Original Article

Screening of Undiagnosed Hyperglycemia and Elevated Blood Pressure in Periodontitis Patients

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Abstract

Objective: To evaluate the prevalence of previously undiagnosed hyperglycemia and hypertension in dental settings and their association with periodontal health.

Material and Methods: Conducted at The University College of Dentistry, University of Lahore, this cross-sectional study included 322 individuals aged 20 and above, selected through purposive sampling from the Periodontology outpatient department. After institutional review board approval, blood pressure readings were taken using a digital sphygmomanometer 15 minutes after patient arrival. Blood glucose levels were measured using a glucometer. Periodontal health was assessed using periodontal charting and the Basic Periodontal Examination (BPE) scoring technique. Statistical analysis, including chi-square tests and descriptive analysis, was performed to evaluate associations.

Results: Among 322 participants (mean age: 46 years), 27% were previously undiagnosed hypertensive, and 13.1% were hyperglycemic. Blood pressure ranged from 99/60 mmHg to 218/120 mmHg, while blood glucose varied from 67 mg/dL to 439 mg/dL. Periodontal health assessment revealed that 38.8% had BPE Code 3 and 10.2% had Code 4, both significantly associated with unknown hyperglycemia and hypertension. Gingivitis was more prevalent in those under 50 years, whereas periodontitis was common in older individuals. Patients with mean arterial pressure >100 mmHg showed a higher inclination toward periodontitis.

Conclusion: The findings highlight the importance of opportunistic screening in dental settings for early detection of hyperglycemia and hypertension. A significant correlation between these conditions and periodontal health underscores the need for integrated healthcare approaches.

Keywords: Hyperglycemia, Hypertension, Periodontal Health, Periodontal Disease, Opportunistic Screening.

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Introduction

Diabetes and hypertension are highly prevalent, chronic and non-communicable diseases that have significant public health challenges.[1] Few authors reported that there is an identifiable connection between the development of obesity, diabetes, and hypertension and insulin resistance.[2] Hypertension plays an important role in the maintenance of health of an individual. Whereas untreated hypertension can lead to cardiovascular disease, chronic kidney disease, and even stroke. 25% of world population is

affected by hypertension which is expected to rise to 29% by the year 2025.[3] Diabetes is a health challenge which has debilitating oral manifestations. It is a disorder of high blood glucose level affecting carbohydrate metabolism. It is generally acknowledged that people with diabetes have higher rates of periodontal disease which worsens the glycemic control. Globally 463 million adults have diabetes in which 90% of the people have type-II diabetes mellitus.[4] A study conducted in 2020 in Pakistani population shows that Pakistan ranks 3rd in diabetes prevalence around the world after China and India[5]. Another study conducted in Pakistan proved that the 33million people are affected with it.[3] It is also possible to better comprehend metabolic syndrome by taking into account these three metabolic factors: excess body weight, diabetes, and hypertension. In which there are a number of diseases that are affecting the individual`s health. These include abdominal obesity, high blood pressure, increased fasting glucose, high triglyceride levels and low HDL cholesterol levels.

Chronic inflammatory periodontal disease is characterized by the degradation of periodontal tissues, which results in the formation of pathological pockets surrounding afflicted teeth, the loss of alveolar bone, and the breakdown of connective tissue. The risk of developing periodontitis is increased in diabetic patients by 2-3 folds.[6] There are various mechanisms by which diabetes is linked with periodontitis, including neutrophil dysfunction, reduction in collagen synthesis and the changes in gingival microbiota[7]. The hyperglycemia condition that leads to the buildup of advanced glycated end products may be the cause of the patient`s worse periodontal health when their glycemic control is low. The production of inflammatory mediators such as IL-1, IL-6, tumor necrosis factor a, and CRPs is triggered by these products, which in turn intensifies the process of periodontal degradation.[8] These oral plaque-associated microbes, nutritional decencies, hormonal changes and others[9] are also the cause of periodontitis which damages the periodontium. Microorganisms present in the oral cavity of human body and colonize hard surfaces of teeth and oral soft tissues. Majority of these oral microbes are essential but some are associated with the diseases like poor glucose control in diabetes mellitus and various cancers.[10] Recently periodontitis has also been considered as a risk factor for the patients of cardiovascular diseases (CVD) due to the inflammatory process caused by microorganisms present in biofilm.[8] Hypertension is a complex condition that has been the subject of numerous studies. One approach of research involves examining the potential of nitric oxide (NO) as a vasodilator. Although traditional methods of using organic compounds to deliver NO have not proven effective in clinical trials, recent studies have highlighted the promise of inorganic nitrate, which is converted to nitrite in the body. This conversion process has been found to lower blood pressure in a dose-dependent manner in healthy individuals and produce significant and consistent reductions in hypertensive patients. The potential implications of this approach are substantial, with the potential to significantly decrease cardiovascular morbidity and mortality. Moreover, emerging evidence suggests that the entero-salivary circulation of nitrate to nitrite plays a crucial role in modulating baseline blood pressure levels, further underscoring the intricate relationship between dietary components and physiological processes in the management of hypertension.[12] 30 prospective and retrospective studies were analyzed by researchers. 25 of the 30 studies that made up the analysis showed that those with a diagnosis of periodontitis had a greater prevalence of hypertension (range 7–77%) compared to people without the illness (range 4–70%).[10]

