Science Journal of Clinical Medicine
2020; 9(2): 37-42
http://www.sciencepublishinggroup.com/j/sjcm
doi: 10.11648/j.sjcm.20200902.14
ISSN: 2327-2724 (Print); ISSN: 2327-2732 (Online)

Aetiologic Diagnosis and the Efficacy of Interventional Treatment of Intraluminal Central Airway Spheroid Masses

Wei Song, Wangjian Zha, Jiwang Wang*

Department of Pulmonary and Critical Care Medicine, the First Affiliated Hospital of Nanjing Medical University, Nanjing, China

Email address:
wangjiwangnanjing@163.com (Jiwang Wang)

*Corresponding author

To cite this article:
Wei Song, Wangjian Zha, Jiwang Wang. Aetiologic Diagnosis and the Efficacy of Interventional Treatment of Intraluminal Central Airway Spheroid Masses. *Science Journal of Clinical Medicine*. Vol. 9, No. 2, 2020, pp. 37-42. doi: 10.11648/j.sjcm.20200902.14

Received: May 14, 2020; **Accepted**: June 4, 2020; **Published**: June 17, 2020

Abstract: *Objective* To explore the diagnosis of, clinical characteristics of and effects of interventional therapy for intraluminal central airway spheroid masses. *Methods* Forty-four patients with intraluminal central airway spheroid masses were summarized retrospectively, and the clinical characteristics and therapy were analysed. *Results* Cough and shortness of breath were the predominant symptoms, followed by hemoptysis, fever and chest pain. The aetiologic diagnoses were 12 cases of inflammatory granulomas, 5 cases of foreign matter, 5 cases of squamous carcinoma, 4 cases of leiomyoma, 3 cases of lipomyoma, 2 cases of inflammatory myofibroblastic tumor, and one case each of glomus tumor, adenocarcinoma, mucoepidermoid carcinoma, malignant melanoma metastasis, carcinoid, adenoid cystic carcinoma, chondrosarcoma, combined small cell carcinoma, hamartoma, mixed tumor, neurilemmoma, acidophilic adenoma and salivary gland tumor. The numbers of masses located in the trachea, left main bronchus, right main bronchus and bronchus intermedius were 20, 13, 7, and 4, respectively. Electrocautery snare and electrocoagulation probe was the most commonly used interventional therapy method, followed by argon plasma coagulation and cryotherapy; stent implantation was used in 1 case. Thirty-five cases achieved a complete response or partial response after treatment, 8 cases achieved a mild response, and 1 had no response. *Conclusion* The symptoms of intraluminal central airway spheroid masses were atypical and easily misdiagnosed or missed; benign lesions were the leading cause, and the first pathological type was inflammatory granuloma. Endoscopic intervention was the effective, safe technique.

Keywords: Central Airway Obstruction, Bronchoscopes, Diagnosis, Interventional Therapy, Electrocautery

1. Introduction

The central airway includes the trachea, right and left main bronchi and bronchus intermedius. Central airway obstruction (CAO) caused by intraluminal spherical masses is relatively rare and can be caused by multiple benign or malignant lesions that are easily misdiagnosed or missed. Due to the specific lesion site, many patients have urgent, critical symptoms at the time of treatment, and the disease progresses so quickly that the patients are prone to asphyxia; therefore, substantial attention should be paid to these lesions [1]. Intraluminal central airway masses vary in shape; most are irregular, but spheroid masses are occasionally encountered. Very few studies have reported the disease with a description of the morphology of the lesions. We collected 44 patients with masses that occurred in the central airway and had intracavitary growths with spherical or rounded shapes under direct visualization by a flexible bronchoscope who were seen in the past 6 years in our hospital, analysed the pathologies and effects of interventional therapy, and explored the outcomes and characteristics of these diseases. We expect the results of this study to help focus the attention of clinicians on this issue.

2. Materials and Methods

2.1. Study Population

A total 2056 inpatients and outpatients receiving bronchoscopic interventional therapy from January 2014 to November 2019 were collected. Ultimately, 44 patients (2.14%) were identified as having intraluminal central airway spheroid masses. This retrospective review was approved by

the Institutional Review Board of the First Affiliated Hospital of Nanjing Medical University.

