Original Article

Bronchial thermoplasty reduces asthma exacerbation and improves quality of life in asthma with type 2 inflammation

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Background: Bronchial thermoplasty (BT) is suggested for asthma patients with type 2 inflammation who are not eligible for or unresponsive to biologic drugs. In this study, we aimed to study the effectiveness of BT in asthma patients with type 2 inflammation.

Methods: This is a retrospective observational analytic study that enrolled moderately-severe asthma patients with type 2 inflammation; who did not respond to medium-dosed inhaled corticosteroids, long-acting beta2-agonists, and at least one other controller; to receive BT. All patients did not respond to or could not afford biologics. We collected the Asthma Quality of Life Questionnaire (AQLQ), Asthma Control Test (ACT), pulmonary function test, number of emergency department visits, and hospitalizations at baseline, 3-, 6-, and 12-month post-treatment. Adverse events were also recorded.

Results: Seventeen patients completed the 12-month follow-up after BT. There were significant improvements from baseline in total AQLQ scores from 3.57 [interquartile range (IQR): 2] to 4.88 [IQR: 2.3] (P=0.004). All AQLQ domains were significantly improved. The ACT score also significantly improved from 13 [IQR: 5] to 20 [IQR: 7] (P=0.004). There were significant decreases in emergency department visits from 4 [IQR: 11] to 2 [IQR: 5] (P=0.01), hospitalizations from 1 [IQR: 2] to 0 [IQR: 1] (P=0.03), systemic steroid dose used from 5 [IQR: 5] to 1.25 [IQR: 5] mg per day (P=0.03), and days of reliever used in 2 weeks from 14 [IQR: 6] to 0 [IQR: 3] (P=0.001). All Omalizumab was discontinued within 12 months after BT. Common adverse events were wheezing and dyspnea and no serious complications were found.

Conclusions: BT is an alternative and effective treatment for asthma with type 2 inflammation without serious complications.

Keywords: Bronchial thermoplasty (BT); type 2 inflammation; quality of life; severe asthma; retrospective observational analytic study

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Introduction

Asthma is a chronic airway disease associated with airway hyperresponsiveness and airway inflammation. Current epidemiological data suggests a concerning rise in the global incidence of asthma, a chronic inflammatory disorder of the airways. Therefore, the disease results in a significant burden on both health and the economy worldwide (1).

Asthma manifests itself with a broad spectrum of clinical presentations, ranging from subtle, often unnoticed symptoms to severe disease significantly impacting quality of life. These presentations include episodic or persistent dyspnea accompanied by wheezing. Exacerbating triggers encompass allergens, upper respiratory tract infections (URTIs), sinusitis, exercise, and cold temperatures (2). Previous cluster analysis proposed a classification for asthma as a complex biological network pathway by using multidimensional factors (clinical, biological, and physiological) into clinical phenotypes [atopic, late onset, aspirin-exacerbated respiratory disease (AERD), non-atopic, smokers, obesity-related and elderly] combined with molecular pathophysiology called endotype (high degree of T helper 2/low degree of T helper 2) which associated with type 2 inflammation (3,4).

Severe asthma, characterized by persistent disease activity despite optimal controller therapy, represents the most challenging clinical phenotype. It is defined by either: uncontrolled symptoms despite high-dose inhaled corticosteroids (ICS) combined with another controller medication (and/or systemic corticosteroids); or persistent disease despite maximal treatment (5). Patients with severe asthma experience a significant lifelong burden, including progressive lung function decline, an increased risk of future exacerbations, and potential side effects from medications, such as oral corticosteroids (OCS) (6). Type 2 inflammation is found in about half of patients with severe asthma and is characterized by elevated blood eosinophils, sputum eosinophils, and increased fractional exhaled nitric oxide (FeNO) (7). In some patients, type 2 inflammation is refractory to high-dose ICS and requires OCS to control the disease (8,9).

