ISSN: 0975-3583,0976-2833 VOL12, ISSUE 06, 2021

Oral and Cardiovascular Health: An Unascertained Connection

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Abstract
The fact that oral health is associated with cardiovascular disease has been established in a substantial number of studies, although we still do not know if the relationship between the two is causal in nature.There is increasing evidence on the basis of recent studieswhich supports the fact that oral infectionto be associated with cardiovascular disease development. The advent of the inflammation paradigm in coronary pathogenesis stimulated research in chronic infections caused by a variety of micro-organisms—such as Helicobacter pylori, Chlamydia pneumoniae and cytomegalovirus—and various other dental pathogens, since these chronic infections are thought to be involved in the etiopathogenesis of cardiovascular disease by releasing cytokines and other pro-inflammatory mediators.Evidence also suggests poor oral health in general to be associated with atherosclerotic cardiovascular disease; however, this relationship has not been a major focus in clinical practice of cardiology. Here, we have tried to review and find connection between various conditions of oral health related to the cardiovascular diseases.
Keywords: Oral health, cardio vascular disease, oral infections, heart diseases

Introduction

Cardiovascular disease contributes to about three-quarter of the global burden occurring in developing countries and it seems that in most of developing countries the morbidity and mortality due to cardiovascular disease would have a sharp increase in the upcoming decades because of the high prevalence of risk factors and also aging of their populations.[1] During last few years, numerous studies have assessed the association between varioussystemic diseases including cardiovascular diseases and oral infections. These studies support the fact that oral infections, specifically periodontitis may act as an independent risk factor for different systemic conditions including osteoporosis, pulmonary infections, diabetes mellitus pre-term low-weight births, mortality, infections in other body sites as well as the cardiovascular diseases.[2]

The two diseases share common risk factors such as diabetes, advanced ageand smoking and the issue has potential impact because both the conditions have a high incidence; while cardiovascular disease is known worldwide as the leading cause of death, oral health disease on the other hand is one of the most common diseases and closely linked to daily

ISSN: 0975-3583,0976-2833 VOL12, ISSUE 06, 2021

activities.[3]According to data from the National Health and Nutrition Examination Survey (NHANES III), periodontitis patients have a four-fold increased risk of suffering a heart attack.[4]

Discussion

The link between cardiovascular disease& oral health has been debated in the past.Observational studies have shown a positive association between the two diseases.[5]Since cardiovascular diseases are one of the leading cause of death around the globe, greater attention has been focused on the fact that infections of the oral cavity might be associated with various heart conditions including atherothrombosis: heart infarction, stroke, and peripheral vascular disease[2].The American Heart Association, lists periodontal disease as one of the less well-documented or potentially modifiable risk factors for heart diseases, with a risk estimate mainly for those aged 25–74 years.[6]

Periodontal diseases and cardiovascular diseases

There is also growing evidence that points to the fact of periodontal diseases as a potential risk factor for cardiovascular diseases.[7] Several studies have demonstrated that inflammatory process reaction in atherosclerotic lesions may possibly be the link between cardiovascular & periodontal disease.[8]Some studies have examined the association between cardiovascular disease & oral health and reported that people with periodontal disease are at increased risk up to 25% for cardiovascular diseases.[2]One study indicated that 84.4% individuals with cardiovascular disease had periodontal disease compared to those only 22.5% in individuals without cardiovascular disease.[9] Results of a recent meta-analysis showed that periodontal disease as well as poor oral health could act as risk factors in the pathogenesis of cardiovascular disease.[10] The association between Cardiovascular disease & dental hygiene risk factors has been reported by Frisbee et al. with a drawback that study was based on self-reported oral hygiene behaviourand did not consider the clinical oral examination to investigate the association of different risk factors for both coditions.[1]

Destructive periodontal disease involving various bacterial species including the Gramnegative ones have been reported to be a significant predictor of coronary heart disease[11]. A joint consensus report of the American Academy of Periodontology & European Federation of Periodontology concluded that the evidence supporting an increased risk for cardiovascular disease among those with periodontal disease was strong and that the association was independent of other cardiovascular risk factors.[12]

