Research Paper Medical Science

Comparative Study of Lung Volumes in Relation to Duration of Exposure of Steel Factory Workers of Jammu City

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ABSTRACT

Background: Occupational lung diseases are caused by environmental exposure that occurs during one's work. Welding is an important occupational activity, in part because from 0.2-2% of the working population reported to be engaged in welding. The adverse health effects of welding also come from chemical, physical and radiation hazards due to noise, heat, radiation. Welders may also suffer from systemic toxicity, due to welding related substances absorbed through lungs.

Aims and Objectives: The present study was designed to determine the various lung volumes and correlate the findings with the duration of exposure among workers exposed to steel dust.

Material and methods: Two hundred workers working in steel factories in Bari Brahamana industrial estate of Jammu province. The workers were divided into 2 group's cases (welders) and controls (selected from office workers, electrician, drivers etc.) Lung volumes were performed with computerized spirometer (Medspiror).The data was analysed with the help of computer software SPSS 12.0 for windows & Epi-info version 6.1.

Results: Lung volumes were lower in case of welders than controls in all the three groups. The difference was found to be statistically significant. In group III, all parameters were less than cases of group I & II.

Conclusion: Study revealed that lung volumes were decreased in cases i.e. welders as compared to the control group. On analysis the influence of length of exposure on lung volumes significant decline was seen in cases as compared to control, further the decline was maximum in cases with greater than 5 years of exposure

KEYWORDS steel and iron industry; lung volumes; welders

Introduction:-

The steel & iron industry has been one of the world' s most important heavy industries ever since it was founded due to its giant plants and massive equipment's [1]. Occupational exposure occurs in industry as well as in agriculture and may lead to acute diseases after brief, heavy exposure or to chronic diseases after lesser but prolonged exposure. In addition, repeated exposure may cause acute lung damage .Occupational lung diseases are caused by environmental exposure that occurs during one's work. [2] Welding is an important activity in steel and iron industries and 0.2-2% of the working population is reported to be engaged in it. The adverse health effects of welding also come from chemical, physical and radiation hazards due to noise, heat, radiation. Welders may also suffer from systemic toxicity due to welding related substances absorbed through lungs .[3] The reaction of the lung to inhaled inorganic dust depend on many factors, each of which is important by itself but all of which must be considered in combination because they are to some certain extent interdependent. These factors include the chemical nature of dust, the size and shape of dust particles, the concentration of dust particles in the ambient air, the duration of individual's exposure to the dust and the individual variation in immune and inflammatory response. [4]

Extensive evaluation has been done worldwide to study the casual relationship between inhaled steel dust and an adverse biological effect in a particular individual or occupation group .No such study has been conducted in this part of the country. The present study was carried out in steel industry as an attempt to find out respiratory ill effects in relation to common occupation (welding) of people working in steel industries of Jammu province.

Aims and Objective:-

The aim of the present study was to determine the various lung volumes among workers exposed to steel dust in industrial estate of Jammu province and to correlate the findings with the duration of exposure among workers exposed to steel dust.

Material and Methods-

This was a cross-sectional study conducted for a period of 1 year from 2006 to 2007. Two hundred workers working in steel factories in Bari Brahamana industrial Estate of Jammu province. The workers were divided into 2 groups. First group comprised of cases (welders) and second group were the controls (selected from office workers, electrician, drivers etc). 100 cases and 100 controls were included. The cases were

further divided into 3 subgroups I, II, III on the basis of the years of exposure to steel dust which was <2 years, 2-5 years, > 5 years respectively. Workers with history of cardiopulmonary illness were excluded from the study. All the subjects were enrolled after obtaining written consent & all ethical requirements related to human experiments have been fulfilled and on an average 10-15 workers were catered by the Department of Physiology, Government Medical College, and Jammu. For every person lung volumes was performed with the help of Medspiror (Records and Medicare System, Chandigarh). Three readings were taken at the same time of the day in sitting position and best of the three reading was considered in the study .Only two maneuvers i.e. FVC &MVV were required to accumulate all the necessary data. Before taking the record the subjects were fully assured, thoroughly familiarized with the apparatus and demonstrations was given to them how to do various tests.

The various parameters of lung volumes which were studied included FVC(forced vital capacity), $FEV_{.5}$ (forced expiratory volume in half second) , FEV_1,(forced expiratory volume in one second) FEV_3 , (forced expiratory volume in three seconds) and ratios between forced expiratory volume in half second to forced vital capacity ($FEV_{0.5}$/FVC%) , ratios between forced expiratory volume in one second to forced vital capacity (FEV_1/FVC%), ratios between forced expiratory volume in three second to forced vital capacity(FEV_3/FVC%) and maximum voluntary ventilation (MVV).

Statistical analysis

Data analysis was performed using computer SPSS (statistical package for social science) software 12.0 for windows and Epi-Info version 6.1 Mean and standard deviation were calculated chi-square test was applied to compute statistical significance. p- Value of < 0.05 was considered to be statistically significant.

RESULTS

The physical parameters of 200 cases and controls selected for the studies are presented in (Table1).There were no difference between cases (welders) and controls when analyzed for age, height, weight and body surface area.

The comparison of means of lung volumes among cases and controls based on duration of exposure (years) is shown in (Table 2). The lung volumes were lower in cases (welders) than in controls in all the 3 subgroups. This difference was found to be statistically significant for most of the values as shown in (Table 3). In subgroup III all the parameters were impaired than cases of Group I and Group II. The difference was found to be statistically significant for $FEV_{0.5}$, FEV_1, FEV_3, $FEV_{0.5}$/FVC%, FEV_1/FVC and MVV values.