Contrast-enhanced thoracic CT were performed before surgery in all patients. Some patients with no apparent risk factors underwent flexible bronchoscopy under local anesthesia to confirm the locations of the lesions, the degree of stenosis and the relationship with the surrounding tissues. Interventional treatment was performed under general anaesthesia using a laryngeal mask airway or rigid bronchoscopy.

2.2. Anesthetic Methods

For local anesthesia, 2% lidocaine was applied onto the mucosal surface of the tracheal bronchus and midazolam was used via intravenous injection. For general anaesthesia. Intravenous anesthetics like propofol, fentanyl, and remifentanyl were used routinely which was conducted by anesthetists. Neuromuscular blockers were not regularly used. For the rigid intubation, once intubation and ventilation was complete, the therapeutic interventions were initiated. For the laryngeal mask airway (LMA), the bronchoscope was introduced through a silicone LMA with a T-connector.

2.3. Interventional Procedures

2.3.1. High-frequency Electrocautery

An electrocautery snare was used to resect the pedicle tumor or polyps. If the mass had a broad base, an electrocoagulation probe was used to carbonize the lesions. The output power of the electric coagulation was 35~40 watts and that of the electrotomy was 30~35 watts, with a duration of less than 10 seconds per time. Argon plasma coagulation (APC: 1.0–1.6 L/min volume flux of argon gas and output power of 30–60 watts) was applied to the base of the lesion. Intermittent cauterization was applied (3–10 seconds per time) with intermittent flushing with ice-cold saline to keep the operative field clear, and the carbonized solidified tissues were removed promptly with biopsy forceps.

2.3.2. Carbon Dioxide Cryotherapy

The source of refrigeration was liquid carbon dioxide, and the diameter of the flexible frozen probe was 1.9–2.3 mm. After the bronchoscope reached the lesion location, the frozen probe was placed through the working hole; the distance between the metal tip of the probe and the end of the bronchoscope was more than 5 mm. The metal tip of the probe was placed on the surface of the mass or pushed into the mass and frozen for 3~60 seconds. After the freezing process, the probe and the adhesive object were retracted together under freezing conditions.

2.3.3. Airway Stent Placement

In one patient with malignant melanoma tracheal metastasis, due to serious tracheal stenosis caused by multiple intraluminal metastases, the stent was placed under direct vision via bronchoscopy. After opening the airway, interventional therapy could be performed safely. According to the length and diameter of the stenosis segment measured by pre-operative chest CT and three-dimensional reconstruction images, a 40*16 mm bare-metal stent was chosen.

2.3.4. Degree of Central Airway Stenosis

The degree of tracheobronchial stenosis proposed by Freitag was adopted [2].

2.3.5. The Immediate Efficacy Criteria for the Recanalization of Airway Stenosis [3]

Complete response (CR) indicated that the intraluminal tracheal lesions were completely cleared and the function returned to normal; partial response (PR) indicated that over 50% of the tracheal cavity was recanalized, functionality returned to fairly normal, and the symptoms improved; mild response (MR) indicated that less than 50% of the tracheal cavity was recanalized but the lung infection in the distal portion of the stenosis improved after drainage; and no response (NR) indicated that the lesion was not eliminated and the stenosis was not resolved.

3. Results

3.1. Clinical Features

The study was conducted in the First Affiliated Hospital of Nanjing Medical University. Of 44 patients, 29 males and 15 females with an average age of 58.05±19.22 years old (ranged 14~86). The main symptoms were cough (n=32), chest distress (n=23), hemoptysis (n=11), fever (n=7) and chest pain (n=3), 1 case was found during a medical check-up. The diagnosis, lesion locations were listed in Table 1. The time span from symptom onset to diagnosis ranged from several hours to 3 years.

