Case Report

Glomus tumors of the trachea: 2 case reports and a review of the literature

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Abstract: Glomus tumors (GTs) of the trachea are very rare neoplasms that usually arise from the distal portion of the respiratory tree. The origin of these tumors is modified smooth muscle cells of glomus bodies. In this study, we describe two cases of GT of the trachea, as well as the histologic features of these tumors and their treatments. One tumor was diagnosed via bronchoscopic biopsy, and the other tumor was diagnosed via surgery. Clinical follow-up showed that the two patients are alive and well after 8 and 15 months post-treatment, respectively. We also review the literature regarding GTs and discuss the clinical presentation, histologic features, differential diagnosis, treatment and prognosis of these tumors.

Keywords: Glomus tumor (GT); trachea; bronchoscopy

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Introduction

Glomus tumors (GTs) are rare mesenchymal tumors composed of modified smooth muscle cells and normal glomus body cells that constitute less than 2% of all soft tissue tumors. The World Health Organization [2002] defined GTs as benign tumors comprising perivascular cells (1). This type of neoplasm was first reported in 1924 by Masson (2). Here, we describe two cases of GT that occurred in the trachea. In addition, we describe the findings of a comprehensive literature search of the PubMed database using "glomus tumor of trachea" and "bronchial glomus tumor" as key words. Sixty-eight cases of GT of the trachea have been reported publicly. The vast majority of the relevant articles are case reports, and their characteristics are presented in *Table 1*. We also review pertinent literature and discuss the clinical manifestations, pathological types, immunohistochemical expression patterns, differential diagnosis, treatment and prognosis of GTs.

Case presentation

Case 1

A 63-year-old man with a 49-year history of cigarette smoking (49 packs/year) was admitted for a 1-week history of hemoptysis. The patient also complained of occasional cough and chest pain. He exhibited hypertension, but his physical examination demonstrated no abnormalities. A chest computed tomography (CT) series revealed the presence of a 0.5×0.3 cm^2 solid lesion in the lower portion of the trachea, near its posterior wall (*Figure 1A,B*). Bronchoscopy revealed the presence of a cauliflower-like neoplasm with a rich blood supply arising from the posterior membrane of the lower trachea (*Figure 1C*). Bronchoscopic biopsy revealed the presence of a small round cell tumor, likely a GT, although it was necessary to rule out a diagnosis of a neuroendocrine tumor. Immunohistochemical staining demonstrated positive reactivity for vimentin (VIM), smooth muscle actin (SMA), Calponin and Bcl-2 and negative reactivity for cytokeratin (CK), NapsinA, Syn, CgA and

Table 1 Summary of literature review

First author	Year	Age (years)	Sex	Symptoms	Duration of symptoms before treatment	Tumor site (S/M/I/B)	Size (cm)	Treatment	Follow-up
Hussarek	1950	43	F	Dyspnea	Not stated	S	Bean-sized	Tracheal resection	Not stated
Fabich	1980	63	M	Cough	2 years	I	2.5×2.0×1.0	Sleeve resection	Died of complications on the 10th post-op day
Warter	1980	69	M	Dyspnea, hemoptysis	Not stated	M	2.3×1.5×1.5	Segmental resection	Unremarkable
Heard	1982	50	M	Dyspnea	Not stated	I	2.5×1.5×1.0	Sleeve resection	Sepsis, died on the 15th post-op day
Ito	1988	51	M	Hemoptysis	9 months	S	1.5×1.2×1.0	Segmental resection	2 years
Sheffield	1988	74	M	Cough, dyspnea	<1 month	I	2.2	Endoscopic resection	7 months
Kim	1989	54	F	Cough, dyspnea, hemoptysis	3 years (cough)	M	1.5×1.2	Segmental resection	13 months
Shin	1990	47	F	Cough, hemoptysis	3 years	I	1.5×1.0×1.0	Wedge resection	Not stated
Garcia-Prats	1991	58	M	Cough, dyspnea, hemoptysis	Several years	M	2.5×1.8	Segmental resection	8 months
Haraguchi	1991	61	M	Asymptomatic	Asymptomatic	M	1.2	Sleeve resection	Not stated
Arapantoni	1995	65	M	Dyspnea, hemoptysis	3 months (dyspnea), 3 days (hemoptysis)	I	4.5×3.0	Endoscopic resection and Nd-YAG	1 year
Koskinen	1998	66	M	Asymptomatic	Not stated	I	2.0×3.0	Endoscopic resection, Nd-YAG and external radiotherapy	Not stated
Watanabe	1998	43	M	Hoarseness	Not stated	I	2.0×1.6×1.4	Sleeve resection	20 months
Lange	2000	20	M	Asthma-like symptoms	<1 month	B	1.4×1.3×0.6	Bronchial sleeve resection	9 months
Menaissy	2000	34	M	Hemoptysis	2 months	M	2.4×2.1×1.6	Tracheal resection	4 months
Oizumi	2000	48	M	Hemoptysis	Not stated	B	0.7	Bronchial resection	3 months
Gowan	2001	73	M	Chest pain, dyspnea, hemoptysis	5 weeks	M	1.6×0.3×0.6	Segmental resection	6 years
Yilmaz	2002	29	F	Hemoptysis, dyspnea, chest pain	Not stated	B	1.5×1.0×0.5	Bronchial resection	17 months

