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PULMONARY FUNCTION IN WORKERS WITH ASBESTOSIS

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Pulmonary function testing was done in 19 female and 13 male patients suffering from pulmonary asbestosis. Restrictive disturbance of pulmonary function (VC < 80%) was found in 39.4 per cent of males and in 52.4 per cent of females. Decrease in expiratory flow ($FEF_{50} < 60\%$) and $FEF_{25} < 60\%$) was recorded in 53 per cent of male and 44 per cent of female patients with normal VC and FEV_1 %.

For the past 30 years a great number of studies on the effect of asbestos on the lungs of exposed workers have been published. The results of those studies have shown that asbestos fibres cause lung fibrosis, pleural calcifications and lung cancer. As asbestos causes lung fibrosis, changes in lung ventilation are expected to be restrictive. However, the results of many studies are not identical; in some the finding is restriction (1 – 3) and in others besides restriction the main finding is obstruction of the airways (4 – 6).

The aim of this study was to determine the condition of lung function in workers with initial forms of lung asbestosis and to obtain information on the function of respiratory pathways in those workers.

SUBJECTS AND METHODS

We examined 19 female and 13 male workers employed in factories of asbestos products in Serbia. The average age for males was 46 ± 9.5 years and for females 47 ± 9.2 years. The average duration of exposure was 17.2 and 17.6 years ± 6 respectively. There were no significant differences in the age and duration of exposure in the two groups. The female group had four smokers, one ex-smoker and 14 non-smokers and in the male group there were four smokers, eight non-smokers and one ex-smoker.

Lung function was measured with the Wedge spirometer floop 2 manufactured by OL DELT in standing position, with the nose closed. At least three curves of forced vital capacity (FVC) and three curves of vital capacity (VC) were recorded, and the best re-

sults of those parameters were taken for interpretation. The findings for FVC, VC, FEV_1 and FEV_1/VC were compared with *CECA* referential values from 1971 (7); the values of PEF, FEF_{50} and FEF_{25} were compared to normal referential values according to *Cherniack and Raber* (8).

As the criterion for restriction of lung ventilation we used VC 80% and less of the CECA values, with the normal FEV_1/VC relation and for obstruction if the FEV_1/VC exceeded the referential value by 8% and more. The values of FEF_{50} and $FEF_{25} < 60\%$ and those below the norm according to Cherniack, the authors considered to be pathological. Chest x-ray and the interpretation were made according to the ILO 1980 classification and recommendation.

RESULTS AND DISCUSSION

In our sample 25 subjects had 1/1 category asbestosis, two subjects had s 2/2, two had s/t, one had 2t and two subjects had 3t category. Restriction of lung ventilation was present in five male workers and in 10 female workers (Table 1), and obstructive-restrictive changes were found in two male and two female workers. There were no significant differences in the prevalence of lung ventilation deficit between male and female workers.

Table 1

The prevalence of lung ventilation deficit

Ventilation deficit	Males N = 13		Females N = 19		Total N = 32	
	n	%	n	%	n	%
VC < 80%	5	38	10	53	15	47
Obstruction – restriction	2	15	2	11	4	12
Total	7	54	12	63	19	59

Male: Female $\chi^2 = 0.62, 0.166$ N. S.

As total accumulation of asbestos fibres in the lung increases with exposure, it was expected that the subjects who had been exposed to asbestos for more than 20 years would have lung ventilation deficit more frequently.

The hazard from asbestos is directly related to the concentration of asbestos particles. Histopathological studies show that in mild asbestosis the lungs contain approximately 1000 asbestos particles per gramme of pulmonary tissue, while in advanced stages the respected number of particles usually amounts to 5000 – 10000 (9).

However, in our sample the lung ventilation deficit in subjects with over 20 years of exposure was not significantly more frequent $\chi^2 = 0.88$, n.s.

Disturbances of small respiratory airways (FEF_{50} 60% and FEF_{25} 50%) were determined in 50 per cent of male workers and in 44.7 per cent of female workers (Table 3). In

Table 2

Lung ventilation deficit in relation to duration of exposure to asbestos

Ventilation deficit	< 20 years N = 19		⩾ 20 years N = 13	
	n	%	n	%
VC < 80%	9	47	6	46
Obstruction – restriction	1	5	3	23
Total	10	53	9	69

χ^2 = 0.04, 2.24, 0.88 N. S.

workers who had been exposed to asbestos for more than 20 years this disturbance was found more frequently, but not to a significant extent.

The values of spirometric parameters in litres and percentages of normal values are shown in Table 4.