The current theory for pathogenesis states that periodontitis leads to entry of bacteria into the circulatory system,this in turn activates a host inflammatory response which further results in exacerbation, maturation and ultimately atheroma formation thereby increasing the risk of cardiovascular diseases.[13] In a study it was found that among those with established coronary heart disease, periodontal disease increased the likelihood of a recurrent coronary event by nearly 1.5 times[14]In animal experiments, a predominant oral micro-organism (Streptococcus sanguis), induces platelet aggregation, which is an important thrombotic process in arterial plaque formation.[15]

Dental caries and Cardiovascular diseases

Mattila et al were the first to show a statistical association between advanced coronary atherosclerosis& dental infections.[16]S. mutans, a significant contributor to caries, can be found in association to atheromatous plaques of the vascular wall. So it might be presumed that dental caries may also have a proatherogenic effect. Previous studies have been unable to demonstrate a correlation between atherosclerosis and caries.[18] The results study done by Glodnyet alindicated for the first time that dental caries may be an independent risk factor for

ISSN: 0975-3583,0976-2833 VOL12, ISSUE 06, 2021

atherosclerosis, with a magnitude of risk comparable to that of periodontitis [17]The hypotheses proposed in this study, whether caries are a cause of or a co-factor for developing atherosclerosis and whether restorative measures not only protect the tooth from further decay but also protect the patient from acceleration of atherosclerosis, were investigated only prospectively and the hypotheses seems to be very speculative, and the data obtained the study just indicated towards the fact but does not prove it.[17]

Oral Health and Biomarkers of Cardiovascular Disease

Wu and colleagues[19] reported an increase in the serum levels of fibrinogen and CRP, both are well-established biological markers for chronic heart diseases, and both were associated with periodontitis. Mattila and colleagues[16] reported that dental infection was significantly associated with increased von Willebrand factor antigen. In this context, Morrison et al., pointed out a stronger association between gingivitis and cardiovascular disease than between periodontitis and cardiovascular disease.[20]

Katz et al[21] first reported the relation between hypercholesterolemia and severe periodontitis. They observed that higher cholesterol levels coincided with higher scores on the Community Periodontal Index of Treatment Needs (CPITN).[2]In another study by Buhlin's group, a relationship was found between periodontitis and low concentrations of HDL. BMI was also higher in the cardiovascular disease patients with periodontitis than in healthy controls. These findings support the earlier results of Katz et al[21] indicating that periodontal disease may also influence blood lipid concentrations.

Pulp stones and Heart disease

Numerous studies have also shown an association between the formation of pulp stones and atheromatous plaques in the vessels. Edds et al suggested that 74% of patients with reported cardiovascular disease had detectable dental pulp stones, while only 39% of patients without a history of cardiovascular disease had pulp stones.[22]

Kajander et al and Ciftcioglu et al also stated that nanobacteria known to produce biologic apatite over their cellular covering are responsible for dental pulp stone formations, leading to a hypothesis that this might be explained as a common factor between calcifications seen in the aging or traumatized pulp tissues and atheromatous plaques seen in the ischemic heart diseases.[23] Furthermore, osteopontin, a constituent of atherosclerotic plaque, apparently plays a role in plaque calcification, as it is produced by macrophages which, in turn, play a key role in the initiation of calcific changes seen in other necrotic tissues of the body as part of regressive, dystrophic changes attracting calcium, including the renal and carotid artery calcifications.[24]

Ninomiya et al found an even distribution of type I collagen throughout the pulp stones, while osteopontin was found to play an integral role in the process of calcification, as it was found in the peripheral areas of pulp stones.[25] Likewise, in a study by Hirota et al it was found there was a similar occurrence of osteopontin in their immunohistochemical study on atherosclerotic plaque and urinary stones.[26]

Khojastepour et al reported 68.2% of the patients with known cardiovascular diseases and 28.2% of subjects without cardiovascular disease having pulp stones.[27] Ezoddini-Ardakani et al, observed 67.3% of the teeth in patients with ischemic heart diseases having pulp calcifications.Nayak et al, observed the prevalence of pulp stones in hypertensive patients to be 15.85% higher than in the normal subjects included.[28]

