

Effect of Smoking on CRP and Pulmonary Function Test in Adult Population of Bundelkhand Region

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Abstract: Background: Cigarette smoking is the leading preventable cause of mortality that kills an estimated 5 million people annually worldwide. In India smoking is a common habit prevalent in both urban and rural areas. Cigarette smoking has been associated with elevations of CRP levels. Cigarette smoking has extensive effects on various respiratory diseases. This study investigates the impact of smoking and pulmonary function test in adult population of Bundelkhand region. Material and Methods: The Cross sectional study was conducted on 100 patients presenting with clinical features of COPD. The blood levels of CRP were measure and pulmonary functions were done on a computerized spirometer. Results: Most of the smokers were in the age group of 41 - 50 years. Light smokers were commonest, followed by moderate and heavy smokers. Most smokers belonged to rural background and low socio-economic status. CRP levels were found to be elevated in smokers. CRP is significantly related to smoking intensity, duration and pack-years of smoking. All Pulmonary function parameters like FVC, FEV₁, FEV₁/FVC were found to be significantly reduced in smokers. Conclusion: Elevated CRP levels and significantly reduced pulmonary function parameters in smokers, highlighting the deleterious effects of smoking on pulmonary functions.

Keywords: Smoker, CRP, Spirometry, Pulmonary function test

1. Introduction

C - Reactive Protein (CRP) is synthesized by the liver in response to inflammation. CRP test in human blood is one of the most common hematology tests to measure non-specific inflammation⁽¹⁾. In the absence of an acute phase of inflammation, the level of CRP is relatively stable. An elevated baseline inflammatory status, as measured by CRP level, has been shown to increase the risk of several chronic conditions, including cardiovascular diseases^(2,3) lung cancer⁽⁴⁾ and colorectal cancer⁽⁵⁾.

A direct association between elevated levels of CRP, as well as other markers of inflammation, and cigarette smoking has been reported in several investigations,⁽⁶⁾ most studies showing a dose - response relationship between CRP levels and smoking intensity and/or duration⁽⁷⁾.

Smoking cessation has been shown to induce immediate reduction in the levels of several inflammation markers. With specific reference to CRP, various cross sectional studies showed that ex - smokers have reduced CRP levels as compared to current smokers, the reductions being, however, significant only after several years since cessation (i. e., 5 to 20 years)⁽⁸⁾. In particular, two studies on heavy smokers found no significant differences in CRP levels between current and short - term smoking cessation^(9,10).

Cigarette smoking is by far the most important risk factor for COPD and the most important way that tobacco contributes to the risk of COPD⁽¹¹⁾. Cigarette smokers have a higher prevalence of respiratory symptoms and lung function abnormalities, greater annual rate of decline in FEV₁ and a greater COPD mortality rate than non - smokers.⁽¹²⁾ These differences between cigarette smokers and non - smokers are in direct proportion to the quantity of smoking. Smoking

leads to rapid decline in pulmonary function tests (PFTs) specially those indicating diameter of the airways such as forced expiratory flow in one second (FEV₁).⁽¹³⁾

2. Material and Methods

The cross sectional was conducted on 100 smoker patients attending OPD with respiratory symptoms who were selected after fulfilling the inclusion and exclusion criteria. An ethical clearance was taken from the institutional ethical committee.

The smoker patients with more than 18 years of age and radiologically no significant pleuroparenchymal lesion were included in the study. the exclusion criteria for the study were having age <18 yrs; non smokers; radiologically significant pleuroparenchymal lesion; pregnancy; chest wall deformities; infection (ruled out by history and examination); myocardial infarction within the past 6months; angina; congestive heart failure; malignancy; cirrhosis and patients on end stage renal disease.

Particulars of the patients such as name, age, sex, area of residence with other parameters such BP, Chest X - Ray, pack years of smoking etc were noted.

Smoking index: The Smoking index for an individual was equal to multiplication of the average number of cigarettes/bidis smoked per day and duration (in years) of tobacco smoking. Further, smokers were classified as per exposure level, on the basis of smoking index criteria⁽¹⁴⁾.

Habit Smoking Index (Frequency × duration)

Non - smokers 0

Light smokers 1 - 100

Moderate smokers 101 - 200

Volume 12 Issue 6, June 2023

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Heavy smokers more than 200

The electronic spirometer machine was used for doing pulmonary function tests after giving appropriate instructions. FVC and FEV1 were record for atleast three FVC maneuvers, and the best FEV1 was use for analysis. An FEV1/FVC ratio of less than 0.7 was use to define airflow obstruction.

