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## *Porphyromonas gingivalis*: A scoping review

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### **Abstract**

**Introduction:** *Porphyromonas gingivalis* is a Gram-negative anaerobic bacterium, which is considered a key to the onset of inflammatory conditions affecting the supporting tissues of teeth.

**Objective:** To analyze the literature on the epidemiology, diagnosis, treatment and oral manifestations of *P. gingivalis*.

**Methodology:** Information from articles published in PubMed, Scopus and Google Scholar with the words "*Porphyromonas gingivalis*", "epidemiology", "periodontal disease", "oral manifestations", "treatment" was analyzed.

**Results:** The epidemiology of this pathogen is more than 85% in patients with periodontal disease. The method to diagnose *P. gingivalis* is by ELISA. The best treatment is scaling and root planing with antibiotic or antiseptic adjuvant. It manifests clinically with periodontal disease.

**Conclusions:** *Porphyromonas gingivalis* has a high presence in periodontal disease and predisposes to diseases such as rheumatoid arthritis and Alzheimer's disease.

**Keywords:** *Porphyromonas gingivalis*, periodontal disease, epidemiology, diagnosis, treatment, oral manifestations

### **1. Introduction**

Periodontitis is a chronic inflammatory disease that destroys tooth-supporting tissues and eventually leads to tooth loss, is considered one of the most prevalent oral conditions endangering the oral health of 70% of people worldwide [1]. It was estimated in the United States in 1999, the annual expenditure for the treatment of periodontal disease exceeded millions, and that rate was rising over the years [2].

*Porphyromonas gingivalis* is a gram-negative anaerobic bacterium, it is considered a key to the initiation of inflammatory conditions that affect the supporting tissues of teeth [3]. It alters the balance between oral microbial communities and promotes oral dysbiosis, the dysbiotic state, is different in functional capacities and shows a higher expression of genes involved in synthesis, energy regulation and bacterial motility, transforming into disease [4]. Its virulence factors include mainly proteases, endotoxins and organic acids. Gingipains that promote the invasion of gingival tissue, in addition to inducing an abnormal immune response in the host and causing an imbalance between the host and the microorganisms [5].

It is necessary to update the information about the pathogens that cause periodontal disease, in the present work, the literature on *Porphyromonas gingivalis* was analyzed, particularly its epidemiology, diagnosis, treatment and oral manifestations.

### **2. Materials and Methods**

Information from articles published in PubMed, Scopus and Google Scholar was analyzed, with emphasis on the last 5 years. The quality of articles was evaluated based on the standard guidelines, i.e., identification, review, choice and inclusion. The quality of the review was assessed using the measurement instrument for evaluating systemic reviews. The search was performed using the Boolean logical operators AND, OR and NOT.

It was performed with the words "*Porphyromonas gingivalis*", "periodontal disease", "epidemiology", "oral manifestations", "treatment". The keywords were used individually, as well as each of them related to each other.

### 3. Results and Discussion

#### 3.1 Epidemiology

*Porphyromonas gingivalis*, as black on blood agar, was detected 85.75% in the subgingival plaque of patients with chronic periodontitis [2].

Rheumatoid arthritis is a disease characterized by inflammation and chronic pain of the synovial joints, *P. gingivalis* can cause a potentially fatal inflammatory immune response, in some epidemiological studies have reported that the presence of *P. gingivalis* may increase the prevalence of rheumatoid arthritis [6, 7].

Different studies have concluded that *P. gingivalis* is linked to patients suffering from rheumatoid arthritis, its polysaccharide is found 50% in patients with periodontitis studied [8, 9].

Alzheimer's disease has been shown in different studies to be strongly linked with periodontal disease, as the presence of this disease raises the prevalence of Alzheimer's [10, 11].

*P. gingivalis* has been found in several studies to be associated with systemic diseases such as Alzheimer's disease, in addition to the presence of *P. gingivalis* on the tongue of patients [12-14].

*Porphyromonas gingivalis* is found in more than 80% in periodontal disease patients, the pathogen increases the prevalence of rheumatoid arthritis and Alzheimer's disease.

#### 3.2 Diagnostics

##### 3.2.1 ELISA and indirect fluorescent antibody techniques

These techniques have been tested for the identification of *Porphyromonas gingivalis* in pathologies outside the oral cavity. These techniques are very simple and very specific, they are limited by the small number of antibodies available, they are not adapted to polymicrobial samples [15].

ELISA helps to measure serum protein levels in periodontal tissues in addition to determining the level of oxidative stress in fibroblasts, as well as pathogen detection [16, 17].

##### 3.2.2 Real-time PCR (RT-PCR) and multiplex PCR

There are molecular diagnostic techniques, they do not require culture, as they are able to identify non-culturable bacterial, but they need specific probes and require that the microorganisms studied have been previously sequenced [18-21].

##### 3.2.3 Transposon sequencing

The use of the technology transposon sequencing helps to define the core essential genome of *P. gingivalis* and its involvement for abscess formation, its epithelial colonization and how it becomes more resistant with cigarette nicotine promotion [22].

##### 3.2.4 Increased serum levels of branched-chain amino acids

It can be identified in patients with a disruption of the intestinal microbiome, as it is associated with an increase in serum levels of branched-chain amino acids, which implies in the patient an increase in insulin resistance and an increased risk of cardiovascular disease [23].

