Original Research Article

Indian Journal of Emergency Medicine
Volume 6 Number 2, April – June 2020
DOI: http://dx.doi.org/10.21088/ijem.2395.311X.6220.2

Study of Critical Influence of Smoking on Human Blood and Lungs at Konaseema of Andhra Pradesh

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Received on 05.02.2020
Accepted on 28.02.2020

Abstract

Background: Smoking of cigarette remains the leading cause of preventable premature morbidity and mortality in both developed and developing countries. It is responsible for Coronary heart disease, 90% of chronic obstructive pulmonary diseases and lung cancer. The study is undertaken to highlight the critical effect of smoking. *Objectives:* 1. Effect of cigarette smoking on Hematological parameters and study them concerning the duration of smoking. 2. To study the Pulmonary function tests to detect emergency lung conditions in smokers with relation to duration and number of cigarettes smoked per day. *Methods:* A total of 100 healthy subjects (50 smokers) of age group 30-50 years were selected attending the out-patient department of KIMS. The control group (50 non-smokers) subjects were the non-teaching staff of KIMS Medical College. Hematological parameters such as Hb concentration, RBC count, TLC and Platelet count were performed using Hemo auto analyser Sysmex KX-21 and ESR was obtained by Westergren's method. Spirometry was performed using AD instrument. *Results:* Smoking caused abnormal Hematological parameters, which resulted in increased levels of Hb, RBC count, TLC, Platelet and ESR. ($P<0.0001$) And it had a negative impact on lung functions when compared to non-smokers. Smokers showed a significantly higher decline in PEFR, FVC, FEV1 and ratio of FEV1/FVC($P<0.001$). *Conclusion*: Results showed abnormal hematological and pulmonary function tests which causes dangerous deterioration of lungs and human body function.

Keywords: Chronic smoking; Hematological Parameters; Pulmonary function tests; Spirometry.

How to cite this article:

Bhargava Prasad Bathula, Haider Shaik, Vijender Mallot et al. Study of Critical Influence of Smoking on Human Blood and Lungs at Konaseema of Andhra Pradesh. Indian J Emerg Med 2020;6(2):61–68.

Introduction

Cigarette smoking has been considered as the single most significant cause of preventable morbidity and premature death.[1] For many young people, smoking usually begins for psychological causes such as parental smoking, curiosity, rebelliousness and assertion of independence. Once it becomes regular, the pharmacological properties of nicotine are a significant influence on the persistence of habit.[2] The WHO estimates that there are about 1.1 billion smokers in the world, one – third of which are aged between 15-20 years. Most of these smokers are in developing countries (800 million) and are men (700 million). If current trends continue, the number killed by tobacco use will be more than triple to 10 million annually by the year 2020.[3]

According to WHO estimation, 45 million women and 194 million men use tobacco in smoke or smokeless form in India[4]. It is the most important

modifiable risk factor for coronary artery disease, COPD, hypertension, and nasopharyngeal and bronchial cancer.[5]

Since early 1950, many studies have shown a direct relation between smoking, Hematological parameters, peripheral vascular disease and stroke, but it was not until 1964 that the US Surgeon General's report warned of a potential relationship between smoking and emphysema.[6]

In the most multi-varied analysis, cigarette smoking is the only significant predictor of airflow obstruction after adjustment for the effects of age and initial forced expiratory volume in one second (FEV1).[7]

Aims and Objectives

1. The effect of cigarette smoking on Hematological and Pulmonary function tests.
2. Evaluation of Pulmonary function tests in smokers like Forced Vital capacity, Forced Expiratory Volume in the first second (FEV1), Ratio of FEV1 /FVC, Peak Expiratory Flow (PEFR).
3. To study the Hematological and Pulmonary function tests in smokers with relation to the duration of smoking.
4. To study the Pulmonary function tests in smokers with relation to the number of cigarettes smoked per day.
5. To study the similar Hematological and Lung function parameters of appropriately matched controls. (Non-smokers).
6. To compare the results of the above two groups and hence study the effect of smoking on Hematological and Lung functions.

