Is FEV1 determined in a plethysmograph a better indication of obstructive lung disease than FEV1 determined by a spirometer?

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IN A CURRENT PAPER in the Journal of Applied Physiology (3) the authors have tried to find out whether the compression of the gas in the lungs during a forced expiration influences the grading of decreased lung function in patients with sick lungs either due to emphysema or chronic bronchitis. They utilize the fact that during a forced expiration FEV1, measured plethysmographically (FEV1-pl) is larger than FEV1 measured at the mouth (FEV1-sp).

The reason for the decrease in FEV1 during a forced expiration is in general most likely that the elastic recoil pressure (Pel) is decreased because of the compression of the thorax and is smaller than one would expect from the gas coming out via the mouth. As Pel is a determinant for maximum flow (2), compression of the lungs decreases the elastic recoil pressure, and hence the maximum flow, and the more the compression is increased, the more the air is compressed. This is due to the fact that the relationship between Pel and volume is offset with respect to the curve describing Pel as a function of lung volume obtained with noncompressed air in the lungs, i.e., the static expiratory pressure-volume curve. Effort is an important factor. The more effort the smaller the FEV1 as also found by Krowka et al. (1). Therefore, the primary reason for the deviation of FEV1-sp from FEV1-pl is likely to be a shift in the maximum flow-static recoil curve with a smaller static recoil for a given volume remaining in the lungs. Minimal compression (minimal effort) therefore tends to give larger FEV1 than does maximum effort.

Most recommendations regarding performance of lung function tests state that the correct FEV1 is measured with maximum effort and that the largest value should be chosen. The examiner is here sitting between two chairs. Should one choose the largest effort or the largest flow?

If FEV1-pl is measured, gas compression does not influence the FEV1, and this dilemma will be avoided.

As noted by the authors, a number of factors influence the degree of compression (and how much FEV1-pl deviates from FEV1-sp): the size of the lungs is important. Therefore subjects with a predominant emphysema are likely to have more lung compression than subjects with chronic bronchitis. Increased upstream resistance and increased airway collapsibility may have the same effect.

To make the study more complete, the authors have also included “patient-centered” values like dyspnea, quality of life, exercise tolerance (6MWD), MRC score, SGRO, exacerbation frequency. Furthermore, spirometry (other than FEV1 and FEV1-p) was included, i.e., lung volumes respiratory impedance (FOT), diffusing capacity, and arterial blood gases, but none of these was influenced by gas compression. The site of maximum resistance as measured by the FOT method did not seem to influence the difference between FEV1-pl and FEV1-pl.

This is not to be expected either, if the major part of the gas compression is in the periphery, upstream from the choke point.

The basic concept is that increased alveolar pressure and increased lung volume give increased difference between FEV1-sp and FEV1-pl, and this seems to be true for emphysema (cf. Table 1). Bronchodilatation seems to increase especially FEV1-pl, so that after treatment, there was no longer a difference between FEV1-pl and FEV1-sp, which is understandable if FEV1-sp approaches FEV1-pl due to decreased resistance (and less gas compression).

An interesting observation is that the GOLD score, which is based on the numerical value of FEV1-sp, was significantly shifted from III–IV to I–II classes, which is due to the increase in FEV1-pl, but this was not true for the new GOLD grading system based mainly on clinical symptoms where the distribution of A-B and C-D stages was insignificantly different between groups using FEV1-sp or FEV1-pl.

The authors conclude that FEV1 is more decreased in subjects with dominant emphysema than in those with dominant chronic bronchitis. They do not recommend that plethysmographic determination of FEV1-pl should replace FEV1 in grading of respiratory diseases, but determination of FEV1-pl gives a better understanding of the forced expiration.

DISCLOSURES
No conflicts of interest, financial or otherwise, are declared by the author(s).

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REFERENCES