SUPPLEMENTARY MATERIAL

Figure legends

Figure S1. Correlations between RV/TLC and impulse oscillometry parameters (% of predicted) including **(A)** difference between resistance in 5Hz and 20Hz (R_5-R_{20}), **(B)** reactance in 5 Hz (X_5), **(C)** resonant frequency (F_{res}) and **(D)** area under reactance curve between 5 Hz and resonant frequency (AX). RV, residual volume; TLC, total lung capacity.
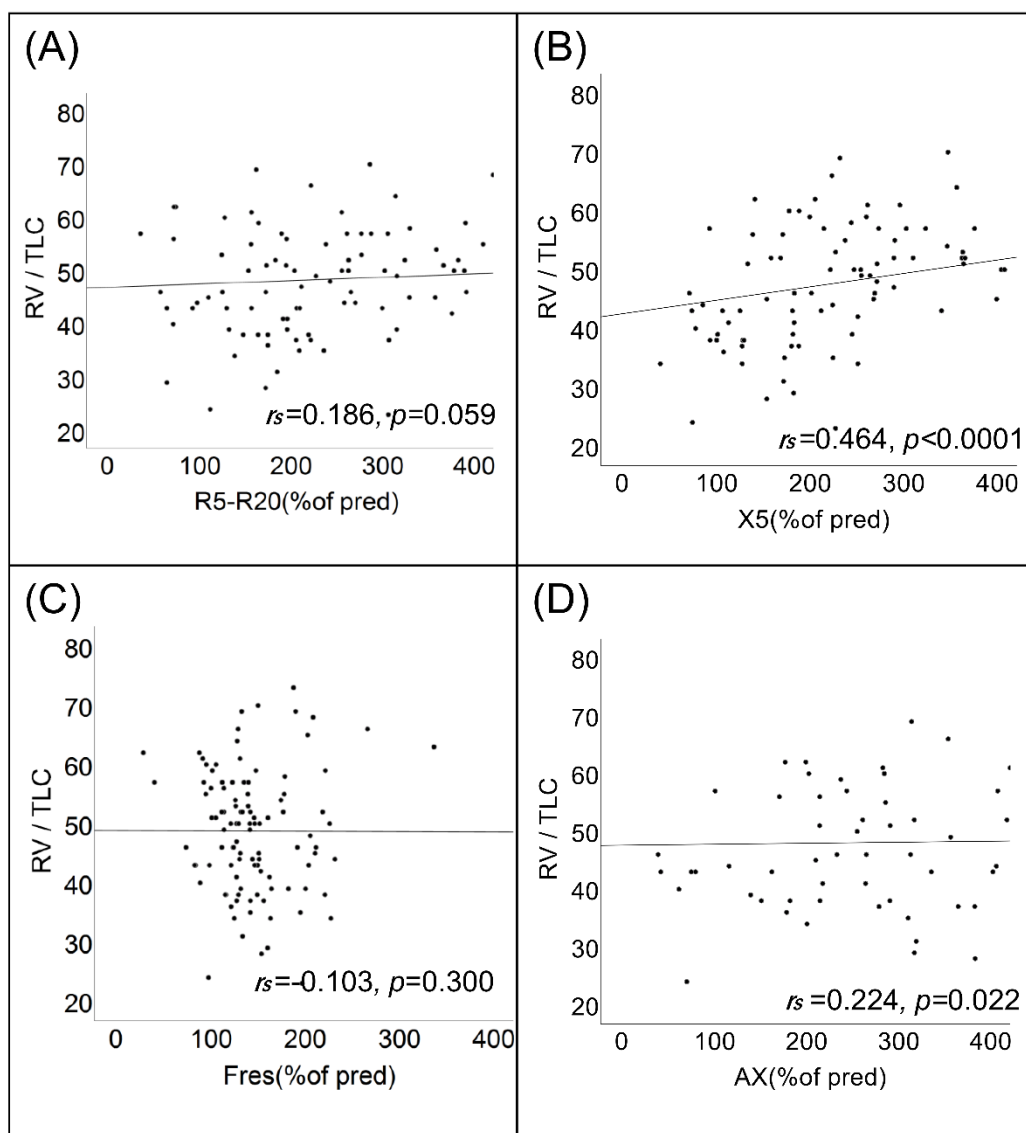
Figure S2. Receiver operating characteristic curve analysis of impulse oscillometry parameters (% of predicted) to detect static lung hyperinflation (SLH) in patients with severe asthma. R_5, resistance in 5 Hz; R_{20}, resistance in 20 Hz; X_5, reactance in 5 Hz; F_{res}, resonant frequency; AX, area under reactance curve between 5 Hz and resonant frequency.
