RESEARCH COMMUNICATION

Safety and Efficacy of Argon Plasma Coagulation for Resection of Lipomas and Hamartomas in Large Airways

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Abstract

Aims: To describe the use of argon plasma coagulation (APC) for radical resection of lipomas and hamartomas in large airways. Methods: Eight patients (7 males and 1 female) were retrospectively reviewed. Data extracted included patient demographic characteristics, type and location of lesion, type of anesthesia used, number of APC sessions required, complications, length of hospital stay, and outcomes. All patients were followed-up for a minimum of 24 months. Results: The patients had a mean age of 54.6 ± 13.5 years. Lipomas were diagnosed in five and hamartomas in three. Because complete removal of the tumor could not be achieved during one session, two additional APC treatments were carried out in one of the patients, and three in another. Duration of each procedure ranged from 90 to 120 minutes. For the six patients performed under general anesthesia, only one session was required, and the mean time was 110 min. All tumors were completely removed, and no perioperative or long-term complications occurred. During a minimum follow-up of 2 years, no recurrence was noted in any patient. Conclusions: Complete resection of lipomas and hamartomas inside large airways can be safely achieved via APC. Further studies regarding the use of this technique for other tumor types are warranted.

Keywords: Argon plasma coagulation - lipomas - hamartomas - tumor resection

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Introduction

Lipomas and hamartomas, like any masses located in the large airways, can result in airway obstruction, dyspnea, bleeding, intractable cough, and post-obstructive pneumonia (Morice et al., 2001). Medical management for these conditions is ineffective, and open surgery can cause serious injuries to the airways and/or local restenosis can occur postoperatively. Over the past several years, a number of minimally invasive interventional techniques have been developed, and as a result several endobronchial therapies are currently available for interventional bronchoscopists including neodymium-doped yttrium aluminum garnet (Nd:YAG) lasers, as well as other lasers and endobronchial electrocautery (Morice et al., 2001). While these methods are capable of removing tumors located in the airways, they are not without risk and in many cases all of the target tissue is not reachable (Morice et al., 2001; Bolliget et al., 2006).

Argon plasma coagulation (APC) is another minimally invasive technique permits rapid coagulation, and requires little manipulation of the target. Advantages of APC include its portability, simplicity to operate, and cost (Morice et al., 2001; Bolliget et al., 2006). APC is becoming increasingly popular; however, despite being studied in various patient settings (Reichle et al., 2000; Okada et al., 2001; Tremblay and Marquette, 2004), more data regarding the effectiveness and safety in the treatment of various airway conditions, particularly benign and malignant tumors, is needed. The purpose of this report is to describe radical resection of lipomas and hamartomas in large airways. This appears to be the first report of such curative not palliative of these tumors.

Materials and Methods

Patients

Medical records of eight patients diagnosed with lipomas or hamartomas based on histopathological examination of bronchoscopy biopsy specimens that underwent APC therapy between 2003 and 2007 were respectively reviewed. Patients were included if the tumor was located in the lumen of the airway, the diameter of the tumor was between 5 to 10 mm, and if there was functional lung distal to the obstruction making relief of postoperative pneumonia possible. All patients were followed-up for a minimum of 24 months (patients with less than 24 months follow-up were excluded). This study was approved by the Institutional Review Board of our hospital, and because of the retrospective nature, the requirement of patient informed consent was waived.

APC Method

Local anesthesia was administered with a flexible

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bronchoscope (Olympus, Tokyo, Japan) passed through the nasal cavity and glottis into the airway, or general anesthesia was induced followed by tracheal intubation and mechanical ventilation. Local anesthesia was administered by the endoscopist performing the procedure, and general anesthesia by an anesthesiologist. Next, as described previously (Reichle et al., 2000; Morice et al., 2001; Dang and Zhang, 2007), a flexible bronchoscope was inserted through the endotracheal tube or a rigid bronchoscope (Karl Storz, Tuttlingen, Germany) was inserted and the flexible bronchoscope was inserted through the rigid bronchoscope. The APC catheter (APC 300; ERBE, Elektromedizin Ltd., Tubingen, Germany) was inserted proximal to the lesion in the airway through the working channel of the bronchoscope. The lesion was visualized and coagulated, and necrotic tissue was removed with a grasping forceps. Coagulation and resection were performed until the intraluminal lesion was completed removed, and the surface of the lesion was parallel to the normal airway wall. An energy of 40 to 60 W and an argon flow rate of 0.3 to 2.0 L/min were used for resection of the intraluminal portion of the lesions. For resection of the lesion root and residue on the lumen wall, which was performed in all patients, only 20 to 30 W were used to ensure that the lumen of the airway was not penetrated. An APC probe of 2.3 mm was used in all cases, and an optimal distance of the probe tip to the target of 3-5 mm was used. In all patients, heart rate (including electrocardiogram), respiration rate, blood oxygen saturation, and blood pressure were continuously monitored during the procedure. Procedure success was defined as complete removal of the lesion.

