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Original Article

Association between periodontitis and chronic obstructive pulmonary disease: A retrospective study

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ABSTRACT:

Background: Both Periodontitis and Chronic Obstructive Pulmonary Disease (COPD) are chronically progressive Diseases of inflammatory origin that share common types of risk factors like- smoking, age, and lower level of socio-economic status. **Aim:** Aim of the current study was to evaluate an association between periodontitis and chronic obstructive pulmonary disease. **Materials and methods:** This retrospective study was designed by including patients with COPD who were hospitalized. Data regarding periodontal parameters were retrieved from patient records. 300 patients were selected and further categorized into- a) Group A (those suffering from COPD; n=150) and Group B (control subjects, n=150) who were age-matched. Inclusion criteria were. 1) Patients hospitalized for more than three days and diagnosed with acute respiratory disease or COPD; 2) Patients with no history of COPD taken as controls and 3) Age-matched between 20-60 years. Statistical analysis: Chi-square test, t-test, and contingency analysis were performed. **Results:** statistically significant associations among various periodontal health parameters and COPD were obtained. **Conclusion:** There is definite and conclusive evidence between periodontitis and chronic obstructive pulmonary disease.

Keywords: Periodontitis, chronic obstructive pulmonary disease, prognosis.

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INTRODUCTION

“Periodontal medicine” is a novel branch or adjunct arm of the specialization ‘Periodontology’ and represents a coalescence between medicine with dentistry. Various studies have established that infection of periodontal origin is a ‘probable’ risk factor for developing a variety of systemic diseases which include pulmonary and cardiac diseases.^[1,2,3] Infections of the respiratory tract likewise pneumonia and exacerbation of chronic obstructive pulmonary disease (COPD) involve aspiration of bacterial pathogens from the oro-pharynx into the lower portion of the respiratory tract. Failure of these host defensive mechanisms results in the elimination of pathogens

from mucosal surfaces. These defense mechanisms may results in mucosal proliferation, sometimes, re-infection and destruction of tissues.^[4,5,6] It has been suggested that dental plaque acts as a reservoir of respiratory pathogenic organisms, especially in high-risk category patients who have poor oral hygiene.^[5] Especially, the hospitalized patients are extremely prone to oral colonization by these pathogenic bacteria when compared with the ambulatory and non-institutionalized subjects with disease.^[7,8] Chronic obstructive pulmonary disease or in short, COPD presents with progressive obstruction in airflow and is accompanied by inflammation of airways. The overall prevalence of this disease ranges

between 9 % to 10 % among adults who are aged 40 years or more.^[9]

Poor status of oral health (for example, periodontal diseases) has been closely associated with Chronic Obstructive Pulmonary Disease.^[10] Patients diagnosed with Chronic Obstructive Pulmonary Disease may suffer from periodic episodes of acute exacerbations or worsening of pulmonary functions, that may be partially attributed to infections and are mainly caused by bacterial species such as *Streptococcus pneumoniae*, *Haemophilus influenzae*, *Moraxella catarrhalis*, or a rhinovirus.^[11,12]

COPD is pathologically characterized by gradual as well as a progressive collection of macrophages within the lung tissues. Initially, the accumulation of macrophages is most clearly evident within respiratory bronchioles. Additionally, the proteolyzed fragments of elastin exhibit chemotactic properties for macrophages that produce various matrix metalloproteinases (MMPs) which undergo direct participation in the destruction of lungs. Both the CD4+ and CD8+ T lymphocytic cells show an increase within the walls of the airway along with the alveoli of patients diagnosed with chronic obstructive pulmonary disease. Epithelial lining cells in those with smoking habits and COPD demonstrate an increase in expression of CXCL10 which is a ligand for T cell-CXCR3. Various T-cell products like CD40 induce MMP expression in all mononuclear phagocytic cells. These cytotoxic T lymphocytic cells specifically target the alveolar epithelial lining cells and cause induction of cellular death, especially in cells that have a latent viral infection. Other types of cells, for example, dendritic cells, eosinophils along mast cells have also been found within the pulmonary tissues of patients suffering from COPD.^[13]

COPD is a severe, disabling as well as a debilitating condition that requires extended periods of hospitalization and may usually culminate in death. There is sufficient evidence to show that an improvement in oral hygiene status and frequent utilization of oral health care services cause a reduction in progression as well as the occurrence of a variety of respiratory disorders.^[14,15] Periodontitis has been proven to enhance the risk of developing the respiratory disease, thus, dentistry and particularly, Periodontology have shown a significant role in the prevention of these systemic diseases. Thus, this study was planned to evaluate an association between periodontitis and chronic obstructive pulmonary disease.

