Comparison of the utility of multiple breath inert gas washout parameters in cystic fibrosis

Ventilation inhomogeneity, measured using multiple breath washout (MBW), reflects small airway function and has emerged as a valuable tool in cystic fibrosis (CF). Improved sensitivity to detect early lung damage has been suggested from preschool children through to adults and confirmed in high-resolution CT (HRCT) studies. Longitudinal utility is now emerging. A large number of parameters reflecting overall ventilation inhomogeneity have been proposed, but consensus is lacking about the optimal parameter to report.

The two most commonly reported are lung clearance index (LCI) and moment ratios (MR). LCI, the easier to calculate and understand conceptually, represents the number of lung turnovers (or functional residual capacities, FRC) required to reduce the end tidal inert gas concentration to 1/40th of its starting value. The calculation of MR adds more weight to the latter portion of the washout curve and, while more complicated in their derivation, offer improved robustness to variations in tidal volume ($V_t$) and potentially improved sensitivity. Truncation of MR to facilitate comparison between subjects is recommended. In practice, however, the large $V_t$ fluctuations used by Saidel et al are beyond that seen during routine MBW tests, which encourage regular tidal breathing. The derivation of these parameters is described in more detail in the online supplement.

MBW tests from two cohorts, a CF (n=56) and a healthy control (n=32), containing preschool children through to adults were retrospectively studied. Testing, performed in triplicate with results averaged, took place at the West-Swedish CF Centre, Gothenburg, Sweden using equipment previously described. In children a regular spontaneous breathing pattern was targeted, while more complicated in their derivation, offer improved robustness to variations in tidal volume ($V_t$) and potentially improved sensitivity.

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The statistical analyses: 

- For non-parametric continuous variables, the Mann–Whitney test for non-parametric continuous variables and multivariate logistic regression analyses to investigate factors influencing the within-subject coefficient of variation (CV) of MBW indices from the triplicate tests. Data were pooled from previous studies with ethics approval, and some of the LCI CF data have been previously reported.

The document includes a figure and references, but the full text is not visible in the image. The references are cited throughout the text and are likely to be included in the final version of the document. The figure, which shows a correlation between lung clearance index (LCI) and the first moment ratio in its untruncated ($\mu_1/\mu_0$) and truncated forms ($\mu_1/\mu_0 - 8$, $p<0.001$), is described as follows:

"Figure 1 Correlation between lung clearance index (LCI) and the first moment ratio in its untruncated ($\mu_1/\mu_0$) and truncated forms ($\mu_1/\mu_0 - 8$, $p<0.001$)."

The reference list includes numerous studies on the topic of MBW, its utility, and its applications in cystic fibrosis, as well as other related conditions. The corresponding author, P D Robinson, is contacted for more information.

Correspondence to Dr P D Robinson, The Children’s Hospital at Westmead, Locked Bag 4001, Westmead, NSW, 2145 Australia; paul3@chw.edu.au

Competing interests None.

Contributors PDR was responsible for conception and design of this study, analysis and interpretation of data and the writing of the manuscript. PMG was responsible for performing the original recordings, analysis and interpretation of the study results and contributed to the writing of the manuscript. AL was responsible for original recruitment of subjects and setting up of the laboratory and contributed to the writing of the manuscript.

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For a full list of references, please refer to the PDF version of the article.