Original Article

Periodontal status of patients with nontubercular respiratory diseases hospitalized in a tertiary care hospital

ABSTRACT

Background: There is strong evidence that periodontal disease (PD) is related to various systemic diseases including respiratory diseases. Dental plaque is the primal cause of PD, and it can also be used as a reservoir of lung pathogens. After inhalation, it can cause a variety of respiratory infections. In addition, low nutritional status and immunosuppression due to treatment or disease progression may affect the oral health of the hospitalized patients with nontubercular respiratory diseases. Here, we aimed to assess the periodontal status in hospitalized patients with nontubercular respiratory problems.

Materials and Methods: We have enrolled 100 hospitalized nontubercular respiratory ill patients and 100 periodontal patients in this study. Periodontal clinical parameters, namely plaque index (PI), gingival index (GI), pocket probing depth (PPD), and clinical attachment level (CAL) were evaluated in both the groups. Modified Kuppuswamy's socioeconomic scale was utilized to assess the education, occupation, and monthly family income.

Results: Sociodemographic profile was comparable in both the studied groups. Hospitalized patients with nontubercular respiratory diseases had more severe PD (PPD and CAL) and poorer oral hygiene (higher PI), although the GI was lower compared to patients in the periodontal group. In addition, compared with patients in the high-income group, low-income patients are at greater risk of periodontal infections.

Conclusions: Our data show that the prevalence of periodontal infections in hospitalized patients with non-tubercular respiratory diseases is higher, indicating that there is an association between PD and respiratory diseases.

Keywords: Hospitalization, oral health, periodontal disease, respiratory disease, risk factors

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INTRODUCTION

According to the World Health Organization, approximately 10% of the world population is suffering from severe periodontal diseases (PD).[1] PD affects the supporting tissues that surround the tooth and that sustain it. On the other hand, respiratory diseases, namely chronic obstructive pulmonary disease (COPD), asthma, and lung cancer are considered as a major cause of morbidity and mortality across the globe. PD has been known to have a possible risk for multiple systemic diseases, including respiratory diseases,[2-4] cardiovascular diseases,[5,6] and diabetes.[6,7] The possible persuasive reasons supporting the association between PD and respiratory diseases could be chronic inflammatory nature of both diseases, and oral cavity being a common anatomical structure for accessibility inside the body.[3]

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Dental plaque, the primal factor for PDs, can also act as a reservoir for pulmonary pathogens, which on aspiration can result in diversified respiratory infections. In addition, interaction between the resident dental plaque flora and established respiratory microbes ultimately leads to colonization by the latter in the niches of oral cavity.[8] Consequently, dental plaque may shed into the salivary fluids due to a number of physiological forces contaminating the respiratory tree distally on aspiration. The inability of host immune system to eradicate such microbes from mucosal surface of respiratory tree leads to their proliferation, often leading to infection and necrosis.[4,9] Other reasons were due to alteration of oral mucosal surfaces by periodontitis associated enzymes resulting in adhesion and colonization of pulmonary pathogens, destruction of salivary pellicle by periodontal bacteria modulating adhesion of pulmonary pathogens, and lastly, alteration of respiratory epithelium by salivary cytokines.[10]

Various studies have suggested that hospitalized patients have a greater risk of oral colonization by bacteria in comparison to ambulatory patients.[11,12] Further, an incredible increase in the quantity as well as complexity of dental biofilm was observed in hospitalized and critically ill patients because of their inadequate oral hygiene maintenance.[13-16] Poor oral health has shown a casual relation with COPD,[17,18] lung cancer,[19,20] asthma,[21,22] pneumonia,[23-25] interstitial lung disease (ILD),[26] pleural effusion,[26] bronchiectasis,[27] pneumothorax, and allergic bronchopulmonary aspergillosis (ABPA). There is a good evidence highlighting that maintaining good oral hygiene (proper tooth brushing and/or antibacterial rinsing) can result in a reduced rate of lower airway infection in hospitalized patients.[28-30]

