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REVIEW ARTICLE

RELATIONSHIP BETWEEN ORAL HEALTH AND CARDIOVASCULAR DISEASES-A NARRATIVE REVIEW

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Abstract

Background: Poor dental heath associated with poor quality of diet, increased levels of inflammation, and conditions increase risk of cardiovascular diseases (CVD)and mortality. Periodontitis associated with CVD risk occurs due to bacterial interaction and resultant toxins released into blood, resulting in endothelial dysfunction and proatherogenic, prothrombotic effect. It also results in inflammatory and immune reactions. These mechanisms describe association of periodontitis with peripheral vascular disease, stroke, and coronary heart disease.

Materials and methods: The present review aims to describe linkage between oral and CVD – mechanisms behind it and its chief pathologies.

Inclusion criteria: included clinical trials that evaluated the current literature on the risk of cardiovascular diseases (CVD)and mortality associated with periodontitis written in English.

Exclusion criteria were: original primary studies, due to language limitations , abstracts, letters to the editor, book chapters, case reports, conference abstracts, duplicate publications, and in vitro and in vivo animal experimental studies.

A comprehensive electronic literature search was performed in the following databases: PubMed, PMC, ScienceDirect, and Scopus using the Medical Subject Heading (MeSH) terms: periodontal disease, cardiovascular disease, periodontal therapy 28 articles were found and16 full-text articles of high methodological quality were selected acording to the review method used, the PRISMA.

Results: As a result, some studies have shown the role chronic and periodontal diseases (PD) are involved in the development and progression cardiovascular diseases (CVD).These factors which determine the nature of the course of cardiovascular diseases (CVD).

Importance of oral health education, especially for chronic oral infections, proved to be effective for cardiac health and quality of life considering an early diagnosis through oral disorders than CVD. Common risk factors for early diagnosis include microbiological, clinical, inflammatory, and molecular markers.

Conclusion: Biomarkers of oral health enable screening of several cardiovascular disorders. Both dentists, cardiologists, and other medical healthcare providers should extend their roles, considering the association between oral and cardiovascular disorders.

Keywords: **periodontal disease, cardiovascular disease, periodontal therapy**

Introduction

An aging individual is characterized by poor oral health, chronic conditions and diseases which influence quality of life and health. Oral health troubles like dry mouth and tooth loss with periodontal disease build up all through adulthood and worsen with age. Loss of teeth and periodontal diseases (PD) are associated with high risk of CVD due to hypo-salivation and other habits.

In developing countries, CVD is considered as the primary and top cause of chronic disease mortality and morbidity. As per World Health Organization, approximately 31% of global deaths take place due to CVD. The risk factors contributing to CVD include family history,limited physical activity, use of tobacco, obesity, meager dietary intake, oral health, and other systemic illnesses. Among all these, PD due to poor oral health is one of the growing potential risk factors for CVD.

Around 700 oral microbes reside on surfaces of teeth along with dental plaque which constitute biofilm that adapts to environmental changes. Gingivitis developed from plaque extends into contiguous gingiva, triggering immune response and inflammatory reaction. Gingivitis progresses to PD due to apical migration of bacteria and inflammation along root surfaces and penetrates into tooth's supporting structures, including neighboring bone. PD leads to irreversible destruction of connective tissue fibers, causing resorption of bone and tooth loss[1].Association between coronary heart disease (CVD) and poor dental health has been reported recently in adults with moderate periodontal disease. Inflammatory mediators and CVD play an aggravating role in chronic dental infection. This association of tooth and CVD may be attributed to previous caries or periodontal disease through inflammatory and immune-mediated mechanisms.

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The current review provides an insight into the association between CVD and PD with poor oral health.[2]

BIOLOGICAL MECHANISMS BETWEEN PD AND CVD

Mechanistic studies have provided evidence for dental infection as a potential mediator of ASCVD. Whether this process is initiated and advanced through direct translocation of bacteria or bacterial products or the downstream inflammatory and immune-mediated mechanisms re- mains unclear[1,3]

Immune activation

The immune response triggers PD macrophages, activates T-cell, and B cell. These immune responses develop and progress into CVD. *P. gingivalis*is a powerfulactivator of macrophages and innate immune response, which producesHeat Shock Protein, a trigger molecule linking PD and CVD.