Bronchial thermoplasty (BT) is a procedure that applies thermal energy from a radiofrequency generator to the airway. Although the exact working mechanism is not certain, it is believed that BT decreases airway smooth muscle/airway remodeling/bronchial hyperresponsiveness (10). A study comparing the effectiveness of BT, and mepolizumab revealed nonsignificant differences in asthma control and exacerbation rate (11). Therefore, BT may be an alternative treatment for patients who are unresponsive to or cannot afford biological therapy.

Previous studies of BT in patients with moderate–severe asthma revealed improvement in their quality of life, and reduction of exacerbation with low rates of severe complications (12-17). According to the Global Initiative for Asthma (GINA) guideline, BT is recommended as an advanced therapy for uncontrolled asthma in type 2 subjects who are unresponsive to biological therapy (5). However, information on the effectiveness of BT in Asian populations is limited. A few studies in Asian populations found that BT improved the quality of life, however, they did not report specific results for type 2 inflammation (18-20). Therefore, this study aimed to evaluate the effectiveness of BT for treating asthma with type 2 inflammation in real-life observation of the Thai population. We present this article in accordance with the STROBE reporting checklist (available at https://jtd.amegroups.com/article/

Highlight box

Key findings

- Bronchial thermoplasty (BT) significantly improved asthma quality of life and Asthma Control Test scores in patients with type 2 inflammation.
- BT reduced emergency department visits, hospitalizations, systemic steroid use, and reliever medication use.
- All patients who were previously on Omalizumab discontinued it after BT.
- BT was associated with mild adverse events but no serious complications.

What is known and what is new?

- BT has been studied as a potential treatment for severe asthma.
- Type 2 inflammation is a key driver of asthma in many patients.
- Biological therapies, such as omalizumab, are often used to treat asthma with type 2 inflammation.
- This study provides evidence for the effectiveness of BT in patients with type 2 inflammation who are not eligible or unresponsive to biologics.
- The study demonstrates that BT can improve asthma control and reduce the need for other medications.
- The findings suggest that BT may be a valuable alternative treatment option for patients with severe asthma.

What is the implication, and what should change now?

- BT may be considered as a potential treatment for patients with type 2 inflammation who have not responded to other therapies.
- Healthcare providers should be aware of the potential benefits and risks of BT and discuss this treatment option with eligible patients.

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Methods

Study population

The patients in this study were adults (18–70 years of age) who were diagnosed with moderate-severe asthma with type 2 inflammation and underwent BT at a single-center study at King Chulalongkorn Memorial Hospital (KCMH), Bangkok, Thailand between July 2016 to May 2019. Patients who were lost to follow-up at 12 months were excluded. Moderate-severe asthma patients were defined as patients who required at least 500 µg of inhaled beclomethasone or its equivalent per day and a long-acting beta2-agonist with one additional controller. Uncontrolled symptoms were defined as one of the following; Asthma Control Test (ACT) <20 (22), asthma exacerbation that required systemic corticosteroids, at least 2 bursts of OCS per year or hospitalization at least 1 time per year, and prebronchodilator forced expiratory volume in 1 second (FEV1) <80% (5).

Inclusion criteria for participants include 1. Moderate to severe asthma patients 2. Type 2 inflammation phenotypes 3. Give consent to receive BT, and patients taking anticoagulation medications were excluded. Type 2 inflammation was defined as blood eosinophils ≥150 cells per mL, or FeNO ≥20 parts per billion (ppb), sputum eosinophils ≥2%, asthma was clinically allergen-driven, or needing maintenance OCS (23).

During the study period, the only biologic available was Omalizumab. However, most patients were unable to afford Omalizumab which could be assumed that they will not be able to afford newer drugs which will be more expensive. Therefore, these patients required other affordable therapies to control their asthma including BT.

Ethical statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand (No. 215/62) and informed consent was taken from all the patients. The IRB approval covers research activities in KCMH since the hospital is the main and only teaching hospital of the Faculty of Medicine in Bangkok. All research activities in KCMH must get IRB approval from the Faculty of Medicine, Chulalongkorn University.

