ORAL HEALTH AS A MAJOR RISK FACTOR FOR RESPIRATORY INFECTIONS

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ABSTRACT

One of the leading causes of death worldwide is represented by the respiratory diseases, which include disorders such as pneumonia, occupational lung diseases, asthma, and chronic obstructive pulmonary disease. Recent published data indicate that, in the European Union in 2017, the disorders of the respiratory system were responsible for almost 8% of all deaths [1].

Pulmonary infections could be caused by the oral colonization of possible respiratory pathogens, a process that can be promoted by the specific bacterial flora of the oral cavity or by periodontal diseases.

Key words: oral care, infection, airways, lung, diseases

INTRODUCTION

As is well-known, the second-largest microbiota in the human body, after the gut, is found in the mouth cavity, which may contain bacteria, fungi, viruses, and archaea [2]. The relationship between an oral-lung aspiration axis and numerous infectious disorders is not well established [3]. Under normal circumstances, the oral cavity, rather than the nasal flora, is likely to represent a significant source of the microbiota in the lungs [4].

The entire respiratory tract should be viewed as a continuous ecosystem that comprises gradients and niches that control microbiome dispersion, retention, survival, and growth from the nasal and oral cavities to the pulmonary alveoli [5].

Neisseria, *Corynebacterium*, *Leptotrichia*, *Streptococcus*, *Prevotella*, *Veillonella*, *Fusobacterium*, and *Capnocytophaga* are the major bacterial genera that are most frequently found in the normal oral cavity [6]. *Streptococcus*, *Fusobacterium*, *Pseudomonas*, *Veillonella*, *Prevotella*, and *Capnocytophaga* are the predominant genera in healthy lungs; they also colonize the oral cavity [7].

The main source of the pulmonary flora (acquired by microaspiration and inhalation) and gastric microbiota (acquired via swallowing) is the oral cavity. In the interconnected aerodigestive system, the lungs and stomach are also potential sites for direct mucosal dispersion of microorganisms from the oral and nasal cavities. The epiglottis acts as a major obstruction to prevent liquids, food, and saliva from entering the trachea and passing to the esophagus. Microaerosols formed in the oral cavity, will also pass through the epiglottis

and be aspirated. In perfect health, swallowing removes a significantly amount of saliva from the mouth (around a liter per day) than microaspiration does [8]. Therefore, the proportion of microbiome immigration from the mouth to the stomach should be much higher than to the airways [4]. According to this study, the overall amount of bacteria in the bronchoalveolar lavage fluid was 100–1,000 times lower than what was reported in the oral rinsing flow. In addition, healthy lungs' microbial pathogens shared many members with the oral cavity, but not the nose.

The majority of oral health disorders can be treated and are mainly avoidable, especially when it comes to young ages. Dental caries, periodontal disorders, tooth loss, and oral malignancies account for the majority of occurrences. Orofacial clefts, noma, and oro-dental trauma are further oral disorders of public health significance. According to the World Health Organisation Global Oral Health Status Report (2022), about 3.5 billion people worldwide suffer from oral diseases, with three out of every four of these individuals residing in middle-income nations. 514 million children worldwide suffer from primary tooth decay, while two billion adults are thought to have permanent tooth decay [9].

MATERIAL AND METHODS

A review of studies published between 2000-2022 which studied the relationship between lung infections and oral health was conducted. This systematic search was performed using the keywords “respiratory infection “and “oral microorganism”. The research was made in the PubMed electronic database by searching for the most relevant published original papers and reviews in English and available in full-text published up to December 2022.

RESULTS

Current scientific data regarding the association between various dental diseases (periodontitis, caries, and plaque) and respiratory infections are inconsistent. As a general note, a large number of patients with infectious respiratory diseases also suffer from oral cavity diseases [10].

