ISSN: 2768-0126

Volume 2 Issue 1
www.escientificlibrary.com

ES Journal of Dental Sciences

Periodontal Disease and Hypertension: A Mechanistic Link between Local and Systemic Inflammation

Research Article

DOI: 10.59152/ESJDS/1020

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Received: Feb 08, 2021; **Accepted:** Mar 08, 2021; **Published:** Mar 10, 2021

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Abstract

Objective: To explore the link between hypertension and periodontitis and also to inspect the mechanistic link between local and systemic inflammation.

Materials and Methods: A cross-sectional study included 83 subjects (31 male and 52 female) aged 32 to 94 years. Subjects were selected randomly from Out Patient Department (OPD) of the National Heart Center in Benghazi-Libya. A detailed case history which included information about the patient's overall medical status and oral status was recorded and subjects underwent a complete oral cavity examination administered by a single periodontist. Evaluation of periodontal condition involved probing depth measurement, loss of attachment and bleeding on probing was documented.

Results: The results of this study confirmed a link between hypertension and periodontitis by examining clinical periodontal parameters and general risk factors for cardiovascular in a sample of adult population in Benghazi-Libya. Our data reveal that subjects identified as hypertensive are highly expected to be diagnosed with moderate and severe periodontitis.

Conclusions: The outcomes of this study revealed an important correlation between hypertension and periodontal disease and show a 100% prevalence of the periodontitis in subjects identified as hypertensive and have confirmed that majority of the hypertensive individuals exhibited moderate and severe periodontitis.

Keywords: Periodontal disease, Periodontitis, Hypertension, Blood pressure, Systemic inflammation.

Abbreviations:

PD: Periodontal disease

HTN: Hypertension

P. gingivalis: Porphyromonas gingivalis

HsCRP: High sensitivity C-reactive protein

IL-6: Interleukin 6

BOP: Bleeding on probing

Introduction

Hypertension (HTN) is expected to affect 1.56 billion people by 2025 and is defined as persistently elevated systemic arterial blood pressure. This elevated blood pressure is dependent on numerous risk factors, for instance, age, gender, obesity, smoking, excessive alcohol consumption, physical inactivity, high dietary salt intake, and stress [1]. Periodontitis is a "chronic inflammatory disease", in which severe forms of the disease are linked to specific bacteria that have colonized the subgingival area regardless of the host's protective mechanisms. Many bacteria, such as "porphyromonas gingivals (P. gingivalis), Tanneralla forsythia, Treponema denticola, Aggregatibacter actinomycetemcomitans, prevotella intermedia, and others including Fusobacterium nucleatum, Wolinella recta, and spirochetes", have been associated with severe forms of Periodontal Disease (PD) [2]. The prevalence of PD in the global population is expected to be over 50% [3]. Periodontitis is considered the sixth most dominant disorder with a higher incidence of severe periodontitis, involving 11.2% of the population worldwide [4].

Elevated blood pressure is independently linked to the incidence of cardiovascular events for example stroke, myocardial infarction, peripheral arterial disease and sudden death. The prevalence of HTN in subjects identified as having coronary heart disease is high and exceeds 70% [3]. In addition, the association between HTN and PD is linked to the risk of cardiovascular disease. However, there is rare evidence about the link between chronic PD and HTN. Recently, elevated blood pressure was shown to be linked to oral conditions, particularly caries, PD and tooth loss [1,5,6]. There is evidence of the association between PD and an increase in blood pressure, however, it has not been confirmed in all studies [7,8]. Furthermore, the relation between PD and blood pressure cannot be clarified by identified mechanisms [3]. Inflammation is an essential trigger of HTN. Periodontitis is a chronic inflammatory condition that could be responsible for the pro-hypertensive immune stimulation, however, evidence of a causal association in people is rare. In addition, periodontitis shares mutual risk factors for instance aging, gender, obesity, stress, excessive alcohol consumption, and smoking [9,10]. Therefore, we cannot infer a causal association from observational studies and further research is warranted to elucidate this link. This study aimed to investigate the link between HTN and PD and also to explore the mechanistic link between local and systemic inflammation.

