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To cite this article: Xiudi Han, Shuli Zhang, Weiye Zhao, Dong Wei, Yi Wang, Douglas Kyle Hogarth & Xuedong Liu (2018): A successful bronchial thermoplasty procedure in a “very severe” asthma patient with rare complications: a case report, Journal of Asthma, DOI: [10.1080/02770903.2018.1509992](https://doi.org/10.1080/02770903.2018.1509992)

To link to this article: <https://doi.org/10.1080/02770903.2018.1509992>



Published online: 04 Oct 2018.



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A successful bronchial thermoplasty procedure in a “very severe” asthma patient with rare complications: a case report

Xiudi Han, MD^a, Shuli Zhang, MD^a, Weiye Zhao, MD^a, Dong Wei, MD^a, Yi Wang, MD^a, Douglas Kyle Hogarth, MD^b, and Xuedong Liu, MD^a

^aDepartment of Respiratory Medicine, Qingdao Municipal Hospital Group, Qingdao University, Qingdao City, Shandong Province, China; ^bDepartment of Medicine, Section of Pulmonary and Critical Care, University of Chicago Medical Center, Chicago, IL, USA

ABSTRACT

Introduction: Bronchial thermoplasty (BT) is a unique bronchoscopic treatment for severe asthma that utilizes radiofrequency ablation to reduce smooth muscle in the bronchial walls. Current studies mainly focused on uncontrolled severe asthma with a forced expiratory volume in 1 second (FEV₁) above 60% and associated complications, no human studies have performed on “very severe” asthma as well as its complications. **Case study:** We present a 60-year-old male with more than 15 years history of very severe asthma, who underwent BT. His FEV₁ was only 20.4% predicted, which would have excluded him from all prior clinical trials of BT. The first BT procedure occurred without an issue. After the second BT procedure, he experienced severe dyspnea due to an infection with a non-flu respiratory virus. This illness was complicated by the formation of a pulmonary cyst. During recovering from the third procedure, he developed stomach stones. This is mainly related with taking large amounts of hawthorn previously, also cannot exclude the role of thermal energy injury on gastrointestinal nerve function. **Results:** Despite these unexpected complications, his quality of life greatly improved after BT, yet his lung function did not improve. **Conclusion:** This case is the first to describe BT procedures in patient with this level of lung function compromise, although accompanied with rare complications; our report indicates BT may be an opportunity and choice for the “very severe” asthma patients.

ARTICLE HISTORY

Received 14 June 2018
Revised 31 July 2018
Accepted 5 August 2018

KEYWORDS

Severe asthma; bronchial thermoplasty; pulmonary cyst; stomach stones

Introduction

Asthma is a common, chronic respiratory disease affecting 1–18% of the population in different countries [1]. There are 30 million Chinese with asthma and severe asthma aged ≥ 14 years constitutes up to 5.99% of the asthma population in China [2,3]. Severe asthma leads to significant increase in hospital visits and emergency visits and represents a large consumption of public health resources. Bronchial thermoplasty (BT), approved by the US Food and Drug Administration (FDA) [4] in April 2010 for patients with severe asthma, offers a novel treatment by reducing smooth muscle mass via direct application of thermal energy. Three sequential bronchoscopies are performed targeting the right lower bronchus, left lower bronchus, and the bilateral upper bronchus respectively, approximately three weeks apart. Studies reported that a significant reduction in exacerbations, hospitalizations, and emergency room visits and also a significant improvement

in asthma quality of life questionnaire score (AQLQ) [5–10]. Despite a strong safety record, physicians should pay close attention to possible unexpected complications of BT. The aim of this article is to report a successful BT procedure in a “very severe” asthma patient with an unusual complication of pulmonary cyst and stomach stones after BT.

Case study

The patient is a 60-year-old male who was first admitted to our hospital due to repeated paroxysmal cough, sputum, and wheezing for more than 10 years on 29 November 2012. He is a 30 pack-year smoker with a history of subtotal gastrectomy 14 years ago and the body mass index (BMI) is 22.8 kg/m². The bronchodilator reversibility test was positive at the first admission. Forced expiratory volume in 1 second (FEV₁) was 0.75 L (24.7% predicted), forced vital capacity

CONTACT Xuedong Liu, MD  xuedongliu@263.net  Department of Respiratory Medicine, Qingdao Municipal Hospital Group, Qingdao University, Qingdao City, Shandong Province, China.