CRP levels were assessed by using a high sensitivity ELISA method which is based on the principle of a solid phase enzyme - linked immune sorbent assay.

Statistical analysis was performed using SPSS version 25.0 Continuous variables were expressed as mean ± standard deviation. All p values were two tailed and values of < 0.05 were considered to indicate statistical significance.

3. Results

In this study, 40.0% of cases were found between age group of 41 - 50 years with mean age of 48.26±10.2 yrs. Most of the cases were males (92.0%). There were 70.0% cases were normal BMI levels while 25 (25.0%) were preobese and only 5 cases were obese having BMI of >30kg/m². Forty eight percent of cases were belongs to labour class and 28.0% were farmers. Only 28.0% cases were skilled/professionals.

Table 1: Demographic profile of patients

Particulars	No. of cases	Percentage
Age group (in yrs)		
18 - 30	15	15.0
31 - 40	20	20.0
41 - 50	40	40.0
51 - 60	10	10.0
>60	15	15.0
Male	92	92.0
Female	8	8.0
Gender		
Male	92	92.0
Female	8	8.0
BMI		
Normal (BMI < 24 kg/m ²)	70	70.0
Preobese (BMI= 25 - 29.9 kg/m ²)	25	25.0
Obese (BMI >30kg/m ²)	5	5.0
Occupation		
Skilled/professional	24	24.0
Labour	48	48.0
Farmers	28	28.0

Table 2: Presenting respiratory Symptoms

Symptoms	No. of cases	Percentage
None	20	24.0
Wheezing	51	51.0
Cough	20	20.0
Chest Tightness	45	45.0
Sputum	10	10.0
Mixed	68	68.0

Most of the cases (68.0%) were presents with two or more complaints. Wheezing (51.0%) and chest tightness (45.0%) were the leading cause of symptoms for which cases were presents in hospital.

Table 3: Distribution of cases by duration of smoking

Duration of smoking (yrs)	No. of cases	Percentage
<10	53	53.0
>10	47	47.0
Total	100	100

In this study 53.0% cases were smokers for < 10 years and 47.0% cases were smokers for >10 years.

Table 4: Grade of smoking

Grade of smoking	No. of cases	Percentage
Light	54	54.0
Moderate	30	30.0
Heavy	16	16.0
Total	100	100

Most of the cases (54.0%) were light smokers, while 30 (30.0%) cases were moderate smokers and only 16 (16.0%) cases were heavy smokers.

Table 5: CRP level with duration of smoking

	Duration of smoking		P value
	<10 years (n=53)	>10 years (n=47)	
Mean CRP (mg/L)	2.56±1.89	3.59±1.59	0.0042

The mean CRP level in patients who smoke <10 years duration is 2.56±1.89mg/dl while in patients who smoke for more than 10 years it was 3.59±1.59.

Table 6: FVC (Litres), FEV1 and FEV1/FVC levels in smokers with duration of smoking

	<10 years (n=53)	>10 years (n=47)	P value
Mean FVC (Litres)	3.13±0.95	2.58±1.06	<0.0001 (S)
Mean FEV1 (Litres)	2.81±0.86	2.48±1.02	<0.0001 (S)
Mean FEV1/FVC (%)	89.49±0.54	83.93±23.98	<0.0001 (S)

Mean FVC level in patients who smoke < 10 years duration is 3.13±0.95 L while in patients who smoke for more than 10 years it was 2.58±1.06 litres. The mean FEV1 level in patients who smoke <10 years duration is 2.81±0.86litres while in patients who smoke for more than 10 years it was 2.48±1.02 litres. The mean FEV1/FVC level in patients who smoke <10 years duration is 89.49±0.54 % while in patients who smoke for more than 10 years it was 89.93±23.98 litres. Significant correlation was found in all three parameters.

4. Discussion

Tobacco use is a major risk factor for many chronic diseases, including cancer, lung disease, cardiovascular disease and stroke. It is one of the major causes of death and disease in India. The most prevalent form of tobacco use in India is smokeless tobacco and commonly used products are khaini, gutkha, betel quid with tobacco and zarda. Smoking forms of tobacco used are bidi, cigarette and hookah. Smoking causes cancer, heart disease, stroke, lung diseases, diabetes, and chronic obstructive pulmonary disease (COPD), which includes emphysema and chronic bronchitis.