Table 3

The prevalence of decreased FEF_{50} and FEF_{25} values

FEFV curve	Males		Females		Exposure < 20		Exposure ⩾ 20	
	N	%	N	%	N	%	N	%
FEF_{50} < 60%	7	54	9	47	9	47	7	54
FEF_{25} < 50%	7	54	14	74	12	63	9	69
p > 0.05 N. S.			p > 0.05 N. S.					

They are close to standard FEV_1/VC and FEF_{50} values. Male workers have significantly higher values of those parameters in litres than female workers ($p < 0.05$). This can be explained by differences in body height and sex. However, when comparing spirometric values in percentages of referential values, a statistically significant difference is noted only for FEF_{25}%. In relation to the duration of exposure to asbestos (Table 5) all values except FEF_{25} decrease with length of exposure and statistically significant differences appear only for FEF_1 ($t = 1.99$, $p < 0.05$).

Those results are very similar to the findings of *Remškar and co-workers* (10) who examined 27 patients with an average exposure of 22.4 years and similar radiological changes and found an average decrease of CECA values for VC 25.2% and for FEV_1 22.2%. Somewhat lower values were found by *van de Weyer and co-workers* (11). Vital capacity in subjects with s 1/1 category asbestosis was 69% and in those with 2/1 and 2/2 categories 63.5% of the CECA norm.

The prevalence of restriction and other ventilation changes in our group was significantly lower than in the reports of *Štangl and co-workers* (12) who examined 17 subjects

Table 4

The spirometric values in males and females

Spirometric parameters	Males N = 13 $\bar{X}$	SD	Females N = 19 $\bar{X}$	SD	p
VC lit.	4.1	1.8	2.3	0.8	<0.05
VC %	77.8	25.3	64.8	20.2	N. S.
FEV_1 lit.	3.1	1.5	1.8	0.6	<0.05
FEV_1 %	77.8	29.8	67.1	21.1	N. S.
FEV_1/VC	75.1	14.9	79.2	7.4	N. S.
FEF_{50} lit.	4.7	1.9	3.0	1.2	<0.05
FEF_{30} %	84.6	41.0	69.2	24.0	N. S.
FEF_{25} lit.	1.6	1.0	1.0	0.6	<0.05
FEF_{25} %	65.9	32.8	42.4	19.6	<0.05

Regression equation for VC and FEV_1.
Males: $VC_{(ml)}$ = 8319; 37.9 age; 146.97 exposure (years)
$FEV_{1/ml}$ = 7319; 53.06 age; 103.81 exposure (years)
Females: $VC_{(ml)}$ = 4349; 39.28 age; 10.40 exposure (years)
$FEV_{1/ml}$ = 3970; 40.45 age; 14.04 exposure (years)

Table 5

The values of spirometric parameters (percentages of referential values)

Spirometric parameters	Exposure (years) <20 N = 19	⩾20 N = 13	p
VC %	74.9 ± 25.0	63.2 ± 18.3	N. S.
FEV_1 %	78.8 ± 25.3	62.2 ± 21.8	p < 0.05
FEV_1 / VC	89.7 ± 13.3	87.1 ± 24.8	N. S.
FEF_{50} %	74.2 ± 34.4	74.0 ± 30.0	N. S.
FEF_{25} %	77.6 ± 27.1	65.5 ± 18.0	N. S.

with asbestosis and found restriction in 82.3 per cent of them. It was similar to the results of *Sogomonsjan* (13) who found ventilation changes in 45.5 per cent of 45 workers exposed to asbestos.

The most frequent ventilation change in workers with lung asbestosis was restriction. Its prevalence was the same in workers with the same exposure time; it was greater among female workers. Obstruction was noted in a significantly smaller percentage of

workers than restriction and the most frequent disorder was the decrease of expiratory flow in small respiratory airways. This is the first sign and it can be used for early diagnosis of adverse effects of asbestos on the lungs.

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Sažetak

PLUĆNA FUNKCIJA U RADNIKA S AZBESTOZOM

Autori su ispitali plućnu funkciju kod 19 žena i 13 muškaraca s azbestozom pluća kategorije s 1/1 ili više. Restriktivni poremećaj plućne funkcije (VC > 80%) nađen je u 38,51% muškaraca i 52,4 žena. Smanjenje ekspiratornog protoka ($FEF_{50} < 60\%$ i $FEF_{25} < 50\%$ bilo je prisutno u 53% muškaraca i 43,8% žena s normalnim vrijednostima VC i $FEV_1\%$.

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