Table 1 (*continued*)

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First author	Year	Age (years)	Sex	Symptoms	Duration of symptoms before treatment	Tumor site (S/M/I/B)	Size (cm)	Treatment	Follow-up
Chien	2003	50	F	Cough, dyspnea, hemoptysis	8 years (cough and dyspnea), 1 day (hemoptysis)	I	2.5×2.5×2.0	Segmental resection	1 year
Vailati	2004	40	M	Dyspnea, cough, fever	6 months	B	5.0×1.5	Endoscopic resection	1 month
De Weerdt	2004	37	M	Dyspnea, cough, fever	2 months	B	Not stated	Endoscopic resection + cryotherapy + Nd-YAG laser	3 months
Nadrous	2004	39	M	Hemoptysis	30 months	S	2.0×1.5×1.5	Sleeve resection	3 months
Ren	2005	29	M	Cough, dyspnea	2 years (cough), 2 months (dyspnea)	I	1.7×2.0×1.7	Segmental resection	Not stated
Takahashi	2005	67	M	Cough	Not stated	B	0.8	Bronchial resection	Not stated
Altinok	2006	83	F	Dyspnea, hemoptysis	3 months	S	2.0×1.5×1.2	Partial sleeve resection	1 year
Haver	2008	10	F	Dyspnea, chest pain, cough	3 weeks	M to I	1.8×1.3×1.3	Tracheal resection	2 years
Colaut	2008	70	M	Dyspnea, wheezing	2 months	M	2.0×1.0×1.0	Endoscopic resection and Nd-YAG	2 years
Akata	2008	39	M	Cough	<1 month	B	2.5×2.5×2.0	Endoscopic resection	6 years
Shang	2010	59	M	Chest pain, dyspnea cough	10 years	I	2.0×1.0×0.5	Endoscopic resection + electrocautery	1 year
Shang	2010	22	F	Cough, hemoptysis dyspnea	1 year	I	1.8×1.5×1.4	Endoscopic resection + electrocautery	1 year
Nakajima	2010	30	M	Hemoptysis	6 months	B	1.5×1.3	Bronchial resection	10 months
Parker	2010	43	F	Dyspnea, chest pain, cough	6 months	I	2.0×1.6×1.5	Tracheal resection	11 months
Baek	2011	54	M	Dyspnea, cough	3 months	M	1.3×1.2	Tracheal resection	2 years
Mogi	2011	56	F	Cough, dyspnea	7 months	I	1.3×1.2×1.1	Tracheal sleeve resection	9 months
Ravenna	2011	79	F	Dyspnea, cough	3 months	B	Not stated	Endoscopic resection + Nd-YAG laser	5 years

Table 1 (*continued*)

