

# Periodontal status in hypertensive patients at Hue University of Medicine and Pharmacy Hospital

Tran Tan Tai<sup>1\*</sup>, Doan Thi Van Khanh<sup>1</sup>, Ho Sy Minh Duc<sup>1</sup>, Nguyen Thi Thuy Hang<sup>2</sup>

(1) Faculty of Odonto-Stomatology, University of Medicine and Pharmacy, Hue University, Vietnam

(2) Department of Cardiology, Hue University of Medicine and Pharmacy Hospital, Vietnam

## Abstract

**Background:** Hypertension is one of the major causes of cardiovascular diseases in the world. Periodontal disease is a chronic inflammatory disorder of the tissues surrounding the teeth. 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 periodontitis patients. **Subjects and Method:** A cross-sectional study of 100 hypertensive patients who visited the Department of Cardiology at the Hue University of Medicine and Pharmacy Hospital. Clinical examination of periodontal indices and interview about the history of hypertension for all study subjects. **Results:** Average results of periodontal indices of hypertensive patients are: plaque index (PII)  $1.83 \pm 0.44$ , gingival index (GI)  $1.20 \pm 0.39$ , periodontal pocket depth (PPD)  $2.72 \pm 0.42$  mm, clinical attachment loss (CAL)  $2.03 \pm 1.50$  mm; The rate of periodontitis in hypertensive patients is 74% with proportion of moderate, severe and mild level are 34%, 26% and 13% respectively; duration of hypertension and periodontal indices of the patients are also positively correlated ( $p < 0.05$ ). There was a statistically significant relationship between periodontal status and blood pressure index ( $p < 0.05$ ). **Conclusion:** There is a possible association between periodontal disease and hypertension. Therefore, further investigation is recommended thus will help in managing oral and systemic health diseases.

**Key words:** hypertension, periodontal diseases, oral health.

## 1. INTRODUCTION

Hypertension, defined as values  $\geq 140$  mmHg systolic blood pressure (SBP) and/or  $\geq 90$  mmHg diastolic blood pressure (DBP), is the most common of all cardiovascular diseases worldwide. as well as in Vietnam [1]. According to the Global Burden of Disease Study (2016), severe periodontal disease was the 11<sup>th</sup> most prevalent condition in the world [2]. Periodontitis (PD) is a chronic inflammatory disease caused by a dysfunctional microbiome that leads to the gradual destruction of the tissues surrounding the teeth and leading to tooth loss. Periodontitis may contribute to inflammatory endothelial dysfunction, it has been identified as a risk factor for cardiovascular diseases. In recent years, many studies have shown that periodontitis is associated with hypertension [3 - 5]. Aguilera EM et al (2020) systematically searched for articles published up to 2018, from 81 studies selected, 40 were included in quantitative meta-analyses, showing a positive association between periodontitis and hypertension. The authors note that patients with moderate to severe periodontitis had a higher prevalence of hypertension than patients without periodontitis. In

addition, prospective studies confirmed PD diagnosis increased likelihood of hypertension occurrence [6].

Currently, in Vietnam, there are few data on the association between periodontal disease and hypertension. The prevention and treatment of periodontal disease for this subject has not been paid enough attention. The aim of this study was to:

- To investigate periodontal status in hypertensive patients through indicators: plaque index (PII) gingival index (GI), periodontal pocket depth (PPD) and clinical attachment loss (CAL).

- To find out the relationship and correlation between periodontal indices with the degree of hypertension, duration of disease and some risk factors in hypertensive patients.

## 2. SUBJECTS AND METHODS

### 2.1. Research subjects

The study sample included 100 patients diagnosed with hypertension for at least 1 year, diagnostic criteria according to the Vietnam National Cardiology Association in 2018. Diagnosis of hypertension when measuring blood pressure in the clinic has a SBP  $\geq 140$  mmHg and/or a DBP

≥ 90 mmHg [1]; having no antibiotic treatment in 3 months before participating in the study, no anti-inflammatory and antioxidant drugs; having at least 10 teeth on 2 jaws; having no periodontal treatment within 6 months up to the time of the study.

We excluded pregnant or breastfeeding, patients with mental illness.

All patients agreed to participate in the study and signed the research form.

## 2.2. Research methods

- Study design: A cross-sectional descriptive study was carried out at the Department of Cardiology, Hue University of Medicine and Pharmacy Hospital from October 2019 to March 2020.

- Sample size: for a cross-sectional survey, the appropriate sample size calculation formula is:

$$n = Z^2_{1-\alpha/2} \frac{p(1-p)}{\Delta^2}$$

We chose the rate of periodontitis in hypertensive patients to be 52.15% according to the study by Davide Pietropaoli in 2018 in the United States (7), the probability of type I error  $\alpha$  is 5%, absolute accuracy  $d$  is 0.1. Substituting  $p = 0.5215$ ,  $d = 0.1$ ,  $\alpha = 5\%$  corresponding to  $Z(1-\alpha/2) = 1.96$  into the above formula, we get  $n = 95$ .