Table 1. *Aetiologic diagnosis, lesion location , degree of airway stenosis and immediate effect after interventional therapy of intraluminal central airway spheroid masses.*

Pathological Diagnosis	Lesion Location				Degree of Stenosis					Curative Effect				Total
	T	RMB	BI	LMB	V	IV	III	II	I	CR	PR	MR	NR	(number)
Non-neoplastic lesions														
Inflammatory granuloma	8	1		3	2	3	4	2	1	6	5	1		12
Foreign matter	1	2	2		4	1				4			1	5
Benign Tumors														
Leiomyoma	3	1				2	1	1		2	2			4
Lipomyoma				3	3					1	1	1		3
Acidophilic adenoma	1						1			1				1

Pathological Diagnosis	Lesion Location				Degree of Stenosis					Curative Effect				Total
	T	RMB	BI	LMB	V	IV	III	II	I	CR	PR	MR	NR	(number)
Salivary gland tumor	1						1			1				1
Mixed tumor	1					1				1				1
Neurilemmoma	1						1					1		1
Hamartoma			1		1					1				1
Malignant Tumors														
Squamous carcinoma		1	1	3	2	2	1				3	2		5
Inflammatory myofibroblastic tumor				2	2					1	1			2
Combined small cell carcinoma		1			1							1		1
Carcinoid				1	1					1				1
Adenoid cystic carcinoma	1					1						1		1
Adenocarcinoma		1			1					1				1
Glomus tumor	1						1				1			1
Malignant melanoma metastasis	1					1						1		1
Mucoepidermoid carcinoma				1	1						1			1
Chondrosarcoma	1					1					1			1
Total (number)	20	7	4	13	18	12	10	3	1	20	15	8	1	44

T: trachea; RMB: right main bronchus; BI: bronchus intermedius; LMB: left main bronchus;
CR: complete response; PR: partial response; MR: mild response; NR: no response

Inflammatory granulations were the most common aetiology in 12 of 44 patients who underwent intervention: 4 cases were due to tracheotomies, 3 cases had a history of tracheal intubation, 2 cases were due to tracheal stent implantation after which granulation tissue formed on the end of the stent, 2 cases were due to surgical scarring, and only one case did not have a clear aetiology.

Of 44 patients, 1 patient was misdiagnosed with asthma for half a year. One patient received a delayed diagnosis because of a history of asthma for more than 30 years, and poor asthma control for more than half a month led him to visit the doctor. The other patients received confirmed diagnoses after presenting with cough, poor lung infection control, fever or recurrent lung infections.

3.2. Degree of Airway Stenosis and Interventional Therapy

Of 44 cases, the numbers of patients with grades V (Figure 1A), IV (Figure 2A), III (Figure 3A), II (Figure 4A) and I (Figure 5A) airway stenosis were 18, 12, 10, 3 and 1, respectively (Table 1). 26 cases were received LMA ventilation and 18 were received rigid intubation. Electrocautery snare (Figure 1~3B) and electrocoagulation probe (Figure 4~5B) alone or in combination were the most commonly used methods, with 33 patients and 20 patients, respectively. In addition, 9 patients received argon plasma coagulation (APC), 4 patients received carbon dioxide cryotherapy, and biopsy forceps, foreign body forceps and stent implantation were used in 1 patient each.

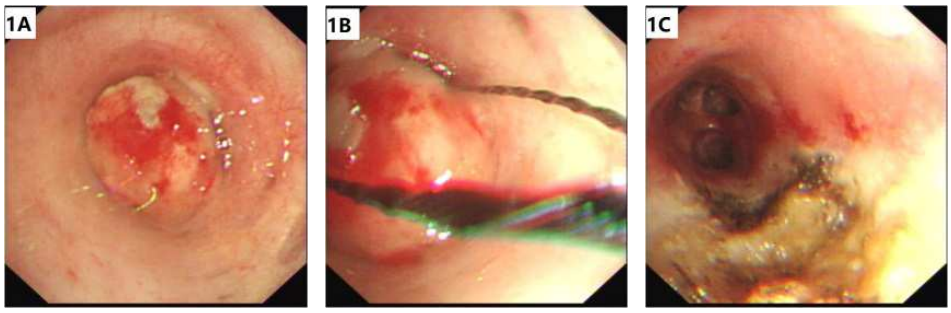

Figure 1. *Grade V airway stenosis, left main bronchus. The tumor surface was partly covered with the purulent secretion (1A), placed the electrocautery snare loop around the base of the tumor (1B)***,** *most of tumor was removed and pathology was lipomyoma (1C). The procedure was done using LMA.*

