Case Report

Anesthetic considerations for bronchial thermoplasty in patients of severe asthma: A case series

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ABSTRACT

The role of anesthesiologist in nonoperating room procedures including pulmonary interventions is expanding. Bronchial thermoplasty (BT) is a minimally invasive bronchoscopic intervention for patients with severe asthma refractory to conventional pharmacotherapy. It involves the application of controlled radiofrequency thermal energy to large- and medium-sized airways. We report our experience for perioperative anesthetic management of patients scheduled for BT. Three patients with severe asthma were planned for BT under general anesthesia. After standard monitoring and intravenous cannula insertion, anesthesia was induced with propofol, fentanyl, and rocuronium after preoxygenation and maintained with propofol target-controlled infusion. The ventilation was controlled mechanically with I-gel used for airway management. The oxygen concentration was titrated to 40% or less at the time of thermal activation delivery. The procedure was performed using a thin bronchoscope inserted through the I-gel working port of the catheter mount. The procedures lasted for around 1 h. After completion of the procedure, the residual neuromuscular blockade was reversed, and I-gel was removed. BT requires three separate procedure sessions performed 2–3 weeks apart, and each session sequentially targets right lower lobe, left lower lobe, and bilateral upper lobes. The challenge involved in BT is due to the airway sharing between anesthesiologists and pulmonologists and anesthesia in a nonoperating room setting in patient with uncontrolled severe asthma. A meticulous preoperative evaluation, perioperative anesthetic plan, and periprocedural monitoring can reduce the complications.

KEY WORDS: Asthma, bronchial thermoplasty, bronchospasm, general anesthesia, pharmacotherapy, nonoperating room procedures

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Received: 16-Sep-2019 **Revised:** 26-Oct-2019 **Accepted:** 02-Jan-2020 **Published:** 30-Oct-2020

INTRODUCTION

The role of anesthesiologist in nonoperating room procedures including pulmonary interventions is expanding. These cases are challenging due to the patient profile, shared airway, unfamiliar environment, and the specific requirement for this procedure. Bronchial thermoplasty (BT) is a minimally invasive bronchoscopic intervention for the management of severe asthma refractory to conventional pharmacotherapy.[1] It involves the application of controlled thermal radiofrequency energy to large- and medium-sized airways as a therapeutic modality. The aim of thermal delivery is to cause ablation of the airway smooth muscle to improve asthma control. Anesthesiologist plays a pivotal role in the management of such cases and is imperative to be familiar with such cases to formulate the perioperative

Access this article online

Quick Response Code:

Website: www.lungindia.com

DOI: 10.4103/lungindia.lungindia_434_19

How to cite this article: Dattatri R, Garg R, Madan K, Hadda V, Mohan A. Anesthetic considerations for bronchial thermoplasty in patients of severe asthma: A case series. Lung India 2020;37:536-9.

anesthetic plan and anticipate and manage potential complications. The main concern as anesthesiologists in these procedures is to maintain adequate oxygenation and ventilation in patients who are inherently prone to complications in view of severe bronchial asthma *per se* as well as due to the procedure in the setting of shared airway. We report our experience for perioperative anesthetic management BT in patients with severe asthma.

CASE REPORTS

Case 1

A 42-year-old male patient with a history of severe asthma for 7 years was planned for BT. There was a history of multiple asthma exacerbations over this duration and a recent history of hospitalization for acute severe exacerbation of asthma 2 months back, for which patient required endotracheal intubation with mechanical ventilation. The patient was on treatment with multiple controller medications that included metered-dose inhaler (MDI) formulations of long-acting β2 agonist (LABA) (formoterol) in combination with high-dose inhaled corticosteroid (ICS) (budesonide), tiotropium, and required low-dose oral prednisolone intermittently. His pulmonary function test (PFT) revealed forced expiratory volume in 1 s (FEV1) prebronchodilator(BD) − 0.75L(27%predicted),post-BD − 0.99L, pre-BD forced vital capacity (FVC) – 1.74 L (51% predicted), pre-BD FEV1/FVC – 43.3 (53% predicted), and post-BD − 44.5 L, which was suggestive of very severe obstructive pattern. Complete hemogram, liver function tests, renal function tests, and chest X-ray were normal.

