Blood Glucose Testing in the Dental Office

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Diabetes mellitus has reached epidemic proportions in many countries. In the United States, more than 8 million cases remain undiagnosed. Current research demonstrates that the addition of blood glucose testing in the dental office has the ability to detect a clinically significant number of undiagnosed cases of diabetes. Studies have also shown that patients are generally accepting of the practice and may be willing to pay nominal out-of-pocket fees to have the screening performed within a dental setting. Since dental practitioners may have access to patients who do not seek out regular medical care, incorporating blood glucose screenings into dental practice may assist in earlier detection of diabetes. Earlier detection may help improve patients' overall health, reduce morbidity and mortality rates, and reduce health care costs associated with diabetes and comorbid conditions. *Int J Evid Based Pract Dent Hygienist 2016;2:28–32. doi: 10.11607/ebh.53*

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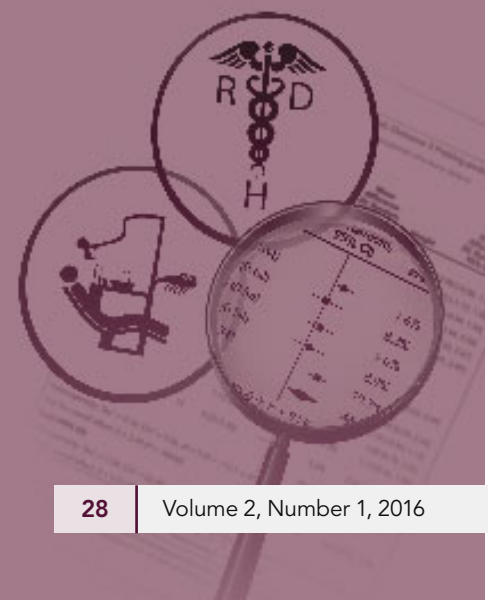

Diabetes mellitus is a major cause of morbidity and mortality. It is estimated that 415 million people worldwide currently have the disease. In the United States alone, 29.3 million people are affected—one in eight adults—making diabetes prevalence in this country one of the highest per capita. Having reached epidemic proportions in many countries, diabetes and its complications are placing a huge burden on health care systems. As of 2015, health care expenditures in the United States have reached $320 billion for treatment of diabetes and its complications, which accounts for nearly half of the $800 billion spent worldwide.[1]

The health and economic impacts of diabetes have prompted global health initiatives, which aim at establishing awareness, education, and management protocols in an attempt to reduce the escalating figures. Even with countless initiatives in place, the global diabetic crisis continues. It is estimated that 642 million people worldwide will have diabetes by 2040, affecting approximately 1 out of every 10 people.[1] Early diagnosis plays a crucial role in reducing diabetes-related morbidity and mortality rates and health care costs. Early interventions and intensive disease management can minimize long-term health effects and complications of the disease, such as retinopathy, nephropathy, neuropathy, and cardiovascular disease.[2]

Diabetes classification

Diabetes mellitus, the body's inability to use or produce enough of the hormone insulin, comes in several forms: type 1, type 2, gestational, and specific rare forms caused by genetics, medication, or other diseases.[3] Type 1 diabetes is an autoimmune disorder that typically occurs in children or

young adults but can appear at any age. In this type, pancreatic β-cells are destroyed, leaving the body unable to produce insulin,[1,3] the hormone that transports glucose throughout the body so that it may be used by the cells as energy. This form requires administration of insulin for treatment. It accounts for approximately 5% to 10% of cases.[1]

β-cells are preserved in type 2 diabetes, which accounts for approximately 90% to 95% of affected individuals.[3] In this type, insulin is produced but is ineffective as the body builds a gradual resistance to the hormone. This results in high blood-glucose levels. Treatment typically consists of diet and exercise, especially in the early stages. Oral medication is also effective when lifestyle modifications are not possible or effective. Over time, insulin production may decrease or cease, depending on the individual. If this occurs, treatment with insulin becomes necessary.[1] While the specific cause remains unknown, incidence is linked to the following risk factors: obesity, family history, older age, race/ethnicity, physical inactivity, and history of gestational diabetes.[4]

Gestational diabetes occurs during pregnancy and has similar risk factors as type 2.[4] This form of glucose intolerance is diagnosed during the second or third trimester.[3] It typically subsides after pregnancy; however, in 5% to 10% of cases, women are diagnosed with having type 2 diabetes postgestationally.[4]

Additional forms of diabetes also exist. Two of these types are maturity-onset diabetes of youth and latent autoimmune diabetes in adults. Causes range from genetic conditions, surgery, infections or diseases, and medications. These types are rare and occur in only approximately 1% to 5% of cases.[4]

