Dental Clinic: Potential Source of High-Risk Screening for Prediabetes and Type 2 Diabetes

Introduction

The global number of individuals with diabetes mellitus (DM) is estimated to be 346 million people; and World Health Organization (WHO) predicts that deaths due to diabetes will double between 2005 and 2030. Many patients with diabetes are undiagnosed and prevalence is increasing exponentially primarily because of an increase in sedentary lifestyle and obesity.[1] According to WHO, the number of people with diabetes has risen from 108 million in 1980 to 422 million in 2014.[2] The global prevalence of diabetes has been rising more rapidly in middle- and low-income countries. When diabetes is not well controlled, complications develop that threaten health and endanger life. Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke, and lower limb amputation.[3]

Screening for diabetes provides an opportunity to identify people with prediabetes who are at increased risk for both type 2 diabetes and cardiovascular disease. Randomized controlled clinical trials have conclusively demonstrated that lifestyle and medication interventions are effective in delaying or preventing the development of type 2 diabetes in high-risk individuals with prediabetes. India had 65.1 million diabetics (majority of them being undiagnosed) and had a mortality of 1 million as a result of diabetes in 2013.[4] It is predicted that by 2030 DM may affect 79.4 million individuals in India.[5] Oral cavity including soft and hard tissues shows early and delayed signs and symptoms of DM; however, awareness of these complications is lacking worldwide.[6] Periodontal diseases have been proposed as the sixth most prevalent complication of DM following other diabetic complications such as dry mouth and dental caries.[7] Early identification of these oral manifestations may help in early diagnosis and in attaining better glycemic control. In a country like India, awareness of dental diseases among people and incidence of seeking treatment...
is increasing day by day. Thus, many patients visit dentist every year. This can be picked up as an opportunity for identification of diabetes at dental setup.

In this study, we have explored the predictive value of use of risk factors, oral signs, and symptoms related to diabetes and random blood sugar (RBS) level for early detection of diabetes or hyperglycemic status of patients visiting dental clinic.

Materials and Methods

A cross-sectional, observational, descriptive, and noninterventional study was conducted during a period of July 2013–July 2017, in patients reporting to dental clinics located in central region of Maharashtra at Aurangabad, India. A total of 1150 patients having age of 40 years and above, reporting to the dental clinic either with the complaint of toothache or any other orofacial problems or routine check-up were involved in the study. Patients having any one of the following criteria were included in the study:

1. Patients with family history of diabetes
2. Patients having one or more risk factors such as smoking, consuming alcohol
3. Patients having history of high blood pressure
4. Patients’ oral hygiene indicators of diabetes such as generalized periodontitis, migrating gingival abscesses, loss of teeth, dry mouth
5. Patients having sign and symptoms suggestive of diabetes such as polydypsia, polyurea, polyphagia, frequent muscle cramping, frequent recent changes in the number of eyeglasses or eyesight, delayed wound healing.

After obtaining consent of the patients, a detailed history was obtained with special emphasis on early signs and symptoms of diabetes. This was followed by complete clinical examination regarding chief complaint. Special importance was given to evaluate oral manifestations of diabetes with respect to periodontal status (probing depth more than 4 mm and mobility of teeth), dental caries, and salivary flow in mouth. Patients having one or more risk factors were counseled about diabetes screening test using RBS level. American Diabetes Association (ADA) criteria were used to classify subjects as normal, prediabetic, and diabetic based on blood sugar level concentration. A blood glucose level between 79 and 140 mg/dL was considered as normal, between 140 and 200 mg/dL as prediabetes, and more than 200 mg/dL as diabetes. A proforma was prepared consisting of history of patient, oral examination, and random blood glucose level.

The study was observational, descriptive, and noninterventional; it was declared as exempt from ethical review.

All the data were analyzed with the help of MS Excel and MiniTap-15. Qualitative data were expressed in percentages and proportions, and their significance was calculated by Z-test and Chi-square test. Quantitative data expressed in form of mean ± standard deviation and their significance was calculated by Z-test for difference of mean.

Results

Among 1150 patients, 733 were male and 417 were female. Age of the involved participants ranged from 40 to 74 years with a mean of 46.5 ± 6 years.

As shown in Table 1, of 1150 patients, 744 (64.69%) patients had random blood glucose level within normal range and 238 (20.69%) had RBS falling in range of prediabetic condition. However, 168 (14.60%) patients were found to have RBS level above 200 mg/dL, suggestive of having diabetes. Thus, there were a total of 406 (35.29%) patients (prediabetic and diabetic) having hyperglycemia based on random blood glucose level.

Prevalence of risk factors in patients with dysglycemia by RBS level is explained in Table 2. The study indicates that older age, family history of diabetes, and presence of symptoms such as polyphagia, polydypsia, and polyurea were highly significant with dysglycemia. Other high-risk factors such as hypertension, delayed wound healing, loss of teeth due to mobility, presence of mobile teeth, and probing depth more than 4 mm were also strongly associated with hyperglycemia.

Discussion

Indians are particularly susceptible to diabetes by virtue of their genome and environment. The socioeconomic distribution of the disease has also changed. Relative malnutrition in utero and abundance of nutrition in early and middle adulthood may explain the epidemics in Indians. Westernization of diet and lifestyle, synergistic with genetic background, has also been postulated as an explanation for the rapidly growing prevalence in the population.

