# Imaging of airway remodelling

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

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

# CT assessment of airway remodelling

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## Benefits[1–6]

- 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

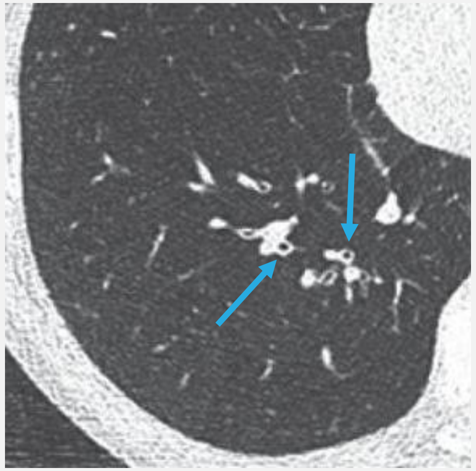
## Limitations[1,2,6]

- 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 remodelling

## Clinical correlates[3,7–12]

- CT-assessed remodelling has been found to correlate positively with asthma severity in adult patients
- CT assessment of gas trapping is associated with asthma severity and airway hyperresponsiveness
- Patients with increased WA% and gas trapping on CT scans may be more likely to exhibit neutrophilic inflammation
- Mucus plugging shown on CT is associated with sputum eosinophilia

**Bronchial wall thickening in a patient with severe asthma as assessed by inspiratory CT[13]**



CT, 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. Aysola RS, et al. Chest 2008;134:1183–1191; 8. Niimi A, et al. Am J Crit Care Med 2000;162:1518–1523; 9. Little SA, et al. Thorax 2002;57:247–253; 10. Busacker A, et al. Chest 2009;135:48–56; 11. Ueda T, et al. J Allergy Clin Immunol 2006;118:1019–1025; 12. Gupta S, et al. Thorax 2010;65:775–781; 13. van den Bosch WB, et al. Eur Respir Rev 2021;30:200186

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# MRI assessment of airway remodelling

## Benefits[1–5]

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

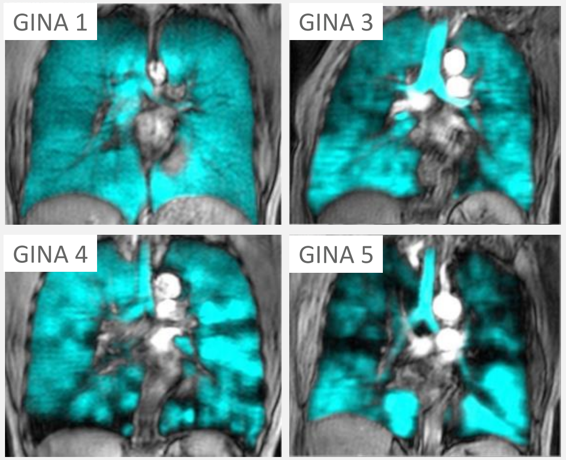
## Limitations[1,4,6]

- 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 $FEV_1$ 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

**Hyperpolarised noble gas MRI static ventilation images of patients at GINA steps 1, 3, 4 and 5[2]**




CT, computed tomography; $FEV_1$, 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; 8. Altes TA, et al. J Allergy Clin Immunol 2016;137:789–796; 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

# EBUS assessment of airway remodelling

## Benefits[1–3]

- 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

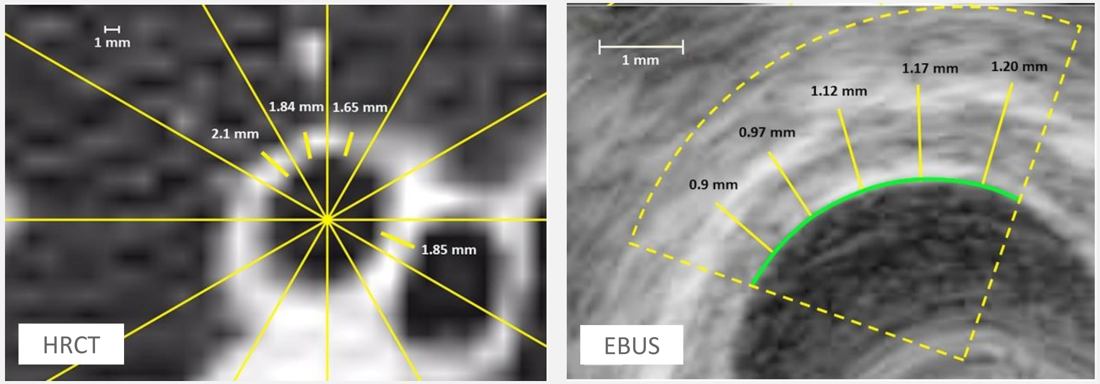
## Limitations[1,2]

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

## Clinical correlates[4,5]

- Thickening of bronchial walls $L_1$, L2 and $L_{3–5}$, as measured by EBUS, is associated with severe asthma
- $PC_{20}$, 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 EBUS[1]




EBUS, endobronchial ultrasound; $FEV_1$, forced expiratory volume in 1 second; HRCT, high-resolution computed tomography; L, layer; $PC_{20}$, provocation concentration of methacholine causing a 20% fall in $FEV_1$

1. Gorska K, et al. Respir Med 2016;117:131–138; 2. Trivedi A, et al. J Allergy Clin Immunol 2017;139:1–10; 3. Manso L, et al. Allergol Immunopathol (Madr) 2012;40:108–116;
4. Soja J, et al. Pol Arch Med Wewn 2015;125:659–665; 5. Kita T, et al. J Bronchology Interv Pulmonol 2010;17:301–306