##### 3.2.5 Presence in mesenchyme

In a cohort study performed on pregnant patients, the presence

of the pathogen was found within the mesenchyme, inside the placentas of patients [24].

It can be concluded that for practical research purposes the detection of *Porphyromonas gingivalis* by ELISA is effective and the least expensive.

#### 3.3 Treatment

##### 3.3.1 Scaling and root planing (Mechanical removal)

In the non-surgical periodontal treatment, it is composed of a hygienic phase, which is composed of a detartration and oral physiotherapy, which will help to control the dentobacterial plaque. Scaling and root planing is given for periodontitis in stages I to IV. However, it should always be taken into account that some sites in the patient's cavity may present a poor response, due to microbial factors, due to residual subgingival biofilm, maintaining a chronic inflammatory response, which does not resolve unless surgical periodontal therapy is performed [25].

In root planing, dentobacterial plaque and calculus are removed at the subgingival level, with the help of curette, in turn smoothing the root or roots of the affected pieces, also eliminating the cementum diseased by periodontal disease, in this process of eliminating the pathogens involved [26, 27].

##### 3.3.2 Antibiotic and probiotic treatment

Patients who received non-surgical periodontal therapy, plus as an adjuvant antibiotic tool, azithromycin 500 mg once daily for 5 days or the use of probiotics showed a greater reduction in pathogenic microbiota, among them *P. gingivalis* [28, 29].

The use of probiotics, *Lactobacillus reuteri*, is considered as an indirect way for the elimination of *P. gingivalis*, the results indicate a significant improvement in reduction of plaque index and gingival index [30].

##### 3.3.3 Oral antiseptics

The use of polyphenols and flavonoids, from plants of the *Epimedium* species in an *in vitro* study was found to result in inhibition of gingipain activity, and interference of the proliferation of the biofilm formed by *P. gingivalis* [31].

The use of the gold standard antiseptic, chlorhexidine, has demonstrated its effectiveness in eliminating bacterial load, in addition to dentobacterial plaque in patients with periodontal disease by 85%, as well as aiding in the healing process after surgical therapy if used in a period no longer than 15 days [32-34].

##### 3.3.4 Non-thermal atmospheric gas plasma (NTAP)

The use of NTAP plus a mixture of argon gas and oxygen, in an *in vitro* experiment, showed in confocal laser scanning microscopy, a reduction in the bacterial load of *P. gingivalis*, in addition to creating a lower resistance to antibiotics [35].

##### 3.3.5 D-arginine (R), D-methionine (M), D-histidine (H) and D-amino acids (D-AA)

The mixture of these amino acids changed the structure of *P. gingivalis* biofilm and decreased the thickness and integration of its biofilm [36].

The best method for the elimination of *P. gingivalis* proven in patients is scaling and root planing, with the help of an adjuvant tool such as antibiotics or antiseptics.

#### 3.4 Oral manifestations

##### 3.4.1 Inflammatory response, edema and bone resorption

As one of the red complex pathogens, *P. gingivalis* affects the

innate inflammatory response of the host, which results in the loss of periodontal supporting tissues, including the periodontal ligament and alveolar bone<sup>[37]</sup>.

*P. gingivalis* is present mainly in the subgingival pocket and deep periodontal pocket of the human oral cavity. Its pathogenic process involves adherence and colonization of periodontal tissues, followed by nutrient acquisition, proliferation and inflammatory response of the host, accompanied by an increase in gingival fluid temperature and the appearance of bleeding at the patient's gingival margin, accompanied by edema<sup>[5, 38]</sup>. It causes alveolar bone resorption in advanced cases, which can be observed radiographically<sup>[39]</sup>.

### 3.4.2 Gingivitis

Plaque-induced gingivitis is an inflammatory response of the gingival tissues in reaction with plaque accumulation; some of the symptoms that may be present, are edema to probing and brushing, redness and gingival enlargement, but absence of attachment loss, with a BOP score  $\geq 10\%$  to  $\leq 30\%$  is considered localized gingivitis, while generalized gingivitis presents  $> 30\%$ , in addition to not counting any site to probing  $\geq 4$  mm depth<sup>[40, 41]</sup>.

### 3.4.3 Periodontal disease.

Periodontal disease is considered when on clinical probing there are deep pockets greater than 3 mm and active, in addition to already having clinical attachment loss, radiographic evidence of bone loss, tooth mobility and pathological migration<sup>[42]</sup>.

The major oral manifestation of *P. gingivalis* is the presence of dentobacterial plaque, subgingival calculus and periodontal disease.

## 4. Conclusions

*Porphyromonas gingivalis* is considered the key to the onset of periodontal disease, which can be clinically manifested by an inflammatory response, bleeding on probing, periodontal pockets larger than 3 mm, in addition to having a significant loss of supporting tissues of the periodontium, its presence increases the prevalence of diseases such as rheumatoid arthritis and Alzheimer, its early detection by ELISA or other diagnostic method can help for proper treatment, such as scaling and root planing with the help of antibiotics or oral antiseptics.

## 5. Conflict of Interest

Not available

## 6. Financial Support

Not available

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