Journal of Applied Physiology (1960) 15: 1073-1074

Fraction of maximum breathing capacity available for prolonged hyperventilation[1]

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ZOCCHE, GIAN PAOLO, HARRY W. FRITTS, JR. AND ANDRE COURNAND. *Fraction of maximum breathing capacity available for prolonged hyperventilation.* J. Appl. Physiol. 15(6): 1073–1074. 1960.—The volume of ventilation which nine healthy young men could maintain for 15 minutes was only 53% of the maximum breathing capacity (MBC). A similar figure was obtained for older patients with chronic pulmonary emphysema. These data suggest that the MBC is not the limiting response to be expected from stimuli such as hypoxia or hypercapnia, and that the capacity of a patient for maintaining an augmented minute volume is an important determinant of the responses these stimuli evoke.

WHILE THE MAXIMUM breathing capacity (MBC) measures the maximal rate at which air can be mobilized, it does not necessarily indicate the ventilation which a subject will achieve when stimuli such as hypoxia or hypercapnia are applied. This may be understood by considering the dissimilarity of the two procedures; whereas the MBC is measured during a period of only 12 seconds, the response to a stimulus is customarily measured between the 15th and 20th minutes of the augmented ventilation which the stimulus provokes. Of the several factors influencing both measurements, fatigue is of particular importance because its role becomes greater as the expenditure of effort is prolonged. Hence, the MBC should exceed the ventilation evoked by hypoxia or hypercapnia (1), a point which Eldridge and Davis have recently emphasized (2).

The present study was designed to investigate the relation between the MBC and the maximum volume of ventilation (HV) which a man can voluntarily maintain over a prolonged period of time. For the sake of contrast, we compared the values obtained in young healthy adults with those recorded in older patients with advanced pulmonary emphysema.

Received for publication May 27, 1960.

[1] This investigation was supported by Research Grant H-2001 (C) from the National Heart Institute of the National Institutes of Health.

METHODS

Several days prior to the study the subject underwent a period of training in which he practiced both the MBC and the HV. Before performing the latter, he was told to choose the maximal level of ventilation which he thought he could maintain for 15 minutes. A few trials usually sufficed for the selection of this level; once chosen, the level generally corresponded to that selected on a second practice day.

On the morning of the study, the subject came to the laboratory and rested quietly for 20 minutes before the experimental procedure was begun. The protocol em-

TABLE 1. *Comparison of MBC and HV in Normal Subjects and Patients With Chronic Pulmonary Emphysema*

Subj. Age	MBC 1	MBC 2	HV	MBC 3	MBC 4	$\frac{HV}{MBC} \times 100$*
	l/min.	l/min.	l/min.	l/min.	l/min.	%
Normal Subjects						
1, 22	149	140	77	123	112	53
2, 24	192	178	114	166	172	62
3, 24	163	146	60	104	132	39
4, 24	164	167	82	120	131	50
5, 28	159	162	90	117	128	56
6, 29	176	185	88	154	159	49
7, 31	192	206	137	181	173	69
8, 35	156	159	90	165	139	57
9, 39	175	175	80	164	169	46
Mean 28	169	169	91	144	146	53
Patients With Pulmonary Emphysema						
1, 49	22	25	17		22	72
2, 49	22	28	13	25	31	52
3, 67	25	28	19	24	22	72
4, 68	28	25	18		22	68
5, 71	39	34	14		45	38
6, 72	28	31	28		33	95
7, 39	36	45	17	36	35	42
8, 69	28	28	10	25	25	36
Mean 61	29	31	17		29	59

* The MBC used in this calculation is mean of 1st and 2nd measurements.