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Bronchial Thermoplasty Under General Anesthesia Using Second Generation Supraglottic Airway Device (Ambu® Auragain): A Case Series

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Abstract

Bronchial thermoplasty is an emerging interventional bronchoscopic procedure aimed at helping patients with moderate to severe asthma. This treatment delivers thermal energy to the bronchial wall during bronchoscopies which leads to an improvement in asthma escaping to conventional pharmacological treatment. Bronchial thermoplasty is performed under mild or deep sedation or general anesthesia requiring tracheal intubation or laryngeal mask insertion. However, sedation presents some secondary effects such as coughing, apnea and patient and/or pneumologist discomfort while general anesthesia with intubation is more invasive and is associated with potentially harmful hemodynamic instability. We therefore decided to perform bronchial thermoplasty with a second-generation supraglottic airway device: Ambu® AuraGain (Ambu A/S, Ballerup, Denmark). This device is anatomically curved and offers a higher seal pressure as well as a clear view of the glottis inlet. Here, we report the use of a second-generation supraglottic airway device (Ambu® AuraGain) in four patients undergoing 12 procedures.

Keywords: *Bronchial Thermoplasty; General Anesthesia; Supraglottic Airway Device*

Abbreviations

BT: Bronchial Thermoplasty; FiO_2: Fraction of Inspired Oxygen; GA: General Anesthesia; NMT: Neuromuscular Transmission; RF: Radiofrequency; SaO_2: Blood Gas Analysis Blood Saturation; SpO_2: Continuous Pulse Oximetry; TCI: Target Control Infusion

Introduction

Bronchial thermoplasty (BT) is an emerging interventional bronchoscopic procedure aimed at helping patients who are suffering from moderate to severe asthma. This treatment results in an improvement in asthma control [1]. In asthma, the airway smooth muscle has an increased contractility leading to bronchoconstriction as well as an increased mass leading to a remodeling of the airway with functional consequences. Long acting β2-agonists are the first line of treatment. Adjunction of anti-inflammatory agents including high-dose oral corticoids leads to long term stability in the majority of patients. Sometimes, the medication doesn't work hence the idea of a non-pharmacological approach by delivering thermal energy during bronchoscopies to induce a prolonged reduction of the airway smooth-muscle mass along with improved contractility [2] and a hypothetically decreased secretion of inflammatory mediators by airway smooth muscle cells [3].

BT is performed under mild or deep sedation [4,5] or general anesthesia (GA) requiring tracheal intubation or laryngeal mask insertion [6]. However, sedation can be unsatisfactory as coughing and apnea do occur, causing patient and/or bronchoscopist discomfort while GA with intubation is more invasive and carries the potential risk of harmful hemodynamic instability [7]. We therefore decide to perform BT with a second- generation supraglottic airway device: Ambu® AuraGain (Ambu A/S, Ballerup, Denmark). This device is anatomically curved and offers a wider integrated gastric access channel compared with other supraglottic devices [8]. Furthermore, it offers a higher seal pressure and a clear view of the glottis inlet in all patients. This enhanced visibility of the glottis inlet allows us to guide direct tracheal intubation if required [9]. The use of a second- generation supraglottic airway device (Ambu® AuraGain) in 4 patients undergoing 12 BT procedures is herein reported.

Materials and Methods

Case series presentation

Ethical committee number B3920154170 and ANZCTR number ACTRN12615001198516 were assigned to this case series. All patients gave written informed consent. Four patients scheduled for BT based on the criteria used in the Asthma Intervention Research 2 Trial Study [10] were enrolled. A total of 12 procedures were studied.

BT consists of the cautious application during bronchoscopy of radiofrequency (RF) electrical energy to the airway wall especially since there are no macroscopic signs with the exception of temporary bleaching of the mucosa [3]. BT is performed using the Alair Bronchial Thermoplasty System (Boston Scientific, Natick, MA, USA) comprising the Alair RF generator and the catheter electrode that is inserted in the flexible bronchoscope.