Materials and Methods

This is a cross-sectional study undertaken in the department of Pulmonary medicine, KIMS General Hospital, Amalapuram. The study was undertaken to observe the effects of cigarette smoking on Hematological parameters and pulmonary function tests of adult male subjects of the age group of 30-50 years. The duration of smoking in years and the number of cigarettes smoked per day is also considered to see the dose-response relationship.

The test group included 50 healthy male, smokers aged between 30-50 years, who were otherwise healthy, attending the Outpatient Department of pulmonary medicine. The control group subjects were the non-smoking non-teaching staff of KIMS Medical College, aged between 30-50 years. Informed consent was taken from all the subjects. All subjects underwent Hematological tests and pulmonary function tests which included- 1. Hemoglobin concentration, 2. Red blood cell count (RBC), 3. Total Leucocyte Count (TLC), 4. Platelet count, 5. Erythrocyte sedimentation rate (ESR), 6. Peak Expiratory flow rate (PEFR), 7. Forced vital capacity (FVC), 8. Forced Expiratory Volume in 1st second (FEV1), 9. Ratio of FEV1/FVC

1. The subjects were selected under the following criteria:

   Inclusion criteria for Test group: 50 smokers:

   1. Age: 30-50 years 2. Gender: Male 3. Duration of smoking: ten years and >10 years 4. Frequency of smoking: > ten cigarettes/day

   Exclusion criteria for Test Group: 50 smokers:

   1. Age: > 50 years 2. Gender: Female 3. Duration of smoking: < 10 yrs 4. Frequency of smoking: <10 Cigarettes/ day 5. H/O Hypertension 6. H/O Diabetes mellitus 7. Smokers with major respiratory problems

   The following Hematological tests were done by using

   Hemo Auto analyser – SYSMEX KX-21.: 1. Hemoglobin concentration 2. Red blood cell count 3. Total leucocyte count 4. Platelet count

   ESR- Erythrocyte Sedimentation Rate: Westergren method

   Normal values: Males: 3-5 mm/hr, Females: 4-7 mm/hr

Spirometry

Spirometry was done using AD Instrument –Power Lab R/30 Series.

Statistical analysis

The results were given as Mean ± Standard deviation and standard error values. Comparisons were performed using students t-test. The p-value of 0.05 or less taken.

Results

One hundred subjects (50 smokers and 50 non-smokers) were included in the study. Hematological tests and pulmonary function tests were conducted in 50 male smokers. [H/O smoking 10 or > 10 years] and compared with age-matched controls [50 male non-smokers]. They were analyzed for the results. The results obtained were expressed as Mean ± Standard deviation.

Table 1: Age distribution in smokers and non-smokers

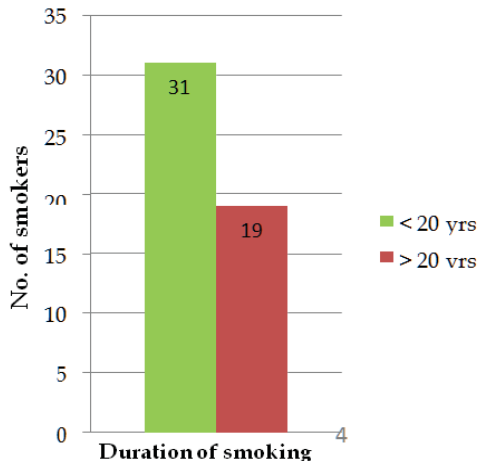
Statusof smoking	Number	Mean (completed years)	Std. Deviation	Std. Error	P-value
Smokers	50	43.62	9.725	1.375	0.613
Non-smokers	50	42.78	6.544	0.926	0.613

Table 2: RBC count in smokers and non-smokers

Status of smoking	Number	Mean (millions/mm^3)	Std. Deviation	Std. Error	P-value
Smokers	50	5.255	0.6829	0.0938	0.000
Non smokers	50	4.634	0.5330	0.0754	0.000