Materials and Methods

This study included 83 subjects (31 male and 52 female) aged 32 to 94 years. Subjects were selected randomly from Out Patient Department (OPD) of the National Heart Center in Benghazi/Libya.

Ethical approval was granted from the faculty of Dentistry, University of Benghazi, the nature and intention of the study was clarified to the subjects and informed consent was obtained from each subject.

A questionnaire involved "socio-demographic" details about every single subject such as name, age and sex. The history of HTN was also recorded. The diagnosis of HTN is based upon patient's medical report that was assessed by a qualified medical doctor and measurement of blood pressure.

An extensive case report which involved information regarding the patient's overall medical health and oral health was documented. Risk factors for instance, diabetes mellitus, tobacco smoking and obesity were also recorded.

Patients were asked for a complete examination of the oral cavity performed by a single periodontist. Teeth were counted and missing teeth were recorded. Tooth mobility was checked visually. Evaluation of periodontal condition involved probing depth measurement in millimeters by using a "calibrated periodontal probe" around existing dentition except for third molars. Measurement was done at six sites of each tooth and the deepest site was noted. Probing depth 4 mm or more were considered to be pathogenic. Bleeding on probing was considered as a sign of gingival inflammation.

Statistical Analysis

Data were analyzed using Excel statistical software. Descriptive statistics including means, standard deviations, and percentages were used to summarize the finding.

Results

A cross-sectional study was carried out with 83 subjects to examine the link between HTN and PD and also to investigate the mechanistic link between local and systemic inflammation. The mean age of the subjects was 58.5 ± 9.6 years, of the 83 subjects who take part in the study, 52 were female and 31 were male. Of the 83 subjects, 44 of them suffered from HTN and diabetes mellitus and 39 suffered from HTN only. History of smoking was evaluated as smoker and non-smoker. Of the 83 subjects, 24 (29%) of

them were considered smokers and 59 (71%) were non-smokers. Obesity was also evaluated as obese and non-obese. Out of the 83 subjects, 30 (36.1%) of them were considered obese and 53 (63.9%) were non-obese (Figure 1).

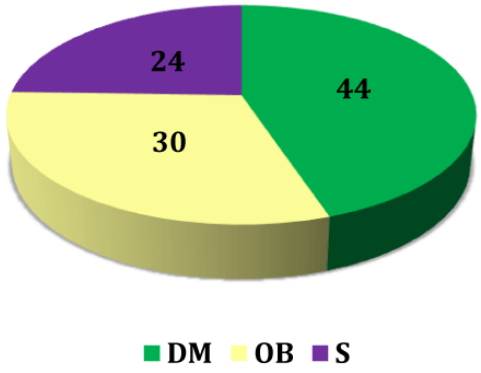

Figure 1: Risk Factors in Subjects Diagnosed with Hypertension: Diabetes Mellitus (DM), Obesity (OB) and Smoking (S).

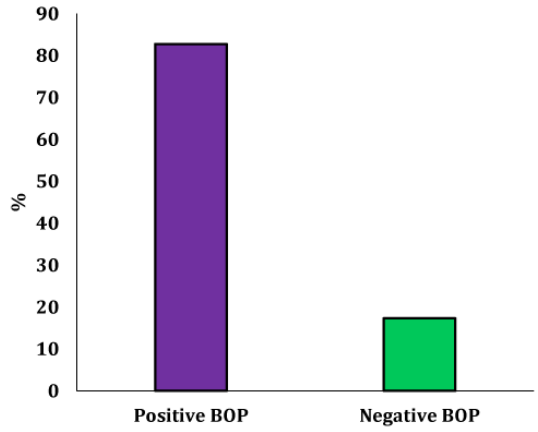

Figure 2: Bleeding on Probing (BOP) in Subjects Diagnosed with Hypertension.

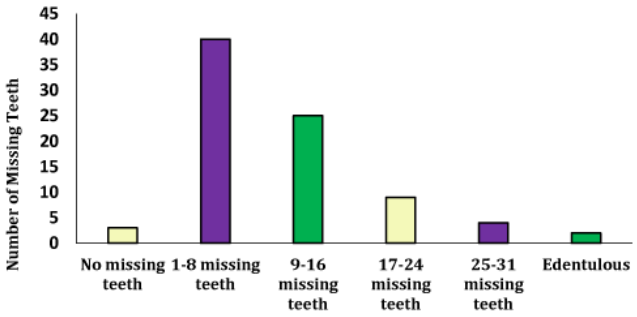

Figure 3: Number of Missing Teeth in Subjects Diagnosed with Hypertension.

