

Hypertension and its association with periodontal parameters in chronic periodontitis

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ABSTRACT: Hypertension is one of the major causes of cardiovascular disease worldwide. Chronic periodontitis (CP) is an inflammatory disease of the supporting tissues of the teeth and is caused by specific microorganism. Previous studies found that there is a biological relationship between hypertension and periodontitis since both diseases share some common risk factors. The objectives of this study were to determine the association between hypertension and periodontal parameters in CP patients. Ninety records of CP patients treated in Dental Clinic, Hospital Universiti Sains Malaysia, Kelantan from 2010 until 2013 were retrieved and reviewed. The diagnosis of periodontal disease and the presence of hypertension were recorded. Demographic data and records of periodontal parameters were also obtained. The data was analyzed using SPSS version 20.0. Majority of the subjects were of Malay ethnic group (94.4%) with the age range between 41 to 61 years (67.8%). More than 50% of the subjects had mild to moderate periodontitis. CP with hypertension counted for 12.2%. There was no significant association between plaque scores, gingivitis scores and periodontal pocket depth with hypertension ($P < 0.05$). However, the clinical attachment loss was significantly higher in CP with hypertension compared to non-hypertensive CP ($P = 0.012$). In conclusion, there is a possible association between periodontal tissue loss and hypertension. Therefore, further investigation is recommended thus will help in managing oral and systemic health diseases.

Keywords: Hypertension, periodontal parameters, chronic periodontitis

Introduction

Hypertension is a major global health disorder affecting about 972 million adult populations in year 2000 and expected to be increased to 1.56 billion by the year 2025 (Kearney *et al.*, 2005). Meanwhile, periodontal disease is a group of chronic inflammatory diseases involving soft tissue and bone surrounding the teeth, known as periodontium. It is characterized by inflammation of tooth-supporting tissues caused by bacterial infection (Jin *et al.*, 2003). Gingivitis is a reversible condition manifests as redness, gum swelling and may progress to periodontitis if left untreated (Tonetti and Van Dyke, 2013).

Periodontal disease is the second most common oral disease alongside dental caries in Malaysia and worldwide (Petersen and Ogawa, 2012). In Malaysia, the prevalence of periodontal disease among adult is 94.0% (Oral Health Division, Ministry of Health Malaysia, 2013). Hypertension and periodontitis share some 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).

Since periodontal disease may contribute to endothelial dysfunction as a result of inflammation, it has been identified as a risk factor for hypertension (Tonetti *et al.*, 2007). Therefore, periodontitis is known to be an important risk factor for cardiovascular disease including stroke (Slowik *et al.*, 2010), peripheral artery disease (Higashi *et al.*, 2009) as well as coronary heart disease (Pasqualini *et al.*, 2012).

There is a prospective cohort study by Kawabata *et al.* (2016) to evaluate the relationship between hypertension and periodontal disease among Japanese university students (n=2, 588) who had undergone health screening before entering university and before graduation. Their study showed that there is a significant association was observed between periodontal disease and hypertension. In addition, a systematic review and meta-analysis which includes studies published up to June 2016 was performed by Martin-Cabezas *et al.* (2016). Sixteen studies assessing the association between periodontal disease and hypertension have been included. The meta-analysis showed that hypertension was associated with moderate to severe periodontal disease (OR, 1.50; 95%CI, 1.27-1.78).

Material and Methods

This is a retrospective study done by retrieving data from 178 records of patients that had undergone periodontal therapy at Dental Clinic, Hospital Universiti Sains Malaysia from year 2010 until 2013. Sample size, n , determination for estimating proportion was calculated by using the following formula:

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

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

The prevalence of hypertension among CP patients from a previous study was 10.8% (Megat Mohd Zainoddin *et al.*, 2013). Therefore, $n = 148$, and after considering 20% of the incomplete records, the sample size was further increased to 178. However, there were only 90 records that fulfilled the selection criteria which included patients diagnosed with chronic periodontitis aged 20 years old and older (Bizzaro, 2013) with complete periodontal record. Pregnant women and patients diagnosed with gingivitis and/or aggressive periodontitis were excluded from the study. The study protocol has been approved by Human Research and Ethics Committee, Universiti Sains Malaysia (USMKK/PPP/JEPeM [267.3.(1.2)] Dated: 17th June 2013).

Demographic and clinical related information were obtained which included medical history, dental history, periodontal charting such as plaque score, gingivitis score, probing pocket depth and clinical attachment loss (CAL). Plaque score was used to determine the oral hygiene status of patients, whereas gingivitis score was used to determine the present of periodontal inflammation. The Plaque Index System proposed by Silness and Loe (1964) was used to assess plaque, while Gingival Index of Loe and Silness (1963) was used to assess the gingival status. Higher score indicates severe gingival inflammation. The severity of chronic periodontitis is classified into mild, moderate and severe based on CAL of 1 mm to 2 mm, 3 mm to 4 mm and more than 4 mm, respectively (Flemming, 1999).

Statistical analysis

Statistical Package for Social Science (SPSS) version 20.0 statistical software was used for data entry and analysis. Descriptive statistics such as mean and standard deviation (SD), frequency and percentages were calculated. Independent t-test was used to compare the means of periodontal parameters in hypertensive and non-hypertensive in CP patients. A *P* value of less than 0.05 was considered statistically significant.