MATERIALS AND METHODS

STUDY SAMPLE

A total of 150 hospitalized patients suffering from COPD were selected as a study group. Similarly, 150 age and gender-matched subjects were selected as controls. The study was conducted after obtaining approval from both the institutional along with the ethical board.

All the hospital records pertaining to each of the selected patients during the period of study were thoroughly screened for details. Both inclusion, as well as exclusion criteria, were determined. A systematic random sampling method was selected for choosing both cases as well as controls. This study was carried out in a period lasting between May 2020 to November 2021.

Inclusion criteria for subjects selection were 1) Patients hospitalized for a duration of more than three days and those who were diagnosed with acute respiratory diseases (such as pneumonia, acute bronchitis, or pulmonary abscess) or an exacerbation of chronic respiratory diseases (like COPD which comprised of chronic bronchitis and/or emphysema) were grouped as cases; 2) Patients with no history of respiratory diseases were considered as control subjects and 3) All patients were age-matched between 20 to 60 years.

The exclusion criteria for subject determination were 1) Patients with a history of any systemic diseases rather than respiratory system disease (for example, diabetes mellitus, endocrinal disorders, etc.); 2) Patients under any specific type of medication that can affect periodontal health; 3) Those subjects who gave any history of periodontal treatment in past six months and 4) Those hospitalized in Intensive Care Units (ICUs); 4) Those who had a history of smoking. Information of a subject's age, gender, socio-economic status, and lifestyle were recorded. Socio-economic status variables included were a) level of education (which was categorized into illiterate, primary school, middle school, high school, and college) and b) monthly income of the entire household (this was categorized into lesser than 5000, 5000 to 10,000 and greater than 1000 Indian rupees (INR)).

PARAMETERS FOR PERIODONTAL AND ORAL HEALTH EXAMINATION

Standardized measures for oral health assessment were considered while examining the oral cavity. These included a) Gingival index (Loe and Silness), b) Plaque index (Silness and Loe), and c) Oral Hygiene Index- Simplified (OHI-S) (Greene and Vermillion).

Clinical attachment level (CAL) was recorded by subtraction of distance from free gingival margin to cement-enamel junction, which was considered as a point of reference for measuring the distance between free gingival margin to the bottom of the gingival sulcus. Probing depths (PD) and CALs measurements were recorded at four index sites on each tooth disto-facial, facial, mesiofacial, and lingual surface. An average measurement for the selected sites was recorded.

Direct oral examination was performed under a proper source of illumination by making the patient sit erect in a dental chair and by using a mouth mirror and William's graduated probe. All these measurements

were conducted by a single calibrated operator to eliminate bias.

STATISTICAL ANALYSIS

All observational data was entered into master charts followed by transfer into Microsoft Excel 2007 spreadsheets. Student's t-test, Chi-square (χ^2) test, and contingency table analysis were done for assessment of diseased group or case group with the

non-diseased or controls group patients to analyze the population generated demographic data and collected periodontal scores. Association between socioeconomic status and periodontal health was assessed as well. The level of statistical significance was considered at P less than 0.05.

RESULTS AND OBSERVATIONS

In group A (case group), 75 % of patients suffered from COPD (of which 85 were males and 65 were females). 20 % of patients had pneumonia and 15 % of COPD patients suffered from abscesses of the lungs.

Mean scores of Gingival Index, Plaque Index, and Oral Hygiene Index for patients with respiratory illness were demonstrated to be statistically significant when compared to the control group: Gingival index (P = 0.02); Plaque index (P = 0.03), and Oral Hygiene Index- Simplified (P = 0.01) (Table 1).

