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Pneumoconiosis as an occupational lung disease: Evaluation of radiographic opacities and pulmonary function tests

(Running Title: Occupational lung disease: Pneumoconiosis)

Mesleki akciğer hastalığı olarak pnömokonyoz: Radyografik opasitelerin ve solunum fonksiyon testlerinin değerlendirilmesi

(Kısa Başlık: Mesleki akciğer hastalığı: Pnömokonyoz)

INTRODUCTION

An occupational disease is a temporary or permanent illness, or a physical or mental disability that a person suffers due to a recurring cause arising from the nature of their work or due to the working conditions of the job.

The definition of occupational disease is set out in Article 17 of the Regulation on the Procedures for the Determination of the Rate of Loss of Working Capacity and Occupational Earning Capacity. The relevant article states as follows: “1-) Which diseases will be deemed as occupational diseases and how long after the actual departure from the work, these diseases will be accepted to be caused by the occupation of the insured if they occur at the latest, are determined and assigned according to the Occupational Diseases List (Annex-2). 2-) In cases where an occupational disease is confirmed by clinical and laboratory results and the cause of the occupational disease is proven by a workplace examination, the disease in question shall be deemed to be an occupational disease by the decision of the Supreme Health Council of Social Insurance, even if the period of liability in the list of occupational diseases has been exceeded.” (Law No. 5510 on Social Insurance and General Health Insurance, Regulation on the

Procedures for Determining the Rate of Loss of Work Capacity and Occupational Earning Capacity, Official Gazette Date: 11/10/2008, Official Gazette Number: 27021).

According to Social Security Institution data, pneumoconiosis is the most common occupational lung disease in Turkey (1).

Pneumoconiosis is a tissue reaction to the accumulation of inorganic dust in the lungs. Pneumoconiosis is an occupational disease that develops as a result of exposure to inorganic dust, is not related to smoking, is preventable, has no specific treatment, is not expected to improve, and can be progressive (2,3).

Pulmonary function tests (PFTs) in the diagnosis of occupational lung diseases are not specific for any cause; however, they are important in the differentiation of obstructive and restrictive disorders and in the evaluation of the severity of the disease (4,5).

In pneumoconiosis, respiratory function may be affected to varying degrees, either restrictive or obstructive.

6 The present study aimed to investigate the relationship between opacity severity and pulmonary function tests in pneumoconiosis.

METHODS

The study retrospectively analyzed 369 cases diagnosed with pneumoconiosis with a report date range of 01/01/2015-31/12/2018, referred to the … Institute by the relevant courts for an opinion on the presence or absence of an occupational disease, as well as the determination and onset date of disability regarding occupational disease.

Demographic characteristics, PFT values, smoking history, occupational and additional respiratory diseases, pneumoconiosis subtypes-opacity types-intensities of the cases were examined according to the *International Labor Organization (ILO)* criteria (6).

In cases where small and large opacity types were found together, opacity types and densities were distributed to the relevant types and densities according to the disability value.

The research data were evaluated using the *"Statistical Package for Social Science (SPSS)" 22* software. The data were expressed as numbers and percentages. Chi-Square test and Kappa agreement statistics were used in the analyses. A p value of less than 0.05 was considered significant.

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The study was approved by the … Institute Presidency Education and Scientific Research Commission (Date: 17/09/2019, No: 21589509/2019/696).

RESULTS

The mean age of 369 male cases at the time of first diagnosis was 44.25±11.86. The age range at the time of the first diagnosis was 40-49 years with 149 cases (40.4%).

According to the decisions of the specialization board, 353 cases (95.7%) were diagnosed with occupational diseases, while 16 cases (4.3%) were not diagnosed with occupational diseases.

Radiologic evaluations conducted by the specialization board revealed a small opacity type in 286 cases (77.5%). Among the small opacity types, q2 (23.8%) and p1 (13%) were the most common, and among the large opacity types, B opacity (7.3%) was the most common (Table 1).

4 Chronic obstructive pulmonary disease (COPD) was the most common (10.8%) additional respiratory disease among 369 cases. 257 cases had no additional respiratory system disease other than pneumoconiosis occupational disease. 237 cases (64.2%) had a history of smoking.

In 190 cases (51.5%), PFT values were normal, while 82 cases (22.2%) showed restrictive-type pulmonary dysfunction. Mild impairment was the most common (18.1%) among the impairments identified in PFT.

The comparison of the types of opacities radiologically determined by the relevant specialization board and the comparison of the cases according to the PFT values are presented (Table 2).

DISCUSSION

In the diagnosis of occupational diseases, pulmonary function tests are not specific for any cause; however, they are important in the differentiation of obstructive and restrictive disorders and in the evaluation of the severity of the disease (4).