Other mechanisms by which PD causes CVD include platelet aggregation, thrombosis formation, and endothelial vascular effects. Oral pathogens like *Streptococcus sanguis* stimulate circulating platelets during bacteremia, leading to thrombo-embolic and transient myocardial ischemia through coronary occlusion. Treatment of PD prevents the increased platelet activation in PD, recommending the use of antiplatelet agents during dental procedures.[1]

CVD biomarkers and PD

Genco et al. reported a high risk of CVD in patients with alveolar bone loss. Individuals with severe gingivitis and periodontal pockets showed a high incidence of CVD. Wu and colleagues reported and considered increased serum CRP and fibrinogen levels as well-established biological markers for CVD. Mattila and colleagues reported a significant association of dental infection with increased levels of von Willebrand factor antigen. Hypercholesterolemia is associated with severe periodontitis, as reported by Katz et al. in2002. They observed higher cholesterol levels in CVD patients, which coincided with higher scores on Community Periodontal Index of Treatment Needs (CPITN). Study by Buhlin's group (2003) found relationship between periodontitis and low concentrations of high-density lipids (HDL) and high body mass index (BMI), indicating that PD influences blood lipid concentrations.

Association of Cerebrovascular Stroke and Poor Oral Health

Cerebrovascular ischemic stroke is third leading cause of death and is statistically associated with poor dental health. Syrjanen et al. in1989observed prevalence of dental infection signs in men with ischemic stroke compared to controls. The above study also reported significant association between dental infection and stroke incases with initial febrile

infection. Among all dental infections, periodontitis is found to have a strong association with incidence of stroke.

Association of Peripheral Vascular Disease and Poor Oral Health

Arteriosclerosis obliterans, a peripheral vascular disease (PVD), is a common cause of obstructive arterial disease in extremities. Pathologically it is characterized by formation of typical atheromatous plaques involving intima of arteries, along with thrombus formation. Smoking is considered as definite risk factor with PD at baseline. PD appears to increase risk of PVD, which needs confirmation by further studies.[4]

Dental Management In CVD

The primary goal for dental management in patients with CVD should ensure that hemodynamic changes incurred during dental treatment should not exceed patient's cardiovascular reserve. This is achieved by minimizing hemodynamic alterations like blood pressure, heart rhythm and rate, cardiac output**,** and myocardial oxygen demand during treatment and by stress-reduction protocols as given below:

- Shorter appointments (morning appointments are preferred as patients are well-rested)
- Use of local anesthesia (LA)minimizes uneasiness.LA agents with vasoconstrictors are controversial in patients with CVD. Epinephrine and levonordefrin are commonly used vasoconstrictors.
- Use of preoperative or intraoperative conscious sedation both are done as per recommendations**.**
- Following excellent postoperative analgesia.

Ischemic heart disease–commonly manifests as angina or myocardial infarction. Periodontal treatment planning is altered by quick appointments, administration of little amounts of vasoconstrictorin LA, and indications for preoperative or intraoperative conscious sedation as per requirements. Intra operative anginal attacks are prevented by supplemental 100%oxygen delivery via nasal canal and administration of sublingual nitroglycerin. Preoperative anxiolytics are recommended in case of emergency dental care for reduction of stress and minimize endogenous epinephrine release.

Dysarhythmias: Anti-dysarhythmic drug sused in these patients cause gingival overgrowth or xerostomia impacting the periodontium and dentition. The use of LA with vasoconstrictors is contraindicated in patients with refractory dysrhythmias. Dental management is performed in septic, controlled medical setting with careful monitoring of cardiac functioning.

Cerebrovascular accident – these patients are managed with administration of oral anticoagulants and physician's consultation before undergoing dental treatment. As a preventive protocol to aid in plaque control, dentist may recommend long-term regimen of chlorhexidine rinses.

Valvular heart disease – preventing infective endocarditis is an essential goal of dental therapy in these patients as dental procedures cause transient bacteremia affecting abnormal or damaged cardiac tissue, especially valves. Systemic antibiotic prophylaxis is recommended along with local adjunct of chlorhexidine mouthrinse before dental procedures in these patients.