Table 1: Inter-group Comparison of Periodontal Parameters

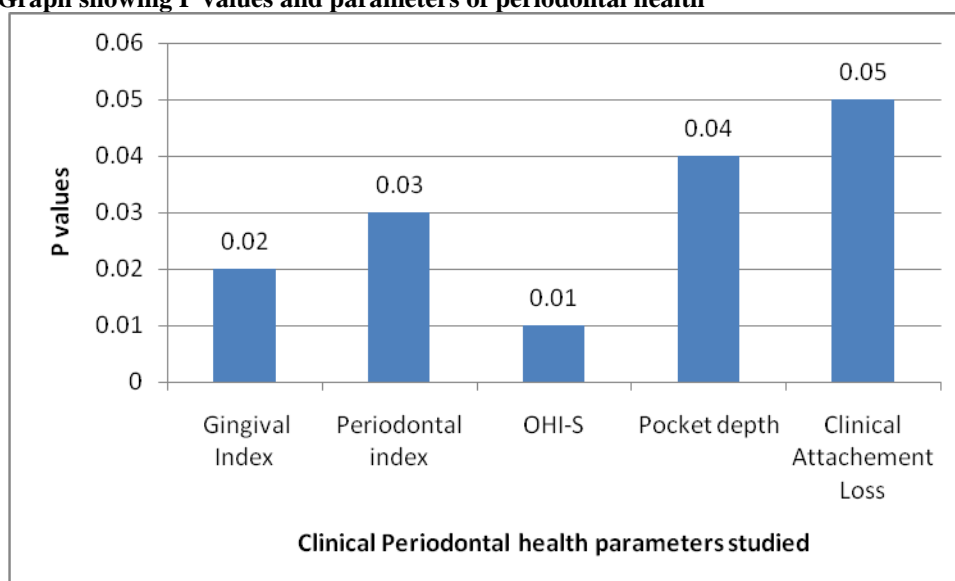
Parameters	Case group	Control group	P values
a) Gingival Index:			
Mean	56.4	34.1	0.02
Standard deviation (SD)	8.12	0.23	
b) Periodontal index:			
Mean	57.3	32.1	0.03
Standard deviation (SD)	0.54	0.98	
c) OHI-S			
Mean	34.67	23.54	0.01
Standard deviation (SD)	4.23	4.65	
d) Pocket depth			
Mean	2.37	0.23	0.04
Standard deviation (SD)	0.34	0.13	
e) Clinical Attachment Loss (CAL)			
Mean	2.13	1.12	0.05
Standard deviation (SD)	0.14	0.03	

Pocket depths were found to be deeper along with higher values of Clinical Attachment Loss (CALs). Both of these periodontal parameters were found to show significant association with chronic obstructive pulmonary disorder i.e. Pocket Depth (P = 0.04) and Clinical Attachment Loss (P = 0.05) (Table 1).

Table 2: Table showing association between socio-economic status and Clinical Attachment Loss (CAL)

Patient distribution as per the level of family income	Clinical Attachment Loss >3.0 mm	Clinical Attachment Loss <3.0 mm	Odds ratio	P-value
With chronic obstructive pulmonary disease (COPD):				
a) < INR 5000	95	110	5.56	0.67
b) > INR 5000	68	57	0.45	

Patients in both the groups i.e., with or without COPD were again further sub-divided into two groups- a) With income below INR 5000 and above INR 5000. Contingency tables were then prepared to calculate odds ratios. The mean CAL score was observed to be statistically higher in the high socioeconomic status group. Thus, a lower socioeconomic status along with clinical attachment level (CAL) was found to be a highly dependent variable among patients suffering from COPD. Odds ratio calculations demonstrated that those patients with COPD belonging to the lower-income group had 6.5 times higher chances to suffer from poor periodontal health status when compared with the high socioeconomic status group. However, no statistical association (P=0.67) was noted in the control group subjects (Table 3).

