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EDITORIAL COMMENTARY

Do Repeated Spirometry Maneuvers Affect Respiratory Mechanics? Resistance Is Not Futile

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Spirometry is a commonly performed clinical test for evaluating and monitoring patients with various respiratory symptoms or conditions, and it can be helpful to discern basic patterns of lung disease. The test involves the use of forced exhalation maneuvers where the measured exhaled volumes and flow rates reflect airway size. Even though the concept of spirometry was developed by John Hutchinson in 1840s [1], the focus remained on the measurement of the forced vital capacity (FVC) and the maximum breathing capacity test [2]. The forced expiratory maneuver was first described more than a century later by Tiffeneau and Pinelli [3]. This was followed by the work of Gaensler [4] where the concept of measurement of the forced expired volume as a fraction of the FVC was introduced. Subsequent technological advancements in spirometry equipment (such as the use of pneumotachographs and computers) has led to the widespread use of spirometry as we know it today.

The physiology of the forced exhalation maneuver [5] has been extensively studied but the impact of repeated forced exhalation maneuvers on airway resistance is not well understood. The paper by Minsky et al. [6] addresses this question with the use of impulse oscillometry (IOS) to assess the impact of each forced exhalation maneuver of spirometry performed by healthy children between 6 and 12 y of age in Brazil. The authors started with an IOS measurement at baseline and repeated it after every forced exhalation maneuver until the child was able to complete spirometry testing based on the American Thoracic Society (ATS) criteria [7]. They categorized participants into three groups based on the number of forced exhalation attempts (≤ 3, 4, and 5–8) and compared the relative change in IOS parameters in each group from their baseline. Their results showed an increase in total (R5) and peripheral (R20) airways resistance between baseline (T0) and the first (T1) and last spirometry maneuvers (T2) for each group. The reactance at 5 Hz (X5) also showed a similar pattern, suggesting that repeated spirometry maneuvers can progressively impact either the inertance or capacitance of the respiratory system. It is interesting to note that the subgroup that required the highest number of spirometry attempts had much higher IOS parameters at baseline, which could be related to the variation in respiratory resistance or airway reactance seen in healthy children. The authors used spirometry reference values based on the study by Polgar and Weng [8], which could limit comparability with other datasets that are based on the Global Lung Function Initiative (GLI) predicted values [9], but it will not affect their overall results.

These findings have clinical significance during the assessment of lung function in patients with asthma or other obstructive airway disorders, where the baseline state of the airway resistance and flow limitation can have an impact on the location of their equal pressure point (EPP). The EPP is the point at which there is equal pressure inside and outside the airway (intrapleural pressure). There is a tendency for airway collapse above the EPP [10]. With repeated spirometry attempts, the EPP would be expected to move further down into the lower airways, thereby causing airways closure much earlier during subsequent forced exhalations affecting the measured values. A more recent ATS technical standard [11] has also recognized the inherent variability in lung function measurements in children and the normal physiology of "airflow limitation" during forced exhalation being different from the pathological decrease in airflow ("airflow obstruction"). Although the clinical impact of airflow limitation with forced exhalation during spirometry is likely to be small, clinicians should consider the number of forced exhalations when interpreting spirometry results in children.

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Declarations

Conflict of Interest None.

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