Table 3: Duration wise distribution of smokers

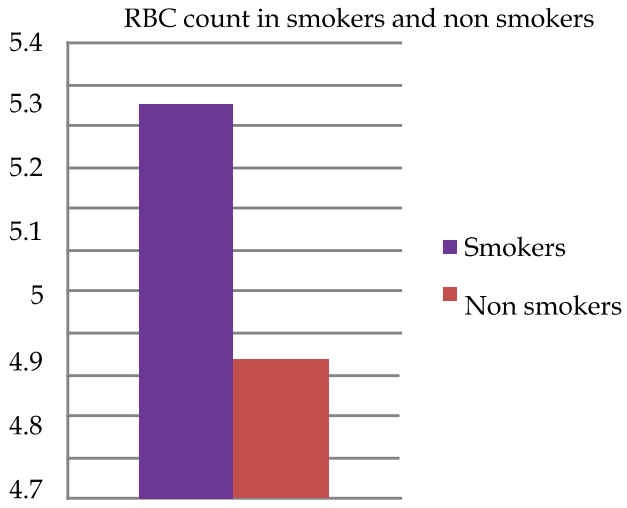
Groups	< 20 yrs		>20 yrs		Total	%
	No.	%	No.	%		
Smokers	31	62	19	38	50	100



Graph 1: Duration wise distribution of smokers

Table 4: TLC in smokers and non-smokers

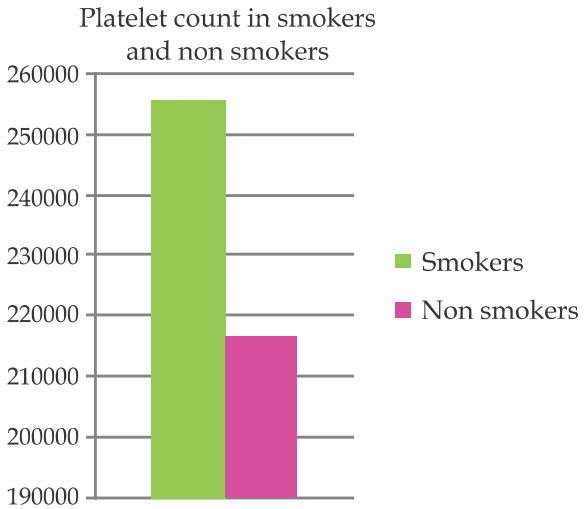
Status of Smoking	Number	Mean /mm^3	Std. Deviation	Std. Error	P-value
Smokers	50	8050	1879.562	265.810	0.000
Non-smokers	50	6858	1245.414	176.128	0.000



Graph 2: RBC count in smokers and non-smokers

Table 5: Platelet count in smokers and nonsmokers

Status of Smoking	Number	Mean Lakhs/mm^3	Std. Deviation	Std. Error	P-value
Smokers	50	255760.00	61835.054	8744.797	0.000
Non-smokers	50	216580.00	35575.209	5031.094	0.000



Graph 3:

Table 6: Comparison of pulmonary function tests in smokers and nonsmokers

PFT	Non-smokers (N=50) Mean ± SD	Smokers (N=50) Mean ± SD	P value
PEFR(Lit/min)	130.214 ± 32.0448	95.524 ± 33.783	< 0.0001*
FVC (Lit)	3.017 ± 0.3025	1.999 ± 0.6617	< 0.0001 *
FEV1	1.729 ± 0.4307	1.130 ± 0.4878	< 0.0001*
FEV1/FVC (%)	58.928 ± 15.6681	41.828. ± 10.2341	< 0.0001*

All values expressed as Mean ± SD Analysis of all parameters done by unpaired t- test.* Highly significant.

Table 7: Comparison of Pulmonary function tests (PEFR and FVC) among smokers in relation to the duration of smoking.

PFT	Duration of Smoking	N	Mean	SD	F	P
PEFR	< 20 yrs	31	63.6	3.80		
(Lit)	>20 yrs	19	58.9	2.10	24.368	< 0.001 HS
FVC	< 20 yrs	31	2.00	0.49		
(Lit)	>20 yrs	19	1.41	0.65	13.292	< 0.001 HS

All values expressed as mean ± SD. Analysis of all parameters done by ANOVA. HS = Highly Significant S=significant.

