Original Article

The association between diabetic retinopathy and periodontal disease

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Access this article online

Quick Response Code:

Website: www.saudijophthalmol.org

DOI: 10.4103/1319-4534.310412

Abstract:

PURPOSE: The purpose of the study was to study the association between diabetic retinopathy (DR) and periodontal disease (PD) in a South Indian cohort.

METHODS: This was a cross-sectional, observational, interdisciplinary hospital-based study wherein patients with diabetes mellitus visiting the ophthalmology department of a university teaching hospital in coastal Karnataka, south India, during the study period, were screened independently for retinopathy by an ophthalmologist and PD by a periodontal surgeon. All the patients were above 18 years of age and did not have juvenile or gestational diabetes. A total of 213 patients consented to participate in the study. The data were analyzed for association using the Chi-square test.

RESULTS: There was a statistically significant association between the presence of DR and PD ($P = 0.02$). The increasing severity of DR was associated with an increase in the components of PD including plaque index ($P < 0.001$) and gingival index ($P < 0.001$).

CONCLUSION: There is a significant association between DR and PD. The awareness of this association can aid in the screening of potentially sight-threatening retinopathy in diabetics presenting to the dental clinic with PD.

Keywords:

Dental plaque index, diabetic retinopathy, gingival disease, India, periodontal disease

Introduction

Diabetic retinopathy (DR) is a leading cause of preventable blindness in the world.[1] The paucity of visual symptoms in the early stages leads to delayed detection and thus poor outcomes despite appropriate management. With an increasing number of people diagnosed with diabetes mellitus (DM) in India, a proportional increase in the patients with retinopathy is expected.[1] However, screening this large population with limited ophthalmological resources is a challenge. Integrating other health-care streams in the detection of DR may be a solution. Hence, comorbidities which may point toward the presence of DR need to be identified. Periodontal disease (PD) is seen more frequently in patients with DM.[2] PD is a chronic inflammation of the gingiva and results in the eventual weakening of the periodontal ligament due to a loss of periodontal tissue, resulting in a gap or "pocket" between the tooth and the gums.[2] Its dual role as a precipitating factor, as well as an outcome of diabetes, has been extensively studied.[2,3] It is associated with increased glycosylated hemoglobin levels.[4] Other studies suggest PD to be a source of inflammatory mediators including tumor necrosis factor (TNF)-alpha and interleukin-6 (IL-6).[5] Elevated glycosylated hemoglobin levels and inflammatory mediators including TNF-alpha have also been associated with the pathogenesis of DR.[6,7] We aimed to study the association of DR with PD in a south Indian cohort. Although this association has been suggested by studies from Iran,[8] Korea,[9] and Japan,[10] there are few studies from the Indian subcontinent.[4,11-13]

Methods

This cross-sectional, observational study was conducted at the Department of Ophthalmology,

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Submitted: 29-Dec-2019
Revised: 19-Oct-2020
Accepted: 08-Nov-2020
Published: 27-Feb-2021

How to cite this article: Tandon A, Kamath YS, Gopalkrishna P, Saokar A, Prakash S, Sarpangala SB, *et al*. The association between diabetic retinopathy and periodontal disease. Saudi J Ophthalmol 2020;34:167-70.

Kasturba Hospital, Manipal, South India, in association with the Department of Periodontology, Manipal College of Dental Sciences, Manipal, between September 2016 and August 2018. Institutional ethics committee clearance was obtained before the initiation of the study (IEC no. 660/2016). The tenets of the Declaration of Helsinki were complied with. The patients above 18 years, having Type 2 DM, visiting the hospital for an evaluation by the physician, and scheduled for ophthalmological and dental screening were included. The screening was scheduled as per the advice of the physician and not necessarily based on patient's symptoms. The patients having juvenile or gestational DM were excluded. All the patients meeting the inclusion criteria were explained the nature of the study and enrolled only after obtaining a written informed consent. The participants then underwent a detailed history and ophthalmic evaluation, with a periodontal evaluation during the time interval when the patient's pupils were being dilated for retinopathy evaluation. This was done by periodontal surgeons, who were blinded to the retinopathy status. The retinopathy assessment was then carried out by an ophthalmologist, blinded to the dental data. The data of retinopathy status and PD grade with specifics were subsequently obtained from the patient's medical records.

