Original Paper

Pulmonary Function in Adults with Severe Eosinophilic Asthma Using Biologicals: A Case-Control Study

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ABSTRACT: The era of biologics has revolutionized the treatment of severe eosinophilic asthma (SEA). Although biologics appear to control SEA, pulmonary function is still poorly assessed with effective techniques. This study aimed to compare pulmonary function between adults living with severe asthma (alwSEA) with and without the use of biologics through a comprehensive approach to measuring pulmonary function, including assessments of pulmonary mechanics, static lung volumes, and small airways. Methodology: This is a cross-sectional study in which 15 alwSEA using biologics (biological group-BG) and 17 alwSEA using conventional therapy (control group-CG) were evaluated. These individuals underwent spirometry, body plethysmography, and respiratory oscillometry. In addition, they underwent the Asthma Control Test and the Asthma Quality of Life Questionnaire. Results: The sample was predominantly female, with 14 women (93.3%) in the BG and 16 (94.1%) in the CG. The groups differed significantly in age, with the BG being younger than the CG [52 (47-61) vs. 60 (54-66) years, p=0.045]. The BG presented significantly higher values of forced expiratory volume in the first second [1.77 (1.45-1.91) vs. 1.27 (1.18-1.47) L, p=0.005]. The CG presented a higher residual volume to total lung capacity ratio [141 (128-157) vs. 108 (89-117) % predicted, p<0.001]. Respiratory system resistance at 20 Hz was higher in the CG [170 (137-216.5) vs. 131.5 (110.8-179.2) % predicted, p=0.038]. Conclusions: In alwSEA, biologics appear to improve not only volumes and flows, but also air trapping. Furthermore, biologics appear to act on central airway resistance.

KEYWORDS: *Asthma, biologics, lung function, symptoms.*

Introduction

Asthma is a common respiratory condition characterized by chronic airway inflammation, variable hyperresponsiveness of the airway smooth muscle, and excessive mucus secretion [1].

Severe asthma is a condition that is highly resistant to conventional treatment.

It affects up to 10% of the total asthma population and has a significant impact on general health and socioeconomic status due to its debilitating symptoms [2].

It is estimated that up to 30% of people with severe asthma have a low Type 2 phenotype, while the majority have a high Type 2 phenotype known as severe eosinophilic asthma (SEA) [3].

In addition to imposing a significant physical and mental burden, SEA is frequently associated with multimorbidity, which worsens clinical outcomes [2].

SEA is characterized by the development of persistent airflow limitations due to chronic eosinophilic inflammation and airway remodeling [4].

This can result in a significant decline in lung function, largely due to small airway dysfunction (SAD) [4,5].

Adults living with severe asthma (alwSEA) often experience frequent exacerbations, an impaired quality of life (QoL), and a significant deterioration of lung function over time, even when they adhere to an optimized therapy regimen involving high-dose inhaled corticosteroids (ICS) and a long-acting beta2-agonist, or a second controller, with or without the use of low-dose oral corticosteroids (OCS) [4].

However, asthma is not classified as SEA when contributing factors are addressed, including improved adherence to therapy or proper inhalation technique [6].

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Biologics represent an advance in the treatment of SEA. Biologics are used as an adjunctive therapy for alwSEA when asthma remains uncontrolled despite treatment with high doses of ICS and long-acting beta-2 agonists [4].

Biologics act on different pathways to inhibit type 2 inflammation. Examples include anti-immunoglobulin E monoclonal antibodies (omalizumab), anti-interleukin (IL)-5 drugs (mepolizumab and reslizumab), IL-5 receptor alpha antagonists (benralizumab), IL-4 receptor alpha (IL-4Rα)/IL-13 antagonists (dupilumab), and anti-thymic stromal lymphopoietin (tezepelumab) [4].

By inhibiting these key factors of type 2 inflammation, biologics reduce airway remodeling. This reverses airway mucus hypersecretion, reduces mucus plugs, and improves lung mechanics [7].

Despite high expectations for biologics, clinical remission is achievable for only a minority of alwSEA patients treated with these medications [8].

Although there is no strong correlation between lung function and asthma symptoms, lung function can be important for monitoring and adjusting treatment [9].