Table 8: Comparison of pulmonary function tests (FEV1 and FEV1/FEVC % among smokers in relation to the duration of smoking.

PFT	Duration of smoking	N	Mean	SD	F	P
FEV 1 (Lit)	< 20 yrs	31	1.24	0.56	8.71	< 0.001 HS
	>20 yrs	19	1.16	0.57		
FEV 1/FVC %	< 20 yrs	31	76.00	28.41	6.228	< 0.01 S
	>20 yrs	19	69.8	24.62		

All values expressed as mean ± SD. Analysis of all parameters done by ANOVA. HS = Highly Significant. S=Significant.

Table 9: Comparison of pulmonary function tests (PEFR and FVC) among smokers in relation to the number of cigarettes smoked per day.

PFT	Frequency (no. of cig/day	N	Mean ± SD	F	P
PEFR (Lit)	10-15	32	63.6 ± 3.9	14.980	< 0.001 HS
	16-20	18	59.7 ± 2.3		
FVC (Lit)	10-15	32	2.17 ± 0.52	24.454	< 0.001 HS
	16-20	18	1.26 ± 0.78		

All values expressed as mean ± SD. Analysis of all parameters done by ANOVA. HS = Highly Significant

Table 10: Comparison of pulmonary function tests (FEV1 and FEV1/ FVC %) among smokers in relation to the number of cigarettes smoked per day.

PFT	Frequency (No. of cig/day	N	Mean ± SD	F	P
FEV1 (Lit)	10-15	32	1.29 ± 0.44	7.64	< 0.001
	16-20	18	1.21 ± 0.82		HS
FEV1/FVC %	10-15	32	74.50 ± 10.61	17.072	< 0.001
	16-20	18	53.25 ± 20.25		HS

All values expressed as mean ± SD. Analysis of all parameters done by ANOVA. HS = Highly significant.

A statistical analysis between multiple groups, duration of smoking no. of cigaretts smoked/day was done using one way ANOVA.

Discussion

In our study, it has been observed that the RBC count and the Hb concentration are increased in smokers (P < 0.0001, both highly significant). This may be because cigarette smoke contains carbon monoxide. The carboxy-hemoglobin (CoHb) found in smokers interferes with oxygen transport and utilization.[46] Smoking reduces tissue oxygen delivery leading to hypoxia. This hypoxia is a potent stimulus for the release of erythropoietin by interstitial cells in peritubular capillary bed in the kidney (85%) and perivenous hepatocytes in the liver (15%). Erythropoietin increases the number of erythropoietin –sensitive committed stem cells in the bone marrow, that is converted to red blood cell precursors and subsequently to mature erythrocytes.[9] It also promotes hemoglobin synthesis by increasing globin synthesis and potentiating δ-amino Levulinic acid synthetase.

Thereby leading to an increase in RBC count and Hb concentration.[10] Studies conducted on RBC count and Hb concentration by Sagone AL Jr. et al., RD Forrest et al., D. Nordenberg et al., Whitehead TP et al. are corroborating with our study.[9, 10,11,12] In our study, it has been observed that in smokers, total leucocyte count (TLC) is increased (P < 0.0001), highly significant). The precise mechanism by which, cigarette smoking leads to an elevated TLC is not clear. The possible hypotheses put forward to explain this finding in smokers are as follows: 1. Cigarette smoke contains many harmful components including acrolein, nicotine, and acetaldehyde, formaldehyde produced from chemical reactions within the cigarette smoke. These predispose to the development of upper and lower respiratory tract infections, which may amplify cigarette smoke- induced lung inflammation. The systemic inflammatory response is characterized by the stimulation of the hematopoietic system, specifically the bone marrow resulting in the release of leucocytes into the circulation aided by colony-stimulating factors like granulocyte-monocyte colony-stimulating factor (GM-CSF).[9] This may lead to an increase in total leucocyte count in smokers.Certain compounds of smoke such as free radicals and phenol-rich glycoproteins directly exert an inflammatory stimulus on macrophages which may trigger the production of inflammatory cytokines such as TNF-α, IL-1 and IL-6.[16] Fibrinogen neutralises the changes on the red cells and makes the red cells sticky, thereby increasing rouleaux formation, which in turn increases ESR.[8,13] Results obtained in studies conducted on ESR by Adekunle A Famodu et al. and Mehrun Nisa et al., corroborate our findings.[15,20] In our study, it has been observed that in smokers with a duration of smoking > 20 years, there is an increase in hemoglobin, RBC, TLC and ESR values. The increase in hemoglobin is statistically significant. (p < 0.024). In smokers with a duration of smoking > Twenty years there is a decrease in platelet count (p=0.117) which is statistically insignificant. Literature reports on the effect of smoking on platelet count seem to be controversial. Dotevall et al. noted no changes in platelet count in female smokers and nonsmokers, and Suwansaksri et al. observed no alterations in PLT in male smokers and nonsmokers.[19,20]

