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Periodontitis associated with bronchial asthma in peruvian adult patients: a cross-sectional study

Fiorella Stefanie Bazán-Tejeda[1], Angel Steven Asmat-Abanto[1,2], Gilmar Roberto Mejía-Sánchez[2], Carlos Alberto Minchón-Medina[3], Oscar Martín Del Castillo-Huertas[1]

[1]Stomatology Study Program, Universidad Privada Antenor Orrego, Trujillo, Peru
[2]Human Medicine Study Program, Universidad Privada Antenor Orrego, Trujillo, Peru
[3]Faculty of Physical Sciences and Mathematics, Universidad Nacional de Trujillo, Trujillo, Peru

Fiorella Stefanie Bazán-Tejeda **ORCID ID:** 0009-0005-6617-2432
Angel Steven Asmat-Abanto **ORCID ID:** 0000-0001-5726-6692
Gilmar Roberto Mejía-Sánchez **ORCID ID:** 0000-0002-1998-149X
Carlos Alberto Minchón-Medina **ORCID ID:** 0000-0002-2441-5302
Oscar Martín Del Castillo-Huertas **ORCID ID:** 0000-0003-0913-6361

ABSTRACT

Objective. This study aimed to determine the relationship between periodontitis and bronchial asthma (BA).

Material and methods. This cross-sectional observational study was carried out with 96 adult patients diagnosed with BA and 96 patients with other respiratory diseases, treated at the pulmonology service of the "Víctor Lazarte Echegaray" - ESSALUD Hospital, Trujillo (Peru), between September and October 2023. Inter- and intra-rater reliability was determined concerning the presence and severity of periodontitis, and a specialist physician determined the diagnosis of BA and its severity. The results were analyzed using the Chi-square test and logistic regression, considering the significance level of $p < 0.05$.

Results. Periodontitis was associated with BA (p=0.000). This association was also found in both sexes (p=0.000) and in patients over 40 years of age (p=0.000). Furthermore, periodontitis severity was associated with the use of corticosteroids in asthmatic patients (p=0.000). On the other hand, no difference was found in the frequency of periodontitis according to sex (p=0.215) or between patients aged 20-40 years and those over 40 of age (p=0.829).

Conclusions. Patients with moderate and severe BA tend to present more severe periodontitis. Furthermore, periodontitis was associated with BA in both sexes, those over 40 years of age, and those asthmatic patients who received corticosteroids. On the other hand, no difference was found in the frequency of periodontitis according to sex or age.

Keywords: periodontitis, asthma, glucocorticoids, immune system

INTRODUCTION

Worldwide, periodontitis and bronchial asthma (BA) are the oral and respiratory diseases with the greatest epidemiological impact, respectively [1,2].

Periodontitis is a multifactorial chronic disease characterized by the gradual destruction of periodontal tissues due to complex dynamic interactions between specific bacteria, host immune responses, and environmental factors [3-5]. Its diagnosis requires a comprehensive evaluation of the periodontium, which includes various clinical parameters such as depth and bleeding on probing, furcation involvement, tooth mobility, and alveolar bone loss [6].

BA is a syndrome that presents a variety of clinical phenotypes with similar symptomatology. It is characterized by the chronic inflammation of the airways, in which several cells and inflammation mediators are involved, generating airflow obstruc-

Corresponding author:
Angel Steven Asmat Abanto
E-mail: aasmat.abanto@gmail.com

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tion, which can be partial, reversible, or total [7,8]. This syndrome generally begins in childhood but can manifest at any stage of life. From childhood to adolescence, the prevalence increases in the male population, while in females, cases are observed from the fifth decade of life. Likewise, other factors such as genetics, obesity, tobacco consumption, and perinatal characteristics influence its development [7,9-13].

It must be taken into consideration that the severity of BA implies both the intensity of the process and the response to treatment [7,14]. Its most common manifestations are wheezing, cough, dyspnea, and chest tightness [15].