The DR was evaluated by indirect ophthalmoscopy and slit-lamp biomicroscopy using a + 90D lens. The grading was modified from the International clinical DR and diabetic macular edema severity scale as no retinopathy, nonproliferative DR (NPDR), and proliferative DR (PDR).[14]

The PD was evaluated by a periodontal surgeon and included an evaluation of probe depth for determining clinical attachment loss (CAL). PD was graded as absent, mild, moderate, or severe disease grades.[15] The plaque index, gingival index, and CAL were calculated.[16] The CAL was graded as mild (<2 mm) and advanced (>2 mm depth).

The Chi-square test was used to determine the association between DR and PD. The one-way analysis of variance (ANOVA) with a *post hoc* Tukey honestly significant difference test was used to analyze the association between DR and the plaque and gingival indices. The risk of PD with DR and CAL, resulting in DR was also studied. The analysis was done using the Statistical Package for the Social Sciences (SPSS) version 15 (SPSS Inc., Chicago, IL, USA).

Results

A total of 213 diabetic patients were enrolled in the study, of whom nearly 70% were males. The mean age in males was 56.1 (±12.3) years and 55.4 (±10.8) years in females. Among these patients, retinopathy was seen in 66.2%, and PD was seen in around 91%. An increase in the duration of diabetes was associated with an increase in the severity of both DR and PD [Table 1]. A significant association was found between the presence of DR and PD, by the Chi-square test (P = 0.02). There was a 1.6 times increased risk of a diabetic having retinopathy, if there was coexisting moderate or severe PD (95% confidence interval [CI], 0.953–2.782; P = 0.02] [Table 2]. The one-way ANOVA was performed to determine an association between the increasing severity of DR and the components of PD including the plaque index [Table 3] and the gingival index [Table 4]. A statistically significant association was found between increasing severity of DR with increasing plaque index (F [2,210] = 6.868, P = 0.001) and increasing gingival index (F [2,210] = 8.998, P < 0.001). *Post hoc* comparisons using the Tukey test revealed that patients with PDR had a significantly higher plaque index when compared to those with NPDR (P = 0.011) and those without retinopathy (P = 0.001). A similar difference was observed in the gingival index between PDR and NPDR (P = 0.002) and between PDR and patients without retinopathy (P < 0.001). The CAL was significantly more in patients with PDR compared to the other two groups, as determined by the Kruskal–Wallis test with P = 0.044. There was a greater risk of retinopathy associated with advanced CAL (95% CI, 1.051–1.516; P = 0.02).

Discussion

An interdisciplinary approach to the growing burden of DM and its complications needs to be promoted. This would improve the reach of the health-care services into the diseased population, for early detection and optimal management. Our study finds an association between two such complications of diabetes, which is managed by two different disciplines of our health-care system.

In our study of 213 diabetic patients, the majority were males. A higher occurrence of DR (NPDR: 51.6%; PDR: 14.6%) was observed, probably on account of the hospital-based recruitment and referral bias by the physician. However, other hospital-based studies from Western India have found the prevalence to be much lower.[17]

PD was observed in around 91% of the patients studied. Although PD is known to be one of the most common chronic inflammatory diseases in humans,[18] the risk of its occurrence

Table 1: Duration of diabetes in the studied population (n=213)

Duration (years)	DR			PD	
	No DR (%)	NPDR (%)	PDR (%)	≤Mild PD (%)	≥Moderate PD (%)
≤5	49 (61.2)	26 (32.5)	5 (6.2)	69 (86.2)	11 (13.8)
5.1-15	20 (27.4)	47 (64.4)	6 (8.2)	48 (65.8)	25 (34.2)
≥15.1	3 (5.0)	37 (61.7)	20 (33.3)	34 (56.7)	26 (43.3)
Total	72	110	31	151	62