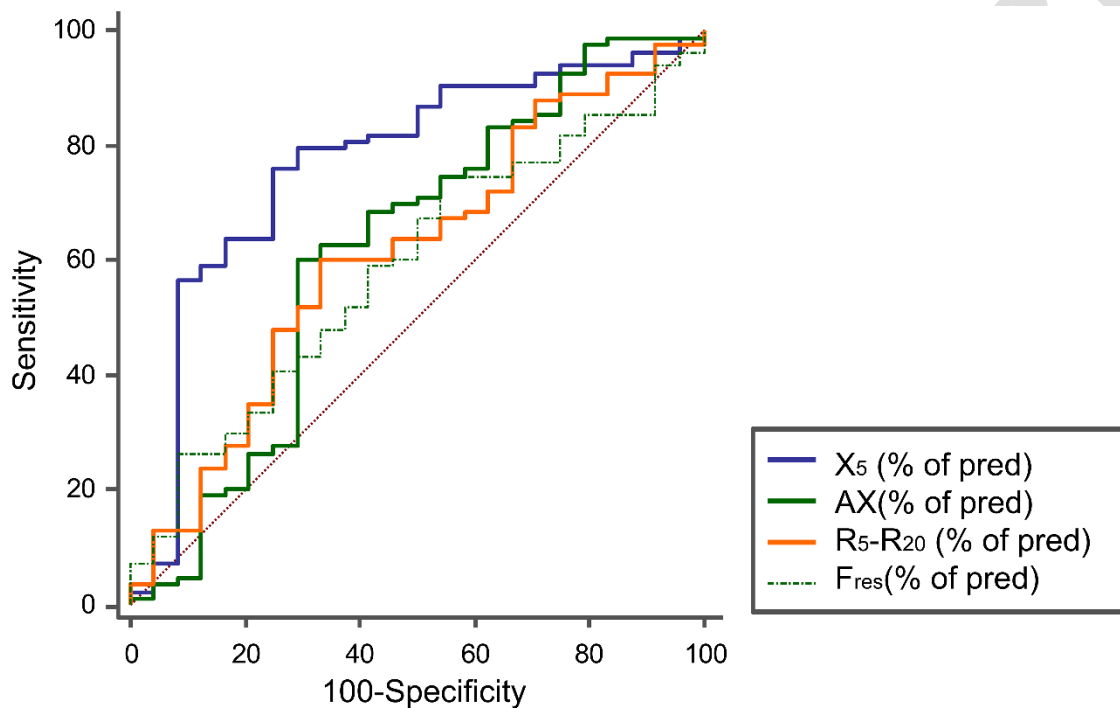
Figure S3. Correlations between RV/TLC and impulse oscillometry parameters, including **(A)** absolute value of resistance in 5Hz (R_5), **(B)** absolute value of resistance in 20 Hz (R_{20}), **(C)** R_5 (% of predicted) and **(D)** R_{20} (% of predicted). RV, residual volume; TLC, total lung capacity.
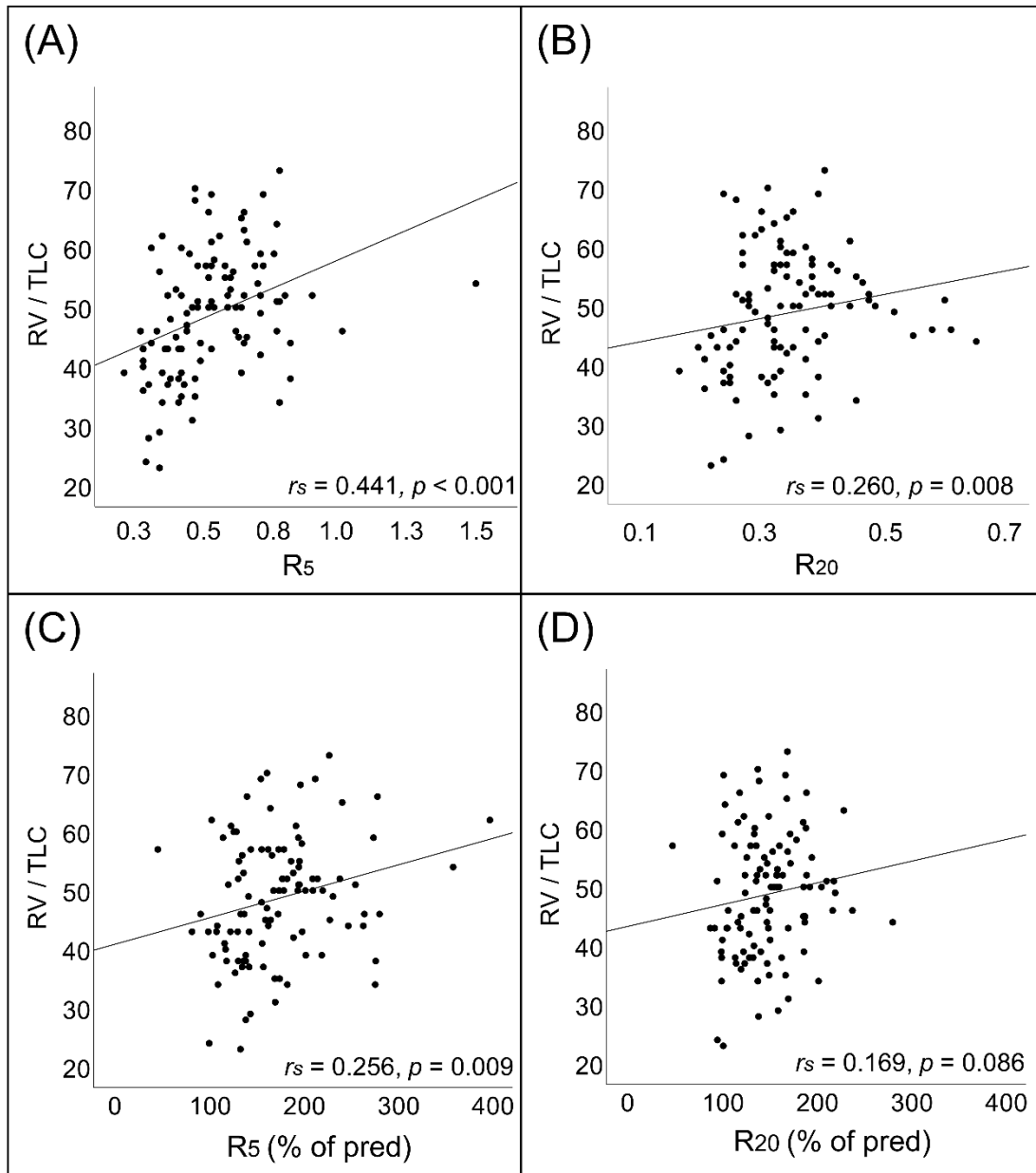
Figure S4. Receiver operating characteristic curve analysis of impulse oscillometry parameters, including **(A)** absolute value of resistance in 5Hz (R_5), **(B)** absolute value of resistance in 20 Hz (R_{20}), **(C)** R_5 (% of predicted) and **(D)** R_{20} (% of predicted) to detect static lung hyperinflation (SLH) in patients with severe asthma. AUC: area under the receiver operating characteristic curve.
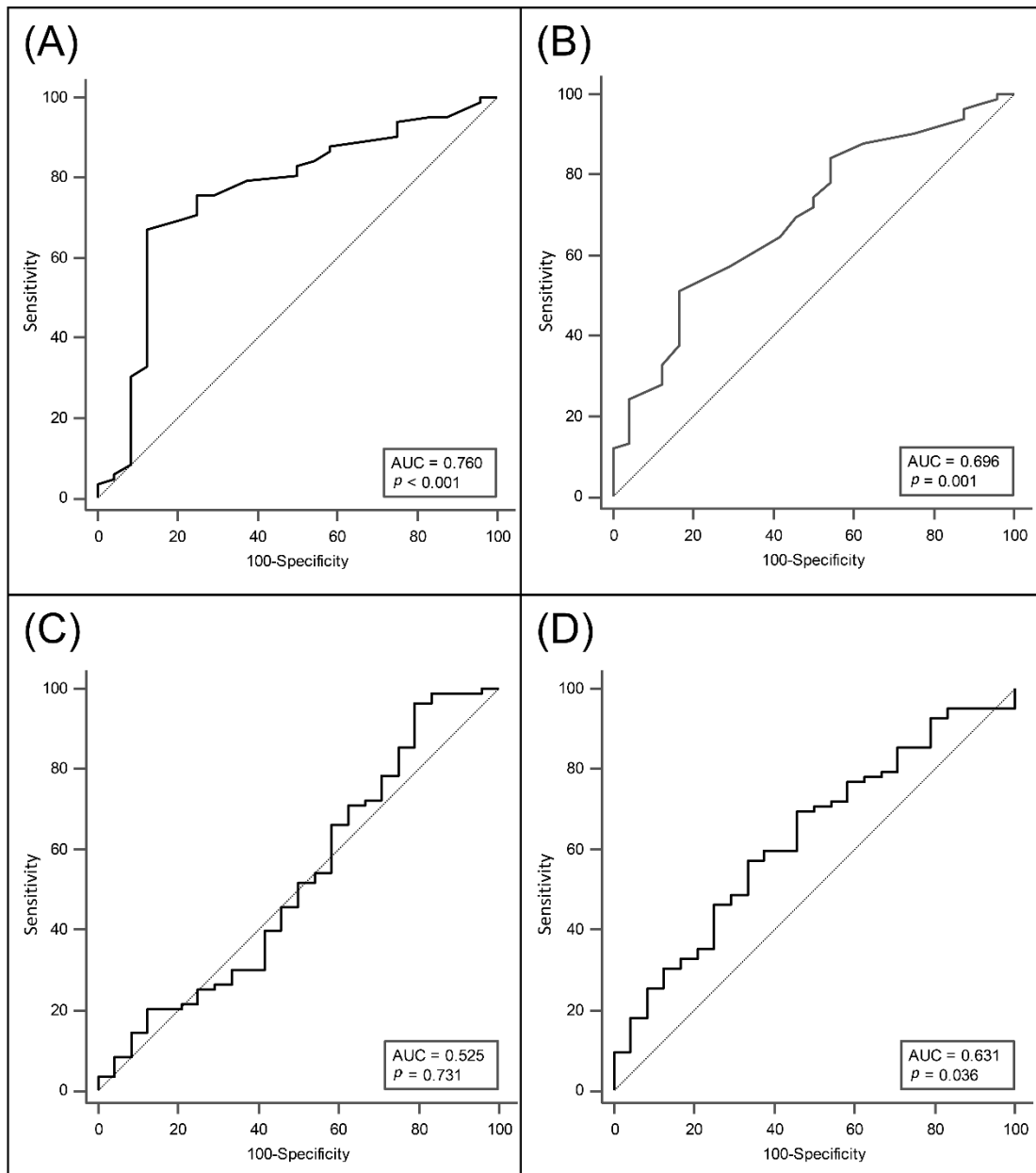
Table S1. Characteristics of the study patients after matching by age and gender

	Total (n = 30)	Patients with SLH (n = 15)	Patients without SLH (n = 15)	*p* value
Female, N (%)	12(40%)	6(40%)	6(40%)	1.000
Age (year)	57.5(50.8-68.0)	57.0(52.0-68.0)	58.0(50.0-69.0)	0.967
BMI (kg/m^2)	25.3(23.4-27.7)	25.2(23.1-27.9)	25.6(24.1-27.7)	0.999
Duration of asthma (years)	17.0(6.5-27.8)	12.0(5.0-26.0)	20.0(9.0-32.0)	0.361
Late-onset asthma, N (%)	12(40%)	5(33.3%)	7(46.7%)	0.456