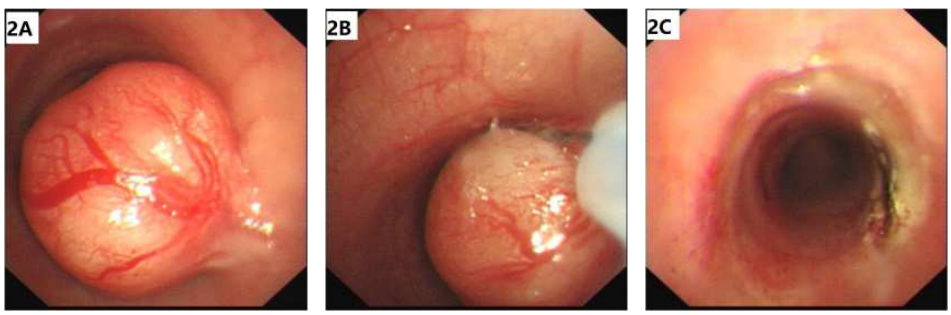

Figure 2. *Grade IV stenosis, middle part of trachea. The tumor surface was smooth with rich vascularity (2A), placed the electrocautery snare loop around the base of the tumor (2B), tumor was completely resected with little bleeding, pathology was mixed tumor (2C). The procedure was done using rigid bronchoscopy.*

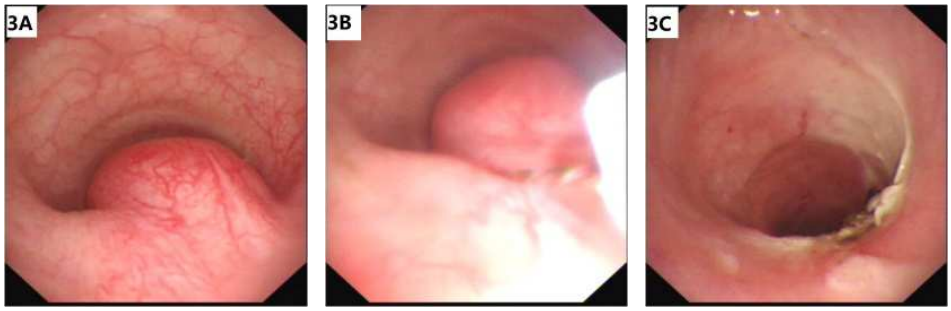

Figure 3. *Grade III stenosis, upper part of trachea (subglottic about 1cm). The tumor had a broad base, its surface was smooth with rich vascularity (3A), placed the electrocautery snare loop around the base of the tumor (3B) aided by electrocoagulation probe, tumor was resected with no bleeding, pathology was leiomyoma (3C). The procedure was done using LMA.*

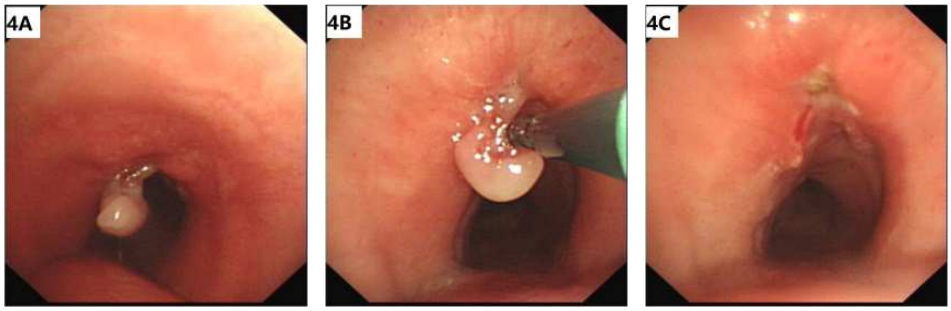

Figure 4. *Grade II stenosis, upper part of trachea at the tracheotomy site, the surface was smooth and pale with no vascularity (4A), removed the mass by electrocoagulation probe (4B), trachea back to unobstructed after intervention, pathology was inflammatory granuloma (4C). The procedure was done using LMA.*