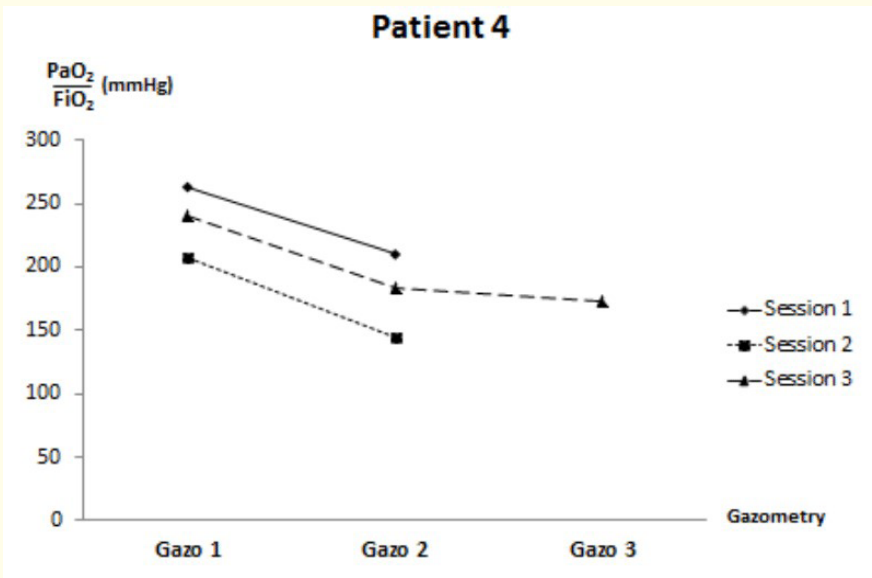
Performing BT requires dexterity, a good knowledge of the airway anatomy and an excellent direct endoscopic vision. A full treatment consists of 30 to 70 activations per treatment, at least 3 weeks apart. Each activation targeting a 5 mm zone of bronchus with a diameter between 3 and 10 mm. The time duration of each session is around 60 minutes [11]. The order of lobe treatment during bronchoscopy is: right lower (BT 1), left lower (BT 2) and right and left upper (BT 3) during the last procedure [12]. Regarding the right middle lobe, no experience have to date been reported due to potential and theoretical concern about middle lobe syndrome [13]. This entity is characterized by recurrent or chronic collapse of the middle right lobe, which is often related to asthma [14].

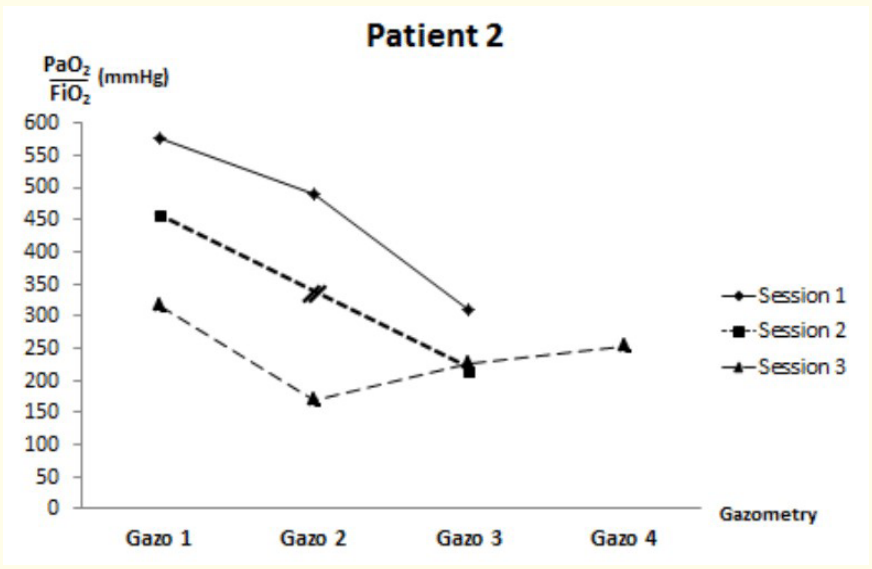
In addition to the patient's chronic treatment, the daily oral corticoid dose was increased to 32 mg of methylprednisolone three days prior to the BT session in order to minimize post-procedural inflammation. Premedication consisted of 0.5 mg of alprazolam PO. After using the World Health Organization Checklist [15] including an assessment of adequate fasting to avoid pulmonary aspiration, appropriate monitoring was applied including: 3-lead electrocardiogram, continuous pulse oximetry (SpO_2), noninvasive blood pressure, depth of anesthesia and neuromuscular transmission (NMT) monitoring. General anesthesia was accomplished with remifentanil and propofol via Target Control Infusion (TCI). During maintenance the infusion was adapted according to the hemodynamic response and a bispectral index between 40 and 60. As soon as the patient lost consciousness and manual ventilation was possible, a bolus dose of rocuronium of 0,6 mg/kg was administered to achieve deep neuromuscular relaxation (post-tetanic count 1 - 2) [16] not only during the Ambu® AuraGain insertion but also during the entire procedure to ensure immobilization, vocal cord adduction and prevention of patient coughing. Patients also received 2 mg/kg of methylprednisolone, 2 gr of magnesium sulfate and 0.5 mg epinephrine tartrate SC in order to improve bronchodilatation [17]. After induction, invasive arterial pressure by radial artery cannulation was performed and blood gas analyses were carried out at 15 minutes intervals. The size of the Ambu® AuraGain was selected according to the manufacturer's recommendations: size 4 for a body weight between 50 and 70 kg and size 5 for a body weight between 70 and100 kg; it was inserted completely deflated and lubricated with sterile saline. A manometer was used to inflate the cuff. Ventilation was achieved with volume-controlled ventilation Autoflow: all the breaths were pressure-controlled, with a delivered level of support-peak pressure alarm - that varies from breath to breath to deliver the set tidal volume [18] - 6 to 8 ml/kg to achieve an end tidal CO_2 between 35 and 40 mmhg. The fraction of