This is the minimum sample size, our study surveyed 100 patients.

- Specific method:

+ Receiving patients diagnosed with hypertension from Department of Cardiology, then conducting patient screening according to exclusion criteria.

+ Making examination forms with information collected from medical records, interview records:

Age, sex, duration of hypertension, blood pressure classification, oral care behavior, smoking, alcohol consumption, adherence to treatment.

+ Examining the clinical features of periodontal tissue: gingival index (GI), plaque index (PII), periodontal pocket depth (PPD), clinical attachment loss (CAL) of study subjects. The criteria for evaluating the above indicators are according to Truong Manh Dung, Ngo Van Toan (2013) [8].

+ Diagnosis of periodontitis: based on oral examination, each subject was diagnosed and graded periodontitis according to the Centers for Disease Control and Prevention (CDC) and the American Academy of Periodontology (AAP) (9). Periodontitis was classified as mild, in the presence of at least 2 interproximal sites with clinical attachment loss (CAL) ≥ 3 mm and at least 2 interproximal sites with probing depth (PD) ≥ 4 mm (not on the same tooth) or 1 site with PD ≥ 5 mm; moderate, defined as at least 2 interproximal sites with CAL ≥ 4 mm (not on the same tooth) or at least 2 interproximal sites with PD ≥ 5 mm (not on the same tooth); and severe, defined as having at least 2 interproximal sites with CAL ≥ 6 mm (not on the same tooth) and at least 1 interproximal site with PD ≥ 5 mm [9].

## 2.3. Data analysis

Data were analyzed using the software SPSS version 20. Describe the data using frequency, percentage, mean and standard deviation. Using  $\chi^2$  test to compare 2 or more ratios and Spearman correlation to determine the correlation coefficient between two variables. A  $p$  value < 0.05 was considered statistically significant for the observed associations or differences.

## 3. RESULTS

### 3.1. Periodontal status in study subjects

#### 3.1.1 General characteristics of study subjects

Table 1. Main characteristics of participants

Characteristics		n	%
Age group	≤ 50	8	8%
	51 - 60	15	15%
	> 60	77	77%
Sex	Male	45	45%
	Female	55	55%
Disease duration of hypertension	< 5 years	50	50%
	5 – 10 years	36	36%
	> 10 years	14	14%

<b>Grade of hypertension</b>	Grade 1	7	7%
	Grade 2	33	33%
	Grade 3	60	60%

The age group over 60 accounts for a high percentage of 77%. The proportion of men is 45%, lower than that of women (55%). The duration of hypertension accounted for a high proportion in the group < 5 years. Patients with grade 3 hypertension accounted for the majority (60%).

### 3.1.2. Periodontal indicators of hypertensive patients

**Table 2.** Average periodontal indices of hypertensive patients

Index	Value (mean $\pm$ standard deviation)
PII	1.83 $\pm$ 0.44
GI	1.20 $\pm$ 0.39
PPD (mm)	2.72 $\pm$ 0.42
CAL (mm)	2.03 $\pm$ 1.50

### 3.1.3. Prevalence and severity of periodontitis in hypertensive patients

**Table 3.** Prevalence and severity of periodontitis in hypertensive patients

Periodontal Status	n	%
Non-Periodontitis	26	26%
Mild Periodontitis	14	14%
Moderate Periodontitis	34	34%
Severe Periodontitis	26	26%

Moderate and severe periodontitis accounts for a high percentage of hypertensive patients.

## 3.2. Relationship, correlation between periodontal indicators with the degree of hypertension, disease duration and some risk factors in hypertensive patients

### 3.2.1. Regarding blood pressure level and periodontal condition

**Table 4.** Distribution of periodontitis rate according to the degrees of hypertension

Periodontal status	Degrees of Hypertension			p
	Grade 1	Grade 2	Grade 3	
Number of periodontitis patients (%)	2 (28.6)	17 (51.5)	55 (91.7)	p<0.05 ( $\chi^2$ Test)
Number of non-periodontitis patients (%)	5 (71.4)	16 (48.5)	5 (8.3)	
Total	7 (100)	33 (100)	60 (100)	

