Original Article

A STUDY ON PULMONARY FUNCTION TESTS IN COAL MINE WORKERS IN KHAMMAM DISTRICT, TELANGANA-INDIA

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ABSTRACT

Respiratory system, representing an important adjunct to the various lung imaging studies. It also measures the function of lung capacity and chest wall mechanics to determine whether or not the patient has a lung problem. Spirometry gives an important clue in terms of respiratory chronic airway disorders and can predict early damage to pulmonary system. Occupational exposures to coal dust affect the different systems of the body. The present study has focused on the workers mined in coal workers (drilling and digging) who are continuously exposed to air pollutants such as coal dust during duty hours in Khammam population. Thirty healthy non – smoker male working in coal mines for more than fifteen years formed the study group, while thirty healthy non–smoker males who are not exposed to air dust pollutants from hospital staff served as control group. The pulmonary function test was assessed using computerized spirometer. The pulmonary function tests (FVC, FEV1, FEV1/FVC%, FEF25 – 75% and PEFR) were significantly decreased in coal mine workers. The results suggest that there in a need to improve control measures and the health status of workers engaged in coal mine dust Pulmonary Function Testing (PFTs) is a valuable tool for evaluating the particles.

KEYWORDS: Spiro meter, Pulmonary function test, coal mine dust particles.

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INTRODUCTION

Coal is a plentiful resource that has been used for thousands of years to produce energy, both in the form of heat and electricity. Coal is a combustible sedimentary rock composed mostly of carbon 86.2%. And hydrocarbons.[1] Types of coal the ranking LIGNITE, SUBBITUMINOUS, BITUMINOUS coal. Other important users of coal include alumina refineries, paper manufacturers, chemical and pharmaceutical industries. Several chemical products can be produced from the by-products of coal. Refined coal tar is used in the manufacture of chemicals, such as creosote oil, naphthalene, phenol, and benzene. Ammonia gas recovered from coke ovens is used to manufacture ammonia salts, nitric acid and agricultural fertilizers. Thousands of different products have coal or coal by-products as components: soap, aspirins, solvents, dyes, plastics and fibers, such as rayon and nylon. Coal is also an essential ingredient in the production of specialist products so coal extraction necessary during coal extraction dust produces it causes respiratory health problems in miners.[2]

Coal dust is a fine powdered form of coal, which is created by the crushing, grinding, or pulverizing of coal. Because of the brittle nature of coal, coal dust can be created during mining, transportation, or by mechanically handling coal.[3]

Coal miners are exposed to a variety of dusts including silica. Tiny particles of coal dust, just 2-5 microns in diameter, are retained in the alveoli. They are engulfed by macrophages but, eventually, the system is overwhelmed and an immune response follows. This produces pulmonary fibrosis. If this is associated with rheumatoid arthritis, it is called Caplan's syndrome. [4] Morbidity and mortality are related to the type of coal dust and the duration of exposure. Dust that is high in silica increases the risk of fibrosis but the rate of progression and severity of the diseases is also influenced by the presence of other minerals in the inhaled dust. A high percentage of free silica gives a high degree of pulmonary fibrosis.[5] Coal workers' pneumoconiosis (CWP) is divided into:

Simple pneumoconiosis -a nodular interstitial lung disease that is graded according to chest X ray (CXR) appearance. Patients are often asymptomatic and the diagnosis is an incidental finding on CXR. There has been much debate as to the effect on lung function - but it does increase the risk of chronic bronchitis, diminish forced expiratory volume in first second (FEV1) and have additive effects combined with smoking.[6] Progressive massive fibrosis - symptoms progress from shortness of breath on exertion, cough, and black sputum to respiratory failure. CXR reveals large nodular, fibrotic masses in the upper lobes. Respiratory function tests show a mixed obstructive and restrictive picture with decreased lung volumes and gas transfer.

MATERIALS AND METHODS

The institutional ethical committee approval was obtained.

Study population;

The present study was conducted in the singareni collieries Khammam (dist) yellandu 21 incline. The study group (group-1) consisted of thirty healthy non-smoker males in the age group of 30-50 years working in coal mines for 15 years experiences were selected. They were selected from the coal mine which is located in the pollution area. While thirty age matched healthy male non smokers, working as hospital staff are taken as controls (group-2)

Subjects with clinical abnormalities of the neuro-muscular diseases ,known cases of gross anemia, diabetes mellitus ,pulmonary tuberculosis, bronchial asthma, chronic bronchiectasis, and malignancy were excluded from the study,the subjects who had undergone abdominal or chest surgery were also excluded from the study.

