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The association of oral health with obstructive coronary heart disease confirmed by coronary angiography: A cross-sectional observational study

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Abstract

Background: Coronary artery diareses (CAD) are the most common cardiovascular disease, known as the primary source of adult mortality and morbidity worldwide. Numerous risk factors have been associated with a high risk of CAD. Current data have given away that inflammations may subsidize acute thromboembolic events in liable individuals. Oral health (in terms of dental and periodontal health) signifies a vital medical problem for several societies affecting people throughout their lifetime. The available evidence suggests that dental and periodontal hygiene has shared multifactorial etiologies with CAD. This study had designed to inspect the association of oral health (in terms of dental and periodontal health) with obstructive CAD confirmed by coronary angiography. Methodology: The study is a single-center, patient (n=118) recruited from Shahid al-Mihrab Center for interventional cardiology. Patients were diagnosed with CAD and had prearranged hospitalization by cardiologists for further cardiac catheterization. All blood analyses had performed on the day of admission and assessed for creatinine, urea, and WBCs using a traditional technique. The index of dental health was the sum of decayed, filled, and missed teeth (DFMT). The periodontal guide was a presence of "clinical-attachment-loss" defined as the space from the "cementoenamel junction to the junctional epithelium attachment". ANOVA tests had applied for continuous variables and chi-square for dichotomous variables. Mean and SD had applied to define continuous parameters, and frequency and percentage had applied to define categorical parameters. A p-value of < 5% designates statistica1 significance. Results: The patients with CAD exhibited poor periodontal state, in which 90.7% have localized and or generalized forms of periodontitis half of them have moderate-severe forms of periodontal inflammation. Equally, the poor dental health was reflected by a high overall DMFT index (14.6±4.7) around 2/3rd of the patients had a DMFT score >9, and they lost 2/3rd of their total dental number. There was a highly significant positive association (0.004) between dental status and the number of critically stenosed coronary arteries. There was a positive high-significant association (0.003) between the severity of periodontitis and the number of critically stenosed coronary arteries. There was a positive non-significant association (>0.05) between stages of periodontitis and the number of critically stenosed coronary arteries. Conclusions: Oral health (in terms of dental and periodontal

health) is associated with obstructive CAD in patients undergoing coronary angiography. There were highly significant positive associations between both dental status and the severity of periodontitis with the number of critically stenosed coronary arteries. There was a positive non-significant association between stages of periodontitis and the number of critically stenosed coronary arteries.

Keywords

oral hygiene, dental health, periodontal diseases, DMFT, CAD, angiography.

al., 1993). Both gum and dental health had involved under the term "oral hygiene". Periodontal diseases are continuing, widespread, and complex inflammation of the paradental tissues, initiated as bacterial biofilm, then enhanced by disturbed immunity and progressive loss of adjacent gum (Al-Mumin & HAA, 2020).

The impact of periodontal diseases has been revealed to be multisystemic, including in the cardiovascular system (Abdul-Amir Maki Al-hindi et al., 2016). Teeth caris have a reversible association with oral health. Several clinical and epidemiological trials had supported a deleterious effect of poor dental health with periodontitis on the coronary vessels (Al-Mumin & HAA, 2020; Al-Saad et al., 2020; Mohammed et al., 2020; WHO, 2023). The available evidence suggests that dental and periodontal hygiene has shared multifactorial etiologies with CAD (Al-Saad et al., 2020; Mohammed et al., 2020).

This study had designed to inspect the association of oral health with obstructive CAD confirmed by coronary angiography.

Methodology and Samples

Study Participants

The study is a single-center, patients (n=118) had recruited from Shahid al-Mihrab Center for interventional cardiology, during the period from February to July 2020. Patients were diagnosed with CAD and had prearranged hospitalization by cardiologists for further cardiac catheterization. Body mass index (BMI), history of smoking habits, diabetes mellitus, and hypertension had registered.