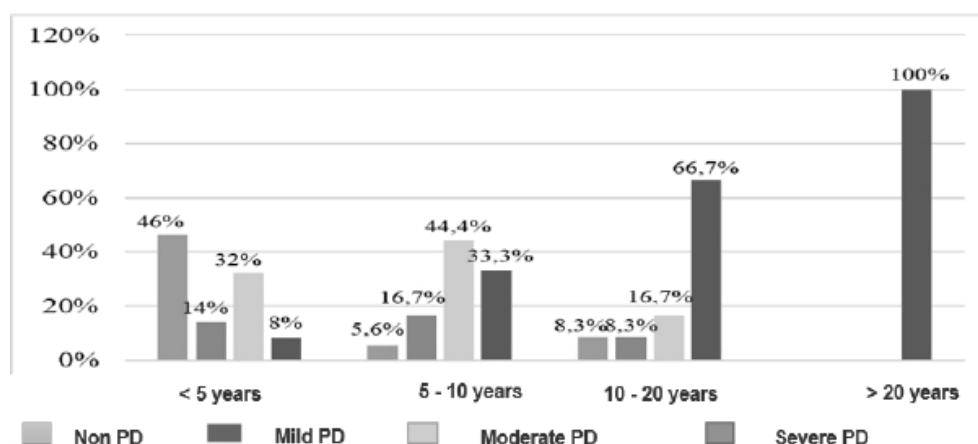
In the group of grade 3 hypertension, the rate of periodontitis accounts for 91.7%. The rate of non-periodontitis is highest in the group of grade 1 hypertension (71.4%). The distribution of periodontitis rate according to the degree of hypertension has a statistically significant difference (p<0.05).

### 3.2.2. Regarding disease duration and periodontal indicators

**Table 5.** Correlation between duration of hypertension and periodontal status

Periodontal status	Duration of Hypertension	
	Correlation coefficients	p
PII	0.523	< 0.05
GI	0.542	< 0.05
PPD	0.585	< 0.05
CAL	0.453	< 0.05
Degree of Periodontitis	0.573	< 0.05

The duration of hypertension and the periodontal indices of the patients are positively correlated with statistical significance ( $p < 0.05$ ).



**Figure 1.** Degree of periodontitis with duration of hypertension

### 3.2.3. Risk factors related to periodontal status of hypertensive patients

**Table 6.** Multivariable analysis of relationship between periodontal disease and some risk factors

Risk factor	OR and confidence interval 95%	p
Brushing teeth <2 times per day	14.286 (4.842 – 42.151)	<0.001
Not having dental check-up	3.981 (1.490 – 10.639)	<0.01
Smoking	0.679 (0.585 - 0.789)	0.998
Drinking alcohol	0.610 (0.185 – 2.014)	0.417
Duration of hypertension more than 5 years	13.346 (3.663 – 48.621)	<0.001
Having hypertension treatment	1.524 (0.468 – 4.965)	0.485
Taking medicine regularly	2.250 (0.747 – 6.773)	0.149
Hypertension	2.846	<0.01

Significant risk factors are: brushing habits, not having dental check-up, hypertension duration over 5 years, hypertension.

## 4. DISCUSSION

### 4.1. Periodontal status of hypertensive patients

Table 2 shows the average plaque index (PII) is  $1.83 \pm 0.44$ , the lowest value is 0.91 and the highest value is 3.00. This suggests that oral hygiene is poor in hypertensive patients. Our results are lower than those of Leye M et al ( $1.9 \pm 0.59$ ) [10], higher than those of Amougou SN ( $1.54 \pm 0.7$ ) [3]. However, this difference is not too large compared to our study.

Poor oral hygiene has results in unhealthy gums of hypertensive patients. The gingival index (GI) assessing gingivitis of hypertensive patients in this study is  $1.20 \pm 0.39$ . Compared with other studies, our average gingival index (GI) is lower than that of Leye M et al ( $1.5 \pm 0.485$ ), Amougou SN ( $1.89 \pm$

0.2) [3, 10]. The comparison is only relative because the diet, habits and oral hygiene awareness in each country and locality are different, leading to different plaque and gum indexes. In general, oral hygiene in hypertensive patients is not good, this leads to poor gingival health of hypertensive patients.

Periodontal pocket depth (PPD) and clinical attachment loss (CAL), used in our study to classify the degree of periodontitis. The average PPD index is  $2.72 \pm 0.42$  mm and average CAL index is  $2.03 \pm 1.50$  mm. This result is lower than that of Nguyen Thi Ngoc Nho (2016) studied on 130 hypertensive patients aged 35-70 years old in Can Tho and showed that: average PPD was  $4.37 \pm 0.46$ ; average CAL was  $2.73 \pm 1.11$  mm (11); M Leye (2014) with 123 hypertensive patients in Senegalese, average PPD:  $2.1 \pm 0.227$ , CAL:  $2.8 \pm 1.859$  [10].