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First author	Year	Age (years)	Sex	Symptoms	Duration of symptoms before treatment	Tumor site (S/M/I/B)	Size (cm)	Treatment	Follow-up
Sakr	2011	66	M	Cough, dyspnea	2 months (cough), 10 days (dyspnea)	S	1.2×0.8×2.0	Endoscopic resection + tracheal sleeve resection	21 months
Okereke	2011	58	M	Dyspnea	Long term	M	1.1	Tracheal resection	6 months
Santambrogio	2011	39	M	Asymptomatic	Not stated	I	1.0	Tracheal resection	51 months
Gong	2011	35	F	Dyspnea	1 year	S	1.5×1.0	Tracheal resection	Not stated
Norder	2012	49	F	Cough, dyspnea	3 years	S	1.2×1.1×1.1	Endoscopic resection	Not stated
Lange-Lazdunki	2012	62	F	Cough, dyspnea	Not stated	I	1.6	Left upper lung resection	Not stated
Cukurova	2012	50	M	Cough, dyspnea, hemoptysis	Not stated	S	Not stated	Endoscopic resection	3 years
Ariizumi	2012	43	F	Asymptomatic	3 months	B	Not stated	Tracheal resection	6 months
Zhu	2013	30	F	Dyspnea, hemoptysis	1 year	B	4.0×0.5×0.5	Tracheal resection	18 days
Fan	2013	15	M	Cough, dyspnea, hemoptysis	3 months	M	2.0×2.5	Tracheal resection	1 year
Ghigna	2013	70	M	Hemoptysis	Not stated	I	1.6	Tracheal resection	Not stated
Ghigna	2013	40	M	Hemoptysis	Not stated	I	1.0	Tracheal resection	Not stated
Chang	2013	76	M	Fever	1 week	M	Not stated	Endoscopic resection	Not stated
Singh	2013	65	F	Cough	3 months	B	1.2×0.4×0.5	Endoscopic resection	Not stated
Wei	2013	39	M	Cough, hemoptysis	1 year	S	1.9×1.4×0.8	Tracheal resection	26 months
Wei	2013	43	M	Dyspnea	3 years	I	2.0×1.5	Tracheal resection	19 months
Choi	2014	52	F	Asymptomatic	Asymptomatic	B	1.6	Resection of carina and both main bronchi	3 months
Choi	2014	64	M	Asymptomatic	Asymptomatic	M	2.6	Tracheal resection	2 years
Xiong	2014	55	M	Cough, chest pain, hemoptysis	5 months (cough and chest pain), 13 days (hemoptysis)	I	0.5×0.3×0.3	Bronchoscopic cryoablation with brachytherapy	6 months

Table 1 (*continued*)

Table 1 (*continued*)

First author	Year	Age (years)	Sex	Symptoms	Duration of symptoms before treatment	Tumor site (S/M/I/B)	Size (cm)	Treatment	Follow-up
Xiong	2014	48	F	Cough, dyspnea	6 years	I	1.2×1.0×0.8	Bronchoscopic cryoablation and argon plasma coagulation	6 months
Wu	2014	58	F	Hemoptysis	Not stated	I	2.2×2.2	Tangential resection with spiral tracheoplasty	2 years
Zhang	2014	54	M	Cough, hemoptysis	4 years	B	2.5×1.5×1.0	Right total lung resection	6 months
Zhang	2014	48	M	Cough	1 year	B	Not stated	Right upper lung lesion resection	7 months
Huang	2015	39	F	Dyspnea	More than 1 year	S	2.5×1.2	Segmental resection	1 month
Liu	2015	39	F	Dyspnea	More than 1 year	S	2.5×1.2	Segmental resection	1 month
Li	2015	15	M	Cough, hemoptysis	2 months	M	1.2×1.0×1.0	High-frequency electrocautery and APC	3 months
Tan	2015	44	M	Cough, dyspnea, hemoptysis	2 months	I	3.0×2.5×1.0	Tracheal resection	20 months
Masoum	2015	21	M	Cough, hemoptysis	Several months	S	Not stated	Endoscopic resection + tracheal resection	1 year
Fernandez-Bu	2015	48	M	Hemoptysis and cough	3 months	I	2.0×2.0	Endoscopic resection	2 years
Brzezinski	2015	38	M	Dyspnea	1 year	S	1.6×1.8×0.8	Tracheal resection	Not stated
Rashid	2015	52	M	Hemoptysis	3 months	B	Not stated	Endoscopic resection	6 months
Xiong	2016	52	F	Dyspnea, cough	6 months	S	2.0×1.0×1.0	High-frequency electrocautery and APC	9 months
Aryan	2016	50	F	Hemoptysis, cough, dyspnea	1 week	B	Not stated	Endoscopic resection	Not stated
Present case	2016	63	M	Hemoptysis	1 week	I	0.5×0.3	High-frequency electrocautery and APC	15 months
Present case	2016	44	M	Hemoptysis, cough	1 week	M	1.0×1.5	Endoscopic resection + tracheal resection	8 months

