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LETTER TO THE EDITOR

Reply to Robbins: Multi-breath washout tests: indices versus model parameters

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TO THE EDITOR: We thank Peter Robbins (2) for his interest in our structure-function study and for bringing our attention to a study of multiple breath washout (MBW) testing and analysis, complementing other recent studies in this journal (e.g., 1). Several issues are raised that in fact pertain to a range of noninvasive lung function techniques including MBW, their most obvious drawback being that very different static or dynamic lung structural features or their spatial arrangement can lead to a similar signal at the mouth. It is our responsibility to explore, by intuition or modeling, all the possible scenarios that could significantly contribute to any given noninvasive measurement.

Alternative scenarios explaining a given MBW result can be illustrated by the mentioned increase in Fowler dead space in patients with chronic obstructive pulmonary disease (COPD). Based on a single-compartment model-guided interpretation of MBW signals, it was hypothesized that "gross collateral ventilation" could be responsible for this. Based on a model incorporating intra-acinar and interacinar asymmetry (4), this same MBW feature can be explained by the loss of terminal bronchioles inducing a peripheral shift of the diffusion front (3). To tease out actual contributions from both potential effects, models should probably include a representative geometry of the collateral channels (enlarged pores of Kohn or overt alveolar destruction), enabling a realistic simulation of convective and/or diffusion gas transport across these channels, and of the resulting MBW signal at the mouth.

A different matter concerns the simplicity of the indices for use in the clinic, where we need to strike a balance between practical feasibility on behalf of the patient performing the test, data analysis within a reasonable time frame, and comprehensive interpretation of the results. Again, interpretation can be explored with lung models that are as complex as they need to be for the problem at hand, but in the end, we need to offer a test and associated indices that are as comprehensive and nonredundant as possible. This allows the health professional to make an informed choice about which indices to use in support of a diagnosis and for patient follow-up. When properly chosen, simple indices, and the state-of-the-art statistical techniques to determine their limits of normal, may be all that is needed in a majority of clinical cases. However, in specific cases (e.g., endobronchial valve placement), a more complex physiological measurement may be warranted, perhaps complemented by quantitative computed tomography (CT). For instance, if a single-compartment-guided MBW analysis were to signal an altered compliance, then the technique laid out in our structure-function study could help localize where the poorly ventilated lung units actually are, potentially guiding intervention.

We welcome any pragmatic approach where measurement, analysis, and (model) interpretation concur in an appropriate degree of sophistication. We do admit to erring on the "archaic" side when critically assessing new MBW analyses (including our own attempts), scrutinizing these for the actual incremental knowledge with respect to existing indices. Some existing indices may turn out to be of misleading simplicity when venturing into their underlying physiological concepts, most of which have been laid out for us over 50 years ago and still need to be reckoned with today.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the authors.

AUTHOR CONTRIBUTIONS

S.A.V. drafted manuscript; S.A.V. edited and revised manuscript; S.A.V., M. P., D.S., B.I., J.d.M., E.V., and J.V. approved final version of manuscript.

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