

FUNCTIONAL TESTS FOR EARLY DIAGNOSIS OF BRONCHIAL OBSTRUCTION

Z. Zlatanov, M. Peneva, H. Tsekov, M. Kokoshjan

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The pathological alterations of terminal respiratory bronchioles present an early event in the course of chronic bronchial obstruction (5). A lot of authors (2, 4, 5, 6) report that maximal expiratory volume rates in small pulmonary volumes (MEV_{50}) (MEV_{25}) depend only on the elastic contraction of the lung and the peripheral resistance of the respiratory tract. Although its small reproducibility (1, 6) this test can be used as a method for early diagnosis of bronchial obstruction because of its easy performance and the possibility of application without an active patient's participation.

The purpose of the present work was to determine the diagnostic value of moment expiratory pulmonary volumes as functional tests for early detection of bronchial obstruction of workers in a region with developed chemical industry.

Material and methods

In the region with developed chemical industry a total of 101 workers from 2 plants with similar production were studied divided into two groups: 1st — 60 workers with clinical data for chronic bronchitis. There were 45 males and 15 females with mean age of $43,77 \pm 2,34$ years, resp. $40,33 \pm 11,0$ years. The diagnosis of "chronic bronchitis" was established according to WHO criteria after following-up the subjective complaints, the data from the present medical documentation and the physical examination. 2nd — 41 workers without any clinical signs of respiratory tract disease ("healthy"). There were 24 non-smokers with mean age of $39,95 \pm 8,17$ years and 17 smokers with mean age of $38,23 \pm 2,56$ years. All of them were smokers for 5 years and more and the number of cigarettes smoked daily was greater than 10.

The vital capacity (VC), forced expiratory volume per 1 sec. (FEV_1), peak expiratory capacity (PEC), maximal expiratory capacity 75 per cent, 50 per cent and 25 per cent (MEC_{75} , MEC_{50} and MEC_{25}) was determined by using the pneumotachograph ("Pneumoscreen") (Jeger). It is to be noted that these indexes were followed-up after physical loading (working test) in chronic bronchitis patients, too. The working test was performed by means of veloergometer from the firm "Medicor" (45 revolutions per minute, initial loading 45 W and gradual loading up to submaximal loading corresponding to 70 per cent of maximal pulse frequency (maximal pulse = $200 - 0,76 \times \text{age}$). The examination was always ceased when an expressed tachycardia (over 160) and tachypnea (over 35) per minute occurred. Electrocardiographic control was performed by using two-polar precordial leads.

In addition, concerning the "healthy" individuals (both smokers and non-smokers), resistance (R_{aw}), total pulmonary capacity (TPC) and residual vo-

lume (RV) by using body plethysmograph ("Bodytest") (Jeger) was also determined.

The results obtained were statistically processed after the methods of variational and alternative analysis.

Results and discussion

Out of the total number of 60 workers with clinical data of chronic bronchitis, 39 ones were with normal VC and FEV₁ rates. With 13 of them, however, all the moment lung capacities were decreased while in 7 ones only MEC₅₀ and MEC₂₅ was diminished. These data confirm the importance of small lung capacities — MEC₅₀ and MEC₂₅ as early functional tests characterizing the increased resistance of the small respiratory tract. The rest 21 (from a total of 60) workers showed functional disorders presented by VC and FEV₁ reduction (ventilatory defect). An obstructive syndrome of ventilatory insufficiency was found out in 12 patients and a mixed syndrome of ventilatory failure — in 9 ones.

The results from the investigations of the workers with clinical signs of chronic bronchitis but without an expressed ventilatory defect (i. e. normal VC and FEV₁ rates) after working loading are demonstrated on table 1. It can be seen that

Table 1

Changes of functional indexes of respiration after physical loading in chronic bronchitis patients without an expressed ventilatory defect (n=39)

Indexes	Before loading			After loading			P
	\bar{x}	S	S \bar{x}	\bar{x}	S	S \bar{x}	
VC (in ml)	3895,87	1870	229,67	3948,90	1408	225,64	>0,05
FEV ₁ (in ml)	3142,22	1024	164,10	3220,27	1012	163,17	<0,01
PEC (l/s)	7,52	3,13	0,16	8,79	2,02	0,35	<0,001
MEC ₇₅ (l/s)	6,40	2,30	0,36	6,30	2,60	0,41	>0,05
MEC ₅₀ (l/s)	4,06	1,42	0,22	4,14	1,50	0,24	>0,05
MEC ₂₅ (l/s)	1,60	0,65	0,10	1,70	0,70	0,11	>0,05

after loading VC and FEV₁ and PEC increased. However, this is statistically significant only concerning both FEV₁ and PEC. There is an evident correlation between these two indices determined by active patient's participation and state of the upper respiratory tract.

The working test significantly reduced FEV₁ as well as all the moment lung expiratory capacities in 5 patients without a ventilatory defect established beforehand. This fact supports the role of the working test as a provocation test to prove the unspecific hyperreactivity of the bronchial tree.

Concerning the patients with a preliminary established ventilatory defect (an obstructive or even mixed syndrome of ventilatory insufficiency) there was only a slightly expressed MEC₅₀ increase without any significant changes of the rest indexes after loading (see table 2).

All the indices studied — R_{aw}, VC, FEV₁, TPC, RV, PEC, MEC₇₅, MEC₅₀, and MEC₂₅ of "healthy" workers non-smokers were within the limits of the norm while a significant reduction of pulmonary capacities in small lung volumes — MEC₅₀ and MEC₂₅ was found out despite the normal rates of the rest functional indices.

Table 2

Changes of functional indexes of respiration after physical loading in chronic bronchitis patients with ventilatory defect (n=21)

Indexes	Before loading			After loading			P
	\bar{x}	S	S \bar{x}	\bar{x}	S	S \bar{x}	
VC (in ml)	3915,83	663,20	191,67	3900	1278,10	442,23	>0,05
FEV ₁ (in ml)	2445,00	380,00	109,82	2506	317,00	91,61	>0,05
PEF (l/s)	5,90	1,90	0,54	6,1	1,73	0,50	>0,05
MEC ₇₅ (l/s)	4,60	1,47	0,42	4,75	3,37	0,94	>0,05
MEC ₅₀ (l/s)	2,57	0,14	0,13	3,08	0,50	0,14	<0,001
MEC ₂₅ (l/s)	0,95	0,30	0,08	1,25	0,47	0,13	>0,05

It can be concluded that lung capacities in small pulmonary volumes (MEC₅₀ and MEC₂₅) are reliable functional tests for detection of an early bronchial obstruction. The test with physical loading can be applied as a provocation test to prove a latent hyperreactivity of the small respiratory tract.

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ФУНКЦИОНАЛЬНЫЕ ТЕСТЫ ДЛЯ РАННЕЙ ДИАГНОСТИКИ БРОНХИАЛЬНОЙ НЕПРОХОДИМОСТИ

З. Златанов, М. Пенева, Х. Цекков, М. Кокошан

РЕЗЮМЕ

Исследовано 101 рабочий в районе с развитой химической промышленностью. У 60 из них имеются клинические данные, свидетельствующие о хроническом бронхите, а у 41 отсутствуют клинические данные, свидетельствующие о легочных заболеваниях. При сравнении рутинных показателей и легочного капациитета небольшой легочной емкости (МЕД₅₀ и МЕД₂₅) устанавливается, что последние могут быть использованы в качестве надежных функциональных тестов при диагностировании ранней бронхиальной непроходимости.