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THE VALUE OF FORCED INSPIROGRAM FOR ESTIMATING REVERSIBILITY OF VENTILATORY IMPAIRMENT IN CHRONIC OBSTRUCTIVE LUNG DISEASE

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In sixty patients with chronic obstructive lung disease the sensitivity of FEV_1 was compared with the sensitivity of FIV_1 in assessing the reversibility of ventilatory impairment. The FEV_1/FIV_1 ratio before and after administration of adrenaline was analysed. The decrease of this ratio after adrenaline was considered as the index of better sensitivity of FIV_1 whereas the increase of this ratio was considered as the index of equal or better sensitivity of FEV_1. In 67% of cases the ratio decreased. In addition to forced expirogram the forced inspirogram i. e. FIV_1 is therefore recommended as a useful test in estimating ventilatory effect of bronchodilators and other antiasthmatic drugs in patients with chronic obstructive lung disease.

Forced inspirogram has not been frequently used as a routine test in assessing the ventilatory impairment. *Comroe* and coworkers (1) have recommended the comparison of forced expirogram and forced inspirogram as a useful procedure in discriminating expiratory and inspiratory difficulties. Other authors (2-4) have suggested that ratio of one second forced expiratory volume to one second forced inspiratory volume (FEV_1/FIV_1) or the ratio of maximum expiratory flow rate to maximum inspiratory flow rate (MEFR/MIFR) may be helpful in distinguishing asthma from emphysema. The lower ratio should indicate the presence of an increased expiratory resistance (emphysema) and higher ratio the presence of both increased expiratory and inspiratory resistance (asthma). *Chapman* (5) however, has analysed FEV_1/FIV_1 ratio in a large number of patients with asthma and emphysema and found that this ratio is of doubtful val-

* The study was carried out in the Hospital for Allergic Respiratory Diseases in Dubrovnik.

ue in distinguishing the two disease. *Jordanoglou* and *Pride* (6) have studied the maximum effort flow-volume curves, both expiratory and inspiratory, of subjects with asthma and emphysema. They have found a low MEFR/MIFR ratio at the point of 50% of vital capacity, and concluded that this ratio does not help in distinguishing a patient with asthma from one with emphysema.

The sensitivity of forced inspirogram as compared to forced expirogram in assessing the reversibility of ventilatory impairment has not been thoroughly analysed. In the studies of *Simonsson* (2) and *Segarra* and coworkers (7) one can see that in certain patients with chronic obstructive lung disease FIV_1 seems to be a more sensitive index of reversibility of ventilatory impairment than FEV_1. Stimulated by these data and also by the observation that patients with chronic obstructive lung disease may show symptomatic improvement after administration of bronchodilators and other antiasthmatic drugs without a measurable ventilatory response in forced expirogram, I have analysed the FEV_1/FIV_1 ratio in these patients before and after administration of adrenaline in order to compare the sensitivity of the two volumes in assessing the reversibility of ventilatory impairment.

METHOD

A group of 60 patients with chronic obstructive lung disease aged over 40 was selected. One second forced expiratory volume did not exceed 1500 ml and was below 50% of the observed vital capacity. Cardiovascular and other chest diseases with the symptoms similar to those of chronic obstructive lung disease were exluded by clinical, radiological and electrocardiographic examination.

The patients were told about the purpose of the examination and instructed in the technique of breathing during the testing. On the Pulmotest Godart forced expirogram and forced inspirogram were registered at the highest speed of kimograph. Forced expirogram was performed after a maximal inspiration while forced inspirogram followed a maximal slow expiration. Both tests were done before and 20 minutes after subcutaneous administration of adrenaline (1:1000) in amounts of 0.3 ml and repeated 3–4 times in order to make the values as reliable as possible. From the spirographic tracings FEV_1 and FIV_1 were read out and the FEV_1/FIV_1 ratio was calculated. The decrease of this ratio after adrenaline was considered as the index of better sensitivity of FIV_1, whereas the increase of this ratio was considered as the index of equal or better sensitivity of FEV_1 in estimating the reversibility of ventilatory impairment.

In order to avoid inaccuracies commonly seen at the begining of forced expirogram the steepest portion of the curve was extrapolated on the base line and one second was calculated from this intersection. The performance of forced inspirogram always lasted more than one second.

RESULTS

Before the administration of adrenaline the mean FEV_1 was almost twice lower than the mean FIV_1. The mean FEV_1/FIV_1 ratio was 0.55. After adrenaline this ratio slightly decreased (Table 1).

Table 1

Mean values of FEV_1, FIV_1 and FEV_1/FIV_1 ratio before and after Adrenaline

	Before Adrenaline		After Adrenaline	
	X	SD	X	SD
FEV_1 (ccm)	910	361	1074	405
FIV_1 (ccm)	1684	615	2074	585
FEV_1/FIV_1 ratio	0.55	0.19	0.52	0.16

As seen from Table 2 in a considerable number of patients (67%) FEV_1/FIV_1 ratio decreased indicating that FIV_1 was a more sensitive index of the reversibility of ventilatory impairment than FEV_1.

Table 2

Number of patients with increased and decreased FEV_1/FIV_1 ratio after Adrenaline

	N	%
Increased ratio	20	33,3
Decreased ratio	40	66,7
Total	60	100,0

Table 3

Mean FEV_1/FIV_1 ratio before Adrenaline in two groups of patients

	Patients with increased ratio N–20		Patients with decreased ratio N–40	
	$\bar{X}$	SD	$\bar{X}$	SD
FEV_1/FIV_1 ratio before Adrenaline	0.49*	0.15	0.58*	0.21

* The difference is statistically significant ($P < 0.05$)

The mean FEV_1/FIV_1 ratio before adrenaline was higher in these patients than in others, suggesting the presence of a more pronounced increase of inspiratory resistance. The difference was statistically significant (Table 3).

