EDITORIAL

# Can Impulse Oscillometry be Used to Monitor Asthmatic Children?

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Children under six years of age find it difficult to control their breath, hence, spirometry is challenging and at times inaccurate. In asthma, estimation of lung functions is of assistance in establishing the diagnosis and monitoring the course of disease as well as response to treatment. Spirometry is based on the physiological changes which occur during maximal expiratory flow (MEF) and is currently used in the management of asthma. MEF, during mid or late expiration (MEF 25-75), is indicative of peripheral airway disease. However, forced expiratory volume in the first second ($FEV_1$) is mostly used to diagnose and monitor asthmatic children [1].

In 1956, Duboies, *et al*. [2] described a non-invasive method of superimposing externally created sound waves on subject's breath and document changes in respiratory mechanics. The resultant measurements were based on the principles of forced oscillatory technique. Later, this was refined and developed into impulse oscillometry (IOS), where low frequency waves of 5 Hz, which penetrate into the lung tissue, and high frequency waves of 20 Hz are delivered to the airways through a pressure transducer kept at the mouth of the subject. A pneumochromatograph is also kept at the mouthpiece to measure resultant changes in the wave patterns during breathing. The IOS works best at respiratory rates of 16-20/min. Some of the outputs are impedance to the generated impulse of 5 Hz (Z5); resistance to 5 Hz, primarily due to small or peripheral airways (R5); reactance, which is a combination of inertia of the air column to move and capacitance of the lung (X5) as well as area of reactance (AX); and resonant frequency where inertia of airways and capacitance of lung periphery are equal [3].

Theoretically, IOS can be done in small children in sitting posture, with nose clipped and cheeks kept flat manually. It does not require their cooperation during breathing. It is claimed that IOS can measure small airway resistance more accurately. However, reference ranges for IOS parameters are yet to be established.

Dawman, *et al.* [4] have compared IOS and spirometry in monitoring asthma in 256 children aged 5-15 y. Three monthly follow-ups were done and IOS and spirometry done at each visit. Children with physician-diagnosed asthma were included. At each visit the patients were classified as controlled, partly controlled, uncontrolled or in acute exacerbation, according to GINA guidelines [5]. The authors observed that $FEV_1$ and IOS parameters such as Z5, R5, X5 and AX and resistance 5-20 were correlated. Both machine parameters differentiated controlled and uncontrolled asthmatics, but in the Receiver operator curve analyses, areas under the curve for all the parameters ranged from 0.52 to 0.58. IOS parameters were assessed against the spirometry with $FEV_1$ as gold standard. However, $FEV_1$ itself does not measure functional status of small airways. Comparison of IOS with MEF25-75 has not been reported. Further analyses, controlling for respiratory rate, gender and anthropometry, from the data generated by the authors may show interesting results. The added value of IOS above standard spirometry in monitoring asthmatic children remains unclear from this work as younger children were not included.

Before IOS comes in routine practice, there is a need to establish normal values for various parameters across all pediatric ages in Indian children. Thereafter, the performance of IOS against commonly used spirometry parameters in specific pulmonary diseases in children has to be done. As of now, IOS seems to be a viable option for measuring lung functions in young children.

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