M, men; F, female; S/M/I/B, superior/medium/inferior/bronchi; Nd-YAG, neodymium-doped yttrium aluminum garnet; APC, argon plasma coagulation.

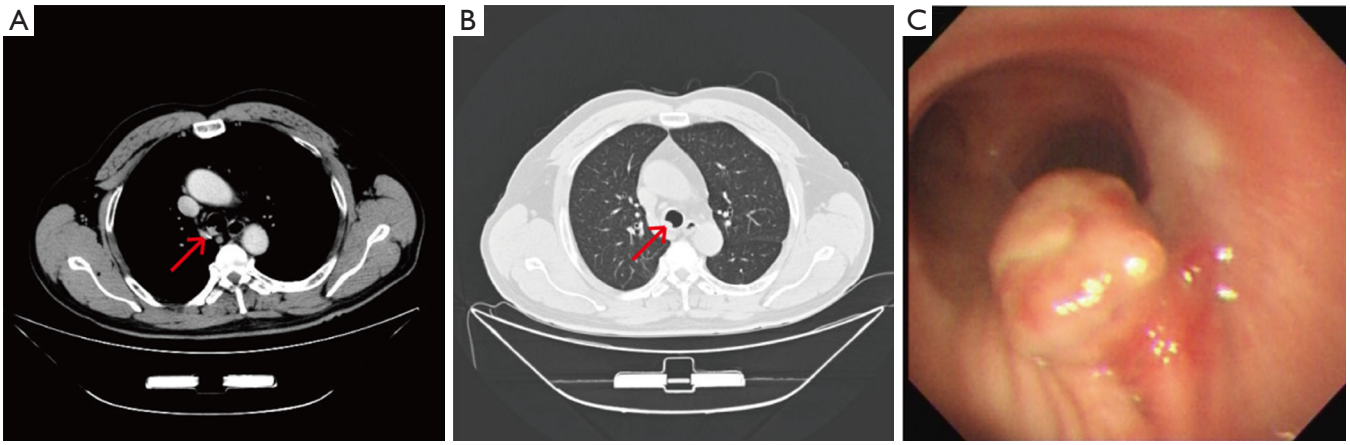

Figure 1 CT and Brochoscopic findings in Patient 1 before treatment. Chest CT images (A,B) of a tumor involving the lower portion of the trachea. The arrow indicates the glomus tumor. Brochoscopy (C) demonstrated a cauliflower-like neoplasm arising from the posterior membrane of the lower trachea.

CD34. Thus, a diagnosis of GT was made (*Figure 2A-D*). The patient was advised to undergo surgical treatment but refused because of the risks associated with surgery. He bled profusely during the fiberoptic bronchoscopy; therefore, we performed bronchial artery embolization (BAE) before performing bronchoscopic resection. The patient underwent high-frequency electrocauterization and flexible bronchoscopic argon-plasma coagulation (APC) for tumor removal. CT demonstrated no obvious abnormalities when the patient was reexamined 3 months after the procedure (*Figure 2E,F*), and the patient exhibited no symptoms or signs of recurrence when last examined at 15 months post-treatment. At present, the patient 1 described herein remains in good condition.