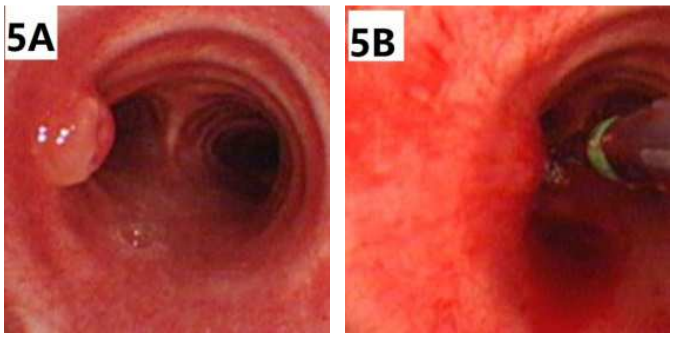

Figure 5. *Grade I stenosis, lower part of trachea, the diameter of mass was about 3mm with smooth surface and rich vascularity (5A), removed by electrocoagulation probe (5B) and pathology was inflammatory granuloma. The procedure was done using LMA.*

Electrocautery snare was the most commonly used technique to remove lesions. Airway obstruction before treatment was serious, and airway stenosis up to grade V or IV was observed in 79.55% of patients. Tumors or polyps were removed by electrocautery snare from the fundus; the postoperative wound was smooth, with little bleeding; and no perforations occurred. Tumors with pedicles could be completely resected with one cauterization, while larger lesions or lesions with a wide base needed repeated electric snare cautery or cautery combined with APC and carbon dioxide cryotherapy. Most pathological lesions disappeared after therapy, and the airway returned to an unobstructed state (Figure 1~4c). On bronchoscopic re-examination after interventional therapy, a superficial scar was found to have formed on the surgical wound; if sphacelus was found to have invaded the wound, it was removed promptly. Even for malignant tumors, similar treatment would still remove airway obstruction and avoid the risk of asphyxiation.

3.3. Curative Effect and Complications

20 patients (45.45%) achieved CR, 15 patients (34.09%) achieved PR, and 8 patients (18.18%) achieved MR after interventional therapy; only 1 patient failed to undergo a complete operation because of bleeding around the tracheal lesion (Table 1). This patient was diagnosed with a transmural calcified foreign body, and another foreign body was removed from his left main bronchus. No patients experienced serious complications during the intervention. Bloody sputum occurred in 20 patients after intervention, but all patients recovered without special treatment. Fever occurred in 7 patients, but the fever onset occurred before the therapy, and their temperatures returned to normal after receiving anti-infection treatment postintervention.

3.4. Follow-up

The patients were followed up from 3 months to 5 years after the interventional therapy. Two patients died: one was a 77-year-old squamous cell carcinoma patient who survived 5 months after treatment, and another was a patient with malignant melanoma tracheal metastasis who survived 4 months after operation. Three patients who all suffered from malignant tumor were lost to follow-up. The average follow-up time of the remaining patients was 29.08 months; for malignant lesions, the average follow-up time was 22.92 months.