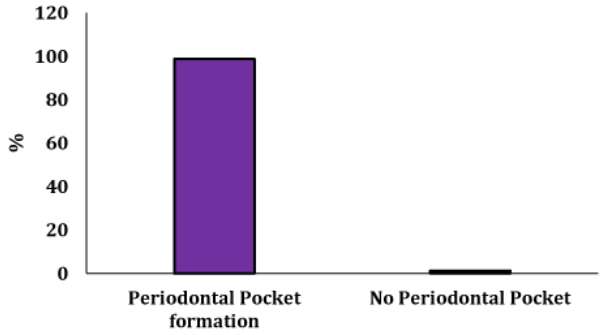

Figure 4: Periodontal Pocket Formation in Subjects Diagnosed with Hypertension.

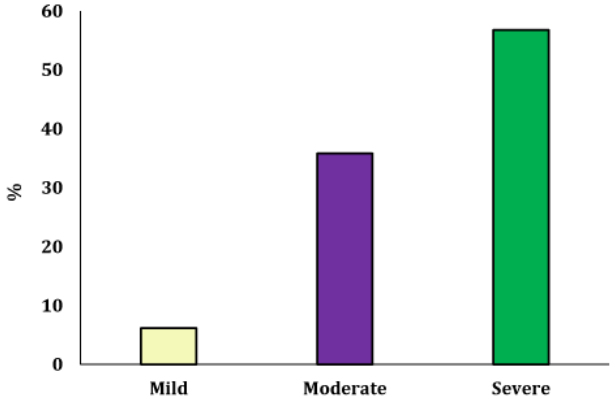

Figure 5: Severity of Periodontitis in Subjects Diagnosed with Hypertension.

Table 1: Periodontal Disease in Subjects Diagnosed with Hypertension: The Number, Percentage, Mean Age and Standard Deviation (ST.DEV)

	Number	Percentage	Mean age	ST.DEV
Chronic Gingivitis	1	1.23	47	0
Mild Periodontitis	5	6.2	54.6	9.2
Moderate Periodontitis	29	35.8	56.4	7.9
Severe Periodontitis	46	56.8	60.3	10.2

Gingival examination shows positive bleeding on probing in 82.7% of the subjects (Figure 2). Average tooth loss was 10.4 ± 7.9. Out of the 83 subjects, 80 (96.4%) have some of their teeth missing and 2 (2.4%) of them were completely edentulous (Figure 3). Probing pockets depth in 98.8% of the subjects was between 5mm and 10mm (Figure 4). OF the 81 dentate subjects, 100% of them have some form of PD extending from gingivitis (1.2%) to periodontitis (98.8%) (Table 1) and 92.6% of those cases were moderate and severe periodontitis (Figure 5).

Discussion

The results of the present study confirmed a link between HTN and PD by analyzing clinical periodontal parameters and general risk factors for cardiovascular in a representative sample of the adult population in Benghazi-Libya. Our data reveal that subjects who have HTN are more likely to have moderate and severe periodontitis.

HTN is a very common chronic disease that affects 30% to 45% of the general population worldwide [8]. Periodontitis is the most common chronic inflammatory disorder and the major reason for tooth loss in the adult population. It has also been associated with endothelial impairment and cardiovascular inflammation. Hence, if causally related, periodontitis might highly impact the worldwide HTN problems and inhibition of PD would have a vital role in the inhibition of HTN and its adverse events [7].

HTN and periodontitis are still major public health problems. They are two diseases that appear to be strongly distinct. Nevertheless, since periodontitis is a chronic inflammatory condition associated with an increase in circulating levels of inflammatory biomarkers [11], the appreciation of periodontitis as a risk factor for HTN has recently grown rapidly [12]. Epidemiologic studies investigating the relationship between HTN and PD have varied in design. However, the majority of studies support a positive correlation between both diseases, whereas others did not find any association [13].

