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SHORT COMMUNICATION

DETERMINATION OF %FVC (FEV/FVC %) AT EXPIRATORY FLOW RATE OF 1 LIT/SEC AND 0.5 LIT/SEC FROM FORCED EXPIRATORY SPIROGRAM

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Abstract : A method for determination of % FVC (FEV/FVC %) at forced expiratory flow rate (FEF) of 1 lit./sec. and 0.5 lit/sec from the forced expiratory spirogram is described. This parameter is simpler to determine and is a better expression of end expiratory flow rate than FEF 75%-85%.

Key words : forced expiratory spirogram end expiratory flow rate FEF 75%-85%

INTRODUCTION

Analysis of forced expiratory spirogram is quite commonly used as a dynamic lung function test in Physiology and also in clinical practice. Two major groups of parameters are being commonly used. (a) The volume of air expired forcibly in a given time, eg. FEV_1, $FEV_{0.75}$, $FEV_{0.5}$, etc. It is also a common practice to express these volumes in term of %FVC. (b) Another group of parameter is to calculate expiratory flow rate during a particular portion of forced expiratory spirogram. These flow rates are important indicators for diagnosis, prognosis and evaluation of chronic obstructive lung disorders. Many such parameters are in use, eg.

FEF 200 cc–1200cc (Maximum expiratory flow rate MEFR)

$FEF_{25\%-75\%}$ (Maximum mid expiratory flow rate MMEFR)

$FEF_{75\%-85\%}$ (Forced end expiratory flow rate FEEFR) (1, 2).

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Other authors have expressed the flow rates between various FVC% remaining in lungs, viz $FEF_{60-70\%}$, $FEF_{55-45\%}$, $FEF_{30-20\%}$, $FEF_{15-5\%}$ (3, 4). In this connotation the last two parameters represent end expiratory flow rate.

It will be appreciated that any one of the above measurements is a somewhat restricted description of the curve. The expiratory flow rate changes from high initial values to ever decreasing values in the last part of the breath. This decline in forced expiratory flow rate parallels the decline in lung volume which occurs as the expiration proceeds. The physiological factors influencing forced expiratory flow rate are dependent on overall mechanical properties of lung.

The resistance to the air flow varies inversely with lung volume and the relation between the two is hyperbolic. Therefore in assessing the flow rates it becomes important to take into consideration the lung volume at which a particular flow rate is achieved (5).

the nasal cycle on both sides of the nose indicating that changes in the activity of mucosa on one side of the nose may influence the other side by a reflex mechanism (3). Connell (7) described a "reciprocal nasal congestion-decongestion reflex" in which a change in the resistance of one nasal passage caused a reciprocal change in the resistance of the other nostril. Hypothalamus was proposed as the centre for the sympathetic effects on nasal mucosa and nasal cycle (3).

In the present study, the possibility of inspiratory and expiratory airflow through the nostrils initiating the reflex mechanism of the nasal cycle was examined. The stimuli arising out of the air flow through nostrils during the process of breathing can be considered as the most naturally and commonly occuring stimuli to the nasal mucosa. Possibly the effect of inspiratory and expiratory air flow through the congested and the patent (less congested) nostril may vary. In this study, breathing practices consisting of (group I) inspiration through patent nostril and expiration through congested nostril, (group II) inspiration through congested nostril and expiration through patent nostril (group III) only inspiration through nose and (group IV) only expiration through nose, throw light on the role of inspiratory and expiratory air flow through nostrils.

Though none of the above breathing practices caused any significant change in the air flow through the congested nostril, they induced congestion in the patent nostril as evidenced by the significant decrease in air flow. The maximum reduction was seen in the Group IV. Hence it can be inferred that the inspiratory and expiratory air flow in the patent and congested nostrils cause congestion of the patent nostril and the expiratory stimuli from the nasal mucosa are possibly more effective than the inspiratory stimuli.

