Video Article

Bronchial Thermoplasty: A Novel Therapeutic Approach to Severe Asthma

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Abstract

Bronchial thermoplasty is a non-drug procedure for severe persistent asthma that delivers thermal energy to the airway wall in a precisely controlled manner to reduce excessive airway smooth muscle. Reducing airway smooth muscle decreases the ability of the airways to constrict, thereby reducing the frequency of asthma attacks. Bronchial thermoplasty is delivered by the Alair System and is performed in three outpatient procedure visits, each scheduled approximately three weeks apart. The first procedure treats the airways of the right lower lobe, the second treats the airways of the left lower lobe and the third and final procedure treats the airways in both upper lobes. After all three procedures are performed the bronchial thermoplasty treatment is complete.

Bronchial thermoplasty is performed during bronchoscopy with the patient under moderate sedation. All accessible airways distal to the mainstem bronchi between 3 and 10 mm in diameter, with the exception of the right middle lobe, are treated under bronchoscopic visualization. Contiguous and non-overlapping activations of the device are used, moving from distal to proximal along the length of the airway, and systematically from airway to airway as described previously. Although conceptually straightforward, the actual execution of bronchial thermoplasty is quite intricate and procedural duration for the treatment of a single lobe is often substantially longer than encountered during routine bronchoscopy. As such, bronchial thermoplasty should be considered a complex interventional bronchoscopy and is intended for the experienced bronchoscopist. Optimal patient management is critical in any such complex and longer duration bronchoscopic procedure. This article discusses the importance of careful patient selection, patient preparation, patient management, procedure duration, postoperative care and follow-up to ensure that bronchial thermoplasty is performed safely.

Bronchial thermoplasty is expected to complement asthma maintenance medications by providing long-lasting asthma control and improving asthma-related quality of life of patients with severe asthma. In addition, bronchial thermoplasty has been demonstrated to reduce severe exacerbations (asthma attacks) emergency rooms visits for respiratory symptoms, and time lost from work, school and other daily activities due to asthma.

Video Link

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Protocol

1. Introduction:

Asthma is a serious public health problem. The current estimate is that 20 million people in the United States suffer from asthma. Each year in the United States alone, there are approximately 13.6 million unscheduled physician office visits, 1.8 million emergency room visits, 0.5 million hospitalizations, and 4,000 deaths (NCHS 2005) due to asthma. The estimated annual cost of asthma in the United States is approximately $19.7 billion. This total includes $5 billion in indirect costs, due to more than 14.5 million lost work days, and $14.7 billion in direct costs, such as asthma medications, unscheduled physician office visits, emergency room visits and hospitalizations (American Lung Association 2007).

Ten percent of the more than 20 million Americans with asthma are diagnosed as having severe asthma. This group of severe asthmatics, however, is responsible for a disproportionate share of the morbidity associated with the disease. Thus, this 10% of patients with the most severe asthma are responsible for the majority of asthma-related healthcare burden, represented by the costs of hospitalizations, ER visits, physician office visits, and use of medications (Cisternas et al, 2003)

Despite regular treatment with high doses of available asthma medications, patients with severe asthma experience frequent and serious symptoms including exacerbations that may be life-threatening and require urgent resuscitative measures including intubation and mechanical ventilation, until the airway obstruction can be relieved. Exacerbations requiring medical intervention result in significant healthcare costs and affect the quality of life for the patient and family. This increased burden of severe asthma reflects the inability of the existing treatment options to adequately control asthma in patients with severe disease.

2. Case Presentation:

The typical patient is about 40 years old, has a history of poorly controlled severe asthma, and despite taking Advair, Symbicort or other equivalent combinations of ICS + LABA twice a day, still experiences difficulty in daily activities due to asthma symptoms.

Bronchial thermoplasty is typically administered in a hospital outpatient bronchoscopy or endoscopy suite or operating room. The patient should be stable to undergo bronchoscopy and the bronchoscopist needs to ensure that the patient remains a good candidate for bronchial thermoplasty by following the patient selection criteria outlined below. In some cases, the procedure may be safely performed on an in-patient basis where the patient can be monitored for a longer period of time before discharge. Patients who are described in the Precautions section 3.4 below might be such candidates.