Study design

This was a retrospective observational study to assess the effectiveness and safety of BT in treating asthma with type 2 inflammation. We collected data from the patient's medical records to reduce recall bias. The baseline characteristics were reviewed from one year before BT to twelve months after BT. The follow-up visits were scheduled at 3, 6, and 12 months after BT. Missing data not more than 1 visit were allowed to be included in this study. The primary outcome was a change in the patient's Asthma Quality of Life Questionnaire (AQLQ) (23) score between baseline and 12 months after BT. Secondary outcomes were changes in ACT score (24), the number of emergency department visits, hospitalizations, intensive care unit admissions, bursts of systemic corticosteroid from asthma exacerbation, doses of OCS, patient-reported days of reliever used in 2 weeks, pulmonary function, and adverse events within 6 weeks after BT.

Procedure

The Alair™ Bronchial Thermoplasty System (Boston Scientific, Marlborough, MA, USA) was used for the BT procedure (12,25,26). All patients underwent BT under general anesthesia. Each patient received three sessions of BT with a 3-week interval between sessions. The first, second, and third sessions were performed on the right lower lobe, left lower lobe, and both upper lobes of lungs, respectively. The number of complete activations and incomplete activations were recorded. The patients were given 50 mg of prednisolone per day for 2 days prior to BT, the day of BT, and 2 days after BT.

Safety

Every patient was hospitalized for 1–3 days after the procedure for observation of possible adverse events. The adverse events from BT were recorded at each session until 6 weeks after the last session. Severe complications were defined as death and respiratory failure that required mechanical ventilation.

Statistical analysis

Data analysis was performed using IBM SPSS Statistics

Table 1 Demographic data and baseline characteristics of patients

Characteristics	Value, N=17
Sex, female	12 (70.6)
Age (years)	54.88±10.89
Body mass index (kg/m^2)	26.82±5.22
Duration of asthma (years)	24.12±16.81
Underlying disease	
Allergic rhinitis	15 (88.2)
Obstructive sleep apnea	2 (11.8)
Sinusitis	7 (41.2)
Medications	
Inhaled corticosteroid dose[a] (µg/d)	1,160 [1,180]
Long-acting B2-agonist dose[b] (µg/d)	100 [25]
Oral corticosteroids dose (mg/day)	5 [5]
Number and percentage of patients on other asthma maintenance medications	
Long-acting muscarinic antagonists (tiotropium bromide) (18 µg/d)	13 (76.4)
Oral corticosteroids	8 (47.1)
Methylxanthines	7 (41.1)
Leukotriene modifiers (10 mg/day)	14 (82.3)
Omalizumab (300 mg/month)	6 (35.3)
Blood eosinophil (cells per microliter)	245 [390]
Serum total IgE (IU/mL)	170 [122]
FeNO parts per billion (ppb)	29 [25]
AQLQ baseline score	3.57 [2]
ACT baseline score	13 [5]
Lung function measure	
Prebronchodilator FEV1, % predicted	76 [31]
Postbronchodilator FEV1, % predicted	87 [29]
Prebronchodilator FVC, % predicted	85 [23]
Postbronchodilator FVC, % predicted	85 [20]
Prebronchodilator FEV1/FVC %	72 [18]
Postbronchodilator FEV1/FVC %	79 [20]

Data are presented as n (%), median [IQR] or mean ± standard deviation. [a], beclomethasone or its equivalent; [b], salmeterol or its equivalent. AQLQ, Asthma Quality of Life Questionnaire; ACT, Asthma Control Test; FEV1, forced expiratory volume in 1 second; FVC, forced vital capacity; FeNo, fractional exhaled nitric oxide; IgE, immunoglobulin E; IQR, interquartile range.

version 22. The normal distribution data including age, body mass index, duration of asthma, and other asthma medications were analyzed with mean and standard deviation. For non-normally distributed data, descriptive statistics were reported as the median and interquartile range (IQR) for central tendency and variability, respectively including medication frequency, blood eosinophil, serum total IgE, FeNO, AQLQ, ACT and Lung function. The Wilcoxon signed-rank test was employed to assess within-group changes in outcome measures at baseline, 3-, 6-, and 12-month post-BT. To estimate the mean outcome over 12 months while accounting for potential within-subject correlations, a generalized estimating equations (GEE) model with a Gaussian link function was utilized. The GEE model output included mean estimates, standard errors (SE), and Wald test statistics for significance testing. Subgroup analyses were conducted for each domain of the AQLQ instrument. All reported P values were two-sided, with a threshold of $P<0.05$ considered statistically significant.

