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DIAGNOSTIC VALUE OF POLYGRAPHY IN WORKERS WITH CHRONIC OBSTRUCTIVE PNEUMOPATHIES

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ABSTRACT

A polygraphic technique for registration of diaphragmatic and mediastinal movement is rarely used for diagnostic purposes. Our aim was to evaluate its diagnostic usefulness in patients with various chronic obstructive pneumopathies. Polygraphic radiographs were taken in 40 subjects suffering from an obstructive pneumopathy. In 28 of them lung function tests were also performed.

The results obtained suggest that polygraphic measurements are of no value unless they are combined with respiratory function tests.

Polygraphy is essentially a modification of kymography, which was originally developed for diagnosis of heart injuries. Recently it has been more and more applied for recording diaphragmatic and mediastinal movements. The kymographs have a fixed or a movable net in front of the patient. The net moves during radiography until the film is fixed, or conversely. As only large radiological institutions possess such equipment, it was suggested that standard X-ray apparatuses be used instead of kymographs. In such a way polygraphy was applied in pulmology for recording the respiratory movements of the diaphragm. Some authors even established a relationship between the movements measured by polygraphy and functional lung abilities[1]. Others suggested to take first a radiograph of the lungs (i.e. polygraphy), and then to decide on a possible investigation of respiratory function. In Yugoslavia polygraphy is rarely used. We therefore decided to establish its diagnostic value.

SUBJECTS AND METHODS

The polygraphic radiographs were taken by an X-ray apparatus of domestic production, with generator SUPER X 800, and Bucky wall stative, under the following conditions: 70–75 kV, the total dose MAS 30–40 (15–20 at each exposure), the distance anode film 180 cm, film size 35 × 35 cm. The subject was positioned as for standard radiography of the lungs PA. After focusing the subject was asked to inspire deeply and to keep air in the lungs. The first exposure followed inspiration. Then the subject had to expire maximally and the

second exposure took place. We insisted that the subject kept a constant position in relation to the cathode tube and film cassette. There were altogether 40 subjects. One radiograph was not technically satisfactory. Therefore, we possess a series of 39 polygraphies.

The lung function tests were performed in 28 subjects suffering from an obstructive syndrome, taking into consideration that obstructive mechanisms could influence the expiratory phase of respiratory cycles, and cause the upward movement of the diaphragm[2,3]. On the other hand, air trapping in the lungs and lung hyperinflation could be caused by any kind of obstructive mechanism. This also limits the motility of the diaphragm. Lung function tests included: analysis of resistance of air flow in respiratory ways (R), forced expiratory volume in one second (FEV_1) and determination of intrathoracic gas volume (IGV).

In most of the examined subjects the clinical diagnosis was chronic bronchitis, chronic obstructive bronchitis or chronic bronchitis with emphysema (29 cases). Two patients had unilateral fibrothorax and eight had pulmonary fibrosis of occupational etiology (pneumoconioses category 1p to 3mn).

RESULTS

The measurements of diaphragmatic movements showed that the amplitudes vary: from almost a fixed diaphragm (amplitude 0–0.5) to the normally movable diaphragm (7 cm). The individual results of amplitude measurements are presented in Table 1. The results for one subject were not

TABLE 1
The results of measurements of the amplitude of the diaphragm.

Amplitude (cm)	Number of patients	Patients with a diagnosis of pneumoconiosis
0.0–0.5	6	1 = 3p (pl); 1 = p with fibrothorax; 1 = fibrothorax only; 1 = 3q (m)
0.6–1.0	2	1 = 2q (m); 1 = 3q (m)
1.1–2.0	5	1 = 3q (m); 1 = 2p
2.1–3.0	9	1 = 3r (n)
3.1–4.0	5	–
4.1–5.0	7	1 = 2p
5.1–6.0	3	–
6.1–7.0	1	–
Total	38	

included in the table. He had pneumoconiosis of radiographic category "3mn" and his right hemidiaphragm had an amplitude of 2 cm and left of 5 cm.

The analysis of resistance to the air flow in respiratory ways (R) clearly shows that increased resistance goes together with low diaphragmatic motility, and that motility is decreased with the increased resistance (Table 2).

TABLE 2
Lung function tests (mean ± S.D.) and amplitude of the diaphragm.

Amplitude (cm)	No of subjects	IGV (ml)	R (cm H_2O/l/s)	FEV_1 (ml/s)
0.0–1.0	2	185 ± 13.4	9.72 ± 11.4	59.5 ± 13.4
1.0–1.9	5	194 ± 35.7	4.43 ± 3.57	60.4 ± 31.0
2.0–2.9	8	167 ± 20.5	4.15 ± 2.76	65.9 ± 22.9
3.0–3.9	3	141 ± 22.7	4.39 ± 0.53	56.0 ± 21.2
4.0–4.9	6	148 ± 15.0	4.01 ± 1.81	69.2 ± 19.8
5.0–5.9	3	126 ± 11.9	1.96 ± 0.70	79.7 ± 21.1
6.0–6.9	1	107 ± —	0.81 ± —	77.0 ± —

The forced expiratory volume in one second (FEV_1) shows no correlation with the value of diaphragmatic movement.

The value of intrathoracic gas volume (IGV) is in reverse relation to the value of diaphragmatic movement. It is logically assumed that lung hyperinflation disturbs the expiratory upward movement of the diaphragm.

DISCUSSION

Even without comparing the results of lung function tests we can make three observations. Firstly, respiratory motility of the diaphragm is lower when the pleuro-pulmonary lesions are more pronounced radiographically. Secondly, respiratory motility of the diaphragm is more influenced by pleural adhesions, pleural calcifications and indurations than by interstitial lung changes. The partially relaxed diaphragm always shows a low motility. However, it is hard to distinguish the cause from the consequence: whether relaxation is a consequence of low motility, or it is the other way around. Thirdly, the size of coniotic pulmonal lesions has little influence on the motility of the diaphragm in polygraphy. On the other hand, the density and profusion of dissemination are more important. This means that pneumoconiosis "3p" affects the motility of the diaphragm more than pneumoconiosis category "1 or 2 mn". However, it is clear that the diagnostic value of polygraphy can be exactly evaluated only if the results of polygraphy are compared to those of respiratory function tests.

The above mentioned indices of lung function suggest that the obstructive syndrome can accompany the limited diaphragm motility. This is especially true for lung hyperinflation. Many factors influence the motility of the diaphragm. In our subjects it was not possible to observe and evaluate each individual factor. The presence of various factors is the main cause why in our study we did not obtain a convincing regularity. In two cases of the lowest diaphragm motility, the value of IGV was influenced by fibrothorax. The effect of lung fibrosis was also clear. A possibility of regularity was reduced because of a small number of cases in some groups: this is why standard deviations are so high.

However, it is quite clear that the factors connected with respiratory obstruction bear a certain influence on the motility of the diaphragm.

Obstructive mechanisms affect expiration, slow it down and make it more difficult. Air trapping produces lung hyperinflation which disturbs motility and excursions of the diaphragm as shown in this paper. However, it is not so for forced expiratory volume in one second, because in polygraphic investigations the patient is not asked to breathe quickly, but normally and this analysis shows only the state of passage of the big respiratory ways.

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