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PERIODONTAL DISEASE AND NOSOCOMIAL PNEUMONIA: A SYSTEMATIC REVIEW

(PENYAKIT PERIODONTAL DAN PNEUMONIA NOSOKOMIAL: TINAJUAN SISTEMATIS)

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ABSTRACT

This study aims to comprehensively review the literature and assess periodontal disease as a risk factor for nosocomial pneumonia in hospitalized patients, particularly those receiving treatment in the intensive care unit (ICU). Case-control studies and "full texts" published between 2013 and 2023 were the data sources and literature following PRISA-ScR criteria. Online electronic search engines from databases, including PubMed, Cochrane Library, and Google Scholar, were used to conduct the scoping review. Four articles were obtained by carefully choosing papers based on inclusion and exclusion criteria. These were then tallied and examined. In this review, four of the 1741 publications were covered. In patients receiving hospital treatment, particularly in the intensive care unit, there is a strong correlation between periodontal disease and nosocomial pneumonia.

Keywords: biofilm; periodontal; nosocomial pneumonia

ABSTRAK

Studi ini bertujuan untuk melakukan pengkajian literatur secara sistematik dan melakukan evaluasi terhadap penyakit periodontal sebagai faktor resiko pneumonia nosokomial pada pasien yang dirawat di rumah sakit terutama pada unit perawatan intensif (ICU). Sumber data yang dikaji merupakan kasus kontrol dan ''full text'' yang terpublikasi dari tahun 2013-2023. Penelusuran literatur sesuai dengan pedoman (PRISMA-ScR). Scoping review dilakukan dengan menggunakan mesin pencarian elektronik secara online dari basis data: PubMed, Cochrane's Library, Google Scholar. Artikel diseleksi berdasarkan kriteria inklusi dan eksklusi sehingga didapatkan empat artikel yang kemudian dilakukan tabulasi dan analisis. Empat dari 1741 publikasi diikutsertakan dalam tinjauan ini. Terdapat hubungan yang positif antara penyakit periodontal dan pneumonia nosokomial pada pasien yang dirawat di rumah sakit terutama pada ICU.

***Kata kunci**: biofilm; periodontal; pneumonia nosocomial*

INTRODUCTION

Periodontitis is a chronic inflammatory reaction involving periodontal tissue due to specific groups of bacteria resulting in progressive loss of alveolar bone that causes loose teeth and can lead to tooth loss.[1,2] Dental plaque biofilms are the main etiological agents in the occurrence of periodontal disease. It is estimated that every one mm^3 of dental biofilm contains about 100 million bacteria. Oral cavity bacteria involved in periodontal disease are known to have an essential role in causing various systemic diseases, including respiratory tract diseases. The number of biofilms that increase over time and the presence of periodontal pathogens in the patient's biofilms are considered reservoirs of microorganisms associated with pneumonia.[3]

Nosocomial pneumonia is a lung infection that occurs during hospital treatment, develops after 48 hours of hospitalization and does not appear at the time of incubation when admitted to the hospital.[4] 25% of nosocomial pneumonia occurs in the emergency room.[5] Among nosocomial pneumonia, VAP is an infection

that develops in patients admitted to the intensive care unit (ICU).[4] VAP is pneumonia that develops in intubated patients more than 48 hours after initiation of mechanical ventilation and is a significant cause of morbidity and mortality in patients in the intensive care unit (ICU). It is reported that the incidence of VAP reaches 15-60% with a mortality rate of 70%.[5,6] In developing countries, VAP rates vary from 10 to 41.7 per 1000 days of ventilator use and are associated with mortality rates from 24% to 76%.[7,8]

Nosocomial pneumonia has been associated with dental plaque biofilms and oropharyngeal colonization in patients with mechanical ventilation.[9] Studies prove that poor oral hygiene and bacterial colonization in the oropharynx are risk factors for Ventilator Associated Pneumonia (VAP). The use of endotracheal tubes facilitates microaspiration of oropharyngeal secretions towards the lower airway. Studies show the incidence of pneumonia is 7-21 times higher in patients with endotracheal tubes than patients without endotracheal tubes. VAP has been shown to increase the length of care for patients in the ICU to be longer, cause disability, and increase mortality.[6,9]