Anticoagulant therapy – consists of administering coumadin derivatives like dicumarol and warfarin in patients with prosthetic heart valves and other valvular disorders and myocardial infarction (MI), cerebrovascular accident (CVA), or thromboembolism. It is recommended to consult the concerned physician to modify anticoagulant therapy if indicated before performing dental treatment on these patients. Consideration of drug interactions with warfarin is recommended:

- Non-steroidal anti-inflammatory drugs (NSAIDs) and aspirin increase risk of warfarin-associated bleeding. Aspirin administration is discontinued for several days before dental procedures induce significant bleeding.
- Vitamin K production decreases due to tetracyclines, interfere with formation of prothrombin, and increase anticoagulation.
- Metronidazole inhibits Coumadin's metabolism and potentiates the anticoagulant effect, whereas penicillin counteracts coumadin's effect.[5,6]

Evidence of Association between Oral Health and CVD

Periodontal interventions like plaque removal reduced systemic inflammation and cardiovascular risk. Plaque removal lowered CRP levelsand Interleukins (IL-6,IL-8) in patients with stable coronary artery disease and periodontitis.[7]

Diet changes due to tooth loss in periodontitis like reduced consumption of fruits, vegetables, carotene, fiber and increased consumption of cholesterol and saturated fat are related with high risk of CVDas reported by Joshipura et al. in 1996. modifications can reduce tooth loss and CVD in behavior and habits.[2] Hamid N et al. 2013 reported oral diseases and CVD having common risk factors contributing to severity of both conditions.[8]

Jansson et al. reported dental health as a risk indicator of fatal CVD, combined with other risk factor like smoking habits.[9]Toxic products like nicotine generated during smoking are among most harmful risk factors for CVD and PD.It causes vasoconstriction compromising nutrition supply to

periodontium. Nicotine also suppresses the natural body immune responses and causes significant neutrophil dysfunction. Other toxic products from burnt tobacco increase LDL oxidation and induce the atherogenic mechanism resulting in chronic inflammation of intima layer and subsequent endothelial dysfunction. Smoking increases blood viscosity and platelet aggregation, shifting pro-and antithrombotic balance towards increasedcoagulation.[10]

Though statistically, contribution of PD in pathogenesis of CVD is small, it is fatal. As destructive PD involves gram-negative bacteria causing bacteremia, these bacteria are reported to be significant predictors of coronary heart disease (CHD). Because both CHD and PD have a multifactorial etiology with extensive range of possible confounding factors, making consensus on importance of relationship between these two conditions.[4].Sanz et al. (2019) reviewed reports from the proceedings of a workshop organized by European Federation of Periodontology (EFP) and the World Heart Federation (WHF), and updated epidemiological evidence for significant association between PD and CVD, including impact of periodontal therapy on cardiovascular and surrogate outcomes. The workshop also threw light on periodontal therapy in patients on antithrombotic therapy and its potential risk and complications. It is also recommended for dentists, physicians, and patients visiting dental and medical practices.[11,12]

Results

As a result, some studies have shown the role chronic and periodontal diseases (PD) are involved in the development and progression cardiovascular diseases (CVD).These factors which determine the nature of the course of cardiovascular diseases (CVD).

Importance of oral health education, especially for chronic oral infections, proved to be effective for cardiac health and quality of life considering an early diagnosis through oral disorders than CVD. Common risk factors for early diagnosis include microbiological, clinical, inflammatory, and molecular markers

Oral health education to CVD patients provides opportunity to improve care and its potential outcomes. Evidence of poor oral health and its association with CVD requires appropriate training of cardiologists, especially nurses, to promote oral health while in practice. Accessible and affordable dental care services for people with CVD are considered mandatory to offer health care services. Hamid N et al. recommended a common risk factor approach preventive program. [8,13,14] Promotion of oral health activities improved periodontal health and changes of systemic markers of inflammation and endothelial function. These effects lowered risk of secondary cardiovascular events.[15,16]

CONCLUSION

Importance of oral health education, especially for chronic oral infections, proved to be effective for cardiac health and quality of life considering an early diagnosis through oral disorders than CVD. Common risk factors for early diagnosis include microbiological, clinical, inflammatory, and molecular markers. Biomarkers of oral health enable screening of several cardiovascular disorders. Both dentists, cardiologists, and other medical healthcare providers should extend their roles, considering the association between oral and cardiovascular disorders.

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Declaration of competing interest

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Data Availability

All data generated or analysed during this study are included in this article.

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