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Health Status of Coal workers with special reference to Pneumoconiosis in Indian context

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Introduction

The progress of a nation is closely linked with its energy resource. Coal is the mainstay for our energy production. To meet up the enhanced requirement, the authority is compelled to increase the output of Coal to a great extent and gradually shifting from non-mechanised to semi-mechanised and mechanised mining. So also open cast mining is being gradually resorted to further accelerate the production. These changes, initially may result in increase production of dust and greater degree of environmental pollution. About 62% of India's energy requirement are being met by the fossil fuel Coal. India's Coal deposit is 11 billion tons[1]

The occupational health problems of the coal workers are well known. In general, the respiratory morbidity, skin problems, sexually transmitted diseases and helminthiasis are usually encountered. The specific health effect is due to inhalation of coal dust causing pneumoconiosis. Of course, it takes years together to develop. The data available regarding the prevalence of Coal Workers Pneumoconiosis (CWP) in our country varies from 0.8% to 18.8%. But the studies were not comprehensive and reliability of the data is questionable. This may probably be due to non-standardised tecniques of diagnosis and faulty selection of samples. However, presently, the diagnosis of Coal Workers Pneumoconiosis has been standardised at the international level . Therefore, it is important to know the real picture of CWP in our country.

Definition of CWP

Pneumoconiosis may be defined as *" the non-neoplastic reaction of the lungs to inhaled mineral or organic dust and the resultant alteration in their structure excluding asthma, bronchitis and emphysema"* [2]. Coal workers pneumoconiosis may simply be defined as *"Occupational disease caused by prolonged retention in the lung of abnormal amounts of dusts derived in the first instance from coal mining operation"* [3]. *"Coal workers pneumoconiosis (CWP) and carbon pneumoconiosis are specific diseases*

resulting from the inhalation and deposition in the lung of carbonaceous dust and the lung's reaction to the dust so deposited" as defined by NIOSH, 1987[4] . Simple coal workers pneumoconiosis and complicated pneumoconiosis or progressive massive fibrosis or masses pseudo-tumorales are the two forms.

Diagnostic Criteria

It is well known that simple coal workers' pneumoconiosis is without any symptoms and signs, if there are no predisposing diseases[2, 5]. Complicated pneumoconiosis may be having some symptoms and signs in the later stages. The diagnosis of CWP is based mainly on the X-ray chest with appropriate and authentic life time occupational history. The X-ray chest to be taken with a 300 mA X-ray machine in large films with appropriate kV (with or without grid) so as to get a clear cut picture of small pneumoconiotic shadows. Quality of film must be good. The X-ray taken to be compared with standard ILO films for classification of the X-rays by three independent readers. Pulmonary function test is of little value in some cases as the workers also may have other respiratory morbidities like chronic bronchitis and emphysema. Smoking is also one of the factors needing consideration. However, some common conditions mimicking simple CWP like miliary tuberculosis, sarcoidosis or histoplasmosis to be kept in mind.

Collection of history with special reference to occupational history

This is one of the most important aspects needs special attention. As our working community are mostly illiterate, special care must be taken to record authentic, reliable history. Standard proforma (preferably precoded) to be prepared, tested and validated prior to collection of information. Due stress to be given for noting occupational history in chronological order with duration of work in each job. This may be in the same organisation or different organisation and if required, proper description of the job to be noted for better understanding. Smoking history is very important. Quantum of smoke, duration of smoking and if left, duration of leaving to be recorded. Standard questionnaire may be included, if needed. Before collection of history, rapport to be established and the confidence of worker must be gained.

It is documented that coal workers are victims of respiratory ailments [7-14]. In addition to general medical history collection, standard respiratory questionnaire may be added to elicit the occurrence of chronic bronchitis. In a study author observed that the main subjective complaints were dry cough (18.15%), expectoration(16.88%), breathlessness (28.44%), chest pain (16.55%) and haemoptysis (7.50%) [14]. The above complaints are found to increase with age and duration of exposure. Chronic bronchitis was present to the extent of 8.83%. Almost similar trend of increase of chronic bronchitis with age and work duration was noted.

Clinical examination

Coal workers' pneumoconiosis is reported to be without any characteristic physical signs [15, 16, 17]. Usually in simple CWP no significant sign is clinically detected. But at times, in few cases detectable clinical sign may be there[15, 17]. In complicated pneumoconiosis some signs may be detected, particularly at the later stages. Demonstrable clinical signs may be there because of non-pneumoconiotic persistent respiratory morbidities or in case pneumoconiosis is associated with other disease conditions. There are distinct possibilities that smoking may help in developing symptoms and signs. It is difficult to correlate explain the cause of chronic bronchitis and dyspnoea: The irritant effect of coal dust may lead to hypersecretion of mucus in bronchitis but whether it is possible to produce obstruction of the airways sufficient to cause dyspnoea is difficult to explain . In our study we have found out diminished breath sound (4.55%), crepitations (6.67%) and rhonchi (8.03%) clinically [14].