The pharmacological treatment of BA includes inhaled corticosteroids (ICS), the first line for moderate or severe BA, and non-corticosteroid drugs for mild BA. The latter is subdivided into short-acting beta-2 agonist bronchodilators (SABA), short-acting muscarinic agonistic bronchodilators (SAMA), long-acting beta-2 agonist bronchodilators (LABA), and long-acting muscarinic agonistic bronchodilators (LAMA). Inhaled SABA and SAMA are characterized by being short-acting drugs, while LABA and LAMA have long-lasting effects [16,17].

The possible association between periodontitis and BA may be due to the pathological activation of the immune and inflammatory process, the side effects of asthma medications, or the interaction between them. Furthermore, asthmatic patients are characterized by mouth breathing, reducing salivary flow and its protective effect, which can promote interaction between immunological and bacterial factors, causing low salivary immunoglobulin A concentration. As a consequence, the use of drugs, such as ICS or bronchodilators, could lead to a significant impact on the development and progression of periodontitis [18,19].

Studies on this topic in South American countries are necessary because the vast majority of studies that have analyzed the association between periodontitis and BA were carried out in continents of Europe and Asia, and this association could vary depending on race, genetic factors, and sociodemographic factors of the study location [20]. This study aimed to determine the association between periodontitis severity and BA in Peruvian adults who attend outpatient pulmonology consultations. The results presented are important for dentists and pulmonologists so that joint multidisciplinary work can be carried out to improve the quality of life of these patients.

MATERIAL AND METHODS

The present study has a cross-sectional observational design and was developed at the "Víctor Lazarte Echegaray Essalud" Hospital (Trujillo, Peru) between September and October 2023.

The sample comprised 192 patients, 96 with the diagnosis of BA and 96 with the diagnosis of a respiratory disease other than BA. The sample size was calculated using the formula for group comparison, using data generated through a pilot study carried out with 40 individuals and with the following parameters: n1 (Number of patients without BA), n2 (Number of patients with BA), k=1 (Number of patients without BA per patient with BA), α=0.05, β=0.05, $z\alpha/2$=1.96 (Normal value with type I error of 5%), $z\beta$=1.645 (Normal value with test power of 95%), p1=0.05 (Prevalence of severe periodontitis in patients without BA, according to a pilot study), p2=0.45 (Prevalence of severe periodontitis in patients with BA, according to a pilot study), ε=0.20 (Expected difference in the prevalence of severe periodontitis between patients with and without BA). The selection method was non-probabilistic for convenience.

Patients included in the study were adults aged 20 years or older who attended the outpatient pulmonology services of the hospital mentioned above. Patients who presented pneumonia, chronic obstructive pulmonary disease, additional systemic diseases concerning respiratory diseases, and those who did not agree to participate in the study were excluded.

To carry out this work, approval was obtained from the Faculty of Human Medicine (Res. No. 2597-2023-FMEHU-UPAO) and the Bioethics Committee of the Universidad Privada Antenor Orrego (Res. Bioethics Committee No. 0652- 2023-UPAO), as well as the Training Directorate of the La Libertad Assistance Network – ESSALUD (PI No. 135 CIYE-O.C.I.Y. D-RALL-ESSALUD-2023), observing compliance with principles established in the Declaration of Helsinki adopted by the 18th World Medical Assembly and the General Health Law of Peru No. 26842.

Before requesting participation, all patients received information about the research purpose. Upon acceptance, patients were given the informed consent form to be read and signed. A specialist physician determined the diagnosis of BA and its severity through clinical examination and spirometry. Respiratory diseases other than bronchial asthma were diagnosed in the same way. Subsequently, the main author evaluated the presence of periodontitis according to the CDC/AAP classification(3), taking into account the following criteria: absence of periodontitis/mild periodontitis (two or more interproximal sites with clinical attachment loss ≥ 3 mm or with probing depth ≥ 5 mm), moderate periodontitis (two or more interproximal sites with clinical attachment loss ≥ 4 mm or with two or more proximal sites with probing depth ≥5 mm) or severe perio-

dontitis (two or more interproximal sites with clinical attachment loss ≥6 mm and one or more interdental sites with probing depth ≥5 mm). The Hu-Friedy PCPUNC15 periodontal probe was used for this measurement, and 6 sites per tooth were recorded.