Large-scale screening to identify asymptomatic individuals who are likely to have diabetes is of particular value because of the long lead time of diabetes, the minimal observable symptoms, the large number of undetected individuals owing to iceberg phenomenon in the community, and the advantage of early diagnosis. Both mass screening and high-risk screening offer their own advantages and disadvantages. However, at dental clinic

| Table 1: Number of patients having altered level of random blood sugar |
|---------------------------------------------------------------|
| Random blood sugar level | Male patients | Female patients | Total |
|--------------------------|----------------|-----------------|-------|
| Normal (RBS 79-140 mg/dL) | 453            | 236             | 744 (64.69%) |
| Pre-diabetic (RBS 140-200 mg/dL) | 153           | 85              | 238 (20.69%) |
| Diabetic (RBS above 200 mg/dL) | 99             | 69              | 168 (14.60%) |
| Total                    | 733            | 417             | 1150  |

RBS=Random blood sugar
high-risk screening is only useful because mass screening is not possible in dental clinics. On the other hand, presence of multiple risk factors in patients can be easily identified by dentist as routine part of history taking and clinical examination. Thus, only high-risk screening is helpful in the dental clinic and not mass screening.

In India, the diabetes epidemic is fast affecting large swaths of population. Concurrently, many people are also unaware of their hyperglycemic status due to lack of health education and lack of self-motivation to get blood sugar level checked. As many people visit their dentist for their oral and dental problems, it can be used as an opportunity for early diagnosis of diabetes as oral cavity acts as one of the indicators of hyperglycemic signs and symptoms. Diabetic screening is not new to dental clinics. In 1974, Chapnick et al. reported diabetes screening in dental clinics.[11]

Diabetic screening in dental clinics can be performed by RBS level or by calculating glycated hemoglobin level, but RBS level is much simpler, rapid, and cost-effective test for diabetes screening.[12,13]

Strauss et al. demonstrated that self-reported information obtained from a standard health history coupled with findings from a periodontal examination in the dental office that included probing depth measurements and assessment of clinical attachment levels resulted in predicted probabilities of undiagnosed diabetes between 27% and 53%. Further analyses from NHANES 2003 to 2004 demonstrated that 93% of individuals with periodontal disease and 63% of those without periodontitis met ADA guidelines for diabetes screening.[14] In addition, Herman et al. demonstrated the predictive value of simple self-reported risk factors such as high blood pressure, high cholesterol, lipid levels, body mass index, and random capillary glucose levels in screening for dysglycemia among patients receiving screening. They have demonstrated that an estimated 30% of nondiabetic adults more than 30 years of age seen in general dental practices have dysglycemia.[15] In our study, we found that among 1150 of adults above 40 years of age and having one of the risk factors that we considered for study, 28.60% of people have RBS in prediabetic range, while 19.13% are found to have RBS level above 200 mg/dL, suggestive of having diabetes. Thus, there were a total of 406 (35.29%) patients (prediabetic and diabetic) having dysglycemia based on random blood glucose level. This value is comparably high when compared with Herman et al.[15]; this is because of high-risk screening criteria used in our study.

Alghamadi et al. randomly collected data from 385 patients (age 40 years and older) visiting dental clinics. Demographic data, body mass index, and family and dental histories were recorded. Individuals with random blood glucose level (RBGL) ≥110 mg/dL underwent oral glucose tolerance test and glycosylated hemoglobin test (HbA1c). Prevalence of confirmed diabetes and prediabetes among the study participants was 16.4% and 15.8%, respectively. They concluded that percentage of undiagnosed type 2 diabetes and prediabetes among patients visiting dental clinics was much higher compared with that reported in medical literature. Thus, they proved that dental clinics can be a potent source for screening diabetics and prediabetes.[16]

Barasch et al. conducted a study in community dental practices to study feasibility of screening patients for abnormal RBS level by means of glucometer and fingerstick testing. A majority of respondents from the 67 participating dental offices felt it was useful and worth routine implementation. Among 498 patients, more than 80% thought blood glucose test in dental practices was a good idea and found it easy to withstand. They concluded that it was well received by patients and practitioners. These results support the feasibility of implementation of blood glucose test in community dental practices.[17]
Furthermore, Strauss et al. studied the potential of dental clinics for glycemic control and screening of diabetes during dental visits of patients. They concluded that gingival crevicular blood collected at the dental visit can be used to screen for diabetes and monitor glycemic control for many at-risk patients.\textsuperscript{18}

In India, Kalladka et al. studied the efficacy of screening for coronary heart disease (CHD) and diabetes in a dental setting by applying a screening strategy to facilitate early identification of individuals at increased disease risk. In their study, only 158 patients were involved and 32% had abnormal blood sugar level. They concluded that use of a dental setting in a developing country could serve as a resource for early identification of patients at increased risk of developing CHD and DM, yet unaware of their increased risk. The dental setting can also serve as an entry point into the medical care system by identifying asymptomatic patients at increased risk of disease and referring these individuals to a primary care provider.\textsuperscript{19}

In our study, 1150 patients unaware about their diabetic status reporting to the dental clinic for dental issues underwent high-risk screening for diabetes. The study revealed that 35.29% of patients had dysglycemia, requiring further evaluation from physician. This indicates that dental clinics can be used as potential sources of high-risk screening for diabetes, supporting the above-discussed studies.

**Conclusion**

This study concludes that dental clinics can be used as potential sources for high-risk screening for diabetes using a single-page tool and simple random blood glucose test. It is revealed that patients are easily convinced to undergo random blood glucose test. Furthermore, it is explored that there is a strong significant correlation between hyperglycemia and risk factors such as family history of diabetes, older age, multiple missing teeth due to periodontal issues, and deep pockets more than 4 mm. High risk diabetes screening is particularly relevant in countries like India where there are a large number of undiagnosed cases. This will enable early diagnosis of diabetes and immediate implementation of treatment so that further acute or chronic complications of diabetes can be well prevented or at least delayed.

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**Conflicts of interest**

There are no conflicts of interest.

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