Discussion

Pulmonary function tests are non-invasive diagnostic tests that provide measurable feedback about the function of lungs. The present study examined respiratory health in relation to a common occupation i.e. welding. Welding involves exposure to and inhalation of a number of agents, depending on the specific welding process. [5] In healthy young adult, the vital capacity is 80% of the total lung capacity and is a significant tool for diagnosis, prognosis and treatment of respiratory insufficiency. [6] In the present study, the mean value of FVC was (2.32± 0.71) in the case of welders as compared to controls (2.70± 0.77) .The value was found to be statistically significant as compared to controls. Similar observation were reported by Pham et al, Lyngengbo et al Khanzadeh and Sobsazek et al [7-10]

Further, lower value was seen among cases with maximum exposure i.e. ≥ 5 years but the difference observed was not significant. Our finding are in agreement with that reported by Ozdemar et al & Beckett et al who have also observed no significant decline in FVC with increased duration of exposure[11,12] FEV_1 provides an indication of expiratory power and overall resistance to air movements in the lungs. FEV_1 is a more reliable indicator to distinguish between obstructive and restrictive diseases. In the present study the mean value of FEV_1 in cases (2.12 ± 0.80) was lower as compared to control (2.53 ± 0.88) and difference observed was also statistically significant. The observations are quite in agreement with the observation of Hunnicutt et al [13], Pham et al [7] and Khanzadeh [9] Keimig et al [14] . No significant decrease in FEV_1 between welders and controls was found by Schneider and Rebohle [15] and Keimig et al [14] in their study. This difference as compared to our might be due to global variations like racial difference and environment factors. Statistically significant decrease in FEV_1 value was observed in welders with maximum duration of exposure (> 5 years) in our study. The value of FEV_1 in cases i.e. welders as compared to controls show significant decrease in all the three groups i.e. <2 years, 2-5 years. ≥ 5years. The mean value of FEV_1/ FVC among cases with ≥ 5 years of exposure show significant decrease (p 0.0004) .The finding of present study with regard to duration of exposure is similar to that of Bradshaw et al and Meo et al [16 ,17] . They also observed significant decrease in FEV_1 /FVC in welders with increased duration of exposure. The mean value of FEV0.5, FEV3 in welders were lower than the control group and the difference observed was significant whereas the mean values of FEV0.5/FVC & FEV3/FVC in welders are decreased as compared to control group.

MVV is a dynamic test of lung function and is considered to be a good guideline of the mechanical efficiency of the lungs. In the present study, the mean value of MVV in cases was 91.88 litres/min and in controls was 101.03 litres/min, the difference observed being statistically significant (p= 0.03).

Conclusion

study revealed that lung volumes were decreased in cases i.e. welders as compared to the control group. On analysis the influence of length of exposure on lung volumes significant decline was seen in cases as compared to controls, further the decline was maximum in cases with greater than 5 years of exposure

TABLE 1: Overall comparison of physical parameters among cases and controls

Parameters	Mean ± SD		p- value
	Cases (welders) (n=100)	Controls (n=100)	
Age	33.16 ±11.08	34.41 ± 8.06	0.36
Weight	53.08 ± 9.24	55.73 ± 14.4	0.12
Height	164.05 ± 7.71	164.52 ± 8.34	0.67
Body surface area	1.57 ± 0.138	1.60 ± 1.19	0.12

TABLE 2: Comparison of means of lung volumes among cases (welders) and controls based on duration of exposure (years)

Parameters	Mean ± SD					
	<2years (Group I)		2-5 years (Group II)		≥ 5years (Group III)	
	Cases (welders)	Controls	Cases (welders)	Controls	**Cases (welders)**	Controls
FVC (L)	2.28± 0.48	3.11± 0.64	2.45± 0.73	2.82± 0.85	2.25± 0.79	2.52± 0.73
$FEV_{.5}$ (L)	1.81 ± 0.56	2.39± 0.94	1.81± 0.73	2.24± O.84	1.55± 0.86	1.83± 0.86
FEV_1 (L)	2.13± 0.48	3.0± 0.75	2.34± 0.79	2.74± 0.85	1.94± 0.90	2.29± 0.86
FEV_3 (L)	2.28± 0.48	3.11± 0.64	2.45± 0.73	2.82± 0.85	2.22± 0.78	2.51± 0.72
$FEV_{.5}$/ FVC%	81.6± 20.6	72.5± 25.0	76.94± 25.4	76.8± 21.0	67.8± 32.5	73.7± 27.4
FEV_1/ FVC%	95.4± 14.4	95.8± 10.1	95.75± 13.8	95.8± 8.37	86.4± 26.0	93.0± 19.2

FEV_3/ FVC%	100.2± 0.27	100.1± 0.16	100.2± 0.28	100.1± 0.19	100.1± 0.70	99.8± 3.00
MVV (L/min)	88.1± 18.6	105.6± 34.3	97.6± 26.4	102.6± 39.4	89.0± 29.1	98.8± 34.1

TABLE 3: Comparison of p- values of lung volumes among cases (welders) and controls based on duration of exposure (years)

Parameters	p- value			p- values for cases of Groups I, II, III
	<2years (Group I)	2-5 years (Group II)	≥ 5years (Group III)	
FVC (L)	0.0000**	0.001**	0.01*	0.08
FEV_1 (L)	0.000**	0.0001**	0.02*	0.01*
FEV_1 (L)	0.000**	0.0007**	0.005**	0.0008
FEV_3 (L)	0.000**	0.0011*	0.006**	0.04*
FEV_1/FVC%	0.06	0.96	0.16	0.0011**
FEV_1/FVC%	0.82	0.97	0.04*	0.0004**
FEV_3/FVC%	0.001**	0.002**	0.33	0.21
MVV (L/min)	0.00001**	0.29	0.03*	0.01*

***Significant** ****Highly significant**

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