The reliability of the method for measuring periodontitis was determined after training with 12 patients through intra- and inter-rater calibration of the main researcher with a dental surgeon specialized in Periodontics and teacher of the Stomatology Study Program at the "Antenor Orrego" Private University (Trujillo, Peru). Kappa coefficient equal to 1 was obtained in both calibrations.

According to the study objectives, collected data were processed automatically using the IBM SPSS Statistics 26.0 statistical software (IBM, Armonk, NY, USA). The association between periodontitis and BA was determined using the chi-square test of independence of criteria, reporting odds ratio (OR). In addition, the association between periodontitis and associated factors was evaluated using binary logistic regression. A significance level of $p < 0.05$ was considered.

RESULTS

The present study was conducted at the Pulmonology Service of the "Víctor Lazarte Echegaray" Hospital in Trujillo (Peru) between September and October 2023. Overall, 96 patients with BA (average age of 68.8 ± 15.2 years) were evaluated, of which 57 (59.4%) were female and 39 (40.6%) were male. In addition, 96 patients were evaluated with a diagnosis of respiratory diseases other than asthma (average age of 65.5 ± 12.6 years), of which 55 (57.3%) were female and 41 (42.7%) were male.

Table 1 shows the association between periodontitis and BA (p=0.000). A high frequency of moderate periodontitis was found in patients with moderate BA (77.8%) and severe periodontitis in patients with severe BA (75.9%). This finding indicates a tendency to present greater periodontitis severity as the BA severity increases, with a positive correlation of 0.608 between variables (p=0.000).

Table 2 shows the association between periodontitis and BA according to sex and age. In both sexes, an association was observed between variables under study (p=0.000). In asthmatic patients, both sexes more frequently presented moderate (49.1% female and 46.2% male) and severe periodontitis (36.8% female and 33.3% male) and, in patients without BA, mild (58.2% female and 34.1% male) or moderate periodontitis (23.6% female and 39.0% male) was observed. Furthermore, it was observed that patients aged 20-40 years with BA mostly presented moderate periodontitis (75%), and in patients without BA, the absence of periodontitis was more common (75%). However, a statistical test was not performed in this group due to the small number of patients (only 8). In asthmatic patients aged over 40 years, moderate (46.7%) and severe (37%) periodontitis was predominantly found, and in patients without BA, mainly cases of mild (48.9%) and moderate (31.5%) periodontitis. In the last group, the association between periodontitis and BA was also evident (p=0.000).

In Table 3, according to the use of corticosteroid therapy in asthmatic patients, an association was also found between the main study variables (p=0.000). Furthermore, a higher prevalence of moderate (51.9%) and severe (40.3%) periodontitis was found in patients who received this treatment compared to those who did not, with a higher frequency of mild periodontitis (52.6%) being reported in the latter group.

Table 4 shows the implementation of the multivariate analysis to verify the relationship between periodontitis and associated factors, considering the presence or absence of BA (model 1) and its classification (model 2). In the first model, adjusted for covariates, no difference was found in the presentation of periodontitis in females compared to males (p=0.215) or in patients aged 20-40 years compared to those over 40 years (p=0.829). Still, there is a tendency for patients with BA to present more severe periodontitis (p=0.000). Model 2, as well as model 1, did not establish differences according to the sex

TABLE 1. Association between periodontitis and bronchial asthma in adult patients who attended the pulmonology service

Asthma classification	Periodontitis								Total	X^2	p
	No		Mild		Moderate		Severe				
	N	%	N	%	N	%	N	%			
No asthma	18	18.8	46	47.9	29	30.2	3	3.1	96		
Asthma	4	4.2	12	12.5	46	47.9	34	35.4	96	58.667	0.000
Mild	0	0.0	12	54.5	7	31.8	3	13.6	22		
Moderate	1	2.2	0	0.0	35	77.8	9	20.0	45		
Severe	3	10.3	0	0.0	4	13.8	22	75.9	29	132.78	0.000
Total	22	11.5	58	30.2	75	39.1	37	19.3	192		