Recently, there has been growing evidence that supports the association between HTN and PD. Several cross-sectional epidemiologic studies have proposed a link between tooth loss, PD and HTN [6,11,14,15], however, whether these links are causally related or as a result of major genetic or behavioral factors that are mutual for both diseases still unclear.

Numerous studies have stated an important positive correlation between HTN and PD relied on self-report or clinical periodontal parameters and HTN using either cross-sectional or case-control studies [15-17]. However, these studies were unable to eliminate causality as a possible reason for the outcomes. The possible role of HTN as a risk factor in PD emphasize the need for prospective studies to eliminate causality as a possible reason for the outcomes [18].

Experimental and clinical observational evidence proposes a clear role of inflammation in the initiation of HTN. Specifically, immune cells activation has been confirmed. HTN is very common in patients diagnosed with immune-mediated illnesses, for instance, rheumatoid arthritis, systemic lupus erythematosus and psoriasis. Therefore, chronic inflammatory conditions could be responsible for pre-hypertensive inflammation. Nevertheless, the mechanisms by which periodontitis is a potential risk factor for HTN were further argued [1]. There is a piece of merging evidence that focuses on the role of inflammation and the host immune response in the impairment of blood pressure regulation and the development of HTN. The systemic inflammatory status associated with periodontitis points towards the possible biological mechanisms linking periodontitis and HTN. Furthermore, T and B lymphocytes, plus monocytes/macrophages in the inflamed periodontal tissues enhance the risk for vascular dysfunction and HTN. Moreover, recently P. gingivalis has been emerged to initiate an immune response, increasing the low-dose angiotensin II which is a pro-hypertensive factor. Notably, treating severe periodontitis has been proven to reduce systemic inflammation and improves endothelial function [6]. Clinical observational evidence proposes that moderate and severe periodontitis is linked to higher probabilities for HTN. As a result of this, it is essential to define if PD can initiate HTN or not.

Recently Czesnikiewicz-Guzik and his group have revealed that immune stimulation induced by P. gingivalis could promote HTN development in mice. Small interventional studies suggested that thorough periodontal treatment may lower blood pressure, however, more evidence is needed to confirm these results [9]. Moreover, numerous studies have addressed the link between tooth loss and HTN. They concluded that HTN was correlated with higher levels of missing teeth [5,18,19]. In addition, the impacts of smoking and diabetes are significant to consider in the association between HTN and tooth loss [20,21]. Because both are linked with HTN and tooth loss. In this regard, our findings are in agreement with the previous studies, both diabetes and smoking when present results in severe tooth loss and HTN [1]. There is also clinical evidence that successful periodontal therapy could help to lower blood pressure in patients diagnosed with HTN [22]. Furthermore, Al-Ghurabei has acknowledged that hs-CRP and IL-6 levels in circulation were higher significantly in subjects diagnosed with periodontitis as

compared to healthy subjects [23]. In contrast, Vidal et al. revealed that periodontal treatment lowers the levels of IL-6, CRP, and fibrinogen in subjects diagnosed with both HTN and severe periodontitis [24]. Therefore, it is obvious that inflammation might offer a possible link between HTN and periodontitis and successful periodontal therapy might help to reduce blood pressure in hypertensive patients.

Conclusions

The findings of this study revealed an important correlation between HTN and PD and revealed a 100% prevalence of the PD in subjects identified as hypertensive and have confirmed that the majority of the hypertensive individuals exhibited moderate to severe periodontitis. Nevertheless, no strong evidence exists to support a causal relationship. Even though a positive correlation exists between HTN and PD, we cannot eliminate, however, that traditional risk factors for instance, male gender, aging, tobacco smoking, obesity, stress and diabetes have an impact on PD severity and also identified as risk factors for HTN since PD and HTN share several mutual risk factors, therefore, in patients who exhibited moderate and severe periodontitis, it is sensible to advise a medical check-up as well as the measurement of blood pressure. Further research is warranted to elucidate the strength of the link between HTN and PD. However, the results of the present study are in line with the present literature.

Acknowledgment

The author would like to thank the clinical staff of the National Heart Center in Benghazi/ Libya, Their assistance is highly appreciated.

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