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Small Airway Disease in Preschool Asthma

Mini Review

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Abstract

The diagnosis of small airway dysfunction in preschool asthma can be made with spirometry and mainly with impulse oscillometry. Its presence is associated with a higher risk of exacerbations, worse control of the symptoms, and loss of future lung function.

Keywords: Asthma, Preschool, Small Airway Dysfunction, Lung Function

Introduction

The airway divides continuously until reaching 23 generations of bronchial branching. Up to the 7th bronchial generation the large airway is found (diameter greater than 2mm). From the 8th generation towards the distal (diameter less than 2mm) the small airway is found, which does not contain cartilage in its walls, so it is easily collapsible and has been identified as the main site of small airway dysfunction (SAD) with allergic inflammation, airflow obstruction and airway remodeling in children with asthma [1].

Spirometry

Some spirometry parameters are used to diagnose SAD. Yi et al. conducted a study on more than 800 children with preschool asthma. They used FEF 25-75%, FEF50% and FEF75% ≤ 65% to define SAD, finding a prevalence of 19.5%. These three parameters were sensitive in reflecting SAD and airway hyperresponsiveness in preschool asthmatic patients with normal FEV1% [2]. However, spirometry cannot be performed reliably in preschool asthma, due to the child's limited ability to perform a reproducible forced expiratory maneuver and the variability of parameters (e.g., FEF 25-75%) used to measure SAD in spirometry [3].

Impulse Oscillometry

In recent years, the development and access to Impulse Oscillometry in preschoolers with asthma has increased, having the advantage of being a quick, non-invasive and highly useful method in children who are not capable of making the effort required by spirometry [4]. In the preschool IOS, the parameters that have been associated with SAD are the reactance area in (AX), the reactance at 5Hz (X5), the resonance frequency (Fres), the difference between respiratory resistance at 5 and 20Hz. (R5-R20) and the R5-R20/R5 ratio (%) (1,3). Furthermore, Gochicoa et al. recently published the reference equations for all these IOS parameters from 2.7 years of age, which will help define SAD more accurately in preschool asthma [5].

In a prospective study carried out in asthmatic preschoolers, Schulze et al. demonstrated that X5 and R5-R20 were more accurate parameters than FEV1 in predicting asthma exacerbations during one year of follow-up [6]. Similar results were reported by Zheng et al. who, in addition to R5-R20, found that AX was the parameter that best pre-

dicted exacerbations and loss of preschool asthma control after 8 to 12 weeks [7]. X5 alone or even better if combined with fractional exhaled nitric oxide has also been a parameter that has proven useful in predicting asthma control in preschoolers [8]. Recently, in a cohort of asthmatic preschoolers followed for 3 years, it was shown that AX and R5-R20 are the parameters that most increased the possibility of having abnormal spirometry at school age (LR+ 50 and 10 respectively), which confirms their usefulness in medium-term follow-up and the increased risk of loss of lung function in the future [9].

The information above has important implications for treatment with inhaled corticosteroids in young children. It has been shown in children with asthma that inhaled corticosteroid formulations with ultrafine particles (1-1.5mm in diameter) that can reach the small airways and have more lung deposite than formulations with particles thicker (3-4mm diameter), as well as better asthma control and decreased severe exacerbations [10]. Therefore, detecting the presence of SAD in preschool asthma can help direct treatment, improve control, quality of life and prognosis of the disease.

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