Furthermore, spirometric parameters, especially low forced expiratory volume in the 1º second (FEV_1), are associated with a deterioration in QoL and an increased risk of exacerbations [10]. Since SAD occurs in up to 91% of alwSEA and is more prevalent in SEA, appropriate tools for assessing SAD have increasingly been incorporated into clinical practice [11].

SAD is actually associated with inadequate symptom control, more frequent exacerbations, a greater need for oxygen therapy, and future deterioration of lung function [11].

In alwSEA, the presence of static lung hyperinflation (SLH) is associated with unfavorable outcomes, including greater SAD severity [12].

In SEA, accelerated lung function decline and mucus obstruction have been attributed to high type 2 inflammation [4].

While they do not appear to represent clinically significant differences, biologic use in alwSEA has been associated with improved symptom control and increased lung function. However, the latter is highly dependent on the method used in functional analysis [13].

SEA poses a significant therapeutic challenge. Individuals with SEA often remain symptomatic and prone to exacerbations and hospitalizations despite the use of optimized conventional therapies [14].

SEA negatively impacts functional capacity and compromises patients' QoL. It also places a burden on healthcare systems, accounting for more than 50% of asthma-attributable costs [15].

Furthermore, SEA frequently causes SAD, a key factor in persistent obstruction and a promising therapeutic target. Recent advances in identifying specific asthma phenotypes have enabled more targeted approaches, particularly the use of biologics to combat eosinophilic inflammation [14].

Biologics appear to significantly improve SEA control, but the response to these agents varies among alwSEA patients. This demands better case stratification to individualize therapy and more effective methods for assessing lung function [16].

Thus, this study aimed to compare lung function in alwSEA patients with and without biologic therapy using a comprehensive approach that included assessments of lung mechanics, static lung volumes, and small airways.

Materials and Methods

Study design and participants

From November 2025 to May 2026, a cross-sectional study was conducted with alwSEA (≥18 years old) who were being treated at the Asthma Outpatient Clinic of the Policlínica Universitária Piquet Carneiro at the State University of Rio de Janeiro in Brazil. The study included patients with physician-confirmed asthma who had at least 12 months of medical records prior to beginning biologic treatment (biologic group [BG]). Patients unable to perform pulmonary function tests (PFTs), with a history of flu-like illness in the last four weeks, with coexisting lung diseases, or with hospital admission in the last month due to asthma exacerbation were excluded.

A control group (CG) composed of alwSEA patients using conventional therapy (ICS and LABA) and patients indicated to start biologic therapy (pre-biologic initiation group) was also used.

Measurements

The Asthma Control Test (ACT) was used to assess asthma control. The ACT has strong evaluative and discriminative properties.

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Consisting of five questions related to the four weeks preceding the assessment, the ACT addresses multiple dimensions of control, including episodes of shortness of breath, nighttime awakenings, limitations in activities of daily living, self-assessment of asthma control, and the need for reliever medication.

The total score ranges from 5 to 25 points. A score of at least 20 on the ACT is considered controlled asthma [17].

QoL was assessed using the Asthma Quality of Life Questionnaire (AQLQ), which was administered by the researchers. This asthma-specific questionnaire has 32 items grouped into four domains: activity limitation (11 items), symptoms (12 items), emotional function (5 items), and environmental stimuli (4 items).

The overall score is the mean of all items, ranging from a minimum of 1 (lowest quality of life, QoL) to a maximum of 7 (highest QoL) [18].

The PFTs used in this study were spirometry, body plethysmography, and respiratory oscillometry (RO).

Spirometry and body plethysmography were performed using an HDpft 3000 device (nSpire Health, Inc., Longmont, CO, USA).

For spirometry, participants were instructed to avoid alcohol, coffee, and large meals for 4-6 hours and 1 hour, respectively, prior to the test.

They rested for approximately 5-10 minutes before the test. During the test, they remained seated with their heads in a neutral position and used a nose clip. For the spirometry test, we adopted Brazilian predicted value equations for comparison with the participants' absolute values [19].

Obstructive ventilatory impairment was defined in the spirometry test by an FEV_1/forced vital capacity (FVC) ratio below the lower limit of normal [19].