Haematological examination

For the diagnosis of CWP routine haematological tests is of no value. In case of other associated disease or non-pneumoconiotic persistent respiratory morbidities the tests may be of help. In our country in the mine areas tropical eosinophilia is commonly encountered with. It may also be helpful in differential diagnosis.

Pulmonary function tests

Pulmonary function test is of little value in cases where other respiratory morbidities like chronic bronchitis and emphysema may be there. Other associated diseases may have some bearing in PFT. However, PFT changes had been seen in the study undertaken by the Centre. Mainly restrictive type of impairment was noticed. Obstructive and mixed type of impairments were also there but to a lesser extent.

Radiological examination

The most important and the diagnostic criterion is standard X-ray chest (PA). The International Labour Organisation has developed standard X-ray set for diagnosing Pneumoconiosis. The diagnosis to be made by comparing the chest X-ray in question with the standard ILO film [18]. There should be 3 independent readers for interpreting the X-ray following the 12 point scale recommended by ILO. Standard procedures have been set for taking the X-ray so also for interpreting in specified illumination level of the view box. Quality of the developed film to be suitable for interpretation.

In our study the X-rays were interpreted by two Occupational Health Specialist and one Radiologist having experience in diagnosing Occupational Lung Disorders. The result of interpretation of 3611 X-ray plates (of the miners working in the underground mines) according to categories of pneumoconiosis were category 0 / 1 – 5.70%; 1 / 0 -- 4.15%; 1 / 1 – 2.49%; 1 / 2 --0.28%; 2 / 1 – 0.11%; 2 / 2 – 0.14% [14]. The prevalence were more in smoker and past smoker than non-smoker group. For practical purposes we have grouped pneumoconiosis into 2 broad main categories (a) suspected and (b) definite pneumoconiosis. Suspected category consisted of 0 / 1 and 1 / 0. The terminology suspected is used because category 0 / 1 has been defined as normal or profusion '0' but there is a strong suspicion of its being considered in category '1'. Similarly category 1 / 0, though predominantly it is thought to be of profusion '1', yet there is strong suspicion of its being considered in the category '0' or normal. Therefore, in this study the prevalence of pneumoconiosis is – suspected 9.86% and definite 3.02%. The opacities were mainly rounded, though irregular opacities were also present in good numbers. The predominant shapes and sizes were p / p (28.39%), q / q (11.83%), s / s

(11.18%), p / s (10.97%), s / t (9.89%). The distribution of predominant shadows in the lungs according to smoking habit were

Shape and Size	Right Lung			Left Lung		
	NS	S	PS	NS	S	PS
p	99	93	22	82	76	21
%	5.17	7.16	5.33	4.28	5.86	5.08
q	30	42	18	36	40	17
%	1.57	3.23	4.36	1.88	3.08	4.12
s	52	53	22	46	51	13
%	2.72	4.08	5.33	2.40	3.93	3.15
t	15	7	4	33	28	15
%	0.78	0.54	0.97	1.72	2.16	3.63

NS = Non-smoker, category strength 1915; S = Smoker, with total 1298 subjects
PS = Past Smoker, consisting of total 413 subjects

Usually in simple CWP the opacities are found in upper halves of the lung fields. In complicated pneumoconiosis the opacities may be single, multiple, unilateral or bilateral of variable shapes and sizes; the distribution may be symmetrical or asymmetrical. Though the shadows are usually found in the upper zones, they may be present anywhere. Multiple irregular masses being dragged by the fibrotic tissue tend to migrate towards the hila. These large shadows may cavitate or rarely calcify[2, 4, 14]. In minority cases the opacities may be in the lower zones of the lungs.