Diagnosis

Diabetes can be diagnosed by the following tests: A1C, fasting plasma glucose (FPG), and oral glucose tolerance test (OGTT). A1C measures the amount of glucose bound to hemoglobin molecules in the blood.[5] This provides a snapshot of long-term blood glucose control over the past 3 months. A value under 5.7 is considered to be in the normal range.[6] Diabetes is diagnosed at A1C levels of 6.5 or higher.[3] Values in between these ranges are considered to be prediabetes, a condition in which an individual is not considered to be diabetic but is at an increased risk of developing type 2 diabetes in the future.[3,6] Since the A1C test does not require fasting, it may be a more convenient option for testing; however, this method does not measure daily changes, so high and low blood-glucose variances are not able to be observed. In addition, the A1C test may produce inaccurate results in certain populations, such as those with sickle cell anemia.[5]

FPG tests require a minimum of 8 hours of fasting from caloric intake. Test results that range from 100 to 125 mg/dL are considered to be prediabetic. Diabetes is diagnosed when values exceed 125 mg/dL. OGTT also requires 8 hours of fasting but with an additional step. In this test, an individual consumes water containing 75 g of dissolved glucose after the initial 8-hour fast. Plasma glucose levels are measured 2 hours following the consumption of glucose water. Plasma levels of 140 to 199 mg/dL are considered to be impaired glucose tolerance, or prediabetes. Levels that exceed 199 mg/dL indicate diabetes.[6] Fasting glucose tests present a challenge for dental office use, since many patients would likely have not fasted prior to their appointments.

Role of the dental office in screening and detection

Undiagnosed diabetes mellitus is a worldwide health concern. Globally, an estimated 174.8 million cases are currently undiagnosed, which accounts for 45.8% of all cases. Lower and middle-income countries are estimated to carry most of this burden, accounting for almost 84% of the total number of undiagnosed cases.[7]

The rate of undiagnosed diabetes varies among countries. Estimated percentages range from 24.1% to 75.1%, with the highest rates found in Pacific Island nations.[7] In the United States, approximately 8.1 million people are undiagnosed.[4] With rates this high, efforts for diagnosis must be increased in order to reduce the health and economic burden of the disease and its complications. Dental offices may be a feasible option to aid in this process, especially since many Americans do not seek regular medical care. According to United States Census Bureau statistics, the overall use of medical services and annual visits to physicians declined from 2001 to 2010. In 2001, adults 18 to 64 years of age accessed medical services an average of 4.8 times per year. By 2010, this number decreased to 3.9 and almost 25% of adults did not visit a medical provider during that

year.[8] Despite the fact that fewer adults sought dental care than medical care in 2010,[8] studies have demonstrated that the need for diabetes screenings in dental offices is both warranted and effective. One study found that about one-third of adults and one-fourth of children who do not regularly visit general health care practitioners do visit dentists,[9] emphasizing the importance of possible incorporation of medical screenings into dental practice. Another study by Mosen et al established that regular dental care was associated with improved glycemic and blood pressure control in diabetic patients, which further demonstrates the significant connection between oral and systemic health management.[10]

Several studies indicate that diabetes screenings in dental practice may be effective. In one recent study, community dental patients with at least one risk factor for diabetes underwent diabetes screenings by obtaining a drop of blood from their finger. The blood was tested by dental staff using a blood glucose meter. Results indicated that 12.2% of the 418 tested had diabetes and 5.7% had prediabetes.[11] Another study assessed random blood glucose levels of 385 dental patients aged 40 years and older. Individuals with readings of ≥ 110 mg/dL had additional testing performed to include the OGTT and A1C tests. Results from the testing confirmed that 16.4% of the study participants had diabetes and 15.8% were prediabetic.[12]

While these studies have significant findings, that is not the case for all. A study by Carmagnola et al found only 1.7% of dental patients tested had undiagnosed diabetes; however, when participants were eliminated based on specific waist circumference and age criteria, the study yielded a rate of 4.3%.[13] Given these and other similar study findings, establishing prescreening criteria based on known risk factors for the disease might be considered for creating testing protocol in dental practice. AlGhamdi et al[12] noted that patients found to have diabetes or prediabetes also had a significantly higher body mass index (BMI). The researchers also noted that these patients were much more likely to report symptoms of polyuria and polydipsia.[12] Factors such as these can potentially be used to prequalify patients for in-office diabetes testing to reduce associated time and cost and to eliminate the need to screen all patients.