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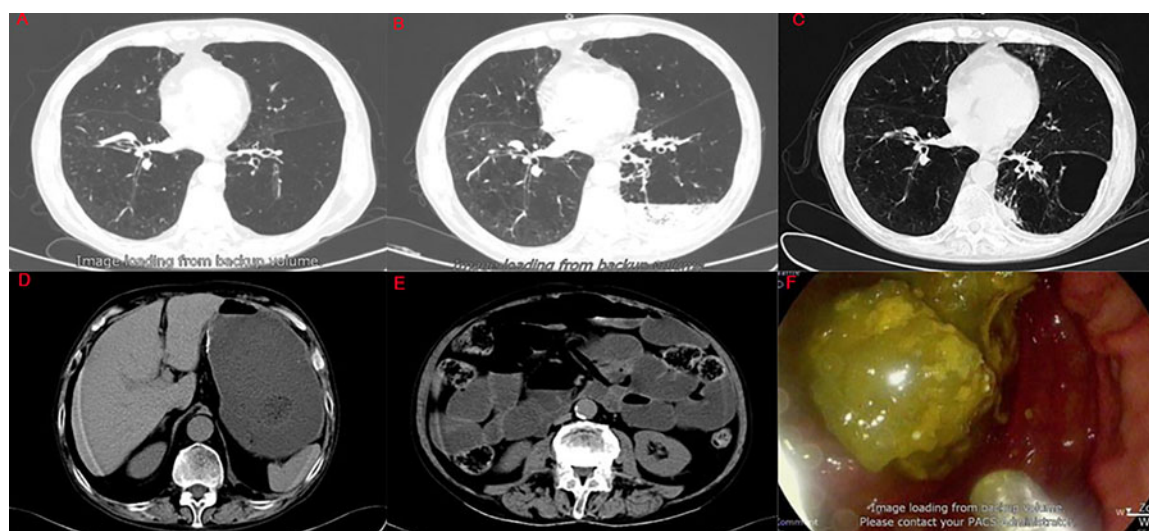


Figure 1. Expressions of computed tomography (CT) and gastroscopy. (A) The chest CT showed mild bronchiectasis and thickening of the bronchial walls in bilateral lower lobes; (B) The chest CT revealed consolidation with pleural effusion in left lower lobe; (C) The chest CT demonstrated a pulmonary cyst development in left lower lobe. (D) The abdominal CT displayed stomach dilatation and gastric bezoars; (E) The abdominal CT showed intestinal gas and effusion; (F) Gastroscopy examination showed a big gastric stone.

(FVC) was 1.60 L (45.6% predicted), and FEV_1/FVC was 46.75%. FEV_1 improved to 0.99 L after administration of inhaled salbutamol, yet a fixed airflow obstruction was present in stable condition. The patient was diagnosed with severe bronchial asthma according to ATS/ERS definition [11] with chronic obstructive pulmonary disease (COPD). Asthma control test (ACT) score was only 7, despite high-dose inhaled therapy (fluticasone/salmeterol 500/50 mcg twice daily and tiotropium 18 mcg daily) plus montelukast (10 mg night daily) and oral methylprednisolone (8–32 mg daily) and noninvasive mechanical ventilation. The patient's activity tolerance was very poor and he relies on an electric wheelchair for his daily life. The frequency of acute exacerbations of hospitalization was 4 per year.

In order to reduce the risk of acute exacerbations and improve the quality of life, a decision was made for the patient to pursue BT. The chest computed tomography (CT) scan showed mild bronchiectasis and thickening of the bronchial walls (Figure 1(A)). The lung function before BT showed FEV_1 was just 0.61 L (20.4% predicted), FVC was 1.63 L (42.8% predicted) and FEV_1/FVC was 37.54%. The first BT procedure was performed on 8 June, 2017 with the patient spontaneously breathing. Sedation with remifentanyl 0.10 mcg/kg/h and propofol 8 mg/kg/h were administered with anesthesiology assistance. Forty activations were administered in the right lower bronchus. The second BT procedure was performed on July 11 utilizing anesthesia monitored sedation with remifentanyl 0.10 mcg/kg/h and involved 23 valid