ACT score	21.0(17.8-24.0)	22.0(19.0-24.0)	20.0(17.0-23.0)	0.142
Medication				
Medium or high dose ICS/LABA/LAMA, N (%)	23(76.7%)	12(80.0%)	11(73.3%)	0.666
OCS, N (%)	13(43.3%)	5(33.3%)	8(53.3%)	0.268
Biologics, N (%)	14(46.7%)	7(46.7%)	7(46.7%)	1.000
FeNO (ppb)	34.0(19.3-80.5)	54.0(17.0-101.0)	20.0(29.0-42.0)	0.329
Blood eosinophil (/µL)	241.5(141.8-317.3)	246.0(138.0-359.0)	237.0(143.0-304.0)	0.917
PEFR (L/min)	300(255.0-410.0)	300.0(240.0-380.0)	310.0(260.0-440.0)	0.486
Spirometry				
FEV_1/FVC (%)	65.0(53.8-73.0)	65.7(52.3-75.2)	64.2(54.3-71.6)	0.885
FEV_1 (% of predicted)	70.6(60.5-88.4)	63.5(60.2-87.8)	84.0(60.6-100.6)	0.254
FVC (% of predicted)	87.4(73.9-95.1)	82.2(66.1-88.7)	91.4(85.6-107.8)	**0.044**
$FEF_{25-75\%}$ (% of predicted)	39.5(21.8-54.2)	37.0(20.0-53.3)	44.0(22.4-68.0)	0.604
BDR (+), N (%)	9(30.0%)	4(13.3%)	5(16.7%)	0.690
TLC (% of predicted)	103.0(94.8-116.3)	105.0(98.0-118.0)	98.0(94.0-111.0)	0.309
RV/TLC	40.5(38.0-50.0)	50.0(45.0-53.0)	38.0(36.0-39.0)	**0.000**
Impulse oscillometry				
R_5 [kPa/(L/s)]	0.44(0.39-0.54)	0.48(0.39-0.55)	0.43(0.31-0.49)	0.191
R_5 (% of predicted)	160.8(131.2-219.9)	178.5(138.7-235.1)	142.8(129.2-198.8)	0.221
R_5-R_{20} [kPa/(L/s)]	0.13(0.10-0.18)	0.14(0.10-0.19)	0.12(0.08-0.16)	0.197
R_5-R_{20} (% of predicted)	224.7(161.6-428.8)	277.5(184.3-481.7)	208.3(149.2-360.4)	0.330
