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Xenon Ventilation Computed Tomography Rules: New technology may open up further understanding in asthma

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In clinical practice, the assessment of asthma control is typically based on the degree of symptoms and lung function abnormalities¹. However symptoms are often not concordant with lung function change and optimal assessment of asthma control remains a clinical challenge. Air trapping, a surrogate of ventilation heterogeneity, is common in patients with asthma, and is a pathophysiologic derangement that is highly predictive of exacerbation risk². In this issue of the Journal, Jung, et al³ and colleagues present a novel means to assess air trapping in adults with asthma based on hyperpolarized xenon CT.

The authors found that abnormalities of regional ventilation as identified by xenon CT were highly associated both with metrics of asthma control as well changes in airway tone as affected by methacholine-induced bronchoconstriction and its subsequent reversal with albuterol. Interestingly, the degree of large airway tone as determined by FEV₁ did not significantly correlate with the results of xenon CT. This suggests that ventilation heterogeneity, as identified by xenon CT, is more informed by distal airway obstruction and less by central bronchomotor tone. The authors suggest that xenon CT is potentially a promising diagnostic tool that can be used as a new method to assess ventilation abnormalities in asthma, and these ventilation abnormalities can be used as novel parameters reflecting the status of asthma control and symptom severity.

The study does have limitations based on its observational design, subjective image scoring methods, and the relative inaccessibility of xenon CT. Furthermore, the dose of ionizing radiation will limit its applicability, particularly in pediatrics. Despite these limitations, we carefully submit that xenon CT is a promising diagnostic tool and will likely yield new information about the pathobiology of asthma.

The authors should be commended for the longitudinal phase of the study which showed that ventilation heterogeneity predicted lung function improvement in response to treatment. There are few, if any biomarkers which inform future improvement in degree of airflow

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limitation and bronchial hyperresponsiveness. Furthermore, air trapping as identified by xenon CT also correlated with a marker of airway inflammation, sputum eosinophilia.

So what does this study reveal of the pathobiology of asthma? First, despite the common view, asthma is not a disorder which uniformly affects the airways. This publication and those based on lung imaging after inhalation of hyperpolarized helium 3 clearly show the prevalence of large regional ventilatory defects in patients with asthma ^{4, 5}. Instead, asthma should be viewed as a focal disorder which affects the lung in a pattern more akin to regional ileitis in the gut. Second, structural and functional changes as identified by xenon CT are highly predictive of asthma outcomes. Important unanswered questions by this study are how triggers such as viral respiratory infections and co-morbidities associated with asthma impact ventilation heterogeneity as identified by novel imaging modalities such as xenon CT.

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