Case 2

A 44-year-old never smoking man was admitted for a 1-week history of cough and hemoptysis. His physical examination demonstrated no abnormalities. Chest CT revealed the presence of a 1.0×1.5 cm^2 nodular lesion on the posterior wall of the upper portion of the trachea (*Figure 3A,B*). Bronchoscopy demonstrated a neoplasm rich in blood vessels arising from the posterior membrane of the upper trachea (*Figure 3C*). The patient subsequently underwent high-frequency electrocautery for tumor removal. Microscopically, the tumor consisted mainly of round or ovoid glomus cells surrounding thin-walled blood vessels. VIM, Syn and Bcl-2 immunohistochemical staining was positive, and SMA immunohistochemical staining was suspectedly positive. In contrast, desmin, CK, CD56, CD34 and EMA immunohistochemical staining was negative. The histological characteristics of the tissues were consistent with those of a neuroendocrine tumor, particularly a carcinoid tumor. The patient therefore underwent tracheal neoplasm resection and tracheoplasty. His surgery revealed that the diameter of his neoplasm was approximately 1 cm and that the lesion involved a portion of the middle tracheal wall approximately 20 cm from the incisors. Immunohistochemical staining demonstrated positive reactivity for VIM, SMA, Syn, Collagen IV and Bcl-2. The histological characteristics and immunohistochemical staining pattern of the tumor were consistent with the diagnosis of GT (*Figure 4A,B*). The tumor had infiltrated the smooth muscle, and this infiltration was accompanied by bone metaplasia and neuroendocrine marker expression. CT (*Figure 4C,D*) was repeated 3 months later and produced normal results, and the patient exhibited no evidence of recurrence 8 months after the procedure. However, patient 2 exhibited infiltrative tumor growth, as well as smooth muscle involvement, bone metaplasia and neuroendocrine expression. Therefore, patient 2 requires long-term follow-up.

Discussion

Clinical epidemiology

GTs normally present as spheres comprising arterial and venous anastomoses that can be found over nearly the entire