Case 2

A 30-year-old female patient with a history of hypertension and diabetes mellitus for 2 years and asthma for 15 years was planned for BT. She was on oral telmisartan/hydrochlorothiazide (40/12.5) once a day for hypertension and oral metformin 500 mg twice daily. The patient was on treatment with multiple controller medications that included MDI formulations of LABA (formoterol) in combination with high-dose ICS (budesonide), tiotropium, and oral theophylline along with regular twice a day use of combination short-acting BDs (salbutamol and ipratropium). She has had a history of multiple hospital admissions for the exacerbation of asthma. She was on oral prednisolone in the past but that had been recently discontinued. Complete hemogram, liver function tests, renal function tests, fasting blood sugar, HbA1c, and chest X-ray were normal. PFT – FEV1 was 2.18 L (79% predicted), 1.74 (73% predicted), FEV1/FVC –79.8% (92% predicted).

Case 3

A 54-year-old female patient with a history of hypothyroidism for 5 years and asthma for 7 years was planned for BT. She was receiving oral thyroxine 100 μg once a day for hypothyroidism. The patient was also receiving treatment with multiple controller medications that included LABA (formoterol) in combination with high-dose ICS (budesonide) and tiotropium. Spirometry demonstrated a moderate obstructive defect, and pre-BD FEV1 was 1.27 L (57% predicted), post-BD 1.28 L, pre-BD FVC 1.58 L (57% predicted), FEV1/FVC 80.6 (100% predicted), and post-BD −80.9.

Anesthetic management

The patients were asked to continue all the baseline medications for asthma till the day of procedure. The patients were kept nil per orally – 2 h for clear liquids, 6 h for solids, and 8 h for fatty meal. Oral prednisolone 50 mg once a day was started 3 days before the procedure which was continued till 1 day after perioperatively. All patients received nebulization with short-acting BDs (levosalbutamol 1.25 mg/ipratropium bromide 500 μg) before shifting to the pulmonary intervention suite. In the suite, a wide bore intravenous (IV) access was secured. Standard monitors such as electrocardiograph, noninvasive blood pressure monitor, pulse oximetry, and capnography were used for intraprocedural monitoring. Bispectral index (BIS) was also used to monitor the depth of anesthesia. The anesthetic management consisted of general anesthesia (GA) with securing of airway using appropriate size supraglottic airway device (I-gel). Following preoxygenation using 100% oxygen till end-tidal oxygen >90%, induction of anesthesia was accomplished using IV fentanyl 2 μg/kg and propofol 2 mg/kg. After checking for the bag-and-mask ventilation, IV rocuronium 0.6 mg/kg was administered. The maintenance of anesthesia was done using propofol target-controlled infusion-Marsh model, to maintain target plasma concentration 2.5–4 μg/ml which titrated to BIS of 40–60 and stable hemodynamic. Ventilation was achieved with manual intermittent positive pressure ventilation. After ensuring adequate anesthesia, a thin flexible video bronchoscope (outer diameter 4.2 mm and channel diameter 2.0 mm) was inserted through the I-gel using a swivel connector and placed distally in the first airway to be treated. A thorough airway examination was performed, and mucus suctioned out. The BT involved the application of controlled radiofrequency energy to the large- and medium-sized airways using Alair (Boston Scientific, Natick, MA, USA) BT system. Alair catheter was inserted through the working channel of the scope, and after its tip placement at desired site, it was activated to deliver energy activations, each activation lasting for 10 s. The process was continued in a contiguous, nonoverlapping manner moving from distal to proximal airway systematically covering all the airways. The procedure lasted for less than an hour, and the duration depended on the number of activations. At the end of the procedure, propofol infusion was stopped, and the residual neuromuscular blocking agent was reversed using IV neostigmine 0.05 mg/kg and glycopyrrolate 0.2 mg/kg. After adequate breathing efforts, I-gel was removed, and the patient was shifted to recovery room. Post procedure, patients received nebulized BDs and discharged on meeting postanesthesia discharge criteria with instructions to continue post procedure medications.

Periprocedural complications

No major complications such as hypoxemia, desaturations, hypotension, bronchospasm, and laryngospasm warranting procedural interruption were noted in any of our patients, although bronchospasm which could be visualized during the application of thermal energy was managed by injecting salbutamol through the working channel of flexible video bronchoscope (1 respule salbutamol (2.5 mg/ml) diluted to 10 ml and 1–2 ml is injected). Cough and wheeze following procedure could be managed by nebulization with levosalbutamol and budecort. None of the patients had major desaturation, hypoxic episodes in the postprocedural period requiring reintubation or intensive care unit admission. Only one patient presented with lower respiratory tract infection 7 days following procedure which required hospitalization and IV antibiotics.