Graph 1: Graph showing P values and parameters of periodontal health

DISCUSSION

COPD is a heterogeneous disease combination of two entities chronic bronchitis along emphysema. The most common symptoms observed among patients diagnosed with COPD include cough, dyspnea, and production of sputum that are chronic in nature and progressive in nature while Periodontitis is a chronic inflammatory condition affecting teeth supporting structures and is characterized by loss of contact between teeth and periodontal tissues. Several studies have reported an association between COPD and periodontal disease. In the current study, significantly high scores of the mean Gingival Index were observed in the case group. Our study findings are supported by those of Sharma and Shamsuddin (2011) who demonstrated a significant association between Periodontal disease and respiratory diseases.^[15] However, contrasting findings have been reported by Scannapieco who reported no significant association between the gingival index and respiratory diseases.^[1] Also, statistically significant scores of the mean periodontal index were reported in our study. Our findings have been supported by the findings of Scannapieco et al and Russell et al.^[1,3] Similarly, Statistically significant differences in mean Oral Hygiene Index-Simplified (OHI-S), mean Pocket Depth (PD) and mean Clinical Attachment Level (CAL) values were observed between both groups. These observations have been supported by findings of Scannapieco et al, Garcia et al and Hayes et al.^[1,2,16]

Kowalski et al (2005) evaluated and compared 100 patients with grade II COPD and 100 age-matched control subjects without any COPD. The frequency, as well as severeness of periodontal disorders among the COPD patients, was found to be higher than the control subjects.^[17] Contrasting evidence was provided by Azharapoo et al (2006) who

demonstrated the etiological correlation between the oral health status and pneumonia or any other respiratory disease. After reviewing published data, it was concluded that there is insufficient evidence of any association (OR < 2.0) between COPD with oral health.^[18]

Leuckfeld et al (2008) assessed a total of 40 patients with or without COPD for the presence of periodontal disease. After doing adjustment for age, gender, and smoking habit, chronic periodontitis was found to be more pronounced in cases suffering from COPD when compared to non-COPD control subjects.^[19]

Fatemi et al in 2009 in their case-control analysis assessed 30 patients each of those suffering from COPD and those without COPD. They observed that periodontal disease was present in a significantly higher number in the case subjects.^[10]

Wang et al (2009) evaluated the association between oral health behaviors with COPD. Approximately 600 patients diagnosed with and without COPD were examined. After adjusting for age, gender, body mass index (BMI), the habit of smoking, it was found that the knowledge level regarding oral health and periodontal health status had a significant association in the COPD group.^[21]

Doe et al (2009) correlated severity of periodontal health with COPD in a total of 200 patients who were diagnosed with and without COPD. It was observed that subjects afflicted with COPD demonstrated a significant loss of attachment loss. Thus, it was concluded from the study that pulmonary functioning diminishes along with an increase in the levels of loss of attachment.^[32]

Similarly, Prasanna et al (2012) in their observational study also found a significant association between pulmonary disease and periodontal health.^[23] Si et al (2012) also found a strong correlation existed between periodontitis and COPD Chinese population.^[24] Zeng

et al in 2012 reported that the existence of periodontal diseases causes a significant increase in the risk of COPD. This is an independent variable than the conventional risk factors that are associated with COPD.^[25]

Ledik et al (2013) explored the possibility if poor periodontal health may be an independent risk indicator for chronic obstructive pulmonary disease in a case-control analysis. It was seen that patients with COPD had significantly poor periodontal health when compared to control subjects thus, indicating that the presence of a periodontal condition may act as an indicator for risk of COPD.^[26]

Peter et al in their observational study on 501 subjects concluded that the severity status of pulmonary obstruction may increase subsequently with worsening of periodontal indices.^[27]

Oztekin and his coworkers evaluated the effect of periodontal disease on COPD. They found that COPD might be associated with the presence of periodontal diseases that are seen as lesser numbers of teeth and elevated levels of mediators of inflammation, most important of which is 'C-reactive protein' found within gingival crevicular fluid or GCF.^[28]

Chun along with his co-investigators assessed the risk of periodontal diseases in patients with COPD in the Taiwanese population. They observed that those with COPD suffered from poor periodontal health more when compared to control subjects.^[29]

CONCLUSION

Patients suffering from COPD demonstrate the poor status of oral hygiene along with a high prevalence of periodontitis. There is a profound lack of awareness as well as negligence towards oral hygiene and health that showed a concomitant increase in severity of COPD. The awareness programs concerning prevention as well as treatment of periodontitis must be included as planned interventional campaigns that are specifically designed for helping patients suffering from COPD.

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