X^2: Chi-square test of independence of criteria

TABLE 2. Association between periodontitis and bronchial asthma in adult patients who attended the pulmonology service, according to sex and age

Group		Periodontitis										
		No		Mild		Moderate		Severe				
		No	%	No	%	No	%	No	%	Total	X^2	p
Sex												
Female	Asthma	2	3.5	6	10.5	28	49.1	21	36.8	57		
	No asthma	8	14.5	32	58.2	13	23.6	2	3.6	55		
	Total	10	8.9	38	33.9	41	36.6	23	20.5	112	42.551	0.000
Male	Asthma	2	5.1	6	15.4	18	46.2	13	33.3	39		
	No asthma	10	24.4	14	34.1	16	39.0	1	2.4	41		
	Total	12	15.0	20	25.0	34	42.5	14	17.5	80	18.899	0.000
Age												
20-40 years	Asthma	0	0.0	1	25.0	3	75.0	0	0.0	4		
	No asthma	3	75.0	1	25.0	0	0.0	0	0.0	4		
	Total	3	37.5	2	25.0	3	37.5	0	0.0	8		
>40 years	Asthma	4	4.3	11	12.0	43	46.7	34	37.0	92		
	No asthma	15	16.3	45	48.9	29	31.5	3	3.3	92		
	Total	19	10.3	56	30.4	72	39.1	37	20.1	184	55.706	0.000

X^2: Chi-square test of independence of criteria

TABLE 3. Association between periodontitis and pharmacological treatment with corticosteroids in adult patients with asthma who attended the pulmonology service

Pharmacological treatment	Periodontitis								Total	X2	p
	No		Mild		Moderate		Severe				
	No	%	No	%	No	%	No	%			
Corticosteroids	4	5.2	2	2.6	40	51.9	31	40.3	77		
No corticosteroids	0	0.0	10	52.6	6	31.6	3	15.8	19		
Total	4	4.2	12	12.5	46	47.9	34	35.4	96	35.404	0.000

X^2: Chi-square test of independence of criteria

TABLE 4. Factors associated with periodontitis in adult patients who attended the pulmonology service

Model			Coefficient	Standard error	Wald	p
Model 1	Threshold	Periodontitis				
		Moderate	1.474	0.283	27.129	0.000
		Mild	-0.359	0.256	1.956	0.162
		No periodontitis	2.139	0.304	49.491	0.000
	Location	Asthma	1.544	0.287	29.029	0.000
		Sex: Female	-0.338	0.273	1.536	0.215
		Age: 20-40	-0.146	0.674	0.047	0.829
Model 2	Threshold	Periodontitis				
		Moderate	1.670	0.303	30.343	0.000
		Mild	-0.497	0.264	3.535	0.060
		No periodontitis	2.581	0.350	54.434	0.000
	Location	Asthma				
		Mild	-0.332	0.456	0.531	0.466
		Moderate	1.390	0.355	15.346	0.000
		Severe	3.969	0.526	56.918	0.000
		Sex: Female	-0.411	0.286	2.062	0.151
		Age: 20-40	0.240	0.681	0.124	0.725

Ordinal logistic regression, Wald test

(p=0.151) and age (p=0.725) of patients, but a trend towards more severe periodontitis in patients with moderate (p =0.000) and severe BA (p=0.000) compared to patients without BA.

DISCUSSION

Currently, BA is one of the most prevalent respiratory diseases worldwide. It is characterized by chronic airway inflammation that generates various clinical manifestations, such as cough, wheezing, dyspnea, and chest tightness [7,8]. Asthmatic patients have reduced salivary flow mainly due to mouth breathing, and several studies suggest that this condition can promote negative effects on the periodontium [19,21,22].

In the present study, periodontitis was associated with BA. Similar results were found by Khassawheh et al. [21], Lee et al. [22], Kelly and El. [23], Shen et al. [24], and Gomes et al. [25]. This association may be due to the pathological activation mediated by the immune system, as well as the side effects of anti-asthmatic drugs [21,22]. However, Shah et al. [26] found different results, which could be because the population under study was composed of patients recently diagnosed with BA who did not have previous pharmacological treatment. This last author also indicated that further studies are required. On the other hand, Ferreira et al. [27] found a low level of evidence about the relationship between periodontitis and BA due to the heterogeneity between investigations and methods used.

