network of vasculature, all of which are vulnerable to the detrimental effects of prolonged elevated blood sugar. The stria vascularis of the cochlea and nephron of the kidney share physiologic, ultrastructural and antigenic similarities. Renal insufficiency and failure commonly occur secondary to vasculopathy associated with uncontrolled diabetes. It would be reasonable to posit similar changes in the cochlea could lead to hearing loss in diabetic individuals. Sudden sensorineural hearing loss is an otologic emergency. Diabetes is a well-known risk factor and poor prognostic indicator for sudden sensorineural hearing loss. Finally, recurrent and recalcitrant infections are the hallmark of uncontrolled diabetes. Malignant otitis externa is one such infection that is commonly seen in diabetics. Although *Pseudomonas* species are frequently the etiology, any bacterial

or fungal organism may thrive in the glucose-rich environment of diabetes. Permanent malformation of the external ear structures with permanent conductive loss, as well as spread to the central nervous system would be expected if prompt assessment and intervention are not available. Even then, in the setting of elevated blood sugar, routine measures may be insufficient.

It is not the task of the audiologist to diagnose and treat diabetes. Yet, considering the number of people currently affected, you will encounter many diabetics in your practice. The audiologist should be encouraged to take the time to learn a diabetic patients' history and what medications they are taking. Watch for otologic complications such as sudden sensorineural hearing loss and malignant otitis externa. Establish relationships with primary care providers willing to see individuals when concerning findings are discovered. In addition, educate primary care providers regarding potential premature hearing loss and diabetics. Audiologic complications and premature hearing loss are rarely considered part of the checklists of abnormalities primary care providers utilize for diabetic surveillance. Currently annual evaluation by cardiologist, podiatrist, ophthalmologist and others are considered standard of care for individuals with diabetes mellitus. Annual audiologic evaluation should be added to this list. Excellent control of blood sugar is known to slow down, but not completely prevent, the adverse effects of diabetes. The audiologist should be a part of the comprehensive team of care givers striving to assist the diabetic to minimize impairment and achieve maximal function. Finally, audiologists should track and critically evaluate evidence of hearing loss in their diabetic patients. Contribution of evidence-based practices and findings will add to the growing body of literature in the fields of diabetes and audiology.

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