DR=Diabetic retinopathy; NPDR=Nonproliferative DR; PDR=Proliferative DR; PD=Periodontal disease

Table 2: The association of periodontal disease and diabetic retinopathy

	PD absent	PD present				Total
	No PD	Mild PD	Moderate PD	Severe PD	Sub-total	
DR absent						
No DR	11	48	7	6	61	72
DR present						
NPDR	7	69	21	13	133	141
PDR	1	15	7	8		
Total	19		194			213

Chi-square test P=0.02; 1.6 times increased risk of DR in presence of moderate or severe PD. DR=Diabetic Retinopathy; NPDR=Nonproliferative DR; PDR=Proliferative DR; PD=Periodontal disease

Table 3: The association of diabetic retinopathy with plaque index

DR	Plaque index				
	n	Mean±SD	Minimum	Maximum	*F*
No DR	72	1.5562±0.35824	0.64	2.26	6.868
NPDR	110	1.6326±0.38103	0.56	2.80	
PDR	31	1.8584±0.42793	0.81	2.86	
Total	213				

P=0.001. DR=Diabetic retinopathy; NPDR=Nonproliferative DR; PDR=Proliferative DR; SD=Standard deviation

Table 4: The association of diabetic retinopathy with gingival index

DR	Gingival index				
	n	Mean±SD	Minimum	Maximum	*F*
No DR	72	1.5943±0.35824	1.13	2.22	8.998
NPDR	110	1.6665±0.27976	0.78	2.64	
PDR	31	1.9261±0.37894	1.13	3.18	
Total	213				

P<0.001. DR=Diabetic retinopathy; NPDR=Nonproliferative DR; PDR=Proliferative DR; SD=Standard deviation

is more in diabetics.[19] There are few studies exploring this association in the Indian diabetic population, which is one of the largest in the world today.[20]

In our study, a significant association between the presence of DR and PD was established. Amiri *et al*. in a study conducted in Iran reported an increased susceptibility of patients with DR to PD.[8] A population data-based study from Korea by Song *et al*. also found a similar association between DR and periodontitis in nonobese individuals.[9] Veena *et al*. described the association between increased levels of glycated hemoglobin and serum creatinine with the severity levels of PD and DR.[13]

We found the plaque and gingival indices in our study population to be significantly higher in patients with PDR. A similar increase in the severity of periodontitis in patients with PDR has been reported by Song *et al*.[9] Noma *et al*. also reported an increased association of proliferative DR with PD with an increase in the vitreous concentrations of IL-6, which is a mediator common in PD.[10] Both DR[7] and a high gingival index[21] have been associated with an elevated glycated hemoglobin.

The risk of having DR was almost 1.6 times greater in the presence of moderate and severe grades of PD in our study. An increased odds of proliferative DR in the presence of PD has been demonstrated in studies from Japan and Iran.[8,10] Song *et al*. found an increased risk of PDR in nonobese Koreans with PD.[9]

The loss of clinical attachment was observed in patients with PDR. CAL of >2 mm had an increased risk of retinopathy. Increased periodontal breakdown and CAL are known to occur in DM. The increased CAL also occurs due to an increased duration of DM, as does retinopathy.[22]

Although our study is able to suggest a link between the DR and PD, further longitudinal studies may be needed to confirm the same. The role of genetic and inflammatory mediators in the pathogenesis of the two conditions including a causal relationship needs to be investigated.

Conclusion

Our study finds a significant association between the presence of DR and PD in a south Indian population. The presence of moderate-to-severe PD in diabetics may indicate the presence of coexisting retinopathy. An integrated effort from different streams of health care needs to be adopted to tackle the growing epidemic of DM and its complications.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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