In addition to the obvious health effects that would result from the addition of blood glucose testing in the dental office and earlier referral of suspected cases to physicians for diagnosis and treatment, there would be significant financial impacts on the health care system as well. A study by Nasseh et al estimated that routine screenings of dental patients aged 40 or older at risk for diabetes, hypercholesteremia, and hypertension could save the health care system $42.4 to $102.6 million per year.[14]

Feasibility of incorporating screening into dental practice

The diabetes–oral health connection is well established, yet many patients remain unaware of the association. A study by Strauss et al concluded that patients generally had a very limited knowledge of the diabetes–periodontal disease relationship.[15] Since dental hygienists are the primary providers for patients' periodontal care, they have prime contact time with patients to provide diabetes–periodontal disease education.[15] Offering diabetes screenings in the dental office could open additional pathways to patient education and awareness in this area.

When considering the addition of medical screenings in dental practice, patient acceptance must first be assessed. Barasch et al[11] found that 98% of eligible patients agreed to undergo nonfasting random blood glucose testing during a routine dental visit. Six of the seven patients who refused did so due to recent testing performed by their primary care physician.[11] In a related study, the researchers surveyed providers who offered the testing as part of their study and found a rate of 84% acceptance of the procedure among participating practitioners. While these results are promising, it should be noted that providers voluntarily participated in the study, which may produce some bias in the response. Overall, the participants found that test administration was both easy and beneficial.[16]

A study by Greenberg et al[17] confirmed the general acceptance of in-office diabetes screenings. In this study, a questionnaire was given to a convenience sample of adult dental patients. Approximately 60% to 94% of participants responded that they were willing to allow a dentist to perform screenings to include finger-stick blood. A majority of the participants (50% to 67%) reported that they were willing to pay up to US $20 for those services.[17] While cost is a factor for many, screenings can be cross-coded with a patient's medical insurance to ensure coverage, limit out-of-pocket expenses, and increase acceptance of the screenings in dental practice.[18]

For individuals who do not wish to undergo testing through invasive methods that involve finger prick or needle stick, the collection of gingival sulcular blood has the potential to be an alternative noninvasive option. Shetty et al collected oozing blood from the gingival sulcus with glass capillary tubes following periodontal probing.[19] It was transferred to test sticks for reading by a blood glucose meter. Out of 100 patients, 50 with known diabetes and 50 without, there were no statistically significant differences found between blood glucose readings from the sulcular blood versus that collected by traditional finger-stick method on the same patients.[19] A similar study by Strauss et al[20] confirmed these findings. The researchers found finger-stick and gingival crevicular blood readings obtained from 408 eligible individuals with select predetermined risk factors to be nearly identical.[20] Additional research is needed to establish the validity and reliability of this method of collection. It may prove to be an important screening tool in future dental practice; however, it should be noted that random plasma glucose test results are generally not accepted as diagnostic. As a screening tool, this test may be considered in symptomatic individuals. Individuals who present with classic diabetes symptoms such as polydipsia, polyuria, or unexplained weight loss can be targeted for this screening type. Those with random plasma glucose values of ≥ 200 mg/dL should undergo an alternate method of testing for confirmation of disease.[6]

The A1C test may be a more feasible option for testing in the dental office. This screening tool has more diagnostic value, as A1C levels do not fluctuate with fasting. In a study by Bossart et al,[21] dental hygienists evaluated patients chairside by using a diabetes risk questionnaire and periodontal status as determinants for performing diabetes screenings. Patients with at least one diabetes risk factor and periodontal disease were then tested using a glycosylated hemoglobin (HbA1c) analyzer. Researchers found that 32% of those tested exhibited prediabetic A1C levels and one patient had a level within the diabetic range. Time and cost were not found to be prohibitive factors in this study. The direct cost for each test was US $9.00. Time spent on screenings for each patient averaged approximately 14 minutes and included patient education, which stressed the importance of follow-up with a primary care physician.[21] These factors would need to be taken into consideration prior to implementation, as reimbursement and/or fee-for-service structure would likely dictate feasibility of incorporation into practice. More studies are needed in this area.

Conclusions

Current statistics demonstrate the need for increased screening for diabetes mellitus. While dentists may not legally diagnose medical conditions, dental offices have traditionally performed routine medical screenings such as blood pressure and heart rate and rhythm, as well as general systemic health assessment through review of comprehensive medical histories. If dental offices were to incorporate blood glucose screenings into practice, suspected cases could be referred to physicians for further evaluation and diagnosis. Practitioners who are interested in adding screening tools to their dental practice are cautioned to refer to their state dental laws prior to initiating testing to ensure it does not extend beyond their scope of practice.

Since studies have demonstrated that blood glucose screenings are generally accepted by patients, it seems feasible that they be incorporated into routine dental care as law permits. The addition of this screening tool is likely to help aid in earlier diabetes detection. In addition, it offers the potential to significantly reduce the incidence of undiagnosed cases. For these reasons, implementing screenings for diabetes in dental settings could help to reduce health care costs and morbidity and mortality rates from this disease and comorbid conditions.

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