3. Patient Selection:

1. The Alair Bronchial Thermoplasty System is indicated for the treatment of severe persistent asthma in patients 18 years and older whose asthma is not well controlled with inhaled corticosteroids and long acting beta agonists.
2. Patients with the following conditions should not be treated:
    - Presence of a pacemaker, internal defibrillator, or other implantable electronic devices,
    - Known sensitivity to medications required to perform bronchoscopy, including lidocaine, atropine, and benzodiazepines,
    - Patients previously treated with the Alair System should not be retreated in the same area(s). No clinical data are available studying the safety and/or effectiveness of repeat treatments.

3. Patients should not be treated while the following conditions are present:
    - Active respiratory infection,
    - Asthma exacerbation or changing dose of systemic corticosteroids for asthma (up or down) in the past 14 days,
    - Known coagulopathy,
    - As with other bronchoscopic procedures, patients should stop taking anticoagulants, antiplatelet agents, aspirin and NSAIDS before the procedure with physician guidance.

4. Caution should be taken in patients with the following conditions due to a potential increased risk of adverse events that may be associated with the procedure. Patients with these conditions were not studied in the pivotal trial and the safety of Alair treatment for such patients has not been determined:
    - Post-bronchodilator FEV1 < 65%.
    - Other respiratory diseases including emphysema, vocal cord dysfunction, mechanical upper airway obstruction, cystic fibrosis or uncontrolled obstructive sleep apnea.
    - Use of short acting bronchodilator in excess of 12 puffs per day within 48 hours of bronchoscopy (excluding prophylactic use for exercise).
    - Use of oral corticosteroids in excess of 10 milligrams per day for asthma.
    - Increased risk for adverse events associated with bronchoscopy or anesthesia, such as pregnancy, insulin dependent diabetes, epilepsy or other significant co-morbidities, such as uncontrolled coronary artery disease, acute or chronic renal failure, and uncontrolled hypertension. The Alair System should only be used in patients stable enough to undergo bronchoscopy
    - Intubation for asthma, or ICU admission for asthma within the prior 24 months.
    - Any of the following within the past 12 months:
        - 4 or more lower respiratory tract infections (LRTI)
        - 3 or more hospitalizations for respiratory symptoms
        - 4 or more OCS pulses for asthma exacerbation

4. Bronchial Thermoplasty Procedure:

1. On the day of the procedure, the bronchoscopist needs to reevaluate and ensure that the patient remains a good candidate for bronchial thermoplasty under moderate sedation.
2. Peri-procedure preparation includes prophylactic administration of OCS (50mg/d) for 3 days before, day of, and day after the procedure to minimize post procedure inflammation, and application of inhaled bronchodilators and anti-cholinergics to suppress airway secretions.
3. The patient is appropriately prepared and placed under moderate sedation. A peripheral intravenous (IV) line and supplemental oxygen (less than 40%) via oral or nasal cannula are recommended with appropriate monitoring for moderate sedation, which would include continuous electrical cardiac monitoring, continuous pulse oximetry, and noninvasive blood pressure monitoring. Once IV access is established and monitors have been applied, premedications can be administered to the patient in preparation for bronchial thermoplasty. Albuterol and an antisialogogue agent such as glycopyrrolate or atropine should be administered a minimum of 30 minutes before the procedure. Sedation administered is IV midazolam and fentanyl with judicious application of topical anesthesia.
4. Bronchial thermoplasty is performed using the Alair System. The equipment is prepared for use and a standard gel-type patient return electrode is affixed to the patient to provide a complete circuit.
5. Bronchial thermoplasty is performed with a standard commercially available high frequency compatible flexible bronchoscope either through an oral or nasal approach, and topical anesthesia applied accordingly. The bronchoscopist anesthetizes the posterior pharynx, vocal cords and bronchial tree before initiating treatment. As the bronchoscopist proceeds down the airways, additional local anesthetics are used as necessary.