The non-surgical therapy sessions for patients with periodontitis necessitate several visits to a dental clinic. In these individuals, non-surgical periodontal treatment may assist in reducing periodontal tissue inflammation, which in turn lowers glycated levels and lowers blood pressure in those with diabetes and hypertension, respectively.[11]During their visits dental health professionals can easily perform the screening of unknown cases of diabetes and hypertension at the dental clinic. Screening does not only benefit in early diagnosis of the disease but it also helps in patient education and thorough treatment plan of the individuals having these systemic conditions. In order to make an early diagnosis screening of the patients for unknown hyperglycemic and hypertensive is important in dental set-up. The dental professionals—and hygienists in particular—can play a vital role in helping patients in managing their general health. Routine dental care screenings

provide early intervention and preventative actions for people who are at risk of diabetes, and they also support a multidisciplinary healthcare strategy. This makes disease identification and treatment more convenient. According to a research conducted in 2015 by Bossart et al, dental hygienists may effectively and conveniently screen diabetic patients for undetected diabetes.[12] They can also identify individuals who may require additional assessment since they are at risk of getting the condition. Another study by Herman WH et al proves that screening for prediabetes and diabetes is feasible in dental office.[13] The screening of hypertensive patient is not discussed in the literature extensively. Thus, the aim of this study was to analyze the prevalence of previously unknown hyperglycemic and hypertensive patients by performing dental screening. Secondary objective of our study was to find association between medical condition and periodontal parameters of the patients.

Material and Methods

The study was conducted at The University College of Dentistry, University of Lahore. Clinical coordinators (NS and AF) underwent training by a periodontist to ensure consistency and accuracy in performing clinical measurements. Ethical approval was obtained from the institutional review board (IRB) of University College of Dentistry (Ref No: UCD/ERCA/80). Following the acquisition of informed consent, the oral examination, diagnosis of oral and dental problems (including an assessment for periodontal disease) and treatment was carried out. The study was cross-sectional, and had a purposive sampling technique, with a sample size of 322. The data collection period spanned three months (December 22 -February 23). The study population included individuals aged 20 years and above, visiting the outpatient department (OPD) of the department of periodontology at the hospital. Inclusion criteria comprised patients capable of providing consent and expressing a willingness to participate in the study. Exclusion criteria included patients with diagnosed diabetes mellitus or pre-diabetes and hypertension, those on medications for cardiac conditions hypoglycemic medications, pregnant women, individuals with traumatic injuries, and mentally retarded patients. The assessment of diabetes involved determining glucose levels through a finger-prick blood sample obtained with a glucometer (On Call EZ 11). A random blood sugar level below 200mg/dl was considered within the normal range, whereas patients with a random blood sugar level exceeding 200mg/dl were categorized as hyperglycemic for this study and they were encouraged to get their HbA1c test but they were not followed through as it was not the scope of the study. Elevated blood pressure (in this study referred to as hypertension) was defined as blood pressure readings surpassing >140/90mmHg for all patients. Recent guidelines for hypertensive patients included Stage 1 hypertensive individuals with blood pressure between SBP 130–139 or DBP 80–89 mm Hg, and Stage 2 hypertensive individuals with an SBP of >140 or a DBP of >90 mm Hg[14]. To make certain that the readings of blood pressure are reliable and accurate patients were positioned in a semi-reclined position for at least 30 minutes before blood pressure measurements were taken from the right arm using a digital sphygmomanometer (CITIZEN). Patients can attain a condition of relative relaxation due to the placement and duration, which reduces the possibility of quick physical activity or stress affecting blood pressure readings. The method is more precise when a digital sphygmomanometer is used, which increases the overall dependability of the blood pressure readings that are recorded. In case of elevated values, blood pressure was re-measured after 15 minutes, with three readings recorded for patients exhibiting high blood pressure in the initial two readings. The third reading was considered the final reading in such cases. Mean Arterial Pressure (MAP) was deduced by the help of following formula[15]

