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REVIEW

Body plethysmography – Its principles and clinical use

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^p This article is dedicated to the memory of the co-author Priv. Doz. Dr. Wolfgang Marek who died in October 2010. He was a passionate researcher and teacher and particularly engaged in the better implementation of physiological insight into clinical practice.

KEYWORDS

Whole-body plethysmography; Intrathoracic gas volume; Functional residual capacity; Specific airway resistance; Airway resistance; Airway obstruction

Summary

Body plethysmography allows to assess functional residual capacity (FRC_{pleth}) and specific airway resistance ($sRaw$) as primary measures. In combination with deep expirations and inspirations, total lung capacity (TLC) and residual volume (RV) can be determined. Airway resistance (Raw) is calculated as the ratio of $sRaw$ to FRC_{pleth} . Raw is a measure of airway obstruction and indicates the alveolar pressure needed to establish a flow rate of 1 L s^{-1} . In contrast, $sRaw$ can be interpreted as the work to be performed by volume displacement to establish this flow rate. These measures represent different functional aspects and should both be considered.

The measurement relies on the fact that generation of airflow needs generation of pressure. Pressure generation means that a mass of air is compressed or decompressed relative to its equilibrium volume. This difference is called "shift volume". As the body box is sealed and has rigid walls, its free volume experiences the same, mirror image-like shift volume as the lung. This shift volume can be measured via the variation of box pressure. The relationship between shift volume and alveolar pressure is assessed in a shutter maneuver, by identifying mouth and alveolar pressure under zero-flow conditions. These variables are combined to obtain FRC_{pleth} , $sRaw$ and Raw .

This presentation aims at providing the reader with a thorough and precise but non-technical understanding of the working principle of body plethysmography. It also aims at showing that this method yields significant additional information compared to spirometry and even bears a potential for further development.

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Introduction

Body plethysmography is a well-established technique of lung function determination. Its frequency of clinical use appears to differ between countries, with the most intensive application in the German-speaking countries. The method

goes back to ideas developed and described by Bert (1878), Gad (1881) and Pflüger (1882) and was technically realized, as a volume-constant box, since the 1950s, especially by DuBois,⁴ Matthys¹⁸ and Ulmer.¹⁶ Subsequently the technique has been continuously improved to reach its current level of sophistication which extensively utilizes the power of

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