F_{res} (Hz)	18.5(15.7-22.2)	18.9(16.9-24.7)	16.9(14.4-21.6)	0.158
F_{res} (% of predicted)	146.6(128.4-185.8)	151.2(132.3-192.8)	142.9(122.5-183.5)	0.290
X_5 [kPa/(L/s)]	-0.2(-0.32 - -0.11)	-0.27(-0.36- -0.20)	-0.14(-0.20 -0.09)	**0.007**
X_5 (% of predicted)	187.0(112.9-304.5)	291.0(182.6-348.8)	128.9(94.6-225.9)	**0.010**
AX (kPa/L)	1.42(0.70-2.03)	1.64(1.05-2.04)	0.96(0.38-1.53)	**0.049**
AX (% of predicted)	445.8(217.1-877.1)	518.4(266.4-900.4)	292.0(152.4-774.6)	0.101

SLH, static lung hyperinflation, defined as the ratio of residual volume (RV) to total lung capacity (TLC) ratio more than 0.4; BMI, body mass index; Late-onset asthma, defined as age of asthma onset ≥ 40 years old; ACT, asthma control

test; ICS/LABA/LAMA, inhaled corticosteroid, long-acting beta-2 agonist and long-acting muscarinic antagonist combination therapy; OCS, oral corticosteroid; FeNO, fractional exhaled nitric oxide; PEFR: peak expiratory flow rate; FEV_1: forced expiratory volume in the first second; FVC: forced vital capacity; $FEF_{25-75\%}$: forced expiratory flow between 25 and 75% of forced vital capacity; BDR (+), a positive bronchodilator response, defined as an increase in either FEV_1 or FVC for more than 12% and 200 mL from the baseline in response to a short-acting beta-2 