METHOD

Research methods

A comprehensive literature search was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines. Scoping this review was conducted using electronic search engines online from databases: PubMed, Cochrane's Library, and Google Scholar. The search strategy in electronic databases uses keywords and Boolean operators (AND, AND NOT, OR, OR NOT), which are used to expand or make the search more specific to facilitate the determination of journal articles used. The search strategy for the PubMed and Google Scholar databases was done using the Text Word method: "(((((periodontal disease[Text Word]) OR (periodontitis[Text Word])) OR (chronic periodontitis[Text Word])) AND (pneumonia[Text Word])) OR (nosocomial pneumonia[Text Word])) OR (ventilator-associated pneumonia[Text Word])." All articles to be reviewed are articles and full text published from 2013-2023. The search was conducted by the author in the time range of December 2023 to January 2024.

Eligibility criteria

Inclusion criteria, such as original articles and case-control studies reported clinical outcomes such as risk factors and association between periodontal disease and

nosocomial pneumonia, especially VAP in ICU patients. Articles that are excluded are article reviews.

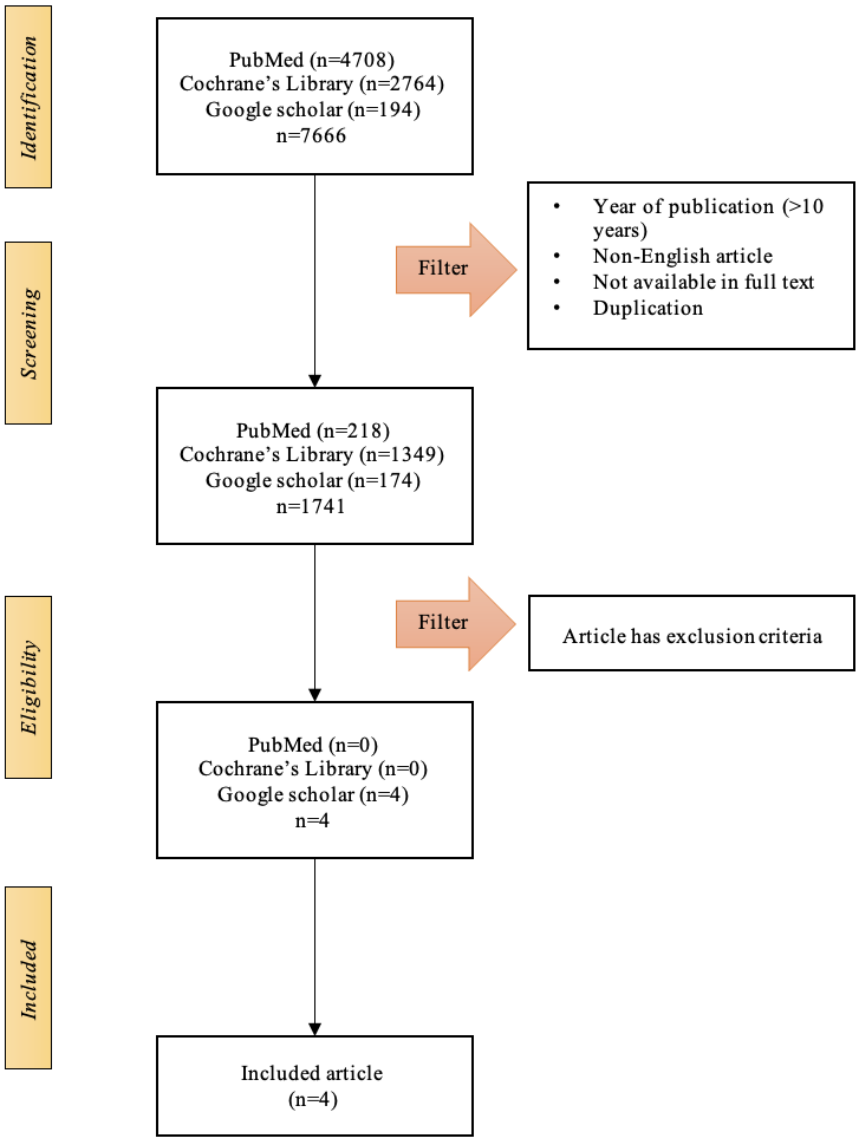

Figure 1. Prisma Flow Diagram

Table 1. Article search strategy in databases

	Specifications
Source	PubMed, Cochrane's Library, Google Scholar.
Keyword and Boolean operator	"(((((periodontal disease[Text Word]) OR (periodontitis[Text Word])) OR (chronic periodontitis[Text Word])) AND (pneumonia[Text Word])) OR (pneumonia nosocomial[Text Word])) OR (ventilator associated pneumonia[Text Word])".
Timeframe	2013-2024

Table 2. Diagnostic criteria for pneumonia and periodontal disease

No	Authors	Diagnostic criteria for pneumonia	Diagnostic criteria for periodontal disease	Result
1	De Marco, et al (2013)	- Not reported	- PDI	PN: 85.7% K: 75% (p=<0.9)
2	Gomes-Filho IS, et al (2014)	- Fluid density or dullness on percussion, crackles on clinical examination of the chest - the appearance of purulent sputum or change in existing features of the sputum at hospital admission - microorganisms isolated from blood cultures - Microorganisms isolated in bronchoalveolar lavage or lung biopsy - histologic evidence of pneumonia - chest radiograph shows a new or progressive infiltration, consolidation, cavitation - pleural effusion	- PD - CAL - BOP - PI	PN: 65.9% K: 38.7% (p=0.00)