For body plethysmography, patients were instructed to avoid smoking for at least one hour before the test and to refrain from eating or exercising during this period. Participants were instructed about the importance of relaxing and breathing normally between measurements, as well as the need to gasp while supporting their cheeks with their palms. The gasping maneuver required small, quick, and uniform breaths.

National equations were used to interpret body plethysmography and compare the absolute values of the participants [20].

RO test was performed using Quark i2m equipment (Cosmed, Rome, Italy). The examination was conducted with the participant seated and breathing calmly for approximately 30 seconds. Participants were instructed to keep their lips firmly sealed to the mouthpiece and support their cheeks with their hands to minimize interference with the measurement.

The following resistive and reactive parameters were evaluated: respiratory system resistance (Rrs) at 5 Hz (R5) and 20 Hz (R20); resistance heterogeneity between 5-20 Hz (R5-R20); respiratory system reactance (Xrs) at 5 Hz (X5); and reactance area (Ax). Values outside the range predicted by the Oostveen et al. (2013) reference equations [21] were considered abnormal.

Statistical analysis

A statistical analysis was performed using SPSS software (version 26, IBM Corp., Armonk, NY, USA). Data normality was verified using the Shapiro-Wilk test and a graphical analysis of histograms. Due to the small sample size and non-normal distribution of the variables, non-parametric tests were used for all comparisons. The Mann-Whitney U test was used to compare continuous numerical variables between the BG and CG groups.

Categorical variables were compared using Fisher's exact test. Results for continuous variables are expressed as the median and the interquartile range (IQR 25-75), and results for categorical variables are presented as absolute and relative frequencies (n and %). The significance level was set at 5% ($p<0.05$).

Results

Of the 34 alwSEA participants evaluated for inclusion in the study, two were excluded: one due to an upper respiratory tract infection within the last four weeks, and one due to an SEA exacerbation requiring hospitalization.

Of the 32 participants evaluated, 15 were from the BG group and 17 were from the CG group.

The sample was predominantly female, with 14 (93.3%) women in the BG group and 16 (94.1%) in the CG group.

The groups differed significantly in age, with the BG group being younger than the CG group [52 (47-61) vs. 60 [54-66] years; $p=0.045$].

There was no statistically significant difference between the groups regarding height, body mass index, or smoking history.

Regarding race, a higher proportion of white patients was observed in the BG group than in the CG group (46.7% vs. 11.8%, p=0.049).

The other clinical variables, including time to diagnosis, number of exacerbations and hospitalizations in the last year, and prevalence of comorbidities such as hypertension and diabetes mellitus, did not differ significantly between the groups.

ACT and AQLQ scores were similar between groups (p=0.217 and p=0.428, respectively).

In the BG group, mepolizumab was the most frequently used biological agent (66.7%), followed by omalizumab (13.3%), tezepelumab (13.3%), and dupilumab (6.7%). Demographic and clinical data are showed in Table 1.

Table 1. Comparison of sample characteristics between the biological and control groups.

Parameter	BG	GC	p-valor
Demographic data			
Age, years	52 (47-61	60 (54-66)	**0.045**
Females, n (%)	14 (93.3%)	16 (94.1%)	1.000
Height, cm	159 (155-165.5)	156 (150-160)	0.198
BMI, kg/m²	27.8 (26.8-31.2)	27.7 (26.4-32)	0.850
Race, n (%)			
White	7 (46.7%)	2 (11.8%)	**0.049**
Brown	3 (20%)	9 (52.9%)	0.076
Black	5 (33.3%)	6 (35.3%)	1.000
Smoking, n (%)			
Non-smoker	13 (86.7%)	14 (82.4%)	1
Former smoker	2 (13.3%)	3 (17.6%)	1
Biological, n (%)			
Mepolizumab	10 (66.7%)	-	-
Omalizumab	2 (13.3%)	-	-
Tezepelumab	2 (13.3%)	-	-
Dupilumab	1 (6.7%)	-	-
Clinical data			
Time since diagnosis, years	12 (7-24)	30 (13-40)	0.082
Exacerbations in the last year, n	3 (1-4.5)	2 (0-2)	0.112
Hospitalizations in the last year, n	0 (0-0)	0 (0-0)	0.510
Comorbidities, n (%)			
Hypertension	10 (66.7%)	13 (76.5%)	0.699
Diabetes mellitus	2 (13.3%)	8 (47.1%)	0.060
Questionnaires, scores			
ACT	23 (17-24)	18 (15-21)	0.217
AQLQ	4.06 (3.36-5.94)	4.31 (2.97-5.31)	0.428