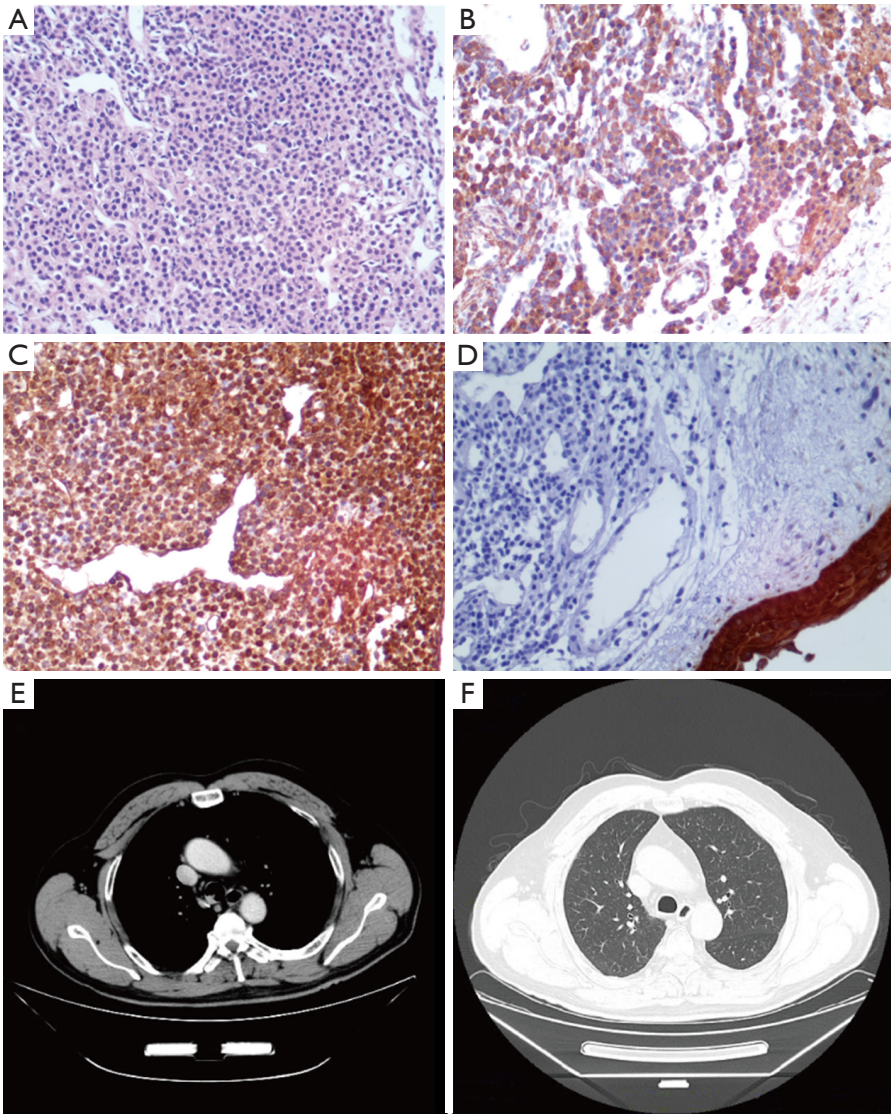

Figure 2 Hematoxylin-eosin (HE) staining, immunohistochemical staining in Patient 1 and CT findings after treatment. Single round cells with a uniform, clear or pale eosinophilic cytoplasm and hyperchromatic nuclei forming microvascular spaces were observed in histopathologic sections (A) (HE, ×200). Positive immunohistochemical staining for SMA (B) and VIM (C) and negative immunohistochemical staining for CK5 (D) were observed in the tumor cells (×200). CT did not show a glomus tumor (GT) in the tracheas after treatment (E,F) .

body (3). Glomus bodies are responsible for temperature control on the skin surface (4). Arteriovenous anastomoses are more common in the extremities than in other locations. In particular, GTs often develop in the nail beds of the extremities. Such tumors account for approximately 70% of all GTs, and lesions involving the torso and head and neck account for 20% of all GTs. GTs have also been reported to occur at unusual locations, such as the nose, sinuses, thoracic region, kidneys, stomach, mediastinum, heart, intestines, muscles, vagina, tendons, ligaments and lungs. Tracheal glomus tumors (TGTs) are fairly rare (5-12).

Macroscopic presentation

To our knowledge, 70 cases of GT, including those described in the above case reports, have been reported in literature to date. A summary of the clinical characteristics of and treatments provided for these previously reported

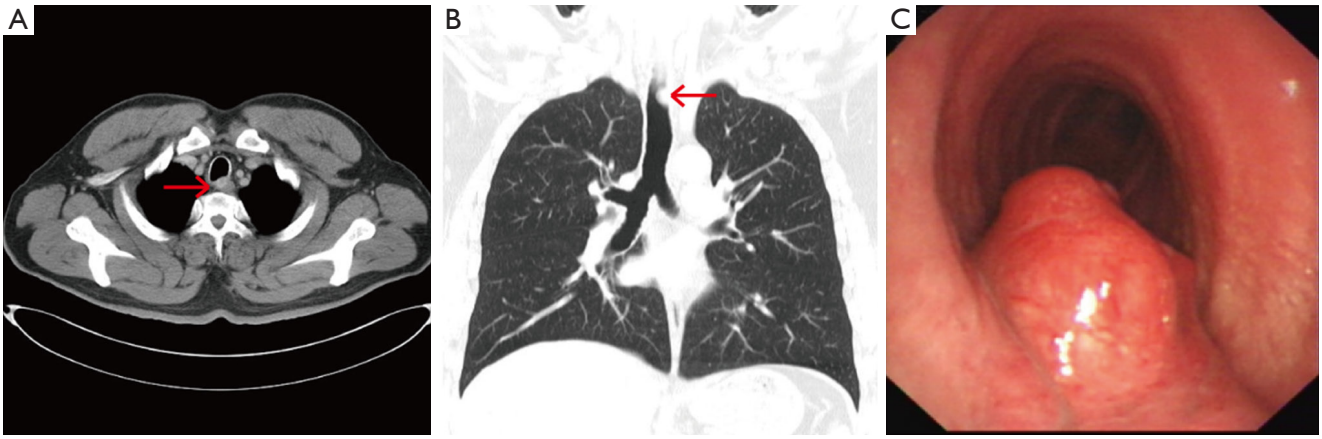

Figure 3 CT and Brochoscopic findings in Patient 2 before treatment. Chest CT images (A,B) of a tumor involving the posterior aspect of the upper portion of the trachea. The arrow indicates the glomus tumor. Brochoscopy (C) demonstrated a neoplasm rich in blood vessels arising from the posterior membrane of the upper trachea.