As respiratory diseases have significant prevalence in our society with high sufferings, if by just reducing a load of periodontal pathogens in the oral cavity, the risk, severity, and the number of exacerbations of respiratory diseases can be reduced, then periodontists can play a pivotal role in its overall prevention. Owing to the correlation between periodontal and respiratory health, it is hypothesized that the hospitalized patients having nontubercular respiratory disease will have poorer periodontal health as compared to the nonhospitalised ambulatory patient. It might be due to their poor oral hygiene with an increased burden of periodontal pathogens in their dental plaque that could be a possible reason for increased susceptibility to pulmonary exacerbations and disease progression in such patients. Here, we assessed the pattern of periodontal status in hospitalized patients with nontubercular respiratory infections, under the following objectives – (a) evaluation of the periodontal status in hospitalized patients with nontubercular respiratory diseases such as COPD, asthma, lung cancer, pneumonia, and ILD and (b) determination of smoking history and socioeconomic status between PD and hospitalized nontubercular respiratory disease patients.

MATERIALS AND METHODS

Study design and setting

In this cross-sectional study, initially, 247 participants were screened, and finally, 100 hospitalized patients with nontubercular respiratory diseases (Group-I) and 100 patients having PD (Group-II) were selected. The study duration was May 2019 to July 2019. Group-I: Respiratory ill patients were recruited randomly among admitted patients from the ward of the department of respiratory medicine. Diagnosis of nontubercular respiratory diseases was confirmed by the chest specialist of the department. Inpatient department of respiratory medicine was regularly checked in interval of 5–7 days, and the patients who fulfill the criteria of the study were enrolled irrespective of gender, only patients from the tubercular ward were excluded. While in Group-II, an equal number (100) of age and sex-matched periodontitis patients were also randomly selected from the patients coming to the regular outpatient department of the department of periodontology from the same hospital. All the participants enrolled under Group-II were clinically checked by a periodontist and fulfilled the criteria of PD. After enrolment detailed demographic, clinical, and dental examination, smoking history and dental practices were evaluated and recorded in a separate case sheet which was compiled by experts from respiratory medicine, periodontology, medicine, and pharmacology. Informed written consent was obtained from all the participants and or their caregivers before enrolling in the study. This study protocol was approved by Institutional Ethics Committee, U. P. (Ref number: 95th ECM II A/P6 dated 21/5/2019). Schematic representation of work is given in Figure 1.

Inclusion and exclusion criteria

We had enrolled participants from the age group of 15–70 years from both genders. Patients suffering from PDs (classification of PDs was according to American Academy of Periodontology International Workshop for Classification of PDs-1999),[31] both dentulous and partially edentulous patients, were included. Hospitalized patients with nontubercular respiratory diseases (lung cancer, COPD, ILD, asthma, pleural effusion, pneumonia, bronchiectasis, pneumothorax, and ABPA) were enrolled. In the study, pulmonary tuberculosis patients, alcoholics and systemically diseased patients (such as diabetes mellitus, cardiovascular disorder, rheumatoid arthritis, ulcerative colitis, preterm

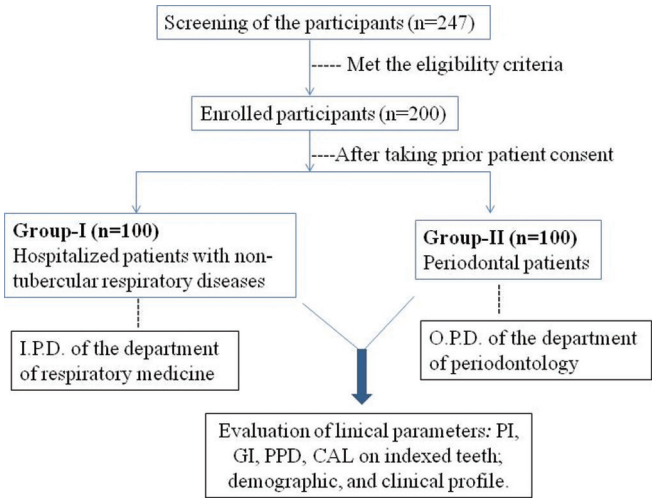

Figure 1: Schematic representation of workflow

low birth weight delivery), lactating and pregnant women, and also those patients who did not give their consent were excluded.