6. The bronchoscope is navigated to the region of the lung to be treated and all target airways are inspected before treatment begins. The bronchoscopist plans the order in which the airway segments are to be accessed and treated, assisted by a map of the airways. Treatment planning is crucial to the thoroughness and ultimately to the success of BT, helping to avoid under- or overtreatment of the airways.
7. The bronchoscope is navigated to the first target treatment site, typically the most distal airway in the targeted lobe. The Alair Catheter is introduced through the working channel of the bronchoscope and positioned at the desired location in the airway. The electrode array at the tip of the Catheter is expanded to contact the airway wall and the bronchoscopist activates the RF Controller to deliver RF energy to the tissue.
8. The RF Controller delivers low-power, temperature-controlled RF energy to the airway, and automatically terminates the energy delivery upon completion of the cycle (approximately 10 seconds). A single activation of the Catheter delivers RF energy over a distance of approximately 5mm (the length of the exposed electrodes within the electrode array). The bronchoscopist must maintain static contact with the targeted 5 mm section during this time, even while airways remain in motion from tidal breathing.
9. The temperature set point, power limit, and delivery time are configured in the RF Controller software, and are not user adjustable.
10. Following the mapped treatment plan, the Catheter is deployed from the distal to the proximal end of the airway being treated. The Catheter is repositioned 5mm proximally after each activation and subsequent activations are performed contiguously avoiding overlap. This technique is used in all accessible airways distal to the mainstem bronchi and ≥ 3mm in diameter.
11. A systematic approach from distal to proximal, working methodically from airway to airway across the region of lung being treated is recommended to ensure that all accessible airways are carefully identified and treated only once. Depending on size and anatomy, a range of approximately 40-80 energy delivery cycles are performed.
12. BT is administered in 3 treatment sessions with a different region of the lung being treated during each session (one lower lobe in session 1; the second lower lobe in session 2; and both upper lobes in session 3). Each treatment is scheduled approximately 3 weeks apart. For the upper lobe regions (treated together typically in one treatment session), the procedure is identical to above, but requires additional time, as it involves navigating the tortuous anatomy of the upper airways and covers more area than either lower lobe. Depending on patient size and anatomy, a range of approximately 60-100 energy delivery cycles are performed.
13. The patient is followed in the recovery room until lung function returns to acceptable levels. This often takes up to 4 hours for each treatment session. See post-procedure follow up section for more details.

5. Post Procedure Follow Up:

1. Up to about 4-hour observation and recovery/monitoring period following each procedure.
2. Spirometry, breath sounds and vital signs (heart rate, blood pressure, temperature, respiratory rate, pulse oximetry) before discharge.
3. Discharge if Post-bronchodilator FEV1 is ≥ 80% of the pre-procedure value and patient is feeling well.
4. Verify prophylactic use of prednisone or equivalent the day following each bronchoscopy.
5. Contact patient via phone calls 1 day, 2 days and 7 days to assess post-procedure status.
6. Office visit at 2 to 3 weeks to assess pulmonary function and schedule subsequent bronchial thermoplasty procedures as appropriate.
7. Follow-up visits for long-term monitoring of improvement of asthma status as needed.

6. Outcome:

The Asthma Intervention Research 2 (AIR2) Trial evaluated the safety and effectiveness of the Alair Bronchial Thermoplasty System. The data from that study was submitted to the FDA and was the basis for the agency's approval of a novel device for the treatment of asthma. The AIR2 data was also published in the January 15, 2010 issue of the *American Journal of Respiratory and Critical Care Medicine (AJRCCM)*. The trial demonstrated that treatment with the Alair System resulted in improved asthma quality of life, as well the following clinically significant benefits over sham during long-term follow-up:

- 32 % reduction in asthma attacks
- 84 % reduction in emergency room visits for respiratory symptoms
- 73 %reduction in hospitalizations for respiratory symptoms
- 66 % reduction in days lost from work/school or other daily activities due to asthma

7. Conclusion:

Bronchial thermoplasty delivered by the Alair System provides a novel, procedure-based treatment for severe asthma that is refractory to conventional therapy. Pulmonologists, allergists, asthma experts, and respiratory therapists should become familiar with the use of bronchial thermoplasty and appropriate selection and management of patients for this procedure. Randomized, controlled clinical trials to date with bronchial thermoplasty have demonstrated significant improvement in outcomes that are important to our patients: quality of life, asthma symptoms, severe exacerbations requiring corticosteroids, days lost from work/school/other daily activities due to asthma, and healthcare utilization. Unlike the currently used drug therapies which require daily use to manage symptoms, bronchial thermoplasty provides benefits and improvements in overall asthma control that are long lasting.

Disclosures

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