Clinical Outcomes

Follow-up bronchoscopy was performed 24-72 hours after the procedure to ensure all necrotic tissue was completely removed prior to discharge. Follow-up bronchoscopies were performed 3, 6, 12, and 24 months after the initial procedure. If recurrence was suspected, a

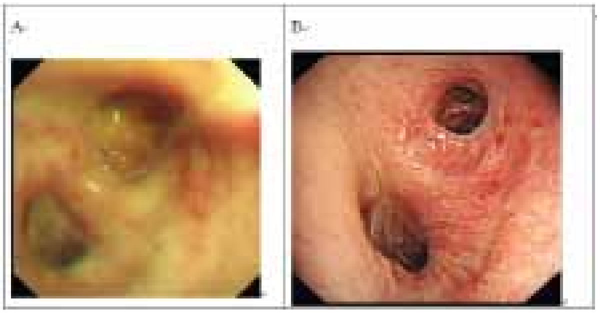

Figure 1. A) Prior to Interventional Treatment, Bronchoscopy Revealed the Left Upper Lobe Bronchus was Obstructed by a Lipoma. B) Two Months after Argon Plasma Coagulation, the Obstruction has been Relieved, and the Surgical Site is well Healed.

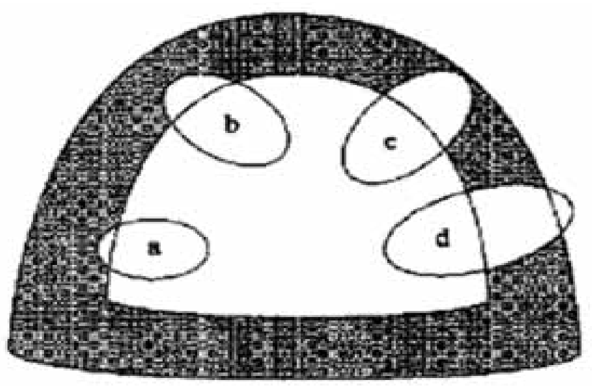

Figure 2. Diagrammatic Description of the Various Locations of Intraluminal Airway Lesions. A) Superficial lesion, which can be eradicated. B) Shallow invasive lesion, which might be treatable. C, D) Deep, invasive lesions which cannot be treated. (Reprinted with permission of Dang BW. [Rational design of the intervention treatment for central airway obstruction disease] Chinese J Tuberc Resp Dis2007;30:452-455.)

biopsy was performed. Patients were no longer followed-up once the base of the former lesion healed completely without tumor recurrence. Complete healing was defined

Table 1. Patient Demographic and Clinical Data

Patient	Sex	Age (years)	Pathology	Location of Lesion	Size of Lesion (mm)	Anesthesia	Bronchoscope	Number of Treatment Session	Total Duration of Treatments (h)
1	M	54	Lipoma	Left Lower Lobe Bronchus	10	Local	Flexible	3	5
2	M	56	Lipoma	Left Upper Lobe Bronchus	10	Local	Flexible	4	8.5
3	M	60	Lipoma	Left Main Bronchus	10	General	Flexible	1	2
4	F	35	Lipoma	Left Upper Lobe Bronchus	10	General	Flexible	1	2.75
5	M	68	Lipoma	Apicoposterior Segment of the Left Upper Lobe Bronchus	6	General	Flexible	1	1.79
6	M	45	Hamartoma	Left Main Bronchus	10	General	Flexible	1	2.25
7	M	76	Hamartoma	Right Middle Lobe Bronchus	7	General	Flexible	1	1.16
8	M	43	Hamartoma	Right Intermediate Bronchus	10	General	Rigid and Flexible	1	1.08

as no obstruction of the lumen, pulmonary tissue was expanded, and the original symptoms were resolved.