Clinical parameters

Clinical parameters, namely plaque index (PI) (Silness and Loe., 1967)[32] and gingival index (GI) (Loe modification-Loe and Silness., 1967)[32] were determined by using Wilkin's explorer #17/23 at six sites per tooth. Pocket probing depth (PPD) and clinical attachment level (CAL) were measured using the University of North Carolina Probe (UNC-15, Hu-Friedy) with cementoenamel junction as a fixed reference point.

Statistical analysis

Qualitative and quantitative data were expressed in percentage, proportions, and standard deviation (SD.) with mean. Student *t*-test and Chi-square test were performed to analyze difference of the continuous variable and categorical variables between control and case groups, respectively. We had used Statistical Package for the Social Sciences Version 15.0 (SPSS, Version 15.0. Chicago, SPSS Inc.) statistical analysis software. Level of significance was taken as $P < 0.05$ (statistically significant) and $P < 0.01$ (highly significant).

RESULTS

The mean age of Group-I-nontubercular respiratory disease patients hospitalized in respiratory care was 38.36 ± 12.94 (mean ± SD) and Group-II was 36.33 ± 13.66 (mean ± SD). Out of 100 Group-I participants, 56 were male and 44 were female. In Group-II, 45 males and 55 females were recruited. Group-I and Group-II were comparable ($P = 0.14$) in terms of age. Majority of the patients of nontubercular respiratory diseases were of lung cancer (44) followed by COPD (23), ILD (ILD, [10]), asthma (6), pneumonia (4), bronchiectasis (4), pleural effusion (4), pneumothorax (1), and ABPA (1). Three (3) patients had died. Details of the patients and their diseases are shown in Table 1.

In periodontal evaluation, the mean PI of Group-II was 1.58 and Group-I was 1.69. GI (mean) of Group-II was 1.54, whereas Group-I was 1.57. In Group-I, the mean PPD was 2.63, and it was 2.45 in Group-II. The mean CAL in Group-I was 3.04 1.83 and in Group-II, it was 1.83. Group-I as compared to Group-II had more severe PDs with a statistically nonsignificant difference in mean PPD but significant difference in mean CAL levels with slightly higher mean PI and GI (nonsignificant) [Figure 2].

Patients hospitalized in the respiratory medicine ward (Group-I) have a history of smoking in either past or present, 55%, nonsmokers (43%), and biomass exposure (2%). In Group-II, majority of the participants were in the category of never-smokers (94%) followed by ex-smokers (4%), and smokers (2%); no patient was exposed to biomass. No significant statistical difference was found in both groups [Figure 3a]. Out of 100 Group-II, socioeconomic status (education, occupation and monthly family income) was found as, lower (0), upper lower (40), lower middle (44), upper middle (12), and upper (4). And in Group-I, lower (2), upper lower (45), lower middle (37), upper middle (14), and upper (2). Socioeconomic status in both the groups was statistically comparable ($P = 0.676$; Chi-square test) [Figure 3b].

DISCUSSION

Our data suggest an association between PDs and hospitalized nontubercular respiratory disease patients, not only in major pulmonary disorders such as lung cancer, COPD, asthma, ILD but also in ABPA, and pneumothorax. Likewise, Sharma *et al.*[33] had stated an association between respiratory and PDs by assessing hospitalized patients with respiratory diseases-pneumonia, COPD, and lung abscess. The authors concluded that these patients had significantly poorer periodontal health compared to the controls. Furthermore, low-income patients were 4.4 times more vulnerable to PD compared to high-income groups. Oberoi *et al.*[6] had examined the PD among patients with respiratory diseases, cardiovascular diseases, and diabetes. And they found that these patients were associated with higher rates of PDs.