Results

Baseline characteristics

This study takes place in a single tertiary care university hospital in Thailand. Seventeen patients completed the 12-month follow-up and were included in the analysis (*Table 1*). The median dose of ICS (beclomethasone or its equivalent) was 1,160 [IQR: 1,180] µg per day. Twelve patients (70.6% of 17 patients) received high-dose ICS, and five patients (29.4% of 17 patients) received medium-dose ICS. The median number of blood eosinophils, serum total IgE and FeNo was 245 [IQR: 390] cells/µL, 170 [IQR: 122] IU/mL, and 29 [IQR: 25] ppb, respectively. Six patients (35.3% of 17 patients) received Omalizumab. Eight patients (47.1% of 17 patients) received maintenance OCS with a median dose of 5 [IQR: 5] mg/day. All patients underwent pulmonary function test before BT.

Procedure

The mean number of activations at the right lower lobe, left lower lobe, and both upper lobes was 139.58 (completed =117, incompleted =22.58), 133.12 (completed =111.12, incompleted =22), and 192.53 (completed =143.59, incompleted =48.94), respectively. The mean operative time was 67 minutes and the mean length of stay was 3.3 days.

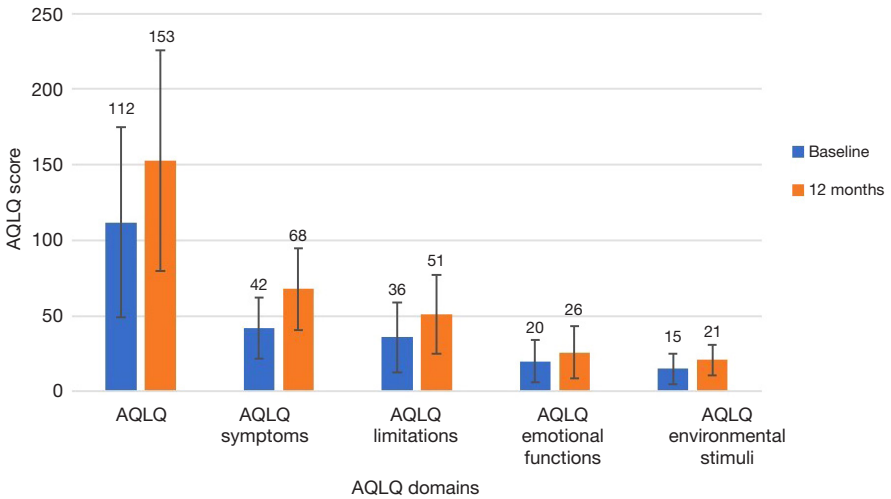

Figure 1 Improvement in AQLQ score in each domain at baseline and 12 months after bronchial thermoplasty. AQLQ, Asthma Quality of Life Questionnaire.

Table 2 Improvement in AQLQ score in each domain at baseline, 3, 6, and 12 months after BT

AQLQ score	Baseline (n=17)	After BT (3 months – baseline) (n=17)		After BT (6 months – baseline) (n=17)		After BT (12 months – baseline) (n=17)	
	Median [IQR]	Median [IQR]	P	Median [IQR]	P	Median [IQR]	P
Total AQLQ	3.57 [2.28]	1.74 [1.50]	0.01	1.66 [1.64]	0.01	1.22 [1.11]	0.004
Symptoms	3.42 [1.92]	1.75 [1.67]	0.01	1.92 [1.58]	0.02	1.58 [1.50]	0.004
Activity limitations	3.27 [2.14]	1.64 [1.73]	0.01	1.45 [1.55]	0.01	0.64 [1.86]	0.02
Emotional functions	4.00 [2.90]	1.40 [2.20]	0.03	1.20 [2.5]	0.02	1.20 [0.90]	0.004
Environmental stimuli	3.50 [2.38]	1.50 [1.63]	0.03	1.50 [1.88]	0.009	1.50 [1.50]	0.006

AQLQ, Asthma Quality of Life Questionnaire; BT, bronchial thermoplasty; IQR, interquartile range.

