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Original Article

Hypertension and its association with the severity of chronic periodontitis: a preliminary study

Siti Norsuryani Shamsuddin, Azelinda Ahmad, Haslina Taib, Wan Majdiah Wan Mohamad*

School of Dental Sciences, Universiti Sains Malaysia, 16150 Kubang Kerian, Kelantan, Malaysia.

* Corresponding author: wmajdiah@usm.my

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Abstract Chronic periodontitis (CP) is an inflammatory disease of the supporting tissues of the teeth caused by specific microorganism. Hypertension is one of the major causes of cardiovascular disease whereas periodontitis has recently drawn increasing attention because of its potential relationship with cardiovascular disease. The objectives of this study were to determine the prevalence of the hypertension in CP patients as well as to evaluate the association between hypertension and severity of CP. One hundred and eighty five records of CP patients treated in Dental Clinic, Universiti Sains Malaysia Hospital (USM Hospital), Kelantan from 2010 until 2013 were retrieved and reviewed. The diagnosis of periodontal disease and the presence of hypertension were recorded. The severity of chronic periodontitis was classified into mild, moderate and severe according to the clinical attachment loss. The data was obtained and analyzed using SPSS version 20.0. Majority of the subjects were from Malay ethnic group (94.4%) at the age range between 41 and 61 years (67.8%). In conclusion, the prevalence of hypertension in chronic periodontitis patients was 12.2%. There was no significant association between hypertension and severity of CP (p=0.229).

Keywords: hypertension, periodontitis, severity of chronic periodontitis.

Introduction

Periodontitis is the most common oral inflammatory disease of the supporting tissues of the teeth caused by specific microorganisms (Saini *et al.*, 2009). *Porphyromonas gingivalis*, *Prevotella intermedia*, *Bacteroides forsythus*, *Campylobacter rectus*, *Actinobacillus actinomycetemcomitans* and the treponemes are among the most common organisms associated with periodontal diseases (Ezzo and Cutler, 2003). It is one of the most common chronic disorders of infectious origin with prevalence of 10% to 60% in adults depending on the diagnostic criteria (Papapanou, 1996).

Recently periodontal disease was found to be associated with cardiovascular disease, a condition which has been linked to systemic inflammatory markers and endothelial dysfunction (Joshipura *et al*., 2004). Chronic periodontitis is a common inflammatory disorder which has been recognized as a risk factor for atherosclerotic complications. Current epidemiological evidence also supports its potential association with increase in blood pressure and hypertension prevalence (Tsioufis *et al*., 2011). It is well known that periodontitis and hypertension share common risk factors, such as increased age, smoking, stress and socioeconomic factors. These risk factors may confound the association of the two diseases (Grassos *et al*., 2010).

Surveyed data from Ministry of Health, Malaysia (2013) revealed that in 2011, the prevalence of hypertension in Malaysians was 32.7% (18 years and above) and 43.5% (30 years and above). Untreated or suboptimal controlled hypertension leads to increased cardiovascular, cerebrovascular and renal morbidity and mortality (Ministry of Health, Malaysia, 2013). Hypertension-related mortality in the United States was estimated to reach 54,000 deaths in 2004 (Rosamond *et al*., 2007) and 43 deaths per

100,000 inhabitants in Puerto Rico in 2002 (García-Palmieri, 2004).

Interestingly, clinical and epidemiological studies have shown that periodontitis-induced systemic inflammation contributes to the development of atherosclerosis and endothelial injury, subsequently lead to endothelial dysfunction (Higashi *et al*., 2008).

A number of research studies have suggested a possible link between chronic inflammation and hypertension, emphasizing the need for further research (Li *et al*., 2005; Boos and Lip, 2006; Li, 2006; Savoia and Schiffrin, 2006). Hypertension has been associated with elevated serum C-reactive protein (CRP), a marker of chronic and systemic inflammation (Bautista *et al*., 2005). Several studies (Sesso *et al*., 2003; Bautista *et al*., 2005; Marchetti *et al*., 2012) found that hypertension is associated with increased levels of CRP and proinflammatory cytokines particularly interleukin-6 (IL-6) (Marchetti *et al*., 2012) as well as tumour necrosis-alpha (TNF-α) (Bautista *et al*., 2005). The level of CRP increases in periodontal disease due to inflammation of the periodontal tissues. In addition, IL-6 is an important pro-inflammatory cytokine which involved in the regulation of host response to tissue injury and infection as well as important in induction of CRP production (Marchetti *et al*., 2012).

A study conducted by Rivas-Tumanyan *et al*. (2012) observed that higher serum CRP levels was found among periodontitis patients when compared to healthy controls, particularly in patients with more aggressive and more generalized forms of the diseases. Similar results were reported between periodontal disease and plasma level of IL-6, with a relation established between the severity of the periodontal attachment loss and circulating IL-6 levels. Elevated levels of CRP are also significantly associated with periodontal disease severity.