There is sufficient evidence in the literature which suggests that patients with ischemic heart diseases show higher degree of pulp calcifications. Localized pulp calcifications are a normal part of the aging process of the tooth physiology, although pulp stones extending to the entire dentition, especially in younger age groups, are infrequent and need further evaluation to

ISSN: 0975-3583,0976-2833 VOL12, ISSUE 06, 2021

predict the risk of other associated diseases, including ischemic heart diseases in the presence of compounding risk factors.[29]

Oral Health and Treatment Needs of Patients Undergoing Cardiovascular Surgery

Cardiovascular surgery encompasses several surgical procedures like aortic diseases, myocardial revascularization, valve replacement or repair, cardiac pacemaker implantation, correction of congenital heart disease and heart transplant. Horder et al in 1909 stressed on the fact that "oral sepsis" was the prime reason for the genesis of infective endocarditis.[30]Introduction of bacteria from oral foci of infection into the bloodstream can lead to a transient bacteremia, enabling the adhesion of microorganisms to previously compromised cardiac tissues.[31] Infection disturbs the coagulation mechanisms and activates pathologic processes in the coronary arteries. A sequale starting from damage to the endothelium and initiation of a fibro-proliferative process in the artery may lead to atherosclerosis.[32]

In an observational study Ansul Kumar et al evaluated the oral health status of preoperative patients admitted to the department of cardiothoracic vascular surgery. Assessment of oral health status, oral hygiene practices and treatment needs of 106 hospitalized patients was done using a structured questionnaire.The principal finding in this study pointed towards the fact that patients with heart disease had poor oral health. The study also highlighted the importance of better interaction among all healthcare professionals to integrate oral health as part of comprehensive inpatient healthcare.[33]

Oral Cancers & Metastasis to the Heart

Cardiac metastasis from squamous cell carcinoma of the tongue is highly unusual.[34]Cancer of the tongue often metastasizes to other organs, most often the lungs, liver or a bone, but such metastasis may not always cause death. Although there are reported cases of cardiac metastasis at autopsy that range from 1.5% to 21.6% among patients who died of a malignant neoplasm,[35] it is very rare for cardiac metastasis to be termed as the direct cause of death.[36]Myocardium is the most frequent cardiac tissue affected by metastasis followed by pericardium and then the endocardium. Involvement of the conducting system is much less common.[36]

The mechanism of metastasis to the myocardium is poorly understood. Pathways that have been postulated are hematogenous spread through the coronary arteries, direct contiguous extension,and retrograde dissemination through lymphatic channels.[37]

DeLoach and Haynes reported that two (11.1%) of nine patients with tongue cancer showed cardiac involvement at autopsy [38] Mnojlovic in his study among a total of 477 autopsies of patients with cancer, found 38 cancers of the tongue, out of which 9 cases (24%) had metastasized to the heart.[39]Nakayama et al. reported finding cardiac metastases at autopsy in 6 (50%) of 12 patients with tongue carcinomas.[40]

Regional and distant metastases play a pivot role in prognostic features of this disease. Myocardial metastasis is a rare site of metastasis from the head and neck malignancies[41] but there seems a possibility for such metastasis to occur. So, it is recommend that patients with head and neck malignancies undergo early echocardiographic evaluation when atypical cardiac symptoms arise.[34]

Good oral health to prevent heart diseases!!

Although numerous studies have been done on oral health & cardiovascular diseases, there is alimited evidence which supports a causal relationship between the two diseases,[42] whether improved oral hygiene care reduces cardiovascular events[43] also, the therapeutic benefit of periodontal treatment for cardiovascular disease is yet unclear.[42]In addition, it is yet to be

ISSN: 0975-3583,0976-2833 VOL12, ISSUE 06, 2021

discovered how oral hygiene care interacts with oral health diseases including periodontal disease, dental caries, and tooth loss in terms of primary cardiovascular prevention.[44]

Conclusion

After examining the various recent studies and reviews based on the connection between oral and cardiovascular health it may be speculated that there is notably a connection between the two i.e oral and cardiovascular health. But, further research using a randomized controlled study design with a sufficiently long follow-up for incidence is needed to establish the fact that effect of treating oral infections can prevent cardiovascular disease in the future.

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