Results

Among the 90 records of periodontal patients, majority of the subjects were Malays (94.4%) in the age range from 41 to 61 years old and more than half of the subjects were males (62.2%). Seventy two patients (80.0%) were non-smoker and they formed the majority of the subjects selected (Table 1). Most of the subjects had mild CP (54.4%) and only 14.4% had severe CP (CAL > 4mm).

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

Variables	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)
Smoker		
Non-smoker		72 (80.0)
Smoker		18 (20.0)
Severity of CP		
Mild		49 (54.4)
Moderate		28 (31.1)
Severe		13 (14.4)

SD = Standard deviation; CP = Chronic periodontitis

Fifty-four (60.0%) chronic periodontitis patients had systemic diseases and out of this 12.2% had hypertension (Table 2).

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 shows the mean comparison of periodontal parameters between hypertensive and non-hypertensive patients with CP. There were no significant difference of all parameters between the groups except for the mean of clinical attachment loss which showed significantly higher value (4.23; SD=1.94) in CP patients with hypertension ($P=0.012$).

Table 3: Mean comparison of periodontal parameters between hypertensive and non-hypertensive patients with CP

Periodontal parameters	HPT n=11 Mean (SD)	Non-HPT n=79 Mean (SD)	Mean differ. (95% CI)	t statistic (df)	P values
Plaque Score (%)	72.73 (26.43)	74.42 (24.57)	1.00 (-15.4, 17.4)	0.12 (88)	0.903
Gingivitis score (%)	69.93(26.82)	52.40 (37.04)	17.0 (-4.8, 38.8)	1.55 (88)	0.124
Periodontal pocket depth (mm)	2.20 (1.09)	1.79 (1.15)	0.41 (-0.3, 1.1)	1.12 (88)	0.266
Clinical attachment loss (mm)	4.23 (1.94)	2.99 (1.71)	1.35 (0.3, 2.4)	2.56 (88)	0.012*

SD = Standard Deviation; CI = Confidence Interval; *Independent t test, significant at $P < 0.05$

Discussion

This is a baseline study to determine the association between hypertension with periodontal parameters in patients attending Hospital USM Dental Clinic. We found that 12.2% of the CP

patients had hypertension and 40.0% did not have hypertension whereas the remainders were presented with hypertension in combination with other systemic diseases such as diabetes mellitus. In Sweden, Holmlund *et al.* (2006) reported that the prevalence of CP with hypertension was 16%. Another study by Soory (2007) found that 22.0% of patients were presented with moderate periodontal disease and 68.0% were presented with severe periodontal disease. A previous study conducted by Zhang *et al.* (2011) reported that the prevalences of hypertension were 18.7% in absence of periodontitis, 35.1% in mild periodontitis, 32.3% in moderate periodontitis and 52.8% in severe periodontitis groups. This evidence indicates there is an association between hypertension and periodontitis. A more severe periodontitis will lead to the patient having a higher risk of developing hypertension.

In the present study, the mean plaque score for hypertensive patients with CP was lower (72.73%) compared to non-hypertensive patients with CP (74.42%). Meanwhile, the mean of gingivitis score for hypertensive patients with CP was higher (69.93%) compared to non-hypertensive patients with CP (52.40%). However, there was no significant difference of mean plaque score, gingivitis score and periodontal pocket depth between hypertensive and non-hypertensive patients with CP. A previous study by Andrew *et al.* (2014) found that the mean plaque and gingivitis scores were higher in patients with gingival overgrowth secondary to anti-hypertensive agents (PS 2.35 ± 0.54 , GI 1.32 ± 0.45) than those without gingival overgrowth (PS 2.13 ± 0.50 , GI 1.23 ± 0.40), but there was also no significant difference of mean plaque score ($p=0.061$) and gingivitis scores ($p=0.275$) between the two groups. Another study by Gaetti-Jardim *et al.* (2009) reported that patients with underlying cardiovascular disease and chronic periodontitis showed higher mean plaque score (60.5 ± 15.4), gingivitis score (61.0 ± 22.5), probing pocket depth (5.4 ± 1.4) and clinical attachment loss (5.7 ± 2.8) compared to periodontally healthy subjects with mean plaque score (51.5 ± 12.5), gingivitis score (17.58 ± 13.4), probing pocket depth (1.55 ± 0.21) and clinical attachment loss (1.75 ± 0.22). These results indicate there is a relationship between cardiovascular disease and periodontitis.

In this study, we found that there is a significant difference of clinical attachment loss for hypertensive patients with CP ($P=0.012$). Since there is no significant difference in the periodontal pocket depth, this might be due to high occurrence of gingival recession in hypertensive CP patients. Shimazaki *et al.* (2007) observed the relationship between periodontitis

and 5 components of the metabolic syndrome (abdominal obesity, triglyceride level, high-density lipoprotein cholesterol level, blood pressure and fasting blood sugar level) in 584 Japanese women. They found that patients presented with 4 or 5 components of metabolic syndrome showed significantly higher odds ratios for a greater pocket depth (6.6; 95%CI=2.6-16.4) and clinical attachment loss (4.2; 95%CI=1.2-14.8). In addition, several studies (Gołbiewska *et al.*, 2006; Holmlund *et al.*, 2006; Engström *et al.*, 2007) reported that hypertensive subjects exhibited a more detrimental periodontal status compared to control subjects.

In conclusion, this present study highlighted a possible relationship between hypertension and periodontal status. However, the underlying mechanism has to be further investigated in a different study design, thus more conclusive findings would be elucidated.

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