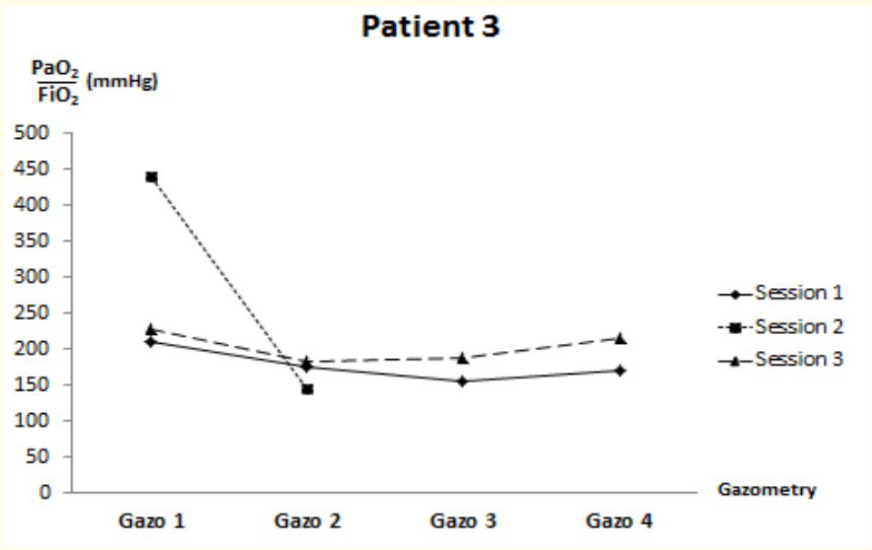
inspired oxygen (FiO_2) is adjusted according to the result of SpO_2 and the result of blood gas analysis blood saturation (SaO_2). Inspiration/Expiration time (I/E) was maintained between 1:2 and 1:3. Arterial saturation below 93% was defined as desaturation. Analgesia was achieved with paracetamol and tramadol. At the end of the BT, propofol and remifentanil infusions were stopped. Residual neuromuscular block was counteracted by sugammadex at a dose of 4mg/kg to achieve a train of four ratio above 90% [16]. Once spontaneous respiration resumed, the Ambu® AuraGain was removed and the patient was taken to the recovery room. Patients were monitored in the recovery room for at least 2 hours. Blood gas analyses were performed upon arrival and upon discharge. Inhaled aerosols (ipratropium bromide/fenoterol bromhydrate: 0.5 mg/1.25 mg and epinephrine tartrate 0.5 mg) were administered upon arrival. Post-procedure stay was 3 days to avoid re-admission reported in other studies [19,20].

Results and Discussion

All the Ambu® AuraGain devices were introduced at the first attempt, with no mucosal trauma. Blood gas analyses showed decreased PaO_2/FiO_2 in 10 sessions at the end of the procedure (Figure 1).







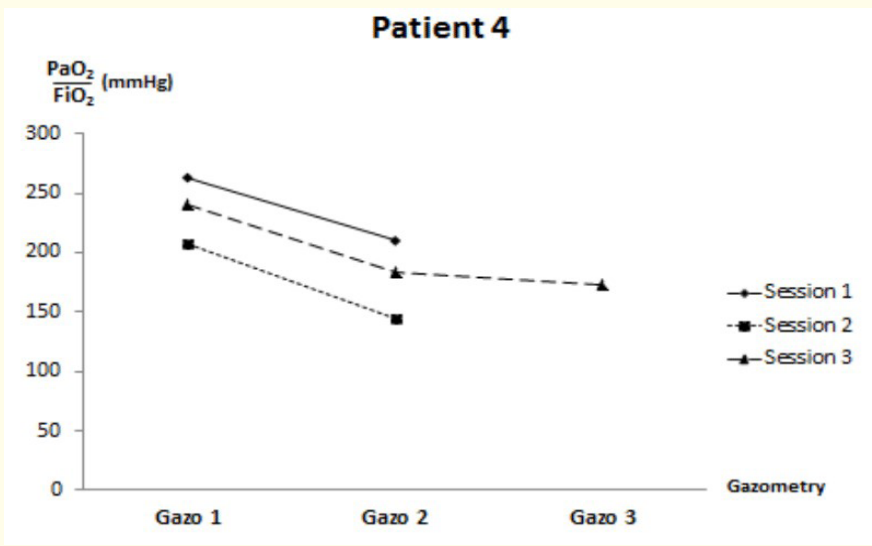


Figure 1: *(Patient 1-4): Evolution of $Pa0_2/FiO_2$ during the 3 sessions in each patient.*