Coronary artery diseases (CAD) are the most common cardiovascular disorder, known as the primary source of adult mortality and debility worldwide (Abdul_Husseein et al., 2020; Abed et al., 2020; Al-Mumin & HAA, 2020). In CAD, there is a reduced myocardial blood supply due to plaque build-up in the coronary arteries. Types of CAD include stable or unstable angina, myocardial infarction, and sudden cardiac death (Mendis et al., 2011). Plaques can protrude into the arterial lumen causing a complete or incomplete obstruction to the bloodstream. Individuals with CAD may have 1-2 plaques or may have lots scattered across the coronaries (Vescovo et al., 2020). There are well-recognized risk factors included in the pathogenesis of CAD; some of them are adjustable, while others are not (Bisciglia et al., 2019). The present data have shown that inflammations may also subsidize acute thrombotic events in liable individuals (Al-Hindi, MJM, et al., 2019; Al-hindi, Mousa, et al., 2019; Al-Mumin, Al-Hindy, & Mousa, 2020; Al-Mumin & HAA, 2020). Coronary angiography is a significant part of the clinical valuation of patients with CAD and is a procedure to analyze the anatomy of the obstruction and the existence of collateral epicardial branches (Aschermann et al., 1993).

Oral health signifies a vital medical problem for several societies affecting people throughout their life causing pain, deformity, and even disabilities (WHO, 2023). It has expected that mouth disorders affect roughly 3.5 billion people (Al-Saad et al., 2020; Mohammed et al., 2020; WHO, 2023). Both oral diseases and CAD share general risk factors, including dyslipidemia, hypertension, diabetes, and genetic factors (Al-hindi, Mousa, et al., 2019; Aschermann et

variables. Mean/SD had applied to define continuous parameters, and frequency/percentage had applied to define categorical parameters. A *p*-value of < 5% designates statistica1 significance.

Ethical Consideration

Informed permission at the start had been gotten from each participant (or family associate). The study had agreed upon by the institutional review board of the Heart Center for research ethics. As well, the entire work was approved by the health directorate of Babylon under the Code: (Col.Med.-Or. Angio. ABD-10-2019).

Results

The study exposed that patients with CAD exhibited poor periodontal state. Around 90.7% of patients had localized or generalized periodontitis, while half of them had moderate-severe forms of periodontal inflammation. Equally, poor dental health had reflected by a high overall DMFT index (14.6±4.7). Around 2/3rd of the patients had a DMFT score >9, and they lost 2/3rd of their total numbers of teeth. The study patients were aged 62.9 years, ranging from 27 to 79 years (77.1% male). The ischemic cardiac segments were as follows: 41% were inferior, 38% anterior, 10% inferolateral, and 11% the uncategorized site (results not shown). The incidence of smoking was relatively high among the patients with (40.4%) were current smokers. More than half of the patients were hypertensive, and 42.1% were diabetic. The gender revealed no impact on both periodontal and dental health among studied participants (results not shown). Most of the CAD patients were overweight, reflected theirs by high BMI (28.1 kg/m2). Biochemical assays of urea nitrogen and creatinine were within accepted values, with a high WBCs count (table-1).

Hematological Assays

All blood analyses had performed on the day of admission and assessed for creatinine, urea, and WBCs using a traditional technique.

Coronary Angiography and Description of CAD

Cardiac catheterization had completed using a standard technique (Janket et al., 2003), based on the "2014 American Heart Association and American College of Cardiology guidelines" to evaluate the grade of coronary occlusion. Obstructive CAD had considered when the luminal stenosis is more than 50% for the left main coronary or more than 70% for the other coronaries. The degree of CAD had divided according to the numbers of the occluded vessel (1, 2, or 3). At best, 2 expert angiographers examined vascular imaging.