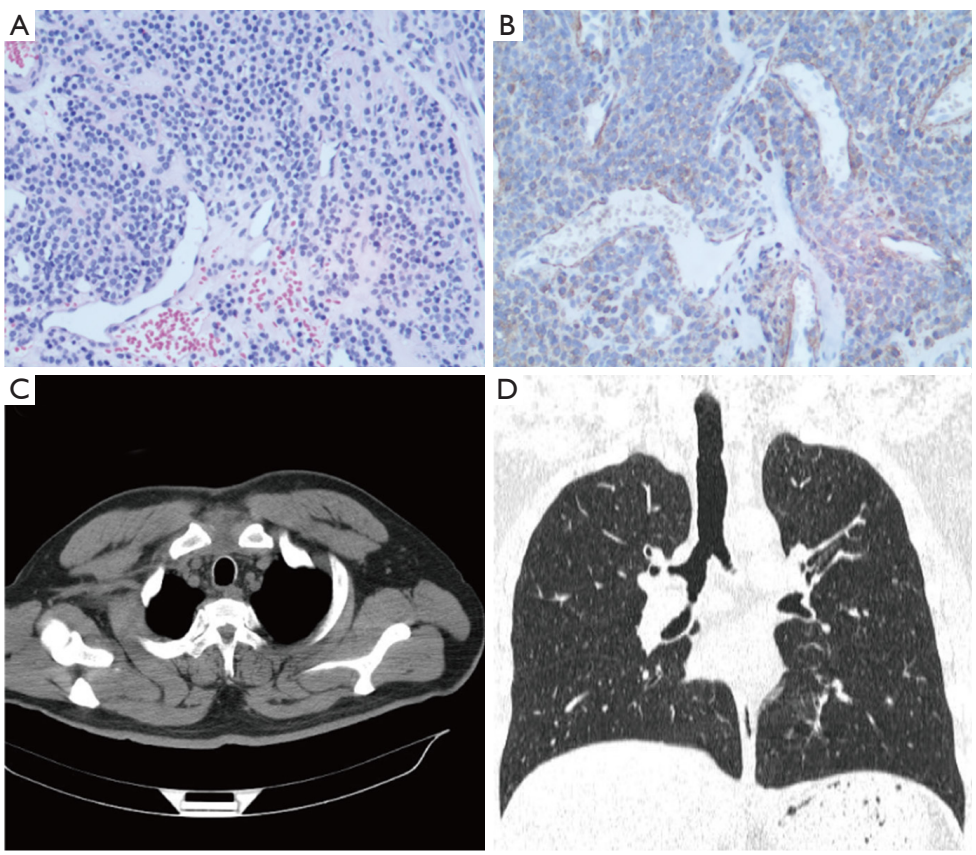

Figure 4 HE staining, immunohistochemical staining in Patient 2 and CT findings after treatment. (A) Single round cells with a uniform, clear or pale eosinophilic cytoplasm and hyperchromatic nuclei forming microvascular spaces were observed in histopathologic sections (HE, ×200); (B) positive immunohistochemical staining for SMA (×200); (C,D) CT did not show a GT in the tracheas after treatment.

Table 2 Summary of previous cases includes in our review

Characteristic	Number	%
Sex		
Men	46	65.71
Female	24	34.29
Symptoms		
Hemoptysis	32	45.71
Cough	36	51.43
Dyspnea	37	52.86
Asymptomatic	7	10.00
Chest pain	6	8.57
Others	5	7.14
Tumor site		
Superior	14	20.00
Medium	14	20.00
Inferior	24	34.29
Bronchi	17	24.29
Medium to Inferior	1	1.43
Duration of symptoms before treatment		
≤1 month	8	11.43
2–12 months	24	34.29
≥1 year	20	28.57
Not stated	14	20.00
Asymptomatic	3	4.29
Long term	1	1.43
Treatment		
Surgical	47	67.14
Endoscopic	23	32.86
Endoscopic resection + tracheal resection	3	4.29
Endoscopic resection + external radiotherapy	2	2.86