Missing data

Due to the coronavirus disease 2019 (COVID-19) pandemic, 4 out of 17 patients were unable to complete the lung function test, so the pulmonary function test outcomes will be analyzed only in 13 patients. Asthma quality of life and asthma control questionnaires, asthma exacerbations, medication use, and adverse events will be analyzed for all 17 patients. Telephone follow-up was conducted during the COVID pandemic to assess exacerbations and respiratory symptoms.

Outcomes

Asthma quality of life and asthma control

Seventeen patients recorded AQLQ scores before and after 12 months of BT. The overall AQLQ scores were significantly improved (Wilcoxon sign-rank test) with an increase of 1.22 [IQR: 1.11] from 3.57 [IQR: 2.28] (P=0.004) (*Figure 1*). Symptoms, activity limitations, emotional functions, and environmental stimuli improved by 1.58 [IQR: 1.50] from 3.42 [IQR: 1.92] (P=0.004), by 0.64 [IQR: 1.86] from 3.27 [IQR: 2.14] (P=0.02), by 1.20 [IQR: 0.90] from 4.00 [IQR: 2.90] (P=0.004), and by 1.50 [IQR: 1.50] from 3.50 [IQR: 2.38] (P=0.006), respectively. The AQLQ scores after three months of BT had the greatest improvement compared with six and twelve months (*Table 2*). The GEE model results revealed that the total AQLQ scores significantly improved over time (Wald =14.61; P=0.002) (*Table 3*). Every domain also improved; symptoms (Wald =16.62, P=0.001), activity limitations

Table 3 Outcomes of the AQLQ score in each domain on GEE analysis. GEE analysis was based on repeated measures based on the interaction of each group by time

AQLQ scores	Baseline	3 months	6 months	12 months	Wald	P
Total AQLQ	3.35 (0.32)	5.17 (0.41)	4.50 (0.47)	4.12 (0.54)	14.61	0.002
Symptoms	3.39 (0.33)	2.56 (0.42)	4.58 (0.49)	4.33 (0.57)	16.62	0.001
Activity limitations	3.27 (0.32)	5.00 (0.43)	4.33 (0.46)	3.88 (0.52)	13.72	0.003
Emotional functions	3.59 (0.40)	5.36 (0.40)	4.80 (0.50)	4.30 (0.58)	11.36	0.01
Environmental stimuli	3.19 (0.37)	4.79 (0.42)	4.32 (0.48)	3.96 (0.52)	10.40	0.02

Data are presented as mean (standard error). AQLQ, Asthma Quality of Life Questionnaire; GEE, generalized estimating equation.

Table 4 The number of healthcare utilization events for asthma exacerbation (events/patient/year)

Number of healthcare utilization events	Baseline	12 months	P value
No. of burst systemic steroids	4 [10]	1 [4]	0.07
No. of emergency department visits (exclude hospitalization)	4 [11]	2 [5]	0.01
No. of hospitalizations	1 [2]	0 [1]	0.03

Data are presented as median [IQR]. IQR, interquartile range.

(Wald =13.72, P=0.003), emotional functions (Wald =11.36, P=0.01), and environmental stimuli (Wald =10.40, P=0.02). The ACT scores were improved from 13 [IQR: 5] to 20 [IQR: 7] (P=0.004).