Various studies (D'Aiuto *et al.,* 2004; Joshipura *et al.,* 2004; Seinost *et al*., 2005) found that periodontitis affects a large number of adults globally and epidemiologically related to atherosclerotic vascular diseases and metabolic syndrome. In periodontitis, chronic inflammation destroys the supporting structure of the teeth and increases the level of CRP. In addition, cross-reactivity of antibodies to periodontal pathogens with antigens present in platelets or endothelial cells might provoke the pro-inflammatory mechanism (Haynes and Standford, 2003).

Petersen (2003) attributes hypertension as the leading cause of cardiovascular mortality. An elevated arterial pressure is probably the most important public health problem in developed countries. The ratio of hypertension frequency in women versus men increases from 0.6 to 0.7 at the age 30 to 1.1 to 1.2 at the age 65 (Kumar *et al*., 2012). Recent studies have shown that the inflammatory effects of periodontal disease help to promote blood clot formation in arteries (Kumar *et al*., 2012). Furthermore, periodontitis patients also were found to have higher levels of plasma oxidized low density lipoprotein (LDL) levels, which means higher risk of developing atheroma plaque (Tamaki *et al.,* 2011).

However, to date, only a few studies have reported on the relation between oral health and hypertension, producing inconsistent results (Rivas-Tumanyan *et al*., 2012). As CP is one of the main oral diseases, therefore this study aims to determine the prevalence of hypertension in CP patients and to evaluate the association between hypertension and severity of CP in a part of Kelantan population. Detection of the hypertension in CP patients may help in the prevention of long term complications of hypertension as these two conditions shared common risk factors.

Materials and methods

A retrospective record review was performed at School of Dental Sciences, USM Hospital, Kubang Kerian, Kelantan, Malaysia. Sample size, *n*, determination for estimating proportion was calculated by using the following formula:

$$n = \left(\frac{z}{\Delta}\right)^2 \left(p(1-p)\right)$$

confidence level (95% CI), $z = 1.96$
precision, $\Delta = 0.05$
prevalence, $p = 10.8\%$

10.8% is the prevalence of hypertension among CP patients from a previous study (Megat Mohd Zainoddin *et al.,* 2013). Therefore, $n = 148$; and after considering 20% of the incomplete records, the sample size is further increased to 178. The sampling frame consists of patients who attended Dental Clinic and satisfied the inclusion and exclusion criteria. The inclusion criteria were all CP patients aged ≥ 20 years old (Bizzaro, 2013) with complete periodontal records. Pregnant women, patients with gingivitis and/aggressive periodontitis were excluded. Ethical clearance was obtained from the Human Research and Ethics Committee, Universiti Sains Malaysia (USMKK/PPP/JEPeM [232.3.(01)] Dated: 16th December 2010).

In present study, records of 178 patients who have been diagnosed with chronic periodontitis and underwent periodontal treatment at Dental Clinic, USM Hospital from 2010 until 2013 were retrieved by simple random sampling method and reviewed. However, only 90 patients had fulfilled the inclusion and the exclusion criteria. Demographic and clinical related information were obtained from the patients' record. These include medical and dental history, periodontal charting for probing pocket depth (PPD) and clinical attachment loss (CAL), and diagnosis of chronic periodontitis. Severity of CP was classified according to the clinical attachment loss (CAL) as mild CP if CAL 1 mm to 2 mm, moderate CP if CAL 3 mm to 4 mm and severe CP if 5 mm or more (Flemming, 1999).

Statistical analysis

Statistical Package for Social Science version 20.0 statistical software was used for data entry and data analysis. Descriptive statistic such as mean and standard deviation (SD), frequency and percentages was calculated. Chi-square analysis was used to determine the association between hypertension and severity of CP while. A *p* value of less than 0.05 was considered statistically significant.

Results

From a total of 178 patients who were randomly selected, 90 patients were included in the study. In this study, majority of the subjects were Malays (94.4%) at the age range between 41 and 61 years (67.8%). There were 56 males (62.2%) and 34 females (37.8%) in the study group. Seventy two patients (80.0%) of patients were non-smoker who form the majority of the subjects selected (Table 1). The prevalence of hypertension in chronic periodontitis patients was 12.2% (Table 2). Table 3 shows the association between the hypertension and severity of CP. We found that there was no significant association between hypertension and severity of CP (p=0.229).

Discussion

This study utilized records of periodontal patients; and thus we faced some limitations particularly regarding the records of their medical status. All data for periodontal charting and medical problem were relied on their medical and dental reports during follow up. However, there might be some underreported medical problems.

This is a baseline study to determine the prevalence of hypertension in chronic periodontitis (CP) patients. In the present study, the prevalence of the hypertension in CP patients was 12.2%. In a study of 100 Caribbean patients, it was found out that 22% of them had moderate periodontal disease while 68% with chronic periodontal disease had hypertension and the remainder 10% had chronic marginal gingivitis/early periodontal disease (Soory, 2007). In a cross-sectional study of 3,352 periodontal patients and 902 normal controls in Sweden, it was reported that the prevalence of CP with hypertension was 16% (Holmlund *et al*., 2006). In another study involving USM patients, it was found that the prevalence of systemic conditions in patients with periodontal disease was 30.5%, which comprises of hypertension and diabetes mellitus (Megat Mohd Zainoddin *et al*., 2013).