In chronic obstructive pulmonary disease (COPD) patients, Azarpazhooh et al. provided poor evidence of association with periodontal disease [11]. However, the authors reveal that effective oral hygiene leads to improved progression and reduced frequency of respiratory disease in adults with risk factors. Similar results were obtained by Sjogren et al. regarding the association with dental plaque [12]. The authors concluded that good oral hygiene reduces the incidence of respiratory diseases and, more particularly, reduces the risk of death from pneumonia.

The association between pneumonia and oral pathology has been investigated in a number of studies suggesting that pathogens in saliva represent a significant risk factor. The study cited above by Azarpazhooh et al. found a direct relationship between dental caries, cariogenic bacteria, dental plaque and the risk of pneumonia [11]. Silvestri et al. revealed that chlorhexidine mouthwash has effects on both gram-positive and gram-negative lung infections [14].

On the other hand, a number of studies have shown that improving oral hygiene through brushing, mechanical scaling or the use of chlorhexidine reduces the risk of pneumonia [12, 13]. In terms of the impact on pneumonia mortality, however, the results are not consistent, as there are analyses that have not revealed a significant impact of scaling in ventilated or non-ventilated patients [14], but also some that have shown a decrease in pneumonia mortality [15]. The presence of fever as a marker of infection was also correlated with oral care interventions. A

study showed that mechanical tooth care measures led to reduced fever duration [14].

Although there is not much data on the relationship between oral hygiene and bronchiectasis in people without cystic fibrosis, based on similarities with COPD and some limited observations, some hypotheses have been made, suggesting a direct relationship between bacteria in the oral cavity and bacterial colonization. It has not been established to date whether prolonged aspiration of bacteria and inflammatory cytokines from saliva can prevent the development of bronchiectasis, as is known to occur with aspiration of gastric acid content. The inflammatory response in the lungs following exposure to inhalation risk factors may be responsible for the development of bronchial and lung parenchymal remodelling changes, as well as systemic inflammation with effects on other systems and organs [16].

DISCUSSIONS

I. Relationship between oral colonization and lung infections

Respiratory infections are a major cause of morbidity and mortality. The breakdown of airway defence mechanisms can manifest itself either through the development of diseases such as bronchopulmonary infections or exacerbation of chronic disorders such as COPD and bronchiectasis [17]. COPD is the third leading cause of death worldwide and exacerbations are now considered to have a major impact on the patients' outcome.

For respiratory infection and eventual nosocomial pneumonia, the teeth may potentially act as a reservoir. Oral periodontopathic bacteria can cause aspiration pneumonia. It has been demonstrated that individuals in nursing homes and intensive care units have typical respiratory infections colonizing their tooth plaque [18].

Bacteria that cause pulmonary infections may start in the mouth cavity. Due to the relocation of the bacteria from the dental biofilm into the respiratory tract, dental plaque, a tooth-borne biofilm that promotes periodontal disease and dental caries, may also have an impact on the onset and progression of pneumonia. Commonly, oropharynx-colonizing bacteria like *Streptococcus pneumoniae*, *Haemophilus influenzae* (more than 60% of healthy people [19, 20]), *Moraxella catarrhalis* (the carriage rate is 5% [21]), *Escherichia coli*, *Staphylococcus aureus* and *Mycoplasma pneumoniae* cause community-acquired pneumonia. On the other hand, enteric Gram-negative bacteria, *Staphylococcus aureus*, and *Pseudomonas aeruginosa* are frequently the culprits behind nosocomial pneumonia. These organisms can be found in the oral cavity in some situations, such as in institutionalized patients and residents of unhygienic water supply locations [18, 22].

In a healthy patient the respiratory tract can protect itself from aspirated pathogens. Pulmonary infections are more likely to occur in patients who have reduced salivary flow, a weak cough reflex, swallowing issues, poor oral hygiene skills, or other physical impairments. Patients in intensive care units who are mechanically ventilated and unable to cough or swallow oral secretions are at risk for ventilator-associated pneumonia, especially if the ventilation lasts more than 48 hours [23]. When intubated, the oral bacterial load increases, and greater dental plaque scores indicate a higher risk of pneumonia [24].