Pulmonary function

A total of 13 patients underwent a pulmonary function test after BT and were included in the analysis. The FEV1 and forced vital capacity (FVC) tended to improve after treatment. However, the increase was not significant. Prebronchodilator FEV1 increased from 76% [IQR: 31%] to 82% [IQR: 38%] (P=0.56). Prebronchodilator FVC increased from 85% [IQR: 23%] to 90% [IQR: 24%] (P=0.94). Prebronchodilator FEV1/FVC increased from 72% [IQR: 18%] to 76% [IQR: 28%] (P=0.41).

Asthma exacerbation

There was a significant reduction in the rate of severe exacerbations after treatment. The number of patients with at least one emergency department visit at 12 months before BT and after BT was reduced from 14 patients (82% of 17 patients) to 7 patients (41% of 17 patients). Telephone follow up was made during COVID pandemic to evaluate exacerbation and respiratory symptoms. Emergency department visits were reduced from 4 [IQR: 11] to 2 [IQR: 5] events per patient per year (P=0.01). The number of patients who required hospitalization due to respiratory symptoms was also reduced from 9 (53% of 17 patients) to 3 (18% of 17 patients). The hospitalization rate was reduced from 1 [IQR: 2] to 0 [IQR: 1] event per patient per year (P=0.03) (*Table 4*). Three patients were intubated for respiratory symptoms before treatment; however, none were intubated for respiratory symptoms after treatment. Due to the few intubation events, the significance of the difference could not be determined.

Medication use

The number of burst systemic corticosteroids for respiratory symptoms decreased from 4 [IQR: 10] to 1 [IQR: 4] times per patient per year (P=0.07). 10 out of 12 patients (83.3%) did not need burst systemic corticosteroids at 12 months.

The days of reliever use in two weeks reduced from 14 [IQR: 6] to 0 [IQR: 3] days (P=0.001). Nine out of 16 patients (56.2%) did not need relievers after 12 months. In 8 patients who required oral prednisolone to control their symptoms, there was a significant reduction in oral prednisolone dose from 5 [IQR: 5] to 1.25 [IQR: 5] mg per day (P=0.03). Four patients (50%) stopped taking prednisolone and 2 patients (25%) decreased their dose. There was 1 patient (12.5%) with an increased dose of prednisolone from 2.5 to 5 mg per day and another patient (12.5%) remained on the same dose (5 mg per day). Six patients who were previously on Omalizumab before BT discontinued Omalizumab at the 12-month follow-up.

Adverse events

No severe complications occurred during the procedure. The most common adverse events during the 6 weeks post-BT were wheezing (23 events), dyspnea (13 events), and respiratory tract infection (11 events). There were

Table 5 Adverse events after bronchial thermoplasty

Immediate complication (within 6 weeks)	Adverse event frequency	Number of patient frequency
Dyspnea	18	11
Wheezing	23	11
Cough	9	6
Hemoptysis	0	0
Chest discomfort	4	3
Upper respiratory tract infection	5	4
Lower respiratory tract infection	6	4
Atelectasis	3	3

respiratory tract infections, 5 were URTIs and 6 were lower respiratory tract infections (*Table 5*). All these infections were resolved by antibiotic treatment.

Although there were 3 events of lung atelectasis, only one patient had bilateral upper lobe atelectasis that was resolved with positive pressure ventilation. There were no severe complications after the procedure.

Discussion

The present study describes the clinical outcome of treating asthma with type 2 inflammation with BT. The GINA guideline recommends treating severe asthma with type 2 inflammation with targeted biological therapy (5). However, biological therapy in many developing countries is not widely affordable. A study using either biological therapy (Benralizumab or Omalizumab) or BT for severe refractory asthma found comparable outcomes of reduced exacerbation, hospitalization, and mean prednisolone dose with improved ACT scores between these methods (26).