The distribution of opacities were more in the right lung; middle and lower zones were the maximum affected zones in both the lung fields. In case of right lung middle and lower zones accounted for 98.28% of the pneumoconiotic shadows. In this study

population the earliest suspected category 0/1 developed in 3rd year of exposure and the earliest suspected category 1/0 developed in 6th year. The first definite case of pneumoconiosis developed in the 8th year. Further progression to higher profusions were found to occur in case of 1/2 in 12 years, 2/1 in 24 years and 2/2 in 28 years. The category of profusion above 2/2 did not develop even after 40 years of exposure. It is observed that with the increase of dust year the percentage of coal workers affected with pneumoconiosis is also showing an upward trend. Another observation is that in each dust year group as the profusion increases the percentage of pneumoconiosis cases decreases[14]

The presence of suspected or changes suggestive of disease symbols on the chest radiographs of coal workers were tb (6.06%), em (2.50%), ef (0.69%), co (0.64%) and cv (0.58%) [14]. Mainly the suspected categories of pneumoconiosis was seen to have shared the largest portions of the two major suspected diseases namely tuberculosis (26 cases out of 34) and emphysema (17 cases out of 22). Of the chronic persistent respiratory symptoms, suspected pneumoconiosis accounted for 7.75% chronic bronchitis and 26.45% dyspnoea cases and in case of definite pneumoconiosis figures were chronic bronchitis – 2.36% and dyspnoea 9.03%.

Careful consideration of our study findings on the development of Coal Workers' Pneumoconiosis, its presenting features: the symptoms, signs: X-ray interpretation results, it can be said that the disease do exist in India with the presentation of similar and dissimilar patterns. Contrary to belief, the sequence of development of the disease showed an early development but the progression rate from lower to higher category was variable.

Electrocardiogram

The ECG is an important investigation to know the prognosis of the pneumoconiotic subjects. There may be right ventricular hypertrophy (RVH), with or without heart failure, particularly in case of complicated pneumoconiosis. Chronic cor pulmonale or RVH is a late feature of pneumoconiosis. For routine purpose its use is limited in our country. Not a single case of RVH was detected in our study(may be due to lower category of pneumoconiosis cases).

Data Analysis

For a valid conclusion a suitable statistical package to be employed during analysing the data. Correctness of data collection, its proper entry, proper analysis of data, correct interpretation and report writing are most important and valuable.

Conclusion

Conclusion to be drawn on the basis of the analysed data. Due care must be taken regarding all the important aspects of the study, limitations to be taken into consideration and then suitable valid conclusion may be drawn.

Recommendation

On the basis of the results, its interpretation, conclusion, implications, suitability of application, cost effective benefitness etc., to be viewed seriously while going for recommendation. Pre-employment and periodic medical examination, proper report keeping and its upgradation, follow up of the workers as per requirements, periodic evaluation of environmental conditions and adoption of remedial measures (if any) are the important aspects needing special consideration. Emphasis needs to be laid on proper health education of the workers and is a must with special reference to adverse effects of dust and other environmental conditions.

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PULMONARY FUNCTION TESTS FOR EVALUATION OF RESPIRATORY IMPAIRMENTS IN MINERS

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1. Importance of Pulmonary function tests

Evaluation of pulmonary function is widely recognized as an essential procedure in cardiorespiratory practice. Pulmonary function test results of an individual is considered as an index of respiratory efficiency of the person concerned. In many lung diseases symptoms can be misleading and physical signs are inadequate where the pulmonary function tests provide the vital information. A large number of pulmonary function tests are now used to determine the nature and extent of pulmonary dysfunction. These tests enable early detection of pulmonary insufficiency in many patient considered normal on clinical and radiological examinations. In industrial medicine these tests are used for the early detection, diagnosis and disability evaluation in different occupational lung diseases.

It is known that the primary function of the respiratory system is to maintain the tension of oxygen and carbon dioxide in the arterial blood within narrow physiologic limits. The three important processes of respiration are : (i) Ventilation, (ii) Diffusion and (iii) Perfusion.

- Ventilation is a process of drawing in of the atmospheric air to reach the alveoli (Inspiration) and removal of the gases back to atmosphere (expiration).
- Diffusion is a process by which the gas transfer across the alveoli capillary membrane due to tension gradient O_2 passes from alveolar gas to pulmonary capillary blood and CO_2 from capillary blood to lung alveoli.
- Perfusion means flow of adequate quantity of blood through the lungs so that the diffuse gases are carried away.

Naturally the three processes are intimately linked in health, but the disease condition may affect any of them above or together. The first and most important and commonly affected process of lung function is the ventilation, compared to the disturbance of gas exchange which occurs far less frequently. Pulmonary function tests have made a valuable contribution in the following five areas (Slonim and Hamilton1981)

1. Basic physiologic knowledge of pulmonary function in healthy man as affected by sex, size, age race and physical training status.
2. Information regarding pathophysiology, the natural history of cardiopulmonary diseases.
3. Diverse research, which has important implications for the rational therapy of disease, analysis of the results of surgery.
4. Early detection, diagnosis and differential diagnosis of disease.
5. Guidance for management and therapy of various cardio pulmonary diseases.