Meanwhile in a study conducted in the rural adult Uygur residents in China, the

prevalence rates of CP and hypertension were 66.0% (934/1415) and 33.8% (478/1415) respectively; the prevalence rates of hypertension were 18.7% (90/481) in absence of periodontitis, 35.1% (131/373) in mild periodontitis, 32.3% (62/192) in moderate periodontitis and 52.8% (195/369) in severe periodontitis groups (Zhang *et al.*, 2011).

The prevalence of CP with hypertension varies among the different population might be due to different lifestyles among these populations. In addition, genetic factor might also be one of the contributing factors for hypertension in CP patients. Several risk factors for periodontal disease have been identified which includes microbiotic/periodontal pathogen, lifestyle (smoking and alcohol use), psychososial factors, chronic diseases (diabetes and hypertension) as well as genetic factors (Genco and Borgnakke, 2013). Other confounding factors which might contribute to hypertension in CP patients are smoking, stress, increased age as well as socioeconomic factors (Leong *et al*., 2014).

In the present study, we found that there was no significant association between hypertension and the severity of CP (p=0.229). Similar result was observed in the previous study by Megat Mohd Zainoddin *et al*. (2013), in which they found that there was no significant association between the severity of CP (mild, moderate and severe) and hypertension (p=0.252). However, they found that there was a significant association between chronic periodontitis and hypertension (p<0.001).

In Sweden, Holmlund *et al*. (2006) had done a study among 4,254 subjects to evaluate the severity of periodontal disease and hypertension. They found that the severity of periodontitis was significantly associated with hypertension (p<0.0005). This result is contradictory with our study. Furthermore, in a study conducted by Zhang *et al*. (2011), Spearman correlation showed an association between chronic periodontitis and hypertension (r(s) = 0.273, p < 0.01) after adjustment for age, gender, body mass index, waist circumference, glycometabolism disorder, hyperlipidemia and chronic kidney disease. They also found that as compared to patient with absence of periodontitis, mild and severe periodontitis patients were found significantly associated with hypertension (p < 0.01) while moderate periodontitis patients was not significantly associated with hypertension (p > 0.05).

In the present study, patients were categorized into mild, moderate to severe CP. Most hypertensive patients had moderate to severe CP whereas most non-hypertensive patients had mild CP. However, there was no significant association between severity of CP and hypertension although there was high prevalence of hypertensive patients with moderate to severe CP compared to the mild form. This indicates severity of CP was not significantly associated with systemic conditions. Lagervall *et al*. (2003) reported the systemic disorders studied include allergy, cardiovascular disease, diabetes mellitus, hypertension, other endocrine disorders, psychogenic disorders and rheumatoid disease. They did not report any correlations between systemic disorders and periodontal disease. Therefore further researches regarding these associations need to be done in order to elucidate whether hypertension has strong association with CP.

Conclusion

In conclusion, the prevalence of the hypertension in chronic periodontitis patients was 12.2%. There was no significant association between the hypertension and severity of CP. The possible cause might be due to the small sample size in this study. Therefore, a study with a larger sample size need to be carried out in order to obtained more accurate result for the benefits of oral health in the future.

Recommendation

This article would serve a great value to the readers since it provides local data which reflects findings in our local population. So far as we are concern, not many local studies were done to evaluate the relationship between hypertension and chronic periodontitis. This preliminary finding would serve as a reference for future study in the field of perio-systemic inter-relationship.

Table 1 Socio-demographic characteristics of patients (n=90)

Variable	Mean (SD)	Frequency (%)
Age	53.41(10.59)	
20-40		8 (8.9)
41-61		61 (67.8)
62-82		21 (23.3)
Gender		
Male		56 (62.2)
Female		34 (37.8)
Race		
Malay		85 (94.4)
Chinese		5 (5.6)
Smoking Status		
Non-smoker		72 (80.0)
Smoker		18 (20.0)
Hypertensive Status		
Hypertension		
Non-hypertension		11 (12.2)
CAL 1-2 (Mild)		79 (87.8)
CAL 3-4 (Moderate &		4 (36.4)
>5 Severe)		7 (63.6)

SD = Standard Deviation, CAL=Clinical Attachment Loss

Table 2 Prevalence of hypertension and non-hypertension in chronic periodontitis patients

Variables	Frequency	95% CI
HPT	11 (12.2)	(0.07,0.21)
Non-HPT	35 (38.9)	(0.29,0.50)

HPT = Hypertension, Non-HPT = Non-Hypertension, CI = Confidence Interval

Table 3 Association between hypertension and severity of chronic periodontitis using Chi-Square test

Severity of CP	HPT	Non-HPT	X^2 statistic (df)	*p* value
Mild	4	20	1.448 (1)	0.229
Moderate-severe	7	15		

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