agonist; R_5, resistance in 5 Hz; R_{20}, resistance in 20 Hz; F_{res}, resonant frequency; X_5, reactance in 5 Hz; AX, area under reactance curve between 5 Hz and resonant frequency; data are shown as number (%) for categorical variables and median (interquartile range, IQR) for non-normally distributed variables. p values were calculated by the Mann-Whitney U test and the values <0.05 were considered statistically significant.

Table S2. Performance of different IOS parameters to detect SLH in patients with severe asthma

Variables	Cutoff value	Sensitivity (%)	Specificity (%)	LR (+)	LR (-)	AUC (95%CI)	Youden Index	*p* value
R_5 [kPa/(L/s)]	>0.49	67.1	87.5	5.37	0.38	0.76 (0.67-0.84)	0.55	**<0.0001**
R_5 (% of predicted)	≤267.6	96.4	20.8	1.22	0.17	0.53 (0.43-0.62)	0.17	0.7313
R_{20} [kPa/(L/s)]	>0.34	51.2	83.3	3.07	0.59	0.70 (0.60-0.78)	0.35	**0.0009**
R_{20} (% of predicted)	>141.3	57.3	66.7	1.72	0.64	0.63 (0.53-0.72)	0.24	**0.0359**

IOS, impulse oscillometry; SLH, static lung hyperinflation, defined as the ratio of residual volume (RV) to total lung capacity (TLC) ratio more than 0.4; R_5, resistance in 5 Hz; R_{20}, resistance in 20 Hz; LR (+), positive likelihood ratio; LR (-), negative likelihood ratio; AUC: area under the receiver operating characteristic curve. 95% CI: 95% of confidence interval.