DISCUSSION

BT is one recently available treatment option for the management of selected patients with severe asthma not controlled with conventional pharmacotherapy.[1] The exact mechanism of BT is not fully understood. It appears to exert its effects mainly on airway smooth muscles, although extracellular matrix, airway innervation, activation and recruitment of inflammatory cells, and process of mast cells in the airway smooth muscle layer are also affected.[2] Various clinical trials and real-life case series have reported the effectiveness of BT in reducing asthma exacerbations and emergency department visits with improvements in quality of life.[3-5] It involves three separate sessions performed 2–3 weeks apart targeting the right lower lobe, left lower lobe, and bilateral upper lobes in sequence. This divided session reduces the procedural length, the duration of anesthesia, and the risk of acute exacerbation of asthma by complete stimulation of the entire airway tree in a single session. The challenges involved in the performance of BT are primarily due to the airway sharing, wherein the main consideration is to maintain adequate oxygenation and ventilation in patients who are inherently prone to airway complications due to the nature of disease as well as the procedure. It is recommended that the patient should be having stable asthma symptoms for 48 h, with no active respiratory tract infection and no acute exacerbation of asthma for 2 weeks before BT.[1]

A thorough preoperative evaluation together with appropriate investigations is essential. The anesthetic plan should aim to minimize the bronchospasm and provide good procedural condition. Bronchospasm could be provoked by laryngoscopy, tracheal intubation, airway suctioning, extubation, and others. Drugs used perioperatively can also trigger bronchoconstriction by histamine release, cholinergic activity, and allergic reactions. Hence, adequate precautions must be taken to minimize the risk by maintaining adequate depth of anesthesia and avoiding the usage of such drugs. Preoperatively, corticosteroid such as oral prednisone is started 3 days before the procedure which is continued postprocedure also to reduce airway inflammation and edema. Antisialagogue medications can be used, but we avoided as it has been reported that reduction in bronchial secretions is not effective rather can interfere with clearing of secretions post bronchoscopy and produce tachyarrhythmias.[6,7]

Anesthesia techniques utilized in BT range from mild sedation to GA, although the choice should be individualized based on patient's comorbidities, body habitus, the need for positive pressure ventilation to keep the distal airways open, the procedural duration, bronchoscopist comfort level, and in accordance with the institutional protocol. Regardless of the modality, it is essential to have a cooperative patient with ideally no cough and excessive respiratory efforts to accurately deliver RF activations and prevent retreatment of the same sites. Various agents such as midazolam, fentanyl, dexmedetomidine, propofol, and remifentanil have been used to provide sedation with varying results.[6-8] The existing literature consists of evidence that supports the use of both GA and sedation each with its own advantages and caveats. The main disadvantage that has been reported with sedation is suboptimal procedural conditions due to frequent interruptions as a result of hypoventilation episodes and airway obstruction requiring interventions such as jaw thrust or insertion of oral/nasal airway to maintain airway patency as compared to the use of GA and supraglottic airway device.[9] Favorable results with moderate sedation using propofol and remifentanil are also reported in literature.[8,9] In our patients, we preferred GA with securing of airway using a I-gel, a supragalottic airway device as it provides optimal procedural condition with lesser need for airway interventions, less desaturation, less airway stimulation, better hemodynamic stability with improved patient, and pulmonologist satisfaction.[10-12] The other advantage with GA is the ability for better airway management with reduced inspired oxygen concentration which might be needed to reduce the risk of airway fire.[12] We preferred total IV anesthesia as the delivery of inhalational agents can be unpredictable in these cases. GA with endotracheal intubation needs to be considered in those with high aspiration risk and in severe refractory asthma with high-peak airway pressures. Antisialagogue medications can be used but we avoided as it has been reported that reduction in bronchial secretions is not effective rather can interfere with clearing of secretions post bronchoscopy and produce tachyarrhythmias.[13]

Complications such as hypoxemia, bronchospasm, laryngospasm, atelectasis due to fibrin plugs, exacerbation of asthma, lower respiratory tract infection, and bronchial artery pseudoaneurysms have been reported.[11,14] Patients should be closely monitored in the recovery area till the vitals are stable, and gag reflex is intact with baseline spirometry values. There could be an initial worsening

of symptoms such as cough, dyspnea, nocturnal awakening, and chest discomfort, and patients should be informed regarding the same.[6] Active wheeze is another complication which might require IV methylprednisolone.

This report is grossly limited by the fact of limited sample size to reach some conclusive recommendations. Large sample size study is required for the same.

To conclude, BT is an emerging treatment modality for refractory asthma. A good preoperative preparation of patients, perioperative anesthetic plan which provides optimal procedural condition, and good communication with the pulmonologist together with appropriate interventions, in case of any complication, can reduce the morbidity and mortality contributing to the success of the procedure. In our opinion, GA provides ideal conditions for the performance of BT with optimal subject and proceduralist satisfaction.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that names and initials will not be published and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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