4. Discussion

The symptoms of an intraluminal central airway mass may be atypical and easily misdiagnosed or missed. The symptoms are related to the size of the lesion, the speed of progression of the disease, and the underlying health status of the patient [4]. Patients may be asymptomatic or have nonspecific symptoms such as an irritated cough and expectoration when the trachea stenosis is less than 50%. When the trachea narrows to 8 mm in diameter, progressive dyspnoea on exertion may occur, which is often misdiagnosed as asthma or COPD [5]. When the tracheal diameter is reduced to 5 mm, patients have difficulty breathing even in a calm state and have symptoms of airway obstruction, such as localized wheezing and inspiratory dyspnoea [6, 7]. The patients whose lesions are located in the main bronchi or intermediate bronchus are confirmed by further examination because of recurrent obstructive pneumonia [8] or some nonspecific symptoms, such as cough and shortness of breath. In our study, 1 patient was misdiagnosed with asthma for half a year, 1 patient received a delayed diagnosis because of a more than 30-year history of asthma, and the others were diagnosed upon further examination due to uncontrolled or recurrent respiratory symptoms. All patients' diagnoses were confirmed by chest CT or bronchoscopy. Therefore, in the clinic, patients with new-onset asthma without a history of allergies or a family history of asthma, those with a suspected diagnosis of late-onset asthma or COPD, patients with a history of asthma or COPD but in whom the predisposing factors and symptoms recently markedly changed, or patients with recurrent or poorly controlled pulmonary infection, the possibility of intraluminal central airway mass should be considered. A chest CT scan is recommended as a routine test before making the above diagnosis or undertaking treatment because chest CT helps determine the location and size of the mass and the relationship between the mass and the surrounding tissue, while chest X-ray is insensitive to an intraluminal mass.

Few studies have reported the morphological characteristics of intraluminal central airway masses, and we summarized and analysed the aetiology of intraluminal central airway spherical masses in patients seen in our hospital in the past 6 years. In non-neoplastic masses, inflammatory granulations were observed in 12 cases. Granulation tissue hyperplasia was caused by a variety of factors, including ischaemia due to pneumatic compression during tracheal intubation; repeated mechanical stimulation as a result of tracheal intubation, tracheotomy or repeated replacement of a tracheostomy tube; mechanical stimulation from both ends of an airway stent; ineffective expectoration after stent implantation; and recurrent infection after long-term tracheal intubation or tracheostomy. Therefore, if patients who have a history of tracheal intubation, tracheotomy or tracheal stent exhibit symptoms of dyspnoea and if they have difficulty weaning or with decannulation, the possibility of airway stenosis should be considered. This type of spherical granulation tissue hyperplasia can be removed by electrocautery snare, electrocoagulation probe, laser or biopsy forceps. For a stenosis resulting from a scar, the use of a needle-shaped electric knife to remove the scar before repeated balloon dilatation could be considered, and attention should be paid to increasing the balloon pressure and the expansion time gradually to reduce the occurrence of complications such as airway wall injury and mucosal laceration. The causes of granulation tissue hyperplasia were difficult to remove in some patients, so repeated interventional treatments were needed. There were 5 cases of spherical foreign bodies in this study; for difficult-to-clamp or brittle spherical foreign bodies, cryotherapy could be attempted [9]. After contacting the surface of the foreign body, the freezing probe froze the body rapidly, and the foreign body and the probe were solidified and easily removed. For the foreign body with a long residence time and obvious surrounding granulation tissue hyperplasia, biopsy forceps, high-frequency electrocautery or laser can be used to remove the granulation tissue first and then remove the foreign body after fully exposing it.

Of 27 spherical neoplasms, 12 were benign, 15 were malignant. Tumor resection was performed mostly using the electrocautery snare, aided by electrocoagulation probe. When electrocautery snare was applied, the wire should be tightened slowly to avoid mechanical cutting. The most common problem of electrocautery snare was incomplete resection of lesions, so it was essential important to manage residual tissue after snare cutting. APC and cryotherapy were the most frequently methods. The penetration depth of APC was controllable and constant, making APC procedures less complicated, and much effective which equal to that of a laser on the tumor. Coagulation with argon plasma is effective in preventing recurrence from the tumor base [10]. APC was also used to stop the bleeding in 7 malignant tumor patients in our study. There was no bleeding or minor bleeding after the intervention and no recurrence has been found during the follow-up thus far for 12 benign tumors. In this study, severe tracheal stenosis due to multiple tracheal metastases occurred in the patient with melanoma, in whom stent implantation was used first to open the airway, and then electrotomy and electrocoagulation were performed to remove the metastatic lesions. Significant improvement was achieved after interventional therapy in a short period in these malignant tumor patients, but for malignant airway tumors, radical surgery was essential for as long as possible after the diagnosis.

