



Imaging of airway remodeling

Learn more about the benefits, limitations, and clinical correlates of imaging techniques available for the assessment of airway remodeling in asthma



EpiCentral
UNDERSTANDING THE CENTRAL ROLE OF THE
EPITHELIUM IN SEVERE ASTHMA AND BEYOND

Understanding of the course of airway remodeling in patients with asthma is limited, in part, due to a lack of longitudinal data¹

Invasive techniques such as bronchoscopy are not suitable for the serial assessment of change over time in the airways²

Imaging techniques such as hyperpolarized gas MRI are non-invasive and can be carried out serially^{3,4}

Advanced imaging technologies may help to address evidence gaps, aiding improved understanding of the pathophysiology of airway remodeling and its clinical significance for patients with asthma¹

MRI, magnetic resonance imaging

1. Prakash YS et al. *Am J Respir Crit Care Med*. 2017;195:e4–e19; 2. Joseph C, Tatler AL. *J Asthma Allergy*. 2022;15:595–610; 3. Ekpruke CD, Silveyra P. *Ann Transl Med*. 2022;10:1189; 4. Kooner HK et al. *Respirology*. 2022;27:114–133

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CT assessment of airway remodeling

Benefits¹⁻⁶

- Gold standard in pulmonary imaging
- Airway wall thickness measurements are consistent with histological examinations
- Simple to measure lung parenchymal density and gas trapping
- Allows identification and quantification of mucus plugging

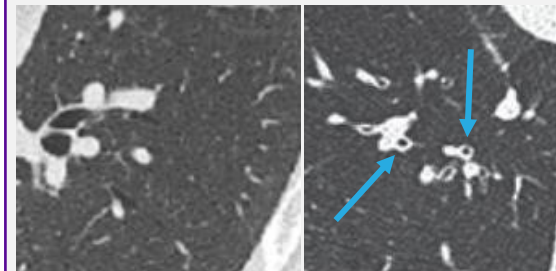
Limitations^{1,2,6,7}

- Complex and potentially difficult to measure airway dimensions
- Low precision for measuring small airways of <1–2 mm diameter
- Cannot distinguish which specific components of the airway wall are thickened in airway remodeling
- HRCT scanning presents significant radiation exposure

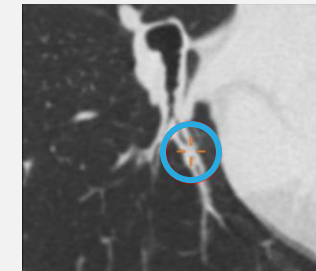
Clinical correlates^{3,8-14}

- CT-assessed remodeling has been found to correlate positively with asthma severity in adult patients
- CT assessment of gas trapping is associated with asthma severity
- Patients with increased WA% and gas trapping on CT scans may be more likely to exhibit neutrophilic inflammation
- Mucus plugging on CT is associated with reduced lung function, increased exacerbation risk, and increased T2 inflammatory markers

Healthy lung (left) and bronchial wall thickening (right) in a patient with severe asthma as assessed by inspiratory CT^{15,16}



Mucus plug in a patient with moderate-to-severe asthma as identified by CT scan¹⁷



CT, computed tomography; HRCT, high-resolution computed tomography; WA%, wall area percentage

1. King GG et al. *Eur Respir Rev.* 2019;28:180111; 2. Dournes G, Laurent F. *Pulm Med.* 2012;2012:670414; 3. Dunican EM et al. *J Clin Invest.* 2018;128:997–1009; 4. Trivedi A et al. *J Allergy Clin Immunol.* 2017; 139:1–10; 5. Stewart NJ et al. *Br J Radiol.* 2022;95:20210207; 6. de Jong PA et al. *Eur Respir J.* 2005;26:140–152; 7. Manso L et al. *Allergol Immunopathol (Madr).* 2012;40:108–116; 8. Aysola RS et al. *Chest.* 2008;134:1183–1191; 9. Niimi A et al. *Am J Respir Crit Care Med.* 2000;162:1518–1523; 10. Little SA et al. *Thorax.* 2002;57:247–253; 11. Busacker A et al. *Chest.* 2009;135:48–56; 12. Ueda T et al. *J Allergy Clin Immunol.* 2006;118:1019–1025; 13. Gupta S et al. *Thorax.* 2010;65:775–781; 14. Chan R et al. *J Allergy Clin Immunol Pract.* 2023;11:195–199; 15. Santone A et al. *Diagnostics (Basel).* 2021;11:293; 16. van den Bosch WB et al. *Eur Respir Rev.* 2021;30:200186; 17. In House Data, AstraZeneca. DoF REF-176078 US-78931 Last Updated 8/23. © 2023 AstraZeneca. All Rights Reserved. This information is intended for healthcare professionals only. EpiCentral is sponsored by Amgen and AstraZeneca.