Pulmonary Function Tests

PEFR decreases more with increase in the duration of smoking and also with an increase in the number of cigaretes smoked per day. This results because smoking causes inflammation and narrowing of airways which causes a decrease in elastic recoiling pressure of the lungs.[21] These findings were the same as of those repeated by Nancy et al.[22] and Prasad BK et al.[23]

FVC: There was a statistically significant decrease in the level of FVC in smokers compared to non-smokers, a decrease therefore reflects, 1. The restriction is secondary to pulmonary or pleural fibrosis. 2. Air trapping secondary to airway obstruction.[17,20] The decreased FVC in our study might be due to a second cause. Similar findings were also reported in multiple studies, by Nancy NR et al.,[22] Danuser B et al., [24] Miller A et al.,[28]

Fev 1: Statistically significant decrease in the level of FEV1 in smokers compared to non-smokers. Increase in resistance to airflow and in FEV1 reduction associated with cigarette smoking can be partially explained by loss of elastic recoil of lung pressure, which reduces the force required to drive the air out of the lung This loss of elastic recoil pressure is attributed to the enlargement of air spaces microscopically rather than to grossly visible emphysema. It was shown that the bronchial reactivity increases in smokers, increasing IgE.[28] This may also affect the FEV1 in smokers It was shown that the bronchial reactivity increases in smokers, increasing IgE.

This reported from Tashkin DP et al.[25] Camilli AE et al.[27], Hogg CJ et al.,[26] Kerstjens et al.[31]., and Apostle GGet al.[32]

Ratio of FEV1/FVC

FEV1/FVC ratio is a more sensitive index of early disease.[33] Smoking leads to changes in FVC and also FEV1.

Thus this ratio is also affected. These findings are similar to many other studies from Walter S et al.,[33] Miller A et al.,[28] Gold DR et al.,[34] Mannino DM et al.,[36] and Gorecka D et al.[37] As it is shown in our study, all the parameters of lung function, which are analyzed showed a decrease in their value, with an increase in the duration of smoking and number of cigarettes smoked per day. Similar findings were found by Miller A et al.,[28] Gold DR et al.,[34] Apostol GG et al.,[32] and Isobel U et al.[38]

As shown by studies such as Tashkin DP et al.,[25] Camilli AE et al.,[27] Dockery DW et al. and Gorecka et al.,[37] that quitting smoking improves the lung function. Hence the inflammatory changes in small airways often reverse with cessation of smoking.

Conclusion

Smokers showed abnormal Hematological parameters and pulmonary function tests. In smokers, RBC count, Hb concentration, total leucocyte count, platelet count and ESR is increased. The results of all these tests are statistically significant. Smokers showed a significantly higher decline in PEFR, FVC, FEV1 and ratio of FEV1/FVC The duration of smoking affected all the parameters, and the effect of duration on Hb concentration, i.e. increased levels, are statistically significant. Regular monitoring of these parameters in smokers is advised so that changes can be detected at an earlier stage of emphysema or COPD and apply preventive measures such as cessation of smoking. Our study provides a variety of adaptations/alterations in airway structure of the lungs and pulmonary function, even in the absence of overt disease. Health education on the hazards of smoking and legislation on banning of smoking in public places has to be encouraged.

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