$$MAP = DP + 1/3(SP - DP)$$

Periodontal diagnosis was determined using periodontal charting and the appropriate radiographs. Pocket depth, measured from the gingival margin to the bottom of the periodontal pocket, was recorded to the nearest millimeter. The number of periodontal pockets (excluding the third molar) per subject was calculated based on patient`s record information. Basic Periodontal Examination (BPE) scoring method was used to correlate the severity of periodontal disease with the medical status, BPE 3 and 4 both represents periodontitis however BPE code 4 means periodontal pockets >5.5mm which essentially represents advanced nature of periodontal

disease compared to code 3 which is 3.5-5.5mm periodontal pocket depths. Statistical analysis was done using SPSS version 25.0 to assess the relationship of BPE with unknown hyperglycemic state and unknown hypertensive. A chi-square test was applied, along with descriptive analysis for patient's age, gender, periodontal conditions, systolic and diastolic blood pressure, and random blood sugar.

Results

In the present study, total numbers of 322 participants were assessed with the minimum age being 20 years to maximum age of 74 years. The mean age of the participants was 46 years. Amongst the participants, 47% (n=151) were males and 53% (n=171) were females. 72.5% (N=234) participants were normotensives whereas 27% (N=88) of the participants had elevated blood pressure (unknown hypertensive). 86% (N=279) of the participants were normoglycemic whereas, 13.1% (N=43) of the participants were hyperglycemic. Participants had systolic blood pressure varying from 99mm of Hg to 218 mm of Hg where diastolic blood pressure ranged from 60mm of Hg to 120 mm of Hg. Blood glucose levels ranged from 67mg/dl to 439mg/dl. 2.5% of the participants had BPE Code 0, 2.8% of the participants had Code 1, 38.8% of the participants presented with Code 3 and 10.2 % had Code 4. Amongst the participants, 10% were hyperglycemic and hypertensive.

Inter-examiner reliability of periodontal probing measurements revealed kappa 0.81 (CI 0.73-0.89). Age group of population <50 years had gingivitis 31.37% (N=101) whereas population with age >50 years had more patient of periodontitis 24.84% (N=80). To assess the relationship of BPE with unknown hyperglycemic state and unknown hypertensive state chi-square test was applied. In unknown hyperglycemic state Code 4 BPE was found to be relatively higher in patient (63.3%) as compared to the normotensive patients (3.8%). Nonetheless, while noticing a hypertensive state, 50% of the population, who were normotensives, appeared with code 2. **(Table 1)**. Relationship of unknown hyperglycemic state and unknown hypertensive state in comparison to age showing 61.3% of the population of age group <50 years were normoglycemic, similar were the results with unknown hypertensive state **(Table 2)**. **Table 3** shows statistical analysis of mean arterial pressure and periodontal diagnosis. Amongst the subjects diagnosed with gingivitis, 78 had a mean arterial pressure between 70-100 mmHg. Whereas, 92 subjects within the periodontitis group have mean arterial pressure of >100 mmHg.

Table 1: *Analysis of Basic Periodontal Examination (BPE) with Hyperglycemic and Hypertensive state*

Condition		Highest Basic Periodontal Examination (BPE) code of the patient					P- Value
		Code 0 N (%)	Code 1 N (%)	Code 2 N (%)	Code 3 N (%)	Code 4 N (%)	
Hyperglycemic State	Unknown Hyperglycemic	0 (0.0%)	0 (0.0%)	12 (30%)	16 (40%)	12 (30%)	0.02
	Normoglycemic	8 (2.8%)	9 (3.2%)	135 (47.9%)	109 (38.7%)	21 (7.4%)	
Hypertensive State	Unknown Elevated Blood Pressure	0 (0.0%)	0 (0.0%)	27 (32.9%)	31 (37.8%)	24 (29.3%)	0.04
	Normotensives	8 (3.3%)	9 (3.8%)	120 (50.0%)	94 (39.2%)	9 (3.8%)	
Unknown Elevated Blood Pressure & Unknown Hyperglycemic		0 (0.0%)	0 (0.0%)	8 (38.1%)	7 (33.3%)	6 (28.6%)	0.06

Chi-square analysis was used for the inter-group comparison

Table 2: *Analysis of Diagnosis (healthy periodontium, gingivitis and periodontitis) with Hypertensive and Hyperglycemic state*