PNEUMONIA

Inflammation of the lung parenchyma can result from infection with bacteria, viruses and fungi, which can colonize the oral cavity and upper airways [25]. The risk of aspiration of infectious agents into the airways is higher in people over the age of 65 or under the age of two, or in those suffering from other conditions that may decrease the efficiency of

the defence mechanisms. In addition, the risk of infection of the lung parenchyma is increased in people undergoing invasive or semi-invasive manoeuvres such as orotracheal intubation, invasive or non-invasive ventilatory support for long periods of time, bronchoscopy, etc. The propharyngeal flora of the patient is the habitat of the pathogenic microorganisms that cause up to 85% of pneumonias which can develop during mechanical ventilation. These pathogens invade and infect the lower airways because of aspiration of saliva or bacterial migration originate internally in the oropharynx [26].

COPD

Chronic obstructive pulmonary disease is a condition characterized by an increased risk of bronchopulmonary infections underlying exacerbations [27]. Due to multiple hospitalizations or emergency care presentations, these patients are at risk of chronic bronchopulmonary colonization and have a reduced capacity for self-care or treatment in the oral care unit.

BRONCHIECTASIS

Bronchiectasis are bronchial dilatations manifested by increased sputum production and increased risk of bacterial colonization. To investigate whether there is a relationship between periodontal disease and bronchiectasis, Brazilian researchers set out to quantitatively explore the presence of *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Porphyromonas gingivalis* in saliva, sputum and nasal lavage. Although the results are not yet published, the study aims to evaluate the change in bacteria concentration before and after antibiotic treatment, in addition to other endpoints such as halitosis, bad breath and the presence of pro-inflammatory cytokines.

II. Effect of oral hygiene procedures on the incidence of respiratory infections

Several studies have argued that the use of 0.12-2% chlorhexidine is associated with a reduction in the risk of ventilator-associated pneumonia [28, 29]. Thus, the risk of lung infections in ventilated patients is about 40% lower compared to control groups, with a number of decontamination interventions ranging from 8 to 21. Oral decontamination with chlorhexidine in these patients is easy and effective, other interventions do not provide any additional benefit. El-Rabbany et al. showed, on the other hand, that in mechanically ventilated patients tooth brushing has a positive effect on oral health, leading to a reduced risk of pneumonia [28].

On the other hand, no significant results were obtained when study objectives included mortality and duration of mechanical ventilation in association with oral decontamination with chlorhexidine. Considering these observations, in correlation with studies that have shown no differences in terms of impact on antibiotic use either, it might be suggested that, the use of acute, broad-spectrum antimicrobial therapies may mask the influence of oral hygiene. This also results in a certain difference observed when studying the impact of oral hygiene on pulmonary infections, with superior results on the prophylaxis of infections and not on their evolution. As for the adverse effects of chlorhexidine, they are transient and expected, and we could mention mucosal irritation and unpleasant taste.

The use of other topical agents for oral hygiene is less addressed in studies; povidone iodine however did not show superior results to chlorhexidine [28].

Although there is a number of inconsistent findings regarding oral hygiene and the risk of respiratory infections, it is noted that there is consistent data suggesting that adequate oral hygiene, through self-care and professional care, reduces the risk of bronchopulmonary infections. We consider

that the factors that determine the non-homogeneity of the results are study populations, study methods and purposes.

CONCLUSIONS

The current paper emphasizes the link between oral hygiene and pulmonary infections, in particular in acute bacterial exacerbation of COPD and pneumonia. The oral hygiene practices like using chlorhexidine and povidone iodine can favourably influence the risk of acquiring respiratory infections especially (*i*) in patients with various comorbidities or (*ii*) in respiratory intensive care units requiring ventilatory support or semi-invasive airway procedures. Additional studies with more pronounced homogeneity are needed to increase confidence in the reduction in the incidence, duration, and mortality of pulmonary infections. The ability to improve health care in persons at risk, to provide cost-effective care, and to enhance the life quality of a patient lies in increasing patients' knowledge of the effects of poor oral health.

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