PULMONARY FUNCTION TESTS;

The pulmonary function tests were carried out using an computerized portable spirometer (bio-net) using the standard laboratory methods. The spirometer was calibrated regularly and a brief physical and general examination was carried out and the anthropometric parameter (name, age, sex, height, weight, occupation, and smoker/ nonsmoker) was entered in the computer. All the pulmonary function tests were done on the subjects comfortably in an upright position. During the test, the subject was adequately encouraged to perform their optimum level and also a nose clip was applied during the entire maneuver. Tests were repeated three times and the best matching results were considered for analysis .the parameters measured by the apparatus were the forced vital capacity (FVC),forced Expiratory Volume in 1st second (FEVI/FVC,)Forced Expiratory flow in (25%-75%), and Peak Expiratory Flow (PEFR) with graphic curves were obtained.

Statistical analysis;

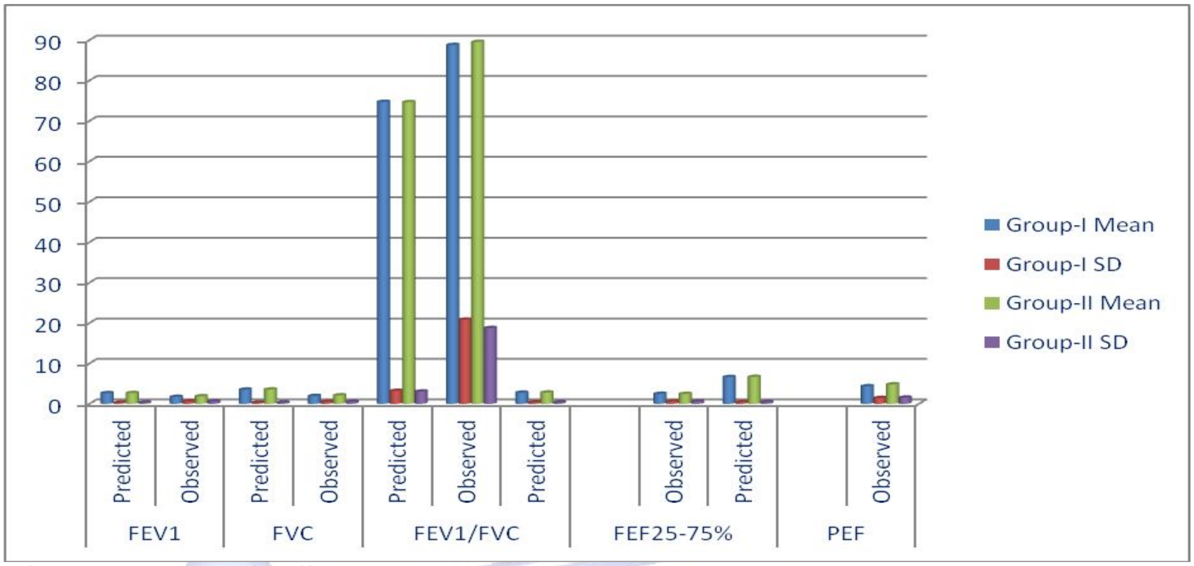
The data of pulmonary function tests were presented as the Mean ± standard deviation for each of the parameter; the two groups were compared by using student t test by spss software.

RESULTS

Table 1: Showing the differences of the various parameters among the groups.

Parameters		Group-I		Group-II		GI-GII
		Mean	SD	Mean	SD	P' Value
FEV1	Predicted	2.63	0.27	2.66	0.3	0
	Observed	1.71	0.61	1.87	0.6	0
FVC	Predicted	3.51	0.27	3.55	0.31	0
	Observed	1.93	0.49	2.09	0.5	0
FEV1/FVC	Predicted	74.69	3.2	74.63	3.04	0
	Observed	88.78	20.8	89.53	18.73	0
$FEF_{25-75\%}$	Predicted	2.75	0.36	2.79	0.38	0.003
	Observed	2.47	0.59	2.44	0.59	0.01
PEF	Predicted	6.62	0.41	6.65	0.43	0
	Observed	4.34	1.44	4.8	1.53	0

Fig. 1: The bar diagram showing group 1 (controls) and group 2 (coal mine workers) comparative values of mean SD and predicted, observed values.



In the present study different pulmonary parameters has been evaluated in coal miners and controls Table 1 contains Group I and Group II are divided according to controls and coal mine workers subjects. Mean and SD of the predicted and observed values of the parameters (FVC, FEV_1, FEV_1 /FVC, FEF_{25-75}% and PEF) has been displayed according to computerized Spirometer result sheets.

Among the all pulmonary parameters of the observed and predicted values of maximum parameter like FVC, FEV_1 , PEF, FEV_1/FVC are shows more significantly decline, but FEF25-75%,(P<0.05). significantly decline

The mean SD values of the lung function parameters for the coal workers and matched controls was seen to significantly decresed in coal mine workers. FEV1 /FVC.[7]

DISCUSSION

Inhalation of coal dust is an important cause of pneumoconiosis in India[8]. The present study was designed to quantify resulting abnormalities in lung function in subjects exposed to coal dust particles as compared to their matched control. The present study demonstrates that prolonged exposure to coal dust markedly decreased the pulmonary function who were exposed to coal dust more than 15 years working experience showed a significant reduction in FVC,FEV1,FEF25-75% and PEFR relative to their matched controls.