Note: The values shown are median (interquartile range) or number (%). Bold type indicates significant differences.
List of abbreviations: BG-biological group, CG-control group, BMI-body mass index, ACT-Asthma Control Test, AQLQ-Asthma Quality of Life Questionnaire.

Regarding pulmonary function as assessed by spirometry, the BG presented significantly higher values of FEV_1 pre-bronchodilator (pre-BD) [1.77 (1.45-1.91) vs. 1.27 (1.18-1.47) L, p=0.005] and post-BD [1.71 (1.48-2.16) vs. 1.31 (1.11-1.48) L, p=0.003], as well as FVC post-BD [2.59 (2.26-3.31) vs. 2.04 (1.78-2.31) L, p=0.001] and post-BD [2.69 (2.37-3.28 vs. 1.98 (1.80-2.28), p=0.002).

The predicted percentage values for FEV_1 and FVC showed a favorable trend for BG, though they did not reach statistical significance.

The forced expiratory flow between 25% and 75% ($FEF_{25-75\%}$) post-BD was significantly higher in the BG [1.36 (0.70-2.04) vs. 0.66 (0.49-1.02) L/s, p=0.031].

The $FEF_{25-75\%}$ pre-BD also showed a trend toward higher values in the BG [1.02 (0.65-1.51) vs. 0.70 (0.52-0.78) L/s, p=0.073].

The FEV_1/FVC ratio pre- and post-BD was similar between groups.

Body plethysmography revealed that the control group had a higher residual volume (RV) [138 (118-162) vs. 103 (80.5-115.5) % predicted, p<0.001] and a higher RV/TLC ratio [141 (128-157) vs. 108 (89-117) % predicted, p<0.001], indicating pulmonary hyperinflation.

There were no significant differences in the percentage of predicted TLC (p=0.174) or airway resistance-Raw (p=0.450) between the groups.

The spirometry and body plethysmography results are detailed in Table 2 and Figure 1.

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Table 2. Comparison of spirometry and body plethysmography parameters between the biological and control groups.

Parameter	BG	GC	p-valor
Spirometry			
FEV_1 pre-BD, L	1.77 (1.45-1.91)	1.27 (1.18-1.47)	**0.005**
FEV_1 pre-BD, % predicted	65.0 (56.5-92.0)	62.0 (44-76)	0.126
FEV_1 post-BD, L	1.71 (1.48-2.16)	1.31 (1.11-1.48)	**0.003**
FEV_1 post-BD, % predicted	70 (60-92)	62 (39-76)	0.113
FVC pre-BD, L	2.59 (2.26-3.31)	2.04 (1.78-2.31)	**0.001**
FVC pre-BD, % predicted	89 (80-98)	79 (64-88)	0.076
FVC post-BD, L	2.69 (2.37-3.28)	1.98 (1.80-2.28)	**0.002**
FVC post-BD, % predicted	92 (81-100)	79 (76-91)	0.054
FEV_1/FVC pre-BD, %	68.8 (60.2-76.3)	65.5 (62.1-70.8)	0.734
FEV_1/FVC post-BD, %	69.2 (62.5-79.5)	64.8 (57.2-70.1)	0.174
$FEF_{25-75\%}$ pre-BD, L/s	1.02 (0.65-1.51)	0.70 (0.52-0.78)	0.073
$FEF_{25-75\%}$ pre-BD, % predicted	40 (22-59)	29 (21-44)	0.242
$FEF_{25-75\%}$ post-BD, L/s	1.36 (0.70-2.04)	0.66 (0.49-1.02)	**0.031**
$FEF_{25-75\%}$ post-BD, % predicted	38 (27.5-79)	29 (18-42)	0.100
Body plethysmography			
RV, % predicted	103 (80.5-115.5)	138 (118-162)	**<0.001**
TLC, % predicted	94 (85-101)	103 (89-111)	0.174
Raw, $cmH_2O/L/s$	8.89 (3.79-14)	8.51 (7.01-20.6)	0.450
RV/TLC	40.12 (32.52-42.1)	37.60 (36.01-39.2)	0.835
RV/TLC, % predicted	108 (89-117)	141 (128-157)	**<0.001**