activations in the left lower bronchus. He did not suffer severe adverse events and was discharged after the first and second BT procedure immediately. Ten days after his second BT, he was readmitted due to a serious exacerbation of asthma after suffering from a common cold. He showed severe wheezing, orthopnea all day, silent chest, tachycardia, and re-use of non-invasive ventilator. Besides, chest x-rays showed no signs of infections. Adenovirus antibody was positive; influenza antigen and respiratory syncytial virus, and parainfluenza virus antibody were negative. However, the condition was not relieved and complicated by a need for intubation and mechanical ventilation due to progressive dyspnea. One week later, the patient was transferred to the general ward after removal of intubation. Unfortunately, the patient suddenly complained of fever and severe needle-like pain on the left chest. The CT scan revealed consolidation with pleural effusion in the left lung (Figure 1(B)). *Acinetobacter baumannii*, *Klebsiella pneumoniae*, *Escherichia coli* and *Candida albicans* were cultured many times. Cefoperazone/sulbactam and fluconazole were administered and the CT scan showed a pulmonary cyst development in the left lower lobe two weeks later (Figure 1(C)).

The patient complained of nausea, vomiting, and epigastric pain three days after the final BT procedure performed on October 19. The patient had eaten lots of hawthorns prior to the BT. The abdominal CT showed gastric bezoars (Figure 1(D)) and intestinal obstruction (Figure 1(E)). About 1000 ml normal saline was instilled daily into the gastrointestinal decompression tube; endoscopic lithotripsy was

performed (Figure 1(F)) and then he recovered and was discharged.

Results

For five months following completion of BT, the patient showed great improvement in asthma symptoms. ACT score was now 23. He has had zero acute exacerbations and has been able to completely withdraw all oral methylprednisolone, the use of the electric wheelchair, and non-invasive ventilator at night. As described in the literature, lung function showed no improvement with an FEV₁ of 0.60 L (19.9% predicted), FVC of 1.56 L (41.0% predicted).

Discussion

Danek CJ first reported that radio frequency energy could reduce airway responsiveness to methacholine chloride for at least three years in dogs by reducing airway smooth muscle contractility in 2004 [12]; and the following year, a prospective feasibility study of BT in the human airway was undertaken to assess the role of BT [13]. Subsequently studies and clinical trials confirmed the safety and effectiveness of BT in the treatment of uncontrolled severe asthma with an FEV₁ above 60% [5–10], even “very severe” asthma [14]. Data from Doeing DC showed that 62.5% patients ($n=8$) had a prebronchodilator FEV₁ less than 50% of predicted with a mean FEV₁ of 37.4% [14]. These successful case series provide the basis for further research on “very severe” asthma patients with FEV₁ below 50%. To our knowledge, our case is the first to illustrate BT successfully performed in patients with FEV₁ of only 20%. Although the lung function did not improve, the patient’s symptom improved significantly and complete withdrawal of daily oral corticosteroids after BT was achieved. Undeniably, this is a successful case, despite there are some risks during BT procedure, BT may indeed be a promising and well-tolerated approach for these “very severe” asthma patients and may be considered even in this very ill cohort, but, more evidences and studies are needed in the future.

The patient developed a pulmonary cyst after the second BT of the left lower bronchus. Though this was in the setting of pneumonia and respiratory infection, a pulmonary cyst is very rare and only one case has been reported post BT [15]. The pathogenesis of pulmonary cyst development is not clear. We postulate that BT leads to changes of local bronchial micro-environment clearance, and the patient more easily

suffered infection; the bronchial diameter became narrower from this infection and inflammation and subsequently results in a check valve and increased airway tension, eventually forming a cyst. It should be noted that the infiltrate of the lower lobe seen on CT may be misinterpreted as pneumonia. This is a common finding post BT, as demonstrated by Debray MP [16].

After the third BT procedure, the patient manifested gastrointestinal symptoms due to formation of stomach stones and intestinal obstruction. The development of stomach stones was mainly related with taking large amounts of hawthorn previously that is the prerequisite for the formation of stomach stones; secondly, gastric volume is smaller after subtotal gastrectomy leading to abnormal distribution. We also speculate whether the energy along the bronchial wall causes dysfunction of the vagus nerve or not, further affecting the gastric emptying and gastrointestinal motility and promoting stomach dilation, stomach stones, and intestinal obstruction. Absolutely, that is just our hypothesis.

Conclusion

Our report demonstrates successful performance of BT in a patient with FEV₁ of only 20% predicted, although there are some risks and complications. For patients with “very severe” asthma, BT may be an opportunity and challenge to improve quality of life. Certainly, more studies need to be conducted to verify the safety and feasibility of BT in patients with “very severe” asthma.

Acknowledgements

The authors wish to thank him and his wife for the publication of this case report and any accompanying images. Written informed consent was obtained from the patient and his wife for the publication of this case report and any accompanying images.

Disclosure statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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