Evaluating the association between periodontitis and BA according to sex in the present work, a slightly higher percentage of moderate and severe periodontitis was found in females. Similar results were reported by Lee et al. [22], where females presented the highest prevalence of having both pathologies. However, the same author found, through multivariate analysis, that male patients had a higher risk of being diagnosed with periodontitis.

In the present study, no statistical test was carried out in patients aged 20-40 due to the small number of subjects in the sample. On the other hand, in asthmatic patients aged over 40 years, an association between variables under study was observed. According to Nazir et al. [28], this is probably due to frequent poor oral hygiene and lack of oral health promotion in older patients. In addition, the probability of presenting a greater risk of periodontitis may be because aging modifies immunological and inflammatory responses, promoting the destruction of periodontal tissues.

In asthmatic patients, a greater prevalence of moderate and severe periodontitis was found in those under the use of corticosteroid therapy as opposed to those who did not use it. However, Khassawneh et al. [21] reported the opposite, indicating that there was no difference between the use of corticosteroids and non-corticosteroids, possibly due to the different classification of the pharmacological treatment implemented in their study, which was based on regular oral corticosteroids, regular inhaled corticosteroids, and non-corticosteroids. On the other hand, Shen et al. [24] showed that asthmatic patients using corticosteroid therapy had a high prevalence of periodontitis compared to those who did not use corticosteroids. This is possible because inhaled corticosteroids generate a reduction in salivary flow and immunoglobulin A concentration, alteration of the immune response, and increase of immunoglobulin E in the gingival tissue, in addition to greater presence of dental calculus due to the elevation of salivary calcium and phosphorus levels, contributing to poor periodontal health. Additionally, inhaled corticosteroids can decrease bone mineral density.

Multivariate analysis is very useful in research because it allows various variables to be studied together, as well as their effect on each other simultaneously, which is not possible through bivariate analysis; for this reason, to enrich the present study, Wald ordinal logistic regression was performed, finding no difference concerning the periodontitis severity according to the sex and age of patients. However, it was found that patients with severe BA tend to have more severe periodontitis, corroborating results found with the bivariate analysis.

As this is a cross-sectional study, it does not allow analyzing the temporal sequence between variables, which is a limitation. However, the results obtained allowed proposing hypotheses to be investigated in the future through longitudinal analytical studies with higher levels of evidence and larger samples [29].

Based on the results, periodontal evaluation for asthmatic patients should be performed to contribute to the early detection of periodontitis and provide appropriate and timely treatment. In this way, due to the anatomical continuity of the oral cavity with the respiratory system, it would be protected from possible contagion of the microbiome that could alter the immune system and promote the spread of pulmonary infectious [30]. Furthermore, asthmatic patients, when using inhaled corticosteroids, are exposed to greater effects of oral bacteria due to the alteration of the immune system generated by these drugs. Further studies should be conducted, considering other designs and factors contributing to the relationship between periodontitis and bronchial asthma. The authors of this study suggest incorporating appropriate inter-consultation and periodontal care into the clinical care guide for asthmatic patients.

CONCLUSIONS

Patients with moderate and severe BA tend to present more severe periodontitis. Furthermore, this association was also found in both sexes, those over 40 years of age and those asthmatic patients who received corticosteroids. No difference was found in the frequency of periodontitis according to sex or age.

Ethics approvals:
To carry out this work, approval was obtained from the Faculty of Human Medicine (Res. No. 2597-2023-FMEHU-UPAO) and the Bioethics Committee of the Universidad Privada Antenor Orrego (Res. Bioethics Committee No. 0652- 2023-UPAO), as well as the Training Directorate of the La Libertad Assistance Network – ESSALUD (PI No. 135 CIYE-O.C.I.Y. D-RALL-ESSALUD-2023), observing compliance with principles established in the Declaration of Helsinki adopted by the 18th World Medical Assembly and the General Health Law of Peru No. 26842.

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Author´s contributions:
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