Note: The values shown are median (interquartile range). Bold type indicates significant differences. List of abbreviations: BG-biological group, CG-control group, BD-bronchodilator, FEV_1-forced expiratory volume in the 1º second, FVC-forced vital capacity; $FEF_{25-75\%}$-forced expiratory flow between 25% and 75%, RV-residual volume; TLC-total lung capacity; Rawa: airway resistance.

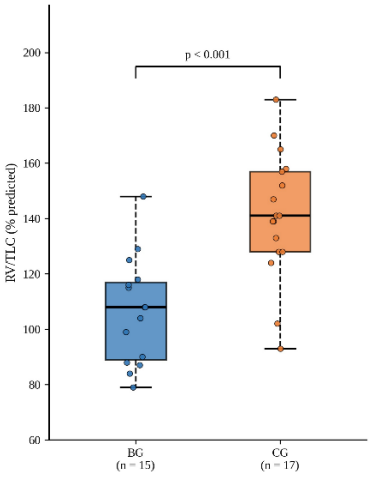

Figure 1. Comparison of the relationship between residual volume and total lung capacity (RV/TLC) between the biological group (BG) and the control group (CG) (p<0.001).

RO revealed a significant difference for R20 as a percentage of the predicted value, which was higher in the CG [170 (137-216.5) vs. 131.5 (110.8-179.2) % predicted, p=0.038].

The other evaluated parameters, including R5, R5-R20, X5, and Ax in absolute and percentage predicted values, did not differ significantly between groups.

However, the CG showed a tendency toward higher absolute R5 values [7.91 (6.03-10.2) vs. 6.12 (4.46-8.94) cm $H_2O/L/s$, p=0.197] and absolute R20 values [6 (5.01-7.93) vs. 4.94 (3.69-6.18) cm $H_2O/L/s$, p=0.081], indicating a tendency toward higher Rwa in this group.

RO data are presented in Table 3.

Table 3. Comparison of respiratory oscillometry parameters between the biological and control groups.

Parameter	BG	GC	p-valor
R5, cm $H_2O/L/s$	6.12 (4.46–8.94)	7.91 (6.03–10.2)	0.197
R5, % predicted	174 (140.8–218.2)	209.0 (166.5–287)	0.198
R20, cm $H_2O/L/s$	4.94 (3.69–6.18)	6 (5.01–7.93)	0.081
R20, % predicted	131.5 (110.8–179.2)	170 (137–216.5)	**0.038**
R5-R20, cm $H_2O/L/s$	1.37 (1.08–3.52)	2.06 (0.95–2.77)	0.706
X5, cm $H_2O/L/s$	-2.05 (-3.29–-1.56)	-4.42 (-5.54–-1.54)	0.302
X5, % predicted	168 (67.8–279.8)	253 (108–357)	0.326
Ax, cm H_2O/L	24.9 (15.6–35.5)	19.3 (7.7–48.6)	0.645

Note: The values shown are median (interquartile range). Bold type indicates significant differences. List of abbreviations: BG-biological group, CG-control group, R5-respiratory system resistance at 5 Hz, R20-respiratory system resistance at 20 Hz, R5-R20,-resistance heterogeneity between 5-20 Hz, X5-respiratory system reactance at 5 Hz; Ax-reactance area.

Discussion

Over the past two decades, our understanding of the underlying immunopathology of alwSEA has grown, leading to targeted therapies and ushering in a new era of biologics.

These therapies have accelerated our understanding of disease mechanisms and how we assess and treat alwSEA.

The main finding of the present study was that alwSEA treated with biologics showed better pulmonary mechanics on spirometry, in terms of both flows and volumes, compared to the CG.