These results suggest the role of air flow through nostrils during breathing which lead to the reflex congestion of the patent nostril. Keeping in view the short duration (15 min) of the practices it may be postulated that when the effect accumulates over long period (a few hours), the hypothalamic centre may trigger the decongestion/congestion of nostrils. Thus it can be suggested that the stimuli arising from air flow through nostrils during the breathing process might from the basis for the periodic reciprocal congestion/decongestion pattern of the nostrils, i.e., the nasal cycle.

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Therefore it has been accepted that a more fruitful approach has been to analyse expiratory flow volume curves. It is a forced expiratory spirogram replotted to show flow as a function of lung volume. It can be recorded by using X-Y plotters in the absence of which it is difficult though not impossible to reconstruct volume flow curve from the forced expiratory spirogram. Such a procedure has already been described (6).

Instead of finding out flow rates between two points on expiratory spirogram it is more accurate and easier to find out a point on the curvilinear portion of the end part of the spirogram, at which a fixed flow rate of 1 lit/sec or 0.5 lit/sec is acheived. This can be found out by drawing a tangent representing a slope of 1 lit/sec or 0.5 lit/sec through a point on the curvilinear portion of the spirogram.

With the usual speed of a recording spirometer (20–30 mm/sec) and 20–30 mm=0.5–1 lit on Y axis, the flow rate of 1 lit/sec or 0.5 lit/sec can be found out by this method.

As regards expression of the flow rate at FVC% some authors preferred to express flow rate at FVC% remaining in the lungs. (4) and others expressed in FEV/FVC% (7, 1, 2). We followed the later expression.

METHODS

Forced expiratory spirogram is recorded on INCO spirometer with a speed of 25 mm/sec and vertical movement of 25 mm representing 0.5 lit volume.

On the graph paper on which forced expiratory spirogram is recorded a line is drawn between a point representing 1 sec on X axis and another point representing 1 lit on Y axis. The slope of this line represents a flow rate of 1 lit/sec. All parallel lines to this line will also have a slope of 1 lit/sec (Fig. 1).

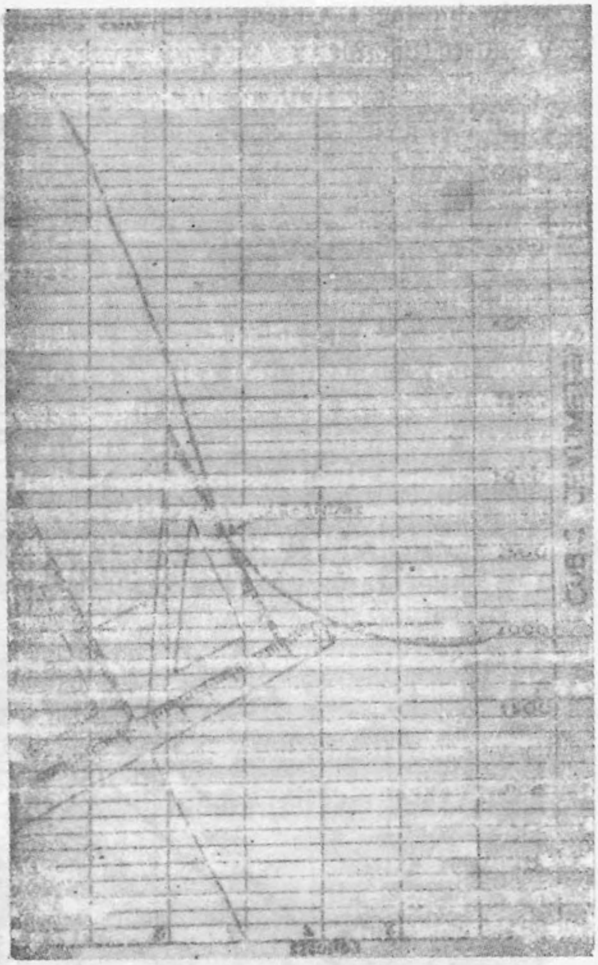

Fig. 1 : % FVC at flow rate of 1 lit/sec
FVC=3700 ml, FEV at 1 lit/sec=3000 ml
FVC %=3000/3700×100=81.08%

To draw the parallels one edge of a set square is placed on this line and measuring scale is placed touching to the lower edge of the set square. The set square is moved towards the curve along the measuring scale till it just touches the curvilinear portion of the curve. This point is marked on the curve. At this point on the curve the flow rate is 1 lit/sec since the tangent through this point is having a slope of 1 lit/sec.