A previous study of BT in Japan reported that patients with moderate to severe asthma with elevated biomarkers of type 2 inflammation had improved AQLQ and reduced exacerbation (18). Our study revealed that using BT for asthma with type 2 inflammation improved the patient's quality of life in all domains over 12 months after BT, especially during the first 3 months after BT. The symptom domain demonstrated the greatest improvement after BT in AQLQ score. These results are consistent with other findings in our study. The number of patients who required an emergency department visit was reduced by an absolute reduction of 50% from 4 to 2 events per patient per year. Moreover, we demonstrated fewer patients who required hospitalization.

In our study, we can discontinue Omalizumab in 5 patients, this may be explained by the improvement of glucocorticoid receptors in airway epithelium (27). A previous study reviewed favorable effects in patients with elevated serum IgE (28). The mean OCS doses were also reduced with an absolute reduction of 75% from 5 to 1.25 mg per day. We found that half of the patients completely weaned off oral prednisolone, and one quarter of the patients reduced their dosage. These results are consistent with previous studies of BT (13,14).

Long-term efficacy 5 and 10 years after BT has been demonstrated with persistent symptom control, reduction in exacerbation, emergency department visits, and safety (16,29). Our study demonstrated the highest quality of life at 3 months after BT, the quality of life decreased in follow-up, but still significantly improved when compared to baseline.

Furthermore, previous cost-effective analysis between BT, omalizumab, and standard therapy for moderate to severe allergic asthma in the USA found that there was more than a 60% chance that BT was more cost-effective than Omalizumab and standard treatment (30). Another cost-effectiveness study of BT in patients with severe uncontrolled asthma from the USA found that BT was also a cost-effective treatment for this group of patients (31). A study of cost-effectiveness in Japan found that BT is also a cost-effective treatment because it reduces hospitalization costs, emergency room visits, and usage of biological drugs used which are very expensive (32). On the other hand, a study concerning the cost-effectiveness of a biological drug in 2019 showed that biological drugs were not cost-effective, and the cost needed to be reduced by at least 60% to become cost-effective (33). These results suggested that BT may be a better alternative treatment for severe asthma due to its cost-effectiveness in a real clinical context.

The BT in our study was done under general anesthesia with hospitalization in all patients. Our regional referral center status, attracting patients from across Thailand, limits the feasibility of same-day discharge due to logistical considerations. Consequently, patient admissions are necessary to facilitate safe patient transport and enable extended monitoring for potential adverse events. General anesthesia facilitated the administration of BT with a high number of activations (up to 100). Our observations suggest

a potential association between the number of activations and favorable outcomes, aligning with previous reports that posit a link between activation count and clinical response (34). However, definitive conclusions require further research with comparative groups receiving either high or standard activation levels.

This retrospective observational study evaluated the use of BT in severe asthma patients. A limitation inherent to this design is the potential for bias due to the reliance on past medical records. While GINA guidelines recommend biomarker assessment for type 2 inflammation (e.g., blood eosinophils, FeNO), some data, such as sputum eosinophils, were unavailable. This raises the possibility of misclassification, as elevated biomarkers can also indicate coexisting conditions like allergic rhinitis. Additionally, the sample size was limited, potentially due to the scarcity of patients meeting the criteria in Thailand and limited patient awareness of BT availability. The reduction of OCS used to 5 mg of prednisolone per day was seen in our study, but we could not explain why some patients are still on 5 mg of prednisolone after BT. This may be due to the patient still having severe uncontrolled asthma or adrenal insufficiency. Due to the pandemic, four patients were unable to complete the pulmonary function tests, limiting our data analysis on the topic.

Nonetheless, this study offers valuable insights into real-world practice. Future prospective studies with larger cohorts are warranted to definitively compare the effectiveness of BT against other biological therapies in type 2 inflammatory asthma.

Conclusions

We demonstrate the effectiveness of BT for patients with asthma with type 2 inflammation in 12 months follow-up. Patients' quality of life was improved with no serious complications. The results of this study support BT as an alternative therapy for patients with asthma with type 2 inflammation.

Acknowledgments

None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-24-1842/rc

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The study was approved by the Institutional Review Board of the Faculty of Medicine, Chulalongkorn University, Bangkok, Thailand (No. 215/62) and informed consent was taken from all the patients.

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