3	Almonds CMS, et al. (2017)	- The presence of a recent infiltrate identified in chest radiograph associated with fever - leukocytosis or leukopenia - cough or purulent sputum - bacterial growth in tracheal aspirate culture	- PI - BOP - CAL	PN: 25% K: 12.5% (p=0.22)
4	Son Minkook, et al (2020)	Pneumonia classification based on ICD-10: - (Def. 1) Pneumonia with any prescription of antibiotics - (Def. 2) Pneumonia includes hospitalization for two days or more - (Def. 3) Pneumonia includes hospitalization for seven days or more	- Periodontal status - BOP	(p=0.1906)

PN: nosocomial pneumonia; K: control; PD: *probing depth;* CAL: *clinical attachment level*; PI: plaque index; GI: gingival index; BOP: *bleeding on probing*; PDI: *periodontal disease index;* BAL: *bronchoalveolar lavage*

RESULT

A total of 7666 articles were identified in three electronic databases: PubMed, Cochrane Library, and Google Scholar. Five thousand nine hundred twenty-five articles were not included in the review because they had been published more than ten years ago, there was no full text available, did not use English, and duplication was found. A feasibility assessment was carried out on the article so that four articles were selected that could be

included in this literature review.

The characteristics of the articles included in this review can be seen in Table 1. Each subject of each study was an individual with nosocomial pneumonia, and an individual without pneumonia was used as a control group. The pneumonia diagnosis criteria used are derived from secondary data based on the ICD-10 pneumonia classification and primary data obtained from clinical conditions, findings of microorganisms in blood culture, and other assessments. Periodontal assessment criteria were also evaluated for each research subject, including PD, CAL, BOP, PI, and PDI. The number of study subjects varied from 23 to 122,551 individuals.

The prevalence of periodontitis in patients with nosocomial pneumonia varies up to 85.7%. A study conducted by Gomes-Filho IS et al. (2014) showed a significant difference between individuals with nosocomial pneumonia and individuals without nosocomial pneumonia in relation to the prevalence of periodontitis. The other three studies showed no significant difference in individuals with periodontitis who had nosocomial pneumonia or without nosocomial infection. However, the prevalence of periodontitis was found to be higher in individuals with nosocomial pneumonia than in individuals without nosocomial pneumonia.