The volume up to this point is expressed as FEV/FVC% (as for FEV_1%). The same procedure is to be followed to find out the flow rate of 0.5 lit/sec by drawing a tangent representing a slope of 0.5 lit/sec (Fig. 2).

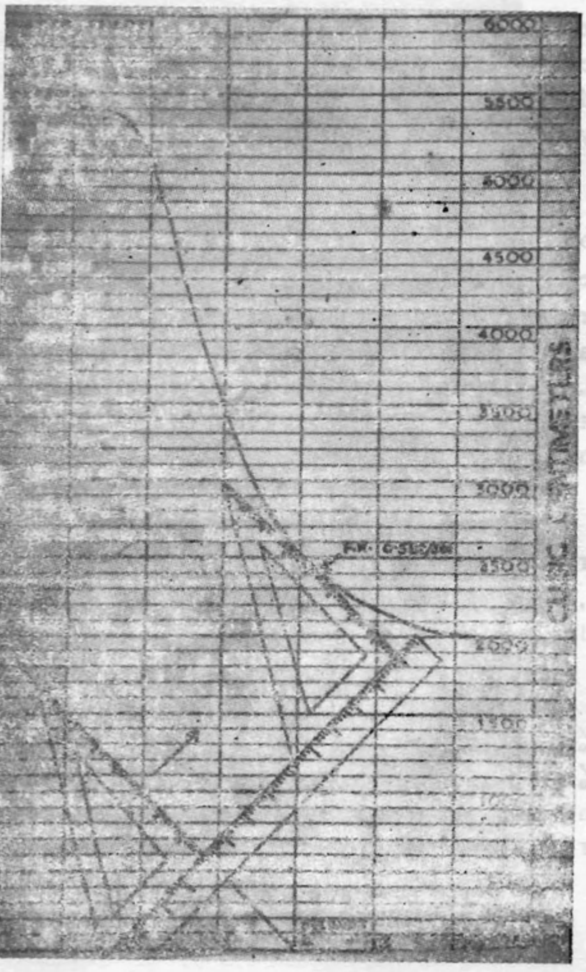

Fig. 2 : % FVC at flow rate 0.5 lit/sec
FVC=3400 ml, FEV at 0.5 lit/sec=3000 ml
FVC%=3000/3400×100=88.23%

It is important to have a curvilinear record at the terminal portion of the spirogram for which proper instructions to the subject and his cooperation is very necessary.

Calculations : From Fig. 1 it is seen that the FVC is 3700 ml and FEV at flow rate 1 lit/sec is 3000 ml. Therefore FVC% at FEF 1 lit per sec is 3000/3700×100=81 08%. Similarly from Fig. 2 FVC% at FEF 0 5 lit/sec is 3000/3400×100=88.23%

DISCUSSION

In normal healthy young adult subjects %FVC at FEF 1 lit/sec is round about 80% and %FVC at FEF 0.5 lit/sec is around 90% so these parameters are parallel to $FEF_{75\%-85\%}$ or forced end expiratory flow rate (FEEFR).

The applied importance of this parameter becomes obvious because it is generally agreed that in the presence of normal FVC and FEV_1 reduced midexpiratory and end expiratory flow rates are commensurate with small air way disease (2).

Parameter like $FEF_{75\%-85\%}$ is an expression of average end expiratory flow rate where as flow rate of 1 lit/sec or 0.5 lit/sec is an absolute value and hence a better expression. Moreover it is simpler for determination.

In a particular condition parallel change in $FEF_{75\%-85\%}$ and % FVC at 1 lit/sec or 0.5 lit/sec should indicate that the latter parameter can be used like the former in assessing the small air way function.

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