Results

Eight patients (seven male), with a mean age of 54.6 ± 13.5 years (range, 35 to 76 years), were included in this study. Patient demographic, clinical, and treatment data are presented in Table 1. Presenting symptoms included chest tightness and shortness of breath (n = 8), dyspnea (n = 3), and cough (n = 8). Lipomas were diagnosed in five patients, and hamartomas were diagnosed in three patients. Airway obstruction diagnosed via bronchoscopy was present in all eight patients, and atelectasis was present in the left upper lobe in one patient, and in the right lower lobe in another patient. All patients also received chest computed tomography (CT) to rule out other pulmonary conditions. All patients had post-obstructive pneumonia, and were receiving antibiotics. In all cases, antibiotics were continued postoperatively.

Two of the eight patients underwent treatment under local anesthesia (Table 1). Because complete removal of the tumor could not be achieved during one session, two additional APC treatments were carried out in one of the patients, and three in the other. Duration of each procedure ranged from 90 to 120 minutes. For the six cases performed under general anesthesia, only one session was required, and the mean time was 110 min (range, 60-180 min). During APC treatment, the oxygen concentration was maintained at < 40% (Reichle et al., 2000; Morice et al., 2001). For patients treated under general anesthesia, synchronized intermittent mandatory ventilation was used with a tidal volume of 6-8 ml/kg of body weight and respiratory frequency of 15-20/min (Reichle et al., 2000; Morice et al., 2001). The peak voltage warning was set to 40 cm H2O. In 3 patients with tumors of the left main bronchus, the initial tidal volume was 350 ml. Ventilation was performed according to the method mentioned above after the tumor was partially removed and the left main bronchus was partially reopened.

Complete removal of the lesion and immediate airway patency was achieved in all cases. In the two patients with atelectasis, the affected lobes expanded within 2 weeks of APC. Patient symptoms resolved completely following APC, and did not recur during the follow-up period. Pre- and postoperative images of a representative case are shown in Figure 1.

A mild, dry cough developed in the two patients who were treated with APC with local anesthesia after the repeat treatments. In both cases, the cough was transient and resolved without medical treatment after the procedure. No other patients experienced a cough, and no other complications were noted during the immediate postoperative period. There was no 30-day morbidity or mortality associated with the procedure. The mean length of stay of the 6 patients who received general anesthesia was 13.3 days (range, 8-16 days). In two of these patients, repeat APC sessions were required, which lengthened their hospital stays. The length of hospital stays for the 2 patients who received local anesthesia were 18 and 27 days. Local anesthesia was administered by the physician who performed the procedure.

No procedure related morbidity occurred during the 24 month follow-up period, and no evidence of recurrence was noted during the follow-up period in any patient, thus no follow-up biopsies were performed.

Discussion

Based on this small case series, APC appears to be effective and safe for treating lipomas and hamartomas in the large airways, and there were no procedural differences for treating the two conditions. Removal relieved obstruction and restored airway function. Lipomas and hamartomas are not malignant, and they originate from the submucosa and grow into the lumen. Since the depth of APC coagulation is 2 to 3mm (Reichle et al., 2000), APC can effectively destroy the residual tumor tissue within the airway wall. The success of APC in the management of these tumors types is likely related to the fact that lipomas and hamartomas have a poor blood supply and contain a relatively large amount of adipose tissue, thus have greater electrical resistance. Because of this, more heat will be produced for a given amount of current, thereby facilitating resection of the lesion.

APC uses an electrically conductive argon plasma (in which the argon atoms are ionized) to deliver a high-frequency current via a flexible probe that does not directly contact the tissue (Morice et al., 2001). This technology permits rapid coagulation, and requires little manipulation of the target. Advantages of APC include its portability, simplicity to operate, and cost (Morice et al., 2001; Bolliget et al., 2006). In addition, with APC the target tissue(s) can be accessed in either a linear or curved, “around the corner”, path. APC effectively provides hemostasis and is universally considered a safe technique due to the limited penetration of the beam (Morice et al., 2001). Unlike when using the Nd:YAG laser, the use of APC does not require goggles.