Condition		Periodontal Diagnosis			P- Value
		Healthy Periodontium N (%)	Gingivitis N (%)	Periodontitis N (%)	
Hyperglycemic State	Unknown Hyperglycemic	0 (0%)	12 (3.73%)	28 (8.70%)	0.01
	Normoglycemic	8 (2.48%)	144 (44.72%)	130 (40.37%)	
Hypertensive State	Unknown Elevated Blood Pressure	0 (0%)	27 (8.39%)	55 (17.08%)	0.03
	Normotensives	8 (2.48%)	129 (40.06%)	103 (31.99%)	
Unknown Elevated Blood Pressure & Unknown Hyperglycemic		0 (0.00%)	8 (38.1%)	13 (61.9%)	0.405

Chi-square analysis was used for the inter-group comparison

Table 3: *Analysis of periodontal diagnosis with mean arterial pressure*

		Periodontal diagnosis			P- Value
		Healthy Periodontium N (%)	Gingivitis N (%)	Periodontitis N (%)	
Mean arterial pressure (mmHg)	70 - 100	6 (4%)	78 (52%)	66(44%)	0.091
	>100	2 (1.2%)	78 (45.3%)	92 (53.5%)	

Chi-square analysis was used for the inter-group comparison

Discussion

The results of this study showed a strong correlation of periodontium with hyperglycemic state as well as hypertensive state. Over the course of historical context, a wide range of research investigations have focused on examining the complex association between diabetes and periodontal disease. The literature[16,17] has extensively demonstrated that patients with diabetes have a higher prevalence and severity of periodontal disease compared to those in good health. There appears to be a substantial variability in the risk of periodontal disease among people with diabetes, depending on the duration of diabetes and the degree of metabolic management. Therefore, screening for diabetes is essential and vital as there is a strong likelihood that gingivitis and periodontal disease are unlikely to occur in a person if they are first examined by a general dentist. Systematic review by Simpson et al[18] concluded that subjects with higher HBA1c is most likely to be the causative factor in periodontal destruction, similar is the results of our study that coincides with this demonstrating that patient with diabetes had gingivitis and periodontitis when screened in the department. A Study conducted in 2015 in which the periodontal health was assessed using probing depths and attachment loss which were found to be more in diabetic individual.[19] All of these studies necessitate the screening of diabetes in our population especially in dental practices.

In a comparable manner one of the concerning conditions affecting a larger portion of the population nationwide is hypertension.[20] In an existing study conducted by Elias and colleagues[21] at a variety of dental facilities. Of the participants in their research who were possibly hypertensive, 46% were not known to be hypertensive, and 54% were under physician care. When evaluated for hypertension, 35% of the population among 46% confirmed positive. Along with the other research, our study also demonstrates a strong correlation with the hypertension. These statistics are in comparison to the percentages of Unknown hypertensive in the current study. A significant portion of the hypertensive population has the illness Unknown and they frequently see their dentists but not their physicians. Mean arterial pressure (MAP) is vital for blood circulation, and its improper regulation can have serious health effects. Low MAP can cause syncope, shock, and inadequate organ blood supply, while high MAP can lead to organ damage, ventricular remodeling, increased heart oxygen demand, vascular injury, and stroke. MAP is tightly controlled to maintain proper organ perfusion, and elevated blood pressure values are positively correlated with MAP, increasing cardiovascular disease risk;[22] our study shows that the population with periodontitis group have more than 50% of the population with mean arterial pressure of > 100mmHg which is significant this may point towards a close relation to hypertension, cardiovascular disease and other circulatory diseases with periodontal disease. The literature has provided inadequate evidence that patients with hypertensive are more likely to develop periodontal disease, and that the relationship between periodontal treatment and mean SBP/DBP is positive. There is an insufficient amount of evidence linking periodontitis to elevated blood pressure. Further research is required to establish a correlation between periodontitis and arterial hypertension.

Conclusion

This study underscores a strong correlation between periodontal health with both hyperglycemic and hypertensive states, particularly evidenced by deeper probing depths. The results highlight how crucial it is to incorporate comprehensive screening for diabetes and hypertension into regular dental procedures in order to enable early identification and treatment of these prevalent yet potentially debilitating diseases.

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Authors Contribution

MH: Conceptualization of Project
MH, SJ: Data Collection
SJ, NK, MH: Literature Search
NK, ZAK: Statistical Analysis
NK, F: Methodology
MH, ZAK, F, SJ: Final Review