Identifying small airway dysfunction in asthma in clinical practice

Natalie Jackson[1], Jethin Rafique[1*,2], Dave Singh[1,2]

BACKGROUND

Small airways are defined as those with a diameter ≤ 2 mm.[1] There is a current focus on small airway dysfunction (SAD) in asthma and the techniques used in order to measure this.[1-3] Postma et al. reported that SAD is present across all severities of asthma and can be measured using different techniques, including lung volumes and oscillometry.[1,3] The case histories described here illustrate how these methods can be applied in a clinical setting to identify SAD in asthma.

CASE HISTORIES

Table 1 shows data from two patients with moderate to severe asthma (Global Initiative for Asthma classification system = 4) who attended our research centre for lung function assessment. Both were non-smoking females of a similar age with uncontrolled asthma; both had Asthma Control Questionnaire scores = 2.3. There were similar levels of fractional exhaled nitric oxide (21 and 12 ppb), FEV_1 (68% and 72% of the predicted value), and FEV_1/FVC ratio (0.61 and 0.70). Patient 1 demonstrated greater reversibility than patient 2 (420 mL and 22% and 240 mL and 12%, respectively).

Body plethysmography was used to assess lung volumes (Autobox 6200 DL; Sensormedics Corporation, CA, USA). Residual volume (RV) was increased (153% of predicted) in patient 1, indicating gas trapping due to SAD. There was no evidence of gas trapping in patient 2. Impulse oscillometry was used in order to measure airway resistance (Masterscreen IOS; Erich Jaeger, Hoechenberg, Germany), with peripheral airway resistance measured by resistance at 5 Hz minus resistance at 20 Hz (R5 – R20).[3] Patient 1 demonstrated a value of 0.23 kPa/L/s, whereas patient 2 had a much lower value of 0.01 kPa/L/s, indicating minimal peripheral airway resistance. These differences in R5 – R20 can be due to small airway inflammation, remodelling or bronchoconstriction.

Table 1. Demographic and clinical data.

Variable	Patient 1	Patient 2
Gender	Female	Female
Age, years	45	41
Smoking status	Never smoker	Never smoker
BMI, kg/m^2	31	26
GINA	4	4
ACQ-7	2.3	2.3
FeNO, ppb	21	12
FEV_1, L	1.87	2.03
FEV_1, % predicted	68	72
FEV_1/FVC ratio	0.61	0.70
Reversibility, mL	420	240
Reversibility, %	22	12
RV, %	153	100
R5 – R20, kPa/L/s	0.23	0.01

BMI: Body mass index; GINA: Global Initiative for Asthma; ACQ-7: Asthma Control Questionnaire 7; FeNO: fractional exhaled nitric oxide; RV: residual volume; R5: resistance at 5 Hz; and R20: resistance at 20 Hz.

CLINICAL MESSAGE

The evidence that SAD is present from mild to severe asthma[3] raises the practical issue of how to diagnose and monitor SAD in clinical practice. SAD was previously thought to be difficult to measure due to the inaccessible nature of the lung periphery.[1] However, these case studies show the potential value of RV and oscillometry measurements in clinical practice; the two cases presented here had very similar clinical characteristics based on spirometry and asthma control, but only one had evidence of significant SAD.

Although normal ranges for oscillometry measurements have yet to be firmly established,[4] the R5 – R20 value for patient 1 is beyond the threshold for SAD used in previous publications.[4,5] Establishing normal ranges for oscillometry is an important future consideration for this technique in clinical practice.

The clinical management of SAD can include the use of inhaled treatments with smaller particle sizes that target the small airways. The diagnosis of SAD may therefore lead to different clinical management. The cases presented here show that the use of RV and R5 – R20 measurements can facilitate the diagnosis of SAD. We believe that diagnosing SAD in asthma should not be overlooked as the opportunity for targeted treatment may be missed.

AUTHOR CONTRIBUTIONS

DS and JR designed the research. JR and NJ organised data collection. DS and NJ wrote the manuscript. JR reviewed and approved the manuscript.

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1. Medicines Evaluation Unit, Wythenshawe, Manchester, United Kingdom.
2. University of Manchester, Manchester, United Kingdom.
*At the time of the study

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