There was also a reduction in air trapping, as measured by body plethysmography, in alwSEA using biologics.

Although RO showed better resistive and reactive parameters, a statistically significant difference was only observed in R20, with lower values noted in alwSEA patients using biologics.

Furthermore, alwSEA are younger and of Caucasian ethnicity. To our knowledge, this is the first study to highlight improvement in air trapping in alwSEA treated with biologics, although the results are preliminary.

Our study showed that, compared to the CG, the BG was composed of younger, white alwSEA, which can be explained, at least in part, by the profile of patients who first seek medical attention.

Since both the BG and the CG had SEA patients who were candidates for biologics, our findings align with those of Lugogo et al. [22], who found that 69% of their 1,884 SEA patients were female.

This was associated with poorer symptom control and QoL.

Consistent with our results, Lugogo et al. [22] observed that younger individuals with an indication for biologics had higher rates of exacerbations and hospitalizations than older individuals.

Although there was no statistically significant difference, our study showed that the BG had a median ACT score of 23, which is well above the ≥20 score defined as controlled asthma on the ACT.

Evaluating 107 alwSEA, Li et al. [12] observed that alwSEA with biologic indications had significantly lower ACT scores than those without indications.

This points to the aggressiveness of the type 2 profile.

Li et al.'s study [12] also showed that the group with biologic indications was characterized by a higher number of ex-smokers, patients with comorbidities, acute exacerbations, and frequent OCS use.

Fernandes et al. [23] evaluated a cohort of 41 alwSEA over a 12-month follow-up period and noted that ACT scores increased significantly from 12 to 21.

The authors also noted that 73% of the alwSEA achieved adequate asthma control (ACT ≥20).

When evaluating spirometric parameters with biologics, the modified Delphi method published by Upham et al. [24] is important to highlight.

Upham et al. [24] surveyed 81 experts from 24 countries and defined a super-responder of SEA as someone who has improved by 500mL or more in FEV_1 in the last 12 months.

In our study, we observed higher values for the BG than for the CG, with medians of ≥500mL for FEV_1 and FVC pre-BD and >0.7L/s for $FEF_{25-75\%}$ post-BD.

Consistent with our findings, Fernandes et al. [23] evaluated a cohort of 41 alwSEA over 12 months and found that biologic use was associated with a 22% improvement in FEV_1.

However, the absolute gain in FEV_1 was 370mL over 12 months, which is below the threshold established by the Delphi method of Upham et al. [24].

We did not separately assess the response to each biologic in spirometry; however, this topic is still under discussion in the literature.

In a recent real-world study, Bourdin et al. [4] observed that alwSEA who started dupilumab treatment experienced greater improvements in lung function, as measured by pre- and post-bronchodilator FEV_1, compared to patients who started treatment with omalizumab, benralizumab, or mepolizumab.

A recent systematic review and meta-analysis also showed that several pulmonary factors are associated with lower rates of clinical remission in alwSEA using biologics.

These factors include worse baseline FEV_1, more severe asthma symptoms, longer asthma duration, and use of maintenance oral corticosteroids (OCS) [8].

Severe asthma exacerbations and the need for rescue medication are more prevalent in alwSEA with SLH [12].

Furthermore, increased RV is associated with the frequent use of short-acting beta-2-agonists and wheezing in patients with

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persistent asthma, which suggests unrelieved air trapping [25].

One of the main findings of our study was a reduction in air trapping, as assessed by body plethysmography, in alwSEA treated with biologics, in both RV and RV/TLC.

Of the 107 alwSEA evaluated by Li et al. [12], 78% presented SLH based on an increased RV/TLC ratio.

Most of the alwSEA with SLH were elderly women with late-onset asthma, less atopy, and SAD.

After 12 months of biologics, the authors observed that alwSEA who received adjuvant biological therapy showed significant reductions in exacerbations, exhaled nitric oxide fraction, and blood eosinophil count, as well as improvements in FEV_1 and X5, with a tendency toward a reduction in the RV/TLC ratio.

Similarly, Pelaia et al. [26] showed that treatment with ICS and biologics improved SLH in patients with varying degrees of asthma severity.