Quantification of Oral Health Status

The index of dental health was the sum of decayed, filled, and missing teeth (DFMT-index) (Al-Saad et al., 2020). The periodontal guide was a presence of "clinical-attachment-loss (CAL)" defined as the space from the "cementoenamel junction to the junctional epithelial attachment" of the tooth (Al-Mumin & HAA, 2020; Lee et al., 2019).

Grouping of Studied Participants

The severity of periodontitis had classified into 3-classes: healthy gum, localized, and generalized gum inflammation. Likewise, the stages of periodontitis had subdivided according to CAL into 4-stages: stage 0 or normal (less than 2mm), stage 1 or mild (2-3mm), stage 2 or moderate (4-5mm), and stage 3 or severe when CAL was more than 5mm.

Statistical Analyses

All statistical breakdowns had verified with SPSS-software, version 27. ANOVA tests had applied for continuous variables and chi-square for dichotomous

Table-1: Clinical and demographic Baseline characteristics of the study participants

	Mean	Std. Deviation

Age (years)		62.9	13.4
Male Sex no %		91 (77.1)	
Current Smokers no %		48 (40.4)	
BMI (Kg/m2)		28.1	5.2
WBCs		10.3	3.9
Urea Nitrogen mg/dl		14.9	26.3
Creatinine mg/dl		0.78	0.63
DM no %		50 (42.1)	
HT no %		57 (58)	
Number of affected vessels by coronary angiography			
One vessel no %		30 (25.4)	
One-Two vessel no %		31 (26.3)	
Three vessels or more no %		57 (48.3)	
Periodontal health status			
Severity no %	Normal	11 (9.3)	
	Localized/generalized	107 (90.7)	
Staging no %	Normal/mild	55 (46.6)	
	Moderate/severe	63 (43.4)	
Dental health status			
Total DMFT scoring		14.6	10.7
DMFT Classes no %	1-4	26 (22)	
	5-9	15 (12.7)	
	> 9	77 (65.3)	
DMFT Components	Decayed teeth	2.8	3.3
	Missed teeth	11.7	9.2
	Filled teeth	0.8	1.1
	Total teeth	20.2	10.4

There was a highly significant positive association (0.004) between dental status with the number of critically stenosed coronary arteries (table-2).

Table-2: Classes of DMFT scoring distributed according to the Number of affected coronary vessels

Number of affected coronary vessels	Classes of DMFT scoring			Total	P-value
	1-4	5-9	More than 9		
1-vessels	4 (26.7)	2 (13.3)	9 (60)	15	0.004
1-2 Vessels	1 (7.1)	3 (21.4)	10 (71.4)	14	
3 or more Vessels	1 (3.8)	1 (3.8)	24 (92.3)	26	
Total	6	6	43		

There was a highly significant positive association (0.003) between the severity of periodontitis and the number of critically stenosed coronary arteries (table-3).

Table-3: Severity of Periodontitis distributed according to the number of affected coronary vessels

Number of affected vessels	Severity of Periodontitis			Total	P-value
	Normal	Localized	Generalized		
1-vessels	0	2 (7.7)	28 (92.3)	30	0.003
1-2 Vessels	0	15 (50.0)	16 (50.0)	31	
3 or more Vessels	2 (3.8)	2 (3.8)	53 (92.3)	57	
Total	2	19	97	118	

There was a positive non-significant association (>0.05) between stages of periodontitis and the number of critically stenosed coronary arteries (table-4).

Table-4: Stages of Periodontitis distributed according to the number of affected coronary vessels

Number of affected vessels	Staging of Periodontitis				Total	P-value
	0	1	2	3		
1-vessels	2 (7.1)	13 (42.9)	4 (14.3)	11 (35.7)	30	> 0.05
1-2 Vessels	0	18 (57.1)	9 (28.6)	4 (14.3)	31	
3 or more Vessels	2 (3.8)	20 (34.6)	20 (34.6)	15 (26.9)	57	
Total	4	51	33	30	118	

Discussion

The present study intended to evaluate the association between periodontal and dental status with obstructed CAD identified by coronary angiography. The oral hygiene (in terms of dental and periodontal health) of the patients was poor. The data yielded by this study provides convincing evidence that significant associations had been shown between dental health and coronary obstruction. Nonetheless, the periodontal parameters revealed that the severity but not the grades were a risk indicator for coronary obstruction.