DISCUSSION

The results clearly show that in certain patients with increased respiratory resistance, both expiratory and inspiratory, the improvement of ventilatory function after administration of bronchodilators can be better demonstrated using forced inspirogram than forced expirogram. Providing that a maximal effort was performed during the testing the higher increase of FIV_1 following administration of adrenaline indicates that the inspiratory resistance was more reversible than the expiratory resistance. This could be explained by the presence of bronchial collapse as an irreversible component of expiratory airway resistance but also by a possible increase of pulmonary compliance – a change which enhances inspiratory flow. These assumptions, however, remain to be proved.

CONCLUSION

In certain patients with chronic obstructive lung disease forced inspirogram appears to be a more sensitive test for assessing the reversibility of ventilatory impairment. In addition to forced expirogram, forced inspirogram i. e. FIV_1 should therefore be routinely used in estimating ventilatory effect of bronchodilators and other antiasthmatic drugs in patients with chronic obstructive lung disease.

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Sadržaj

VRIJEDNOST FORSIRANOG INSPIROGRAMA ZA PROCJENU REVERZIBILNOSTI VENTILACIJSKOG POREMEĆAJA U KRONIČNOJ OPSTRUKTIVNOJ BOLESTI PLUĆA

U šezdeset bolesnika s kroničnom opstruktivnom bolesti pluća uspoređena je osjetljivost volumena u prvoj sekundi forsirane ekspiracije (FEV_1) i volumena u prvoj sekundi forsirane inspiracije (FIV_1) u procjeni reverzibilnosti ventilacijskog poremećaja. Analiziran je odnos FEV_1 prema FIV_1 prije i poslije potkožne primjene adrenalina. Pad ovog odnosa poslije adrenalina uzet je kao indeks za bolju osjetljivost FIV_1, a porast kao indeks za jednaku ili bolju osjetivost FEV_1. U 67% slučajeva odnos FEV_1 prema FIV_1 je pao, pa je stoga za procjenu ventilacijskog učinka bronhodilatatora i drugih antiastmatičkih lijekova u bolesnika s kroničnom opstruktivnom bolesti pluća preporučen forsirani inspirogram, tj. FIV_1 kao koristan dopunski test forsiranom ekspirogramu.

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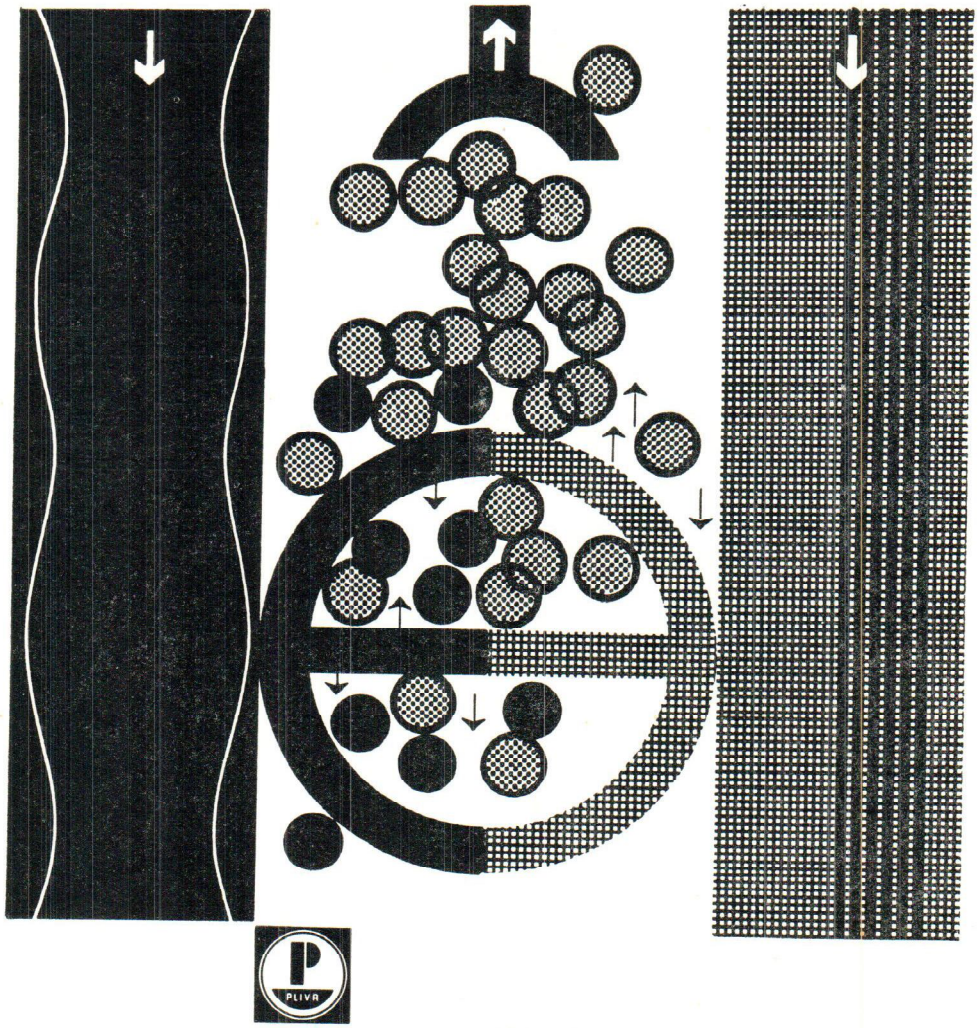

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