In coal workers' pneumoconiosis (CWP), pulmonary function impairment is usually consistent with radiologic findings. In cases of progressive massive fibrosis (PMF), functional involvement is prominent and severe, whereas in simple pneumoconiosis, involvement is rare and milder. However, cumulative dust exposure has been shown to be the most determinant of pulmonary function loss (7). Furthermore, pulmonary function loss is more pronounced in the first years of coal dust exposure, while the rate of dust-induced pulmonary function loss slows down in the following years (8).

Since silicosis is more fibrinogenic, the occurrence of a restrictive pattern is more common. However, there is no definitive criterion for functional involvement due to silicosis. Functions could be present normally or in the form of obstruction or restriction. The most common functional change is obstruction. No correlation is frequently observed between functional changes and radiologic involvement (9-11).

5 In a study investigating the impact on lung function in underground coal miners in the United States between 2005 and 2009, 13.1% of cases had abnormal spirometry results. Of these abnormal spirometry results, 24.9% were in category 1, 28.9% in categories 2 and 3, and 40% in the PMF group. After accounting for age, body mass index, duration of underground work, and smoking, simple CWP was found to increase the risk of abnormal lung function by 1.8 times and PMF by 3.7 times (12).

Another study conducted in miners with simple CWP profusion showed a progressive decrease in forced expiratory volume in one second (FEV1)%, forced vital capacity (FVC)%, and FEV1/FVC values with increasing category. For each of these three spirometry measurements, progressively lower lung function was observed with increasing profusion range, and the most significant decrease was found in FEV1% (13).

In Dik's (14) study, the difference between FEV1%, FVC%, and FEV1/FVC values between the subcategories of CWP was found to be significant in the evaluation of the mean values of PFT parameters according to CWP categories. The highest FEV1 and FVC averages were in category 1 patients with simple CWP, the FEV1% and FVC% values decreased as the category of simple CWP and complicated CWP increased, and the lowest FEV1% and %FVC averages were in category B+C patients with complicated CWP. It was found that FEV1/FVC values decreased as the intensity increased, that is, as the intensity increased from the group of patients diagnosed with category 1 simple CWP to the group of patients diagnosed with category B+C PMF.

In the present study, a significant difference was found in the relationship between the opacity types and densities of the cases and the PFT values of the cases. The PFT results were found to be normal in small opacity types (63.7%), while pulmonary dysfunction was more common in severe obstructive type (28.6%) and severe restrictive type (28.6%) in large opacity types. Studies indicate that pulmonary function is affected in the progression from simple pneumoconiosis to PMF.

CONCLUSION

Radiologic examinations are the primary means of evaluation and diagnosis of occupational lung diseases. It is known that pulmonary function tests are not specific for the diagnosis of pneumoconiosis; however, since obstructive and restrictive disorders may develop in pneumoconiosis, they are essential in the differentiation of the type of dysfunction present and the evaluation of the severity of the functional impact of the disease. There is no definite correlation between the type of functional involvement in pneumoconiosis; nevertheless, it was observed that pulmonary function was more affected in the progression from simple pneumoconiosis to complicated pneumoconiosis. Thus, it was concluded that it is crucial to follow up radiologic and functional examinations together in workers at risk of occupational lung disease.

Limitations of the Study

Limitations of the study include the inaccessibility of some past radiological imaging and pulmonary function tests due to retrospective scanning of data from the archives of the relevant institution.

Table 1. Distribution of Cases According to Opacity Types According to Radiological Examination		
Opacity Type and Density Distribution	**n**	**%**
A opacity	**10**	**2.7**
B opacity	**27**	**7.3**
C opacity	**22**	**6**
p1	**48**	**13**
p2	**43**	**11.7**
p3	**14**	**3.8**
q1	**41**	**11.1**
q2	**88**	**23.8**
q3	**39**	**10.6**
r2	**12**	**3.3**
r3	**4**	**1.1**
No occupational disease	**16**	**4.3**
Other	**5**	**1.3**
Opacity Type Distribution	**n**	**%**
Small opacity	**286**	**77.5**
Large opacity	**25**	**6.8**
Large and small opacity	**42**	**11.4**
No occupational disease	**16**	**4.3**
Total	**369**	**100**

Table 2. Comparison of Radiologically Detected Opacity Types and Cases According to *PFT Values					
			Opacity Type and Density Distribution		
			Small	Large	Large and Small
*PFT groups	Normal	n	163	5	13
		%	65.7	23.8	39.4
	Mildly obstructive	n	11	0	1
		%	4.4	0.0	3.0
	Moderately obstructive	n	10	2	3
		%	4.1	9.5	9.1
	Severely obstructive	n	4	6	4
		%	1.6	28.6	12.1
	Mildly restrictive	n	47	0	5
		%	19.0	0.0	15.2
	Moderately restrictive	n	6	2	4
		%	2.4	9.5	12.1
	Severely restrictive	n	7	6	3
		%	2.8	28.6	9.1
p<0,001					**Pulmonary Function Test*