The main source of particles in accumulation mode (most intimately related to lung function impairment in coal mine polluted air) FEF25-75 is considered a fairly good test to identify early small airway disease [9,10,11]. Miner exposed to coal dust changes the lung volumes and capacities we can easily find out through the Spirometry.

Obstructive and restrictive ventilator defects are two basic disease patterns detected by Spirometry. An obstructive ventilator defect indicates airflow limitation caused by airways narrowing during expiration [ATS 1991]. A greater reduction in FEV] than in VC (FEV1/FVC decreased) suggests an obstructive ventilatory defect [ATS 1991][12]. Diseases associated with this pattern include asthma, chronic bronchitis, and emphysema [Garay 1992]. Reduced VC and normal or increased FEV1 / FVC suggest a restrictive ventilatory defect [ATS 1991] Pneumoconiosis and other interstitial lung diseases can cause restrictive ventilatory defects. Exposure to respirable coal mine dust may cause obstructive, restrictive, or mixed ventilatorydefects. FEV1 is ideal as a screening tool because it detects ventilatory defects reflecting either restrictive or obstructive patterns owever, FEV1 should not be used without the FEV1 / FVC* ratio to distinguish between disease patterns because FEV1 may be decreased in both the obstructive and restrictive patterns, as shown here;

Coal dust [13] particles reach the alveoli and are ingested by the alveolar macrophages these are removed by mucociliary escalater – when the clearance action is over whelmed, retention of the particles occurs and fibro blasts invade the region and surround the macrophages with release of proteolytic enzymes from the lysed macrophages formation of connective tissue is enhanced.by this process, respiratory bronchioles becomes slowly incorporated in the coal macule aggregate of coal dust,dead and dying macrophages, fibroblasts and connective tissue. These basic lesions of all forms of CWP.

A graphical represntation of lung function versus time spent at the coal mine workers at working places,Shows that subjects who had worked for a longer duration at the coal mine place had lower percentage of predicted values for most of the parameters studied .This reduction is not due to increasing age of subjects. It is likely that this decline in lung function is due to the factors such as exposure to air pollutants like carbon mineral compositon may also contain trace elemets,Arsencic,lead,mangenese,titanium, beryllium uranium [7]. lung function tests are decline plino carta etal studied in young coal miners FVC,FEV1[14], Seixas NS et al studied underground miners lung function tests significantly decline FVC, FEV1, FEV1/FVC. Cumulative exposure increasing prevalence less than 80% predicted.

Exposure to coal mine dust is associated with symptoms of chronic bronchitis but, as already described, bronchitis of itself does not appear to cause detectable loss of FEV1[15]. The explanation for the impairment of lung function in coal miners is therefore likely to lie elsewhere. Studies based on post mortem examination of lungs suggest that coal mine dust can cause centrilobular emphysema, especially when pneumoconiosis is present, but perhaps also in other situations. [16,17,18,19] This is plausible given the experimental evidence that inhalation of dust from mines causes release of inflammatory mediators by neutrophils.[20,21] However, we cannot be certain that this is the only or even the main mechanism whereby lung function is lost. Another possibility is that dust causes inflammation of the small airways, although there is little direct evidence for this. Further clues may lie in the pattern of lung function deficit associated with dust exposure. There is some indication that the loss of FVC relative to FEV1 is greater from dust than from smoking. [22] At present, however, the exact nature of the pathology underlying the loss of lung function in miners is still uncertain.

CONCLUSION

The data suggests that coal air pollutants could account for substantial part of respiratory dysfunctiong.in order to prevent these among coal mine workers the stratagies of use of mask,regular health check up and awareness on health impacts of pollution need to be adopted for protection of coal mine workers [23,24]. A large number of epidemological studies have shown that long term exposure to the particles is associated with adverse effects on health.

Underground coal mines are required to be mechanically ventilated .The purpose of mechanical ventilation is to provide fresh air to the underground miners and to carry off toxic and explosive gases and dusts. The primary purposes of ventilation are to dilute respirable coal dust, to remove explosive concentrations of coal dust and methane from the working faces, and to remove[24] methane from mined-out areas In addition to supplying fresh air. Tobacco products should not be smoked, chewed, or carried into work areas. First priority should be given to primary prevention of occupational respiratory diseases through the reduction of exposures. However, a secondary program of medical screening and surveillance is necessary to identify miners who develop respiratory diseases as a result of their workplace exposures.Informing workers about hazards, Establishing written emergency procedures, Using engineering controls, work practices, and personal protective equipment (including respiratory protection when dust control equipment is being installed, maintained, or repaired)Monitoring exposures Conducting medical screening and surveillance Encouraging smoking cessation Maintaining medical records.

Conflicts of interest: None

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