In the studied population, major proportion (44%) was of lung cancer patients. Zeng *et al.*[19] had performed a meta-analysis

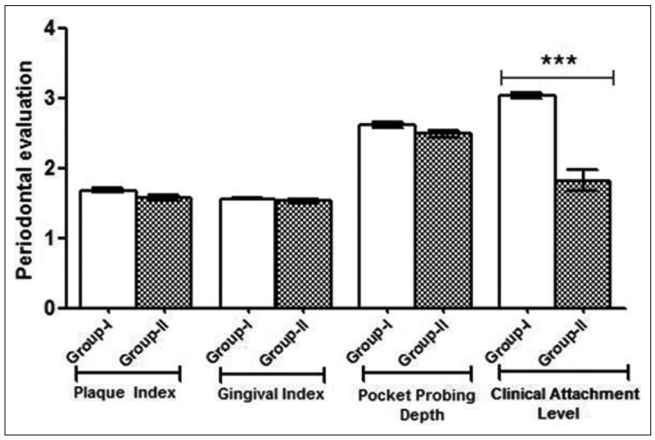

Figure 2: Periodontal parameters of the participants

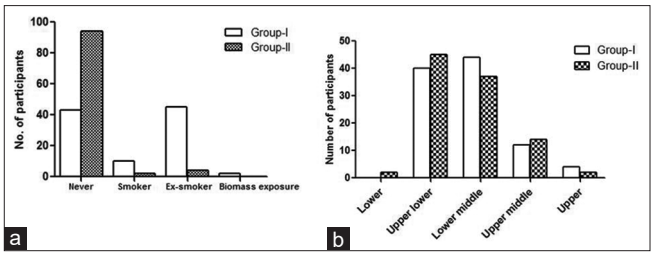

Figure 3: (a) Smoking history and (b) Socioeconomic status of the studied population

Table 1: Distribution of nontubercular respiratory diseases

Name of the nontubercular respiratory diseases	Number
Lung cancer	44
Chronic obstructive pulmonary disease (COPD)	23
Interstitial Lung Disease (ILD)	10
Asthma	6
Pleural Effusion	4
Pneumonia	4
Bronchiectasis	4
Pneumothorax	1
Allergic Bronchopulmonary Aspergillosis	1
Death	3
Total	100

of five cohort studies and concluded that there is a 1.24-fold increased risk of developing LC in individuals who have PDs. Hiraki *et al.*[20] had reported a significant co-relation of lung cancer and teeth loss. Recent work has indicated that periodontal pathogens cause an inflammatory response characterized by elevated levels of C-reactive protein, IL-1 β, IL-6, tumor necrosis factor-α, and matrix metalloproteinases. Hence, exposure to the chronic inflammation induced by the bad quality of oral health may induce and encourage the development of lung cancer, and smoking may intensify inflammation and cancer.

In the present study, COPD patients had poor PDs. Likewise, a meta-analysis of 14 observational examinations by Zeng *et al.*[18] demonstrated a relationship between periodontitis and COPD. To determine COPD's relationship with dental health, Bhavsar *et al.*[34] assessed the periodontal health status and oral health among hospitalized COPD patients. COPD patients were deduced to have significantly lower brushing frequency, poor periodontal safety (OHI and PI), greater gingival inflammation, and deeper pockets/CALs relative to controls. Moreover, COPD patients had substantially higher levels of serum and salivary CRP levels relative to control groups. In addition, Fernández *et al.*[26] analyzed hospitalized patients without sedation or intubation and stated that patients with COPD, tuberculosis, and influenza had major risk of PD.