SpO_2 was never below 93% for FiO_2 between 0.45 and 0.7 during BT. In the recovery room, no severe acidosis was recorded (pH below 7.25), $PaCO_2$ was between 31 mmhg and 45 mmhg and no desaturation was observed. All the sessions were performed without interruption for coughing episodes, bronchoscopist discomfort or other intercurrent problems. No BT procedures were delayed for asthma exacerbation or infection. No intra-hospital event were recorded and there were no readmissions to the hospital in the following 7 days.

BT is performed with a wide range levels of sedation ranging from mild sedation with midazolam and fentanyl [5], TCI of propofol combined with remifentanil [21] or dexmedetomidine or deep propofol sedation [4] or general anesthesia with supraglottic device or tracheal intubation [6].

Wang., *et al*. recently highlighted the suitability to performing BT with controlled ventilation with improved laryngeal mask airway compared to high-frequency jet ventilation through Wei jet nasal airway [8]. Second -generation supraglottic devices besides to offering a gastric access allowing a possible gastric tube placement allowing an active gastric content suction, haven proven seal pressure up to 40 cmH20. This high seal pressure is ensured with low cuff inflation which reduces the trauma caused by pressure on soft tissue. In our series, the seal pressure achieved was deemed adequate to deliver ventilation in accordance with the predefined parameters (described above) in all the asthmatic patients. Adequate steal pressure was deemed correct by the absence of leaks around the procedure site. It should be borne in mind that during BT, a flexible bronchoscope is inserted via a Mainz connector and surrounding leakage can occur leading to unstable mechanical ventilation, hence the choice of intravenous anesthesia. An interesting device that could be used in the future, involves fusing a flexible catheter mount to a laparoscopic trocar used as an adaptor to solve the issue of air leakage occurring dur-

ing bronchoscopy performed under general anesthesia [22] Supraglottic devices have also yielded a reduction in laryngospasm during emergence, a reduction in postoperative hoarse voice and coughing compared with endotracheal intubation [23]. Also, in the asthmatic population, when regional anesthesia is unavoidable, supraglottic devices have been found to be safer when compared to tracheal intubation, which offers a further argument favoring this type of device [24].

In our patients, all the Ambu® AuraGain devices were easily inserted at the first attempt with no mucosal trauma [25]. General anesthesia was also beneficial in reducing anxiety and pain due to activations by the BT catheters and the level of respiratory distress compared to local anesthesia or mild sedation [26,27]. Bronchoscopist was pleased with the working conditions including absence of coughing episodes, movement and easy insertion of the flexible bronchoscope helped by a good glottis inlet thanks to the supraglottic device.

The mean time duration of the 3 BT sessions we recorded (between 26 and 73 minutes) knowing that BT3 sessions were always longer as they concerned 2 lobes, was in accordance with literature, the mean procedure duration reported being between 40 and 60 minutes [11]. As regards the blood gas analysis, we also reported a reduction of the PaO_2/FiO_2 throughout the procedure with no severe desaturation or bronchospasm. The underlying involved mechanism is assigned to an increased bronchic hyperactivity due to thermal aggression by BT catheter and the procedure itself [28].

Conclusion

In accordance with the American College of Chest Physicians consensus statement, suggesting that all physicians who perform bronchoscopy should use topical anesthetic, analgesic and sedative agents when feasible, we reported our small single-center experience describing the feasibility of BT under general anesthesia [29]. Total intravenous anesthesia is reported with deep neuromuscular block and the insertion of second- generation Ambu® AuraGain supraglottic airway devices. All the supraglottic devices were inserted at the first attempt without mucosal trauma and with a seal pressure allowing volume-controlled ventilation in severe asthmatic patients. The bronchoscopist's working conditions were described as excellent among others things because of the strict immobility of the patient allowing the realization of this high precision procedure and the easy flexible bronchoscope insertion through the supraglottic airway device. No severe desaturation, no episodes of coughing and no asthma attacks being reported during the procedure. The type of anesthesia during BT is still matter in debate and require further large-scale studies.

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Conflict of Interest

None.

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