DISCUSSION

An analysis has been carried out on four articles included in this literature review. Selected articles are case-controlled, and the articles that are included can clearly describe the criteria for the diagnosis of periodontitis. The four studies included in this literature review had different diagnostic assessment criteria for periodontitis. The diagnosis of periodontitis is based on clinical periodontal parameters such as probing depth, clinical attachment level, and bleeding on probing. Periodontal diagnostic criteria in some studies are based on the gingival index, plaque index, and periodontal disease index. The criteria used in determining the diagnosis of periodontitis have a significant effect on the prevalence of the reported disease. Five studies describe several diagnostic criteria for assessing nosocomial pneumonia, such as clinical conditions, findings of microorganisms in blood culture, BAL, radiographic examination, and histological examination with various supporting examinations. Another study used a diagnosis of pneumonia based on the ICD-10 classification of pneumonia.

Research conducted by Gomes-Filho IS et al. (2014) found that the frequency of periodontitis in patients with nosocomial pneumonia is higher than in patients without nosocomial pneumonia.

Individuals with periodontitis have been shown to be three times more likely to develop nosocomial pneumonia compared to individuals who are not clinically diagnosed with periodontitis.[10]

In a study conducted by Almondes CMS et al. (2017), it was found that patients with VAP showed a higher prevalence of periodontitis compared to the control group even though statistically, there was no significant difference in both.[3] An insignificant difference in pneumonia risk also occurred in a study conducted by Son Minkook et al. (2020) between groups with and without periodontal disease. However, the number of patients with periodontal disease was higher in patients with pneumonia.[11] This is similar to research conducted by De Marco et al. (2013), which proved that there was no statistically significant relationship between the frequency of the presence or absence of periodontal disease in relation to the incidence of VAP.[12]

Four possibilities explain the relationship between the condition of the oral cavity and the respiratory tract: 1) aspiration of oral pathogens either bacteria periodontal disease, respiratory disease, or both; 2) modification of the respiratory tract mucosa so as to promote adhesion and colonization of respiratory pathogens; 3) destruction of salivary pellicles that protect against pathogens by hydrolytic enzymes produced by periodontal pathogens; and 4) the release of cytokines by inflammatory periodontal tissue that may alter the respiratory epithelium and promote colonization of respiratory pathogens.[3,14] Periodontal pathogens are reported to alter the function of bronchial and alveolar epithelial barriers; there is an increase in the expression of matrix metalloproteinase (MMP)-12, which is involved in the disintegration of the alveolar wall, and a decrease in the expression of the claudin one gene and junctional adhesion molecule A (JAM-A) both of which are involved in epithelial construction. In addition, aspiration oral pathogens also increase mucin production in the respiratory lumen, which can then lead to impaired respiratory function. Overall, these changes will further lead to increased susceptibility to respiratory infections.[13] This potential mechanism has been supported and reported by studies showing that changes can occur in the oral microbiome during mechanical ventilation, with colonization of potential pathogens of VAP.[3] One of the routes of infection for VAP is aspiration of secretions from around the endotracheal intubation tube. First, bacteria attach and multiply in the oral cavity and pharynx. Biofilms then form on the teeth, the outer walls of the trachea, and the intubation

tubes. Large amounts of bacteria in this biofilm can then enter saliva or salivary blood, or blood can then be aspirated into the open respiratory tract, accumulate in the intubation tube, and enter the trachea through the gap between the cuff and tracheal wall, and then flow into the peripheral airway.[5,15]

Based on the four articles included in this literature review, the relationship between periodontitis and nosocomial pneumonia is still considered to have limitations. For a detailed explanation of periodontitis and pneumonia, further research with larger populations and samples is needed. The results of this literature review also explain the importance of the role of dental and oral health care providers in the ICU. ICU patients with poor oral health need to be given treatment to reduce the chances of nosocomial pneumonia.

CONCLUSION

This literature review suggests that periodontal disease may be one of the risk factors for the development of pneumonia. Studies show a positive association between periodontal disease and nosocomial pneumonia. Individuals with periodontitis have a higher chance of developing nosocomial pneumonia compared to individuals without periodontitis.

CONFLICT OF INTEREST

The author declared no conflicts of interest or potential commercial background in this research.

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