ILD is a broad term which includes nearly 200 lung diseases and affects interstitium. ILD patients' lungs show different types of fibrosis and inflammation. American Thoracic Society[35] has categorized four major causes of ILD disease linked with a state which affects other body parts, a disease linked with exposure of lung damaging agent (such as occupational exposure, and tobacco smoke, etc), a disease linked with genetic abnormality (Hermansky–Pudlak syndrome), and idiopathic diseases which was the most common form of ILD. In the present study, we had found 10 patients suffering from ILD who have compromised dental status. Fernández *et al.*[26] had studied on 3059 hospitalized respiratory patients and concluded that there is a 25.2% prevalence of severe PD, and 346 patients belong to interstitial diseases.

Previous studies suggest that patients with asthma are more vulnerable to oral health issues, such as plaque accumulation and decreased salivary flow, in comparison to healthy individuals.[21] Ferreira *et al.*[22] had performed a systematic review and meta-analysis and concluded that asthmatic individuals showed more PDs when compared to healthy individuals. They found that asthmatic patients had major damage to supporting tissue of teeth namely CAL and papillary bleeding. In our data, CAL was increased in cases in comparison to control.

PD bacteria (e.g., *Porphyromonas gingivalis, Actinobacillus actinomycetemcomitans)* have been found in the lungs of patients suffering from pneumonia.[23] In our study, four hospitalized patients suffering from pneumonia have poor dental conditions. A cohort study from Japanese dentists concluded that major tooth loss may influence the risk of mortality from pneumonia.[24] Likewise, Awano *et al.*[25] had stated that mortality from pneumonia was increased by 3.9 times in volunteers having 10 or more teeth with probing depth more than 4 mm.

Bronchiectasis has many similarities with COPD. It is reported that COPD is associated with PD. However, there are limited data on whether bronchiectasis is correlated with PD. Pinto *et al.*[27] had investigated the role of periodontal treatment in the reduction of microorganisms linked with bronchiectasis exacerbation from saliva, sputum, and nasal lavage. The above study is under process. In our data, four participants were suffering from bronchiectasis having poor dental status in comparison to control.

Because of nicotine-mediated vasoconstriction in smokers as well as strong gingival keratinization, gingival bleeding has been reliably documented to occur less in smokers. Measurements of pocket depth in smokers are found to be greater due to increased alveolar bone loss. But in our case, CAL levels were higher in cases depicting past episodes of chronic periodontitis in such patients making them more susceptible to PDs. Tobacco smoking suppresses the development of protective immunoglobulin G2 antibodies, thereby blocking phagocytosis and destroying bacteria by neutrophils. It also paralyzes the ciliary function and hampers the clearance of the lungs, increasing the risk of respiratory disease by more than four-fold.

There are some limitations of the study. More well-executed longitudinal studies are the need of the hour to compare the nontubercular respiratory disease rates in hospitalized patients with and without PD and also interventional studies to determine the effect of periodontal therapy on incidence rates of respiratory diseases in such patients with larger sample size.

CONCLUSIONS

Nontubercular respiratory disease patients suffer from poor periodontal health status indicated by greater mean PI (moderately significant) and significantly higher mean CALs than PD patients representing a past episode of periodontitis that had caused loss of CALs and consequently gingival recession in such patients. Smokers (ex-smoker and current smoker) constituted a major group in Group-I and smoking could be a reason for higher risk for periodontitis since smoking is regarded as one of the leading risk factors for periodontitis as well as in respiratory diseases. Our data show that major group of hospitalized patients were the sufferers of lung cancer and COPD. Lower middle and upper lower class of people were primarily affected highlighting the importance of education and economic background on maintaining oral care. Although poor periodontal health does not directly cause respiratory diseases, it might work together with environmental factors (smoking, pollutants, etc) and/or genetic factors that could promote progression and/or exacerbations of respiratory disease in susceptible individuals.

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Conflicts of interest

There are no conflicts of interest.

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