APC for the treatment of airway lesion can be performed under general anesthesia, or local anesthesia with sedation. In general, local anesthesia with sedation is appropriate if the lesion is small (≤ 5mm) and only one treatment session is required. General anesthesia is appropriate for larger tumors that will require more than one treatment session, a prolonged treatment, or when there is significant airway obstruction. In the cases presented herein, two that required more than one treatment session were treated with local anesthesia; this was because we had not begun performing the procedure under general anesthesia at our hospital when those cases were treated. Though most cases were performed with flexible bronchoscopes, in once case a rigid scope was used because the tumor was relatively large and it completely obstructed the opening of the right middle lobe bronchus and the surgical time is typically longer using a flexible scope. While all of the patients described herein had lesions in the large airways, the method can be used to treat tracheal lesions. All of our patients were receiving antibiotics for the treatment of pneumonia. The use of perioperative antibiotic prophylaxis is recommended for cases in which antibiotics are not being administered for other reasons.

In the case series described herein, no complications were noted either after the procedure, or during the 2-year follow-up period. Potential complications that have been described in the literature include bronchial perforation, airway wall necrosis, neurological events, fire, and death (Reichle et al., 2000; Morice et al., 2001; Okada et al., 2001; Tremblay and Marquette, 2004). As noted by Tremblay and Marquette (2004), complications directly related to APC are rare (Tremblay and Marquette, 2004).

Cryotherapy and high-frequency electrical stimulation can cure early-stage cancers if the lesions are confined to mucosa and there are no metastases (van Boxem et al., 1998; Deygas et al., 2001; Vonk-Noordegraaf et al., 2003). If not completely removed, however, residual tumor in the wall of the airway may grow and re-obstruct the airway. Therefore, removal of residual tumor inside the airway wall is necessary to completely treat the lesion. Thus, if endobronchial techniques such as APC are to be successful, the lesion must be superficial and the residual tumor tissue inside the wall of the airway must be destroyed (Figure 2) (Dang, 2007). All of the patients described herein had benign, superficial lesions (Figure 2a), thus APC could be considered a first-line interventional therapy. Though one can use a YAG laser or mechanical debridement, and apply APC to the base of the lesion, simple mechanical debridement may result in bleeding and obscure the operative field. We did not consider using a YAG laser, because it was not available at our hospital.

In conclusion, complete resection of lipomas and hamartomas inside large airways with can be safely achieved via APC. Further studies regarding the use of this technique in other tumors types are warranted.

Acknowledgments

The first author performed the interventional therapy, patient follow-up, and prepared the report. The second author attended the interventional therapy for six of the eight patients, and prepared the report.

References

Bolliger CT, Sutedja TG, Strausz J, et al (2006). Therapeutic bronchoscopy with immediate effect: laser, electrocautery, argon plasma coagulation and stents. *Eur Respir J*, **27**, 1258-71.

Dang BW (2007). Rational design of the intervention treatment for central airway obstruction disease. *Chinese J Tuberculosis Respiratory Dis*, **30**, 452-5.

Dang BW, Zhang J (2007). The efficacy of endobronchial argon plasma coagulation in the management of intraluminal obstructive lesions of the central airway. *Chinese J Tuberculosis Respiratory Dis*, **30**, 330-3.

Deygas N, Froudarakis M, Ozenne G, et al (2001). Cryotherapy in early superficial bronchogenic carcinoma. *Chest*, **120**, 26-31.

Morice RC, Ece T, Ece F, et al (2001). Endobronchial argon plasma coagulation for treatment of hemoptysis and neoplastic airway obstruction. *Chest*, **119**, 781-7.

Okada S, Yamauchi H, Ishimori S, et al (2001). Endoscopic surgery with a flexible bronchoscope and argon plasma coagulation for tracheobronchial tumors. *J Thorac Cardiovasc Surg*, **121**, 180-2.

Reichle G, Freitag L, Kullmann HJ, et al (2000). Argon plasma coagulation in bronchology: a new method-alternative or complementary? *J Bronchol*, **7**, 109-17.

Tremblay A, Marquette CH (2004). Endobronchial electrocautery and argon plasma coagulation: a practical approach. *Can Respir J*, **11**, 305-10.

van Boxem TJ, Venmans BJ, Schramel FM, et al (1998). Radiographically occult lung cancer treated with fibreoptic bronchoscopic electrocautery: a pilot study of a simple and inexpensive technique. *Eur Respir J*, **11**, 169-72.

Vonk-Noordegraaf A, Postmus PE, Sutedja TG (2003). Bronchoscopic treatment of patients with intraluminal microinvasive radiographically occult lung cancer not eligible for surgical resection: a follow-up study. *Lung Cancer*, **39**, 49-53.