In our study, the rate of periodontitis in hypertensive patients is 74% (Table 3). This result is lower than the study of Nguyen Thi Ngoc Nho (100%)

[11], Majdiah WM et al (100%) [12] and higher than the study of Leye M (5.7%) [10], Pietropaoli et al (52.18%) [7]. Average rate of periodontitis was lower but the rate of severe periodontitis and mild periodontitis was higher than in the above studies. Differences in the prevalence and extent of periodontitis can arise from many different causes: criteria for assessing periodontal disease, differences in sample size, local population characteristics, race and health care conditions. Most of the patients with hypertension in our study are elderly, have poor oral hygiene skills and awareness, and are often more concerned with their overall health than oral hygiene.

According to Tsioufis C et al (2011), Epidemiological evidence also supports a potential association of periodontitis with increased blood pressure levels and the incidence of hypertension. Furthermore, data from cross-sectional studies suggest that in hypertensive subjects, periodontitis may increase the risk and severity of end-organ damage [13].

#### **4.2. Relationship, correlation between periodontal indicators with the degree of hypertension, disease duration and some risk factors**

##### **4.2.1. Regarding the degree of hypertension**

Table 4 shows that the rate of periodontitis accounted for 91.7% in the group of grade 3 hypertension, the rate of non-periodontitis is highest in the group of grade 1 hypertension (71.4%). The distribution of periodontitis rate according to the degree of hypertension has a statistically significant difference ( $p < 0.05$ ). In the study of Aguilera EM et al (2020), periodontitis patients had higher mean SBP of 4.49 mmHg (95% CI: 2.88-6.11) and DBP 2.03 mmHg (95% CI: 1.25-2.81) when compared with no periodontitis [6]. Hypertension causes adjustment in the blood vessels, in the gums; changes in the small blood vessels make it fragile, thus susceptible to bacterial infection [4]. Several studies have reported that periodontal pathogens especially *Porphyromonas gingivalis* and *Actinobacillus actinomycetemcomitans* can be found in atheroma. Endothelial cell damage and smooth muscle cell proliferation lead to adverse changes in vascular function [14]. Knowing the effect of plaque on the progression of hypertension, it is possible to explain the increase in blood pressure values simultaneously with plaque index and gingival index.

##### **4.2.2. Regarding the correlation with the duration of the disease**

Table 5 shows a moderately positive linear correlation between PPD, CAL and duration of hypertension. This correlation may be the result of multiple inflammations or a gradual increase in damage due to poor oral hygiene, or a change in the organism's response or plaque composition [3, 14]. The time-dependent pathogenesis of hypertension provides biological plausibility for the hypothesis of an association between periodontal tissue damage and hypertension [3]. From the above results, it can be concluded that the duration of hypertension is positively correlated with the periodontal status of the patient.

##### **4.2.3. Regarding the correlation with some risk factors**

The multivariate analysis as shown in Table 6 shows that the factors that really have a strong impact on periodontal status in hypertensive patients were: having good oral hygiene (OR=14.286, 95%CI =4.842 – 42.151), not having regular dental check-ups (OR=3.981 95%CI = 1.490 – 10.639) and having the disease for more than 5 years (OR=13.346 95%CI = 3.663 – 48.621). The study also shows that people with hypertension had a 2.846 times higher risk of periodontitis ( $p < 0.05$ ). Many studies also recorded that subjects with good oral care daily and annual dental visits had lower rates of periodontitis than those who did not take good oral care and did not have annual dental examinations [7, 15]. Oral care habits, including regular brushing and regular dental visits, can reduce the risk of periodontitis and a good periodontal health is associated with a better SBP profile during antihypertensive therapy by about 2.3 to 3 mm Hg and with lower odds of treatment failure [14].

In immunology field, there is much evidence that hypertension and periodontitis are closely related through the same immune mechanism [15]. However, in clinical practice, periodontitis and hypertension are two diseases influenced by many risk factors such as smoking, obesity, diet or systemic diseases such as heart disease, diabetes. These factors co-exist in tandem, with a complex influence on human health. One factor may have a stronger effect than the other, thereby reducing, or even altering, the effects of another factor [4, 16]. Therefore, in order to accurately determine the two-way relationship between periodontal disease and hypertension, it is necessary to continue to conduct studies with larger sample sizes with multivariate analysis, longitudinal studies, and clinical trials, the study sample is more homogeneous.

## 5. CONCLUSION

The prevalence of periodontitis is quite high in hypertensive patients. There is a possible association between periodontal disease and hypertension. The duration of hypertension, the degree of hypertension and the periodontal indices of the patients are

positively correlated with statistical significance. Significant risk factors for periodontitis are: brushing habits, not having regular dental check-ups, disease duration over 5 years, hypertension.

Therefore, further investigation is recommended thus will help in managing oral and systemic health diseases.

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