GTGs is presented in *Tables 1,2*. This disease commonly occurs in middle-aged people and is more common among men than among women; specifically, the male: female ratio is 1.92:1. The average age of presentation is 48.8 years (range: 10–83 years). Some patients are asymptomatic (10%); therefore, their diagnoses require a medical examination. The most commonly presenting symptoms among symptomatic GT patients are dyspnea (52.86%), cough (51.43%) and hemoptysis (45.71%). Less frequently, patients can present with chest pain (8.57%). Hoarseness and fever are rare, as only approximately 7.14% of patients present with those symptoms. Most patients (64.29%) have the illness for longer than 1 month before presentation, and the longest reported disease duration before presentation is 10 years, suggesting that this type of tumor grows slowly. Physical examination findings often include low blood pressure, heart rate and respiratory rate, inspiratory dyspnea and wheezing, which is most audible above the clavicle or at the sternal midline during inspiration. Glands and blood vessels are more abundant in the lower bronchial mucosa than in the upper and middle bronchial mucosa (13). Kim *et al.* (14) reported that glomus-like structures can also be found in the tracheal membranous wall. Specifically, TGTs often occur in the posterior membranous wall of the lower trachea. The statistics regarding the locations of TGTs (upper: 20%, middle: 20%, lower: 34.29%, and bronchi: 24.29%) indicate that the lower 1/3 of the trachea is a common location. To date, only one GT, which was described in a case report by Haver *et al.* (15), has been demonstrated to involve the middle-lower portion of the trachea. In this study, patient 1 presented with a 0.5×0.3 cm^2 tumor, the smallest GT reported to date. In contrast, Vailati has described tumors as large as 5×1.5 cm^2. GTs are usually small, exhibiting a diameter of 1.0–2.5 cm, and generally display a clear border, a smooth surface, and numerous capillaries. Most of these tumors are benign and are thus unlikely to exhibit distant metastasis or deep infiltration. Zhang *et al.* (16) described a GT originating from the right main bronchus that obstructed the bronchial cavity and invaded the upper and middle portions of the bronchus, and Huang *et al.* (17) described a GT in the upper bronchus with invasive growth involving all layers of the bronchial wall and the outer membrane of the esophagus. Fernandez-Bussy *et al.* (18) described GTs involving the trachea and the left forearm. The possibility of other distant metastases could not be completely ruled out in these cases.

Microscopic features

Regarding morphology, GTs can present as single tumors or multiple tumors and can also exhibit distant metastases. Multiple GTs are rare and account for approximately 10–25% of GT cases (13). Typical GTs are classified as solid GTs, glomangiomas and glomangiomyomas, depending on their dominant component (19). The classification

Table 3 Antibody panel used in this case study

Characteristic	Glomus tumor	Carcinoid tumor	Hemangiopericytoma
SMA	(+)	(–)	(–)
VIM	(+)	(–)	(+)
CD34	(–)	(–)	(+)
CK	(–)	(+)	(–)
Neuroendocrine	(–)	(+)	(–)

SMA, smooth muscle actin; VIM, vimentin; CK, cytokeratin.

system proposed by Folpe *et al.* (20) in 2001 organized atypical GTs into the following categories: malignant GTs (MGTs), GTs of uncertain malignant potential (UMPGTs), symplastic GTs (SGTs) and glomangiomatosis (GGS). Despite being benign lesions, GTs may behave as aggressive and malignant tumors. The literature regarding MGTs and UMPGTs indicates that approximately 10 cases have been reported thus far and that the incidence of these tumors has gradually increased in recent years. The diagnosis of MGT is reserved for tumors larger than 2 cm in a subfascial or visceral location showing atypical mitotic figures or marked nuclear atypia and exhibiting any level of mitotic activity. The diagnosis of UMPGT is reserved for superficial tumors exhibiting high mitotic activity, deep tumors or large tumors.

Histological and immunohistochemical features

Carcinoid tumors and hemangiopericytomas arise from the submucosa of the trachea, