Contents

Lung Clearance Index

Guidelines & Statements

Preschool Multiple-Breath Washout Testing. An Official American Thoracic Society Technical Statement.

Robinson PD, Latzin P, Ramsey KA, Stanojevic S, Aurora P, Davis SD, Gappa M, Hall GL, Horsley A, Jensen R, Lum S, Milla C, Nielsen KG, Pittman JE, Rosenfeld M, Singer F, Subbarao P, Gustafsson PM, Ratjen F. Am J Respir Crit Care Med. 2018 Mar 1;197(5):e1-e19.

Obstructive airway disease is nonuniformly distributed throughout the bronchial tree, although the extent to which this occurs can vary among conditions. The multiple-breath washout (MBW) test offers important insights into pediatric lung disease, not available through spirometry or resistance measurements. The European Respiratory Society/American Thoracic Society inert gas washout consensus statement led to the emergence of validated commercial equipment for the age group 6 years and above. Subsequently, the focus has shifted to MBW applications within preschool subjects (aged 2-6 yr), where a "window of opportunity" exists for early diagnosis of obstructive lung disease and intervention.

Corrections to an ATS Workshop Report on Multiple-Breath Washout Testing for Patients with Cystic Fibrosis.

Subbarao P, Milla CE, Morgan WJ, Ratjen F. Ann Am Thorac Soc. 2017 Jan;14(1):145.

The corrections regard use of SF6 as a tracer gas, and limitations and certain other aspects of the Innocor Multiple Breath Washout system. The expert group believes that the low concentration of SF6 in the Innocor system likely makes the greenhouse effect of its use immaterial. The statement in the workshop report regarding the limited availability of the SF6 tracer gas refers to the 4% concentration, and not to the gas supplied with the Innocor/PulmoTrace system. The U.S. Food and Drug Administration has approved Innocor using SF6 in low concentration levels as a medical device.

Multiple-Breath Washout as a Lung Function Test in Cystic Fibrosis. A Cystic Fibrosis Foundation Workshop Report.

Subbarao P, Milla C, Aurora P, Davies JC, Davis SD, Hall GL, Heltshe S, Latzin P, Lindblad A, Pittman JE, Robinson PD, Rosenfeld M, Singer F, Starner TD, Ratjen F, Morgan W. Ann Am Thorac Soc. 2015 Jun;12(6):932-9.

The lung clearance index (LCI) is a lung function parameter derived from the multiple-breath washout (MBW) test. Although first developed 60 years ago, the technique was not widely used for many years. Recent technological advances in equipment design have produced gains in popularity for this test among cystic fibrosis (CF) researchers and clinicians, particularly for testing preschool-aged children. LCI has been shown to be feasible and sensitive to early CF lung disease in patients of all ages from infancy to adulthood.

Consensus statement for inert gas washout measurement using multiple- and single- breath tests.

Robinson PD, Latzin P, Verbanck S, Hall GL, Horsley A, Gappa M, Thamrin C, Arets HG, Aurora P, Fuchs SI, King GG, Lum S, Macleod K, Paiva M, Pillow JJ, Ranganathan S, Ratjen F, Singer F, Sonnappa S, Stocks J, Subbarao P, Thompson BR, Gustafsson PM. Eur Respir J. 2013 Mar;41(3):507-22.

Inert gas washout tests, performed using the single- or multiple-breath washout technique, were first described over 60 years ago. As measures of ventilation distribution inhomogeneity, they offer complementary information to standard lung function tests, such as spirometry, as well as improved feasibility across wider age ranges and improved sensitivity in the detection of early lung damage. These benefits have led to a resurgence of interest in these techniques from manufacturers, clinicians and researchers, yet detailed guidelines for washout equipment specifications, test performance and analysis are lacking. This manuscript provides recommendations about these aspects, applicable to both the paediatric and adult testing environment, whilst outlining the important principles that are essential for the reader to understand.

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Clinical Relevance

Inert gas washout: theoretical background and clinical utility in respiratory disease.

Robinson PD, Goldman MD, Gustafsson PM. Respiration. 2009;78(3):339-55.

Multiple breath inert gas washout has demonstrated improved sensitivity, in comparison to spirometry, in the early detection of a number of important disease processes, including cystic fibrosis. Despite this, these important techniques remain under-utilised in the clinical setting and there is a lack of commercially available devices currently available. The recent resurgence of research in this area has produced a large number of important studies and a pronounced international interest has developed in these techniques. This review article will provide an overview of the theoretical background of inert gas washout and analysis indices, review important physiological and clinical insights gained from research to date (as well as from our own experience) to illustrate its utility, and outline the challenges that lie ahead in incorporating these techniques into the mainstream clinical setting.

Lung clearance index in the assessment of airways disease.

Horsley A. Respir Med. 2009 Jun;103(6):793-9.

In the last few years there has been a growing interest in lung clearance index (LCI), a measure of lung physiology derived from multiple breath washout tests. This resurgence of interest was initially driven by the recognition that such assessments were capable of detecting early airways disease in children, and are more sensitive and easier to perform in this population than conventional lung function tests. With an appreciation of the importance of earlier identification of airways dysfunction, and prevention of irreversible structural airway changes, methods of following airways disease in these "silent years" are especially important. LCI has now been reported in studies involving all age groups, from infants to adults, and has a narrow range of normal over this wide age range, making it especially suitable for long-term follow-up studies. In cystic fibrosis (CF) particularly, there is a pressing need for sensitive and repeatable clinical endpoints for therapeutic interventions, and LCI has been proposed as an outcome measure in future CF gene therapy studies.