Although the basic pathogenesis explaining the association of poor dental hygiene with CAD remains indistinct, supporting earlier findings had shown that gum diseases progress gradually and are characterized by enduring inflammation that leads to bony damage and ultimately dental loss (Al-Saad et al., 2020). Worthy of mention is teeth infection and CAD sharing common risk factors, such as smoking, diabetes, and low socioeconomic status (Abdul-Amir Maki Al-hindi et al., 2016; Al-Saad et al., 2020; Mohammed et al., 2020).

A closer look at the results of our study has exposed that the parameters of periodontitis were unfavorable in patients, which had poor dental hygiene. As well, the CAD patients had fewer reserved total teeth. Both phenomena could have improved their periodontal status if the teeth have extracted due to the effects of severe periodontal disease (Briggs et al., 2006). Though still debatable, several observational and clinical studies have found links between dental health and CAD (Abdul-Amir Maki Al-hindi et al., 2016; Al-Saad et al., 2020; Lee et al., 2019). The trial from South Korea directed by Ho Lee et al. revealed that patients with obstructive CAD have significantly more dental loss than healthy subjects, even if obstructive CAD was not associated with all other dental indices, including the DFT (Lee et al., 2019). Zanella et al. from Brazil found that dental loss was significantly related to an increased chance to develop an obstructed CAD (Zanella et al., 2016). The same study fails to show any significant associations between periodontitis and obstructed CAD. However - unlike our outcomes-, there was no difference in CAD patients with <10 teeth compared to those with >10 teeth reported in an Austrian study published in 2011, even when adjusting for other confounders (Berent et al., 2011). A longitudinal trial by DeStefano et al. involved 9760 American adults and exposed that dental disease is associated with a high risk of CAD, mainly in young males (DeStefano et al., 1993).

Chronic dental inflammation was considered the primary pathophysiology of arteriosclerosis and subsequent CAD (Al-Shamma, Alkhafaji, & Al-Hindy, 2023). It has to be pointed out that details of extracted teeth have been registered in the dental form. Yet, just a few patients with missed teeth were attentive to them. The details for dental extractions had checked check in the dental inquiry form. However, only a limited number of

patients with missing teeth were alert of them. In numerous previous reports, missing teeth had been considered an indicator of the presence of a past periodontal disease or the final stage of it, a belief that our results also recommend.

The association between gum disease and CAD had been considering broadly. "Clinical attachment loss" is regarded as the gold standard to express periodontal damage and has been suggested as the signifier for periodontal disease (Tonetti & Claffey, 2005). In 2013, a consensus statement from a shared workshop included the "American Academy of Periodontology" and the "European Federation of Periodontology" decided that there is a constant indication from clinical trials supporting the opinion that periodontitis raises the risk for coronary vascular events (Tonetti, Van Dyke, & workshop*, 2013). However, limited studies have evaluated the link between periodontitis and CAD identified by angiography. A recent study from Poland reported that the oral hygiene of CAD patients (proved by coronary angiography) was significantly worse compared to that of healthy subjects (Stryjewska et al., 2020). Along a similar line, another study from Poland also exposed that poor periodontal health waves were observed in patients with CAD compared to healthy people, and greater severity of periodontitis had linked with a risk factor for myocardial infarction (Wojtkowska et al., 2021). Likewise, a relation of periodontitis with CAD has been recognized in a study conducted in Northern Ireland on middle-aged men and was independent of diabetes and other confounder risk factors (Briggs et al., 2006).