For patients with advanced tumors involving the central airway or patients who could tolerate radical surgery, electrocautery snare, cryotherapy, thermal ablation or stent implantation could be used to rapidly reduce the tumor burden, keep the airway clear, and improve the symptoms and quality of life.

Rigid bronchoscopy has multiple working channels with wide-diameter, so it is convenient to use forceps, graspers or other instrumentation to remove the tumor, to clean the blood or secretions in the airway to avoid anoxia or asphyxia in interventional therapy. Flexible bronchoscopy could be cooperated with rigid one to the lesion site directly in performing the operation as well. However, if the patients with cervical spondylosis or severe kyphosis, rigid bronchoscopy is unsuitable. What's more, rigid bronchoscopy is not very widely used or proficiently used in many districts in China, while flexible bronchoscopy now has been widespread used in China. Flexible bronchoscope introduced through LMA under general anesthesia started much earlier than rigid incubation at our center and resection via flexible bronchoscopies for endobronchial masses has been regularly performed. If the resected mass was too big to extract from laryngeal mask, the tumor would be divided into two parts with electrosurgical snare, and then foreign body forceps was applied to clamp one side of the mass to extract. If the tumor cannot be successfully removed by clamps, cryotherapy would be applied.

The aetiologies of intraluminal central airway spheroid masses are diverse, with atypical symptoms that can easily be misdiagnosed or lead to a missed diagnosis. A chest CT scan combined with endoscopic biopsy and pathological examination can provide an accurate diagnosis. Endoscopic intervention is an effective and safe technique. However, this study is a retrospective analysis, and the number of patients was limited because of the low incidence rate. There may be admission bias or selection bias in the disease spectrum and lesion distribution of the intraluminal central airway spheroid masses. More case studies are needed in the future.

Conflicts of Interest

The authors have no conflicts of interest to disclose.

References

[1] Wang J, Yang Y, Zha W, *et al*. The clinical feasibility of flexible bronchoscopy interventional therapy in patients with central airway stenosis and respiratory failure caused by malignancy. Onco Targets Ther. 2018; 11: 7709-7714.

[2] Freitag L, Ernst A, Unger M, *et al*. A proposed classification system of central airway stenosis. Eur Respir J. 2007; 30: 7-12.

[3] Reichle G, Freitag L, Kullmann HJ, *et al*. Argon plasma coagulation in bronchology: a new method--alternative or complementary? Pneumologie. 2005; 54: 508-516 (in German).

[4] Barros Casas D, Fernández-Bussy S, Folch E, *et al*. Non-malignant central airway obstruction. Arch Bronconeumol. 2014; 50: 345-354.

[5] Stevic R, Milenkovic B. Tracheobronchial tumors. J Thorac Dis. 2016; 8: 3401-3413.

[6] Semaan R, Yarmus L. Rigid bronchoscopy and silicone stents in the management of central airway obstruction. J Thorac Dis. 2015; 7: S352-S362.

[7] Karapantzos I, Karapantzou C, Zarogoulidis P, *et al*. Benign tracheal stenosis a case report and up to date management. Ann Transl Med. 2016; 4: 451.

[8] Bolliger CT, Sutedja TG, Strausz J, *et al*. Therapeutic bronchoscopy with immediate effect: laser, electrocautery, argon plasma coagulation and stents. Eur Respir J. 2006; 27: 1258-1271.

[9] DiBardino DM, Lanfranco AR, Haas AR. Bronchoscopic Cryotherapy. Clinical Applications of the Cryoprobe, Cryospray, and Cryoadhesion. Ann Am Thorac Soc. 2016; 13: 1405-1415.

[10] Uskul BT, Baran R, Turan FE, *et al*. Endoscopic removal of a chondromatous hamartoma by bronchoscopic electrosurgical snare and argon plasma coagulation. Monaldi Arch Chest Dis. 2007; 67: 238-240.