Overall, body plethysmography is an important method for monitoring lung function in alwSEA using biologics.

Although the primary site of airflow limitation in asthma is the small airways, diagnosing SAD is challenging and is often delayed due to the absence of uniform diagnostic criteria and the limited ability of standard lung function tests to detect SAD until significant impairment has already occurred [27].

In our study, we did not observe a significant improvement in R5-R20, which is considered one of the main parameters reflecting SAD in RO, although the median BG was well below that observed in the CG (1.37 vs. 2.06 $cmH_2O/L/s$).

With a larger sample size, Shirai et al. [28] showed that improvement in small airway function preceded changes in FEV_1 in patients receiving benralizumab for severe asthma.

After 12 months of biologic therapy for alwSEA, Li et al. [12] observed improvement in both FEV_1 and R5, the latter of which is also considered a parameter of SAD in RO.

In our study, we highlight the statistically significant difference in R20, a marker of central airways in RO, with a marked decrease in % predicted values when BG was compared to CG.

The relationship between SEA and sleep disorders is an intriguing topic of increasing discussion.

Although biologics show potential to improve sleep quality, their mechanisms of action in obstructive and central apnea require further investigation [29].

Similarly, Waljee et al. [30] demonstrated that short-term use of OCS in alwSEA is associated with sleep disorders, which can significantly alter central Raw.

The strength of this study is that it used a CG with alwSEA as criteria for initiating biologics.

However, there are some limitations that should be noted.

First, the small sample size reduced the statistical power to detect changes in SEA control and lung function.

Second, a subgroup analysis of the different types of biologics was not performed.

The magnitude of improvement in asthma control and lung function varies among different biologics.

There are modest improvements with anti-IL-5 and notably greater improvements with anti-IL-4Rα and anti-TSLP [15].

Third, this is a single-center, cross-sectional study, which limits its external validity.

Conclusions

In alwSEA, biologics appear to improve dynamically assessed volumes and flows, air trapping, and SLH.

Furthermore, biologics appear to affect central Raw when evaluated using specific techniques.

Despite these interesting findings, longitudinal studies with large sample sizes are essential for examining composite measures of alwSEA outcomes over prolonged periods, including symptom control, exacerbation rates, improvement in pulmonary function, and clinical remission.

Understanding these endpoints is important for better comprehending the efficacy of biologics in achieving clinical remission in alwSEA.

Additionally, a careful phenotypic evaluation of alwSEA, including predictive biomarkers, will facilitate selecting the most suitable biologic for each patient in the future.

We are moving towards a future of precision medicine for alwSEA.

Acknowledgement

None to declare.

Author Contributions

Conceptualization, A.S.B., J.R.B., T.T.M., T.P.B., and A.J.L.; Methodology, A.S.B., J.R.B., and A.J.L.; Investigation, A.S.B., I.N.F., and M.P.C.S.; Data analysis, J.R.B.; Manuscript writing and initial draft preparation, A.S.B., J.R.B., and A.J.L.; Manuscript review and editing, A.S.B., J.R.B., I.N.F., M.P.C.S., T.T.M., T.P.B., and A.J.L.; Supervision, T.T.M., T.P.B., and A.J.L. All authors read and approved the final manuscript. If there are other persons whose contribution does not entitle them for being authors, please acknowledge them also here.

Funding

This study was supported by the Conselho Nacional de Desenvolvimento Científico e Tecnólogico (CNPq; Grant numbers #301967/2022-9 and #401633/2023-3), Brazil, the Fundação Carlos Chagas Filho de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ; Grant number #E-26/200.037/2026), Brazil, and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, Grant number Finance Code 001), Brazil.

Conflicts of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Institutional Review Board

The protocol was approved by the Research Ethics Committee of the Hospital Universitário Pedro Ernesto at the Universidade do Estado do Rio de Janeiro, Rio de Janeiro, Brazil, under number CAAE-64172922.0.0000.5259.

Consent Statement

All human subjects involved in this study provided a written informed consent prior to participation, including the consent of publishing their anonymized data.

Data availability

All data presented in the manuscript are available from the authors upon request.

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