As a rebuttal to this point, two other studies had failed to identify any relations between the several periodontal variables with CAD (Malthaner et al., 2002; Zanella et al., 2016). This inconsistency can be clarified by variations among study policies, including criteria for defining periodontal disease and sample features. Henceforth, and to avoid any bias in evaluating periodontitis, the use of a full intra-oral protocol is critical (Kingman, Susin, & Albandar, 2008). Other researchers have reported unfavorable effects of periodontitis with CAD using the "Community Periodontal Index" of Treatment Needs and "Probing depth in Ramfjord teeth", or by assessing 4-6 dental sites (Zanella et al., 2016). Moreover, the conflicting outcomes might be due to variations in the cardiovascular profiles of the patients studied. Likewise, there was likely some missorting caused by imprecisions of oral examination; still, this was dubious as the main factor in identifying those with poor periodontal status. Another source of imprecisions in oral health; is bleeding gum, which may be due to a high proportion of the patients being on antiplatelet drugs (Briggs et al., 2006).

Supporting our outcomes; is evidence that proposes that smoking is the major risk factor for periodontal diseases, and it had appraising that >50% of chronic periodontitis can ascribe to tobacco smoking (Tomar & Asma, 2000). Furthermore, smoke is one of the risk factors for CAD. Hence, it had expected to have been a vital confounder in any assumed association between CAD and periodontitis. Yet, a previous study has revealed a strong link between CAD and periodontitis even in non-smokers (Rutger Persson et al., 2003).

The approvals for anticoagulant use by "Federal Drug Administration" recommend a long-term prescription for preventing thrombotic events in high-risk subjects (Fadheel, Naser, & Al-Hindy, 2022). An initial critical decision in the management of CAD patients is whether to interrupt anticoagulants or not during the angiography study (Venetsanos et al., 2021). Such interrupted oral anticoagulant use can affect oral health particularly gum health and periodontal status, which can misinterpret the actual state of oral hygiene in the current study.

There was no impact of gender on the study variables, which is partly due to the cross-sectional strategy of the current study did not permit any

causal extrapolations. Additionally, the high incidence of smoking in this study (40.4%) may be associated with poor oral hygiene.

To the best of the authors' data, the current work is the first to appraise the relationship between oral health (defined by periodontal and dental status) and CAD assessed by angiography.

Independent of the relations herein considered, the outcomes of our study display that patients who consult a cardiologist if requiring a coronary angiography had expected to present with poor oral hygiene. The current results also highpoint the necessity for better oral care for CAD patients, and for physicians and dentists to pay actual awareness to the oral hygiene of these patients.

Conclusions

Oral health (in terms of dental and periodontal health) is associated with obstructive CAD in patients undergoing coronary angiography. There were highly significant positive associations between both dental status and the severity of periodontitis with the number of critically stenosed coronary arteries. There was a positive non-significant association between stages of periodontitis and the number of critically stenosed coronary arteries. Future larger prospective studies should be executed to identify whether there is a causal relationship between poor oral health and CAD.

Study limitations

This study has some limitations. First, the sample size was small, which rendered our outcomes hard to generalize. Second, the cross-sectional plan of this study impedes a conclusive causal relationship between oral health and obstructive CAD. Third, the socioeconomic conditions and nutritional patterns had not registered in our study, this might impact both oral health and CAD. Finally, oral hygiene status does not define merely by DMFT and periodontal health status, we should consider other parameters like oral health habits (such as frequency of brushing and flossing), assessing plaque, and gingival indices. This was, unfortunately, not possible in this work because it was so difficult to arrange for the examination of patients with CAD in the cardiac center by the dentists, because of the curfew conditions at the time of sampling and data collection, which was continuing for months. Therefore the oral examination was restricted to the assessment of DMFT and periodontal state which were performed by the existing junior dentist. Really, it is the same reason why the study samples were not more than 118 patients. The curve conditions caused the study to miss many patients and/or the junior dentist in the cardiac center.

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