In this study 40.0% cases were found between age group of 41 - 50 years of age with mean age 48.26±10.2 years. It shows that at the age of 41 - 50 years the respiratory symptoms are worsen and shows future risk. Similar result

were found by Rubeena Bano et al⁽¹⁵⁾ with mean age of 48.26±10.09 years.

Males were found to be 92.0%. A study by Gallus S et al⁽¹⁶⁾, 2018, Boskabady et al⁽¹⁷⁾, Nancy C. Jao et al⁽¹⁸⁾ reported 69.54%, 58.6%, 51.0% of males in their studies.

Normal BMI levels were found in 70.0% cases which was similar to studies by Gallus S et al⁽¹⁶⁾ and Rubeena et al⁽¹⁵⁾. Most smokers belonged to rural background and were of low socio - economic status. Study supported by Rubeena Bano⁽¹⁵⁾.

In this study 68.0% cases were presents with two or more complaints, 51.0% cases were presents with wheezing and 45.0% cases were presents with tightness. Similar results were reported by the study in which most and the least prevalent respiratory symptoms among smokers were tightness and cough respectively, about one third (34%) of smokers reported tightness and only 17% had cough symptom reported by M. H. Boskabady et al⁽¹⁹⁾.

As per the criteria of smoking index, 54.0% cases were light smokers, 30.0% cases were moderate smokers and only 16.0% cases were heavy smokers. Our results correlate with study of Rubeena et al⁽¹⁵⁾, in which light smokers were commonest 42.0%, followed by moderate (32.0%) and heavy smokers (26.0%).

As well as the major increases in expression of CRP in response to infection or tissue injury, minor elevation in CRP levels has been recognised as a possible marker of disease in systemic conditions⁽²⁰⁾. Serum CRP concentrations have been measured in parallel to smoking status because of the possible link between smoking and the induction of inflammatory pathways⁽²¹⁾.

The mean CRP level in patients who smoke < 10 years duration is 2.56±1.89mg/dl while in patients who smoke for more than 10 years it was 3.59±1.59. The result is found to be statistically significant (p= 0.0042).

Ex - smokers have significantly lower levels of CRP than current smokers⁽²²⁾. CRP is significantly related to smoking intensity and duration in current smokers. No significant changes were found in a study based on current smokers and ex - smokers with available CRP measurements at baseline and after one year since smoking cessation⁽²³⁾. This means the CRP levels were decrease or increase after long time duration of smoking cessation or duration of smoking.

The mean FVC level in patients who smoke < 10 years duration is, 3.13±0.95 L while in patients who smoke for more than 10 years it was 2.58±1.06 litres. The mean FEV1 level in patients who smoke < 10 years duration is 2.81±0.86litres while in patients who smoke for more than 10 years it was 2.48±1.02 litres. The mean FEV1/FVC level in patients who smoke < 10 years duration is 89.49±0.54 % while in patients who smoke for more than 10 years it was 89.93±23.98 litres. The result was statistically significant in all PFT parameters (p<0.0001). Similar results were found by the study of Rubeena Bano et al⁽¹⁵⁾ and Lava Shrestha et

al⁽²⁴⁾ in which mean all the pulmonary function tests are significantly reduced in smokers compared to non smokers.

Similar results were also found in the study of Rubeena Bano et al⁽¹⁵⁾ conducted on smokers and non smokers. The mean values of FVC in smokers and non smokers was 298±1.06l non 3.13±0.98, FEV1 in smokers and non smokers was 2.48±1.02 and 2.81±0.86l while mean FEV1/FVC in smokers was 83.93±23.98% and in non smokers 89.49±10.54%. The mean all the pulmonary function tests are significantly reduced in smokers compared to non smokers. The association of impaired PFTs in smokers was found to be statistically highly significant by applying unpaired t test of significance.

Lung function impairment in smokers were reported by Burrows et al⁽²⁵⁾, Pandya et al⁽²⁶⁾, Dhand et al⁽²⁷⁾, Gosavi et al⁽²⁸⁾ and Gupta et al⁽²⁹⁾. However, several researchers like Angelo⁽³⁰⁾, Malo⁽³¹⁾ and Indian workers Gupta et al⁽³²⁾ and Mahajan et al⁽³³⁾ observed that there was no change in FVC in smokers and nonsmokers.

5. Conclusion

Tobacco smoking in any form, bidi or cigarette or both, has significantly effects on the pulmonary functions and elevated CRP. These findings underscore the importance of smoking cessation for the prevention and management of COPD and other smoking - related health issues.

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