Hyperpolarized gas MRI assessment of airway remodeling

Benefits¹⁻⁵

- High spatial and temporal resolution of ventilation defects, which reflect airway narrowing
- Allows longitudinal monitoring of disease with avoidance of exposure of patient to ionizing radiation
- Can provide information not captured by pulmonary function tests

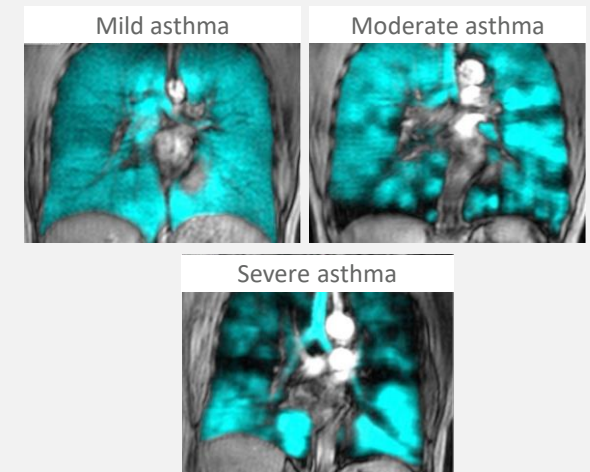
Limitations^{1,4,6}

- Can only be performed at specialized centers due to availability of hyperpolarized gas
- Airway wall thickness cannot be measured
- Slightly reduced spatial resolution compared with CT scans

Clinical correlates^{1-3,7-10}

- MRI ventilation defects are associated with asthma severity and exacerbation risk
- Ventilation defects predict long-term FEV₁ reversibility in mild-to-moderate asthma
- Ventilation defects may also be associated with eosinophilia and poor control of eosinophilic inflammation
- Regions of air trapping and mucus plugging on CT overlap with MRI-assessed ventilation defects

Hyperpolarized noble gas MRI static ventilation images of patients with mild, moderate, and severe asthma^{2,11a}



^aAs defined by GINA guidelines¹¹

CT, computed tomography; FEV₁, forced expiratory volume in 1 second; GINA, Global Initiative for Asthma; MRI, magnetic resonance imaging

1. King GG et al. *Eur Respir Rev*. 2019;28:180111; 2. Kooner HK et al. *Respirology*. 2022;27:114–133; 3. Stewart NJ et al. *Br J Radiol*. 2022;95:20210207; 4. Trivedi A et al. *J Allergy Clin Immunol*. 2017;139:1–10; 5. Petousi N et al. *Thorax*. 2019;74:797–805; 6. de Jong PA et al. *Eur Respir J*. 2005;26:140–152; 7. Mummy DG et al. *J Allergy Clin Immunol*. 2018;141:1140–1141.e4; 8. Altes TA et al. *J Allergy Clin Immunol*. 2016;137:789–796.e7; 9. Svenningsen S et al. *Am J Respir Crit Care Med*. 2018;197:876–884; 10. Eddy RL et al. *Radiology*. 2019;293:212–220; 11. Global Initiative for Asthma (GINA). Global Strategy for Asthma Management and Prevention. 2023. Available from: <https://ginasthma.org/wp-content/uploads/2023/05/GINA-2023-Full-Report-2023-WMS.pdf>. Accessed August 14, 2023
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Benefits¹⁻³

- More sensitive method to study bronchial wall thickness than HRCT
- Capability to discriminate between individual layers of the airways; allows 3–5 layers to be distinguished
- Access to airways as small as 4 mm

Limitations^{1,2}

- Requires bronchoscopy, which carries a risk of bronchospasm
- Standards have not yet been established

Clinical correlates^{4,5}

- Thickening of bronchial walls L₁, L₂, and L₃₋₅, as measured by EBUS, is associated with severe asthma
- PC₂₀, a measure of airway hyperresponsiveness, negatively correlates with the thickness of the second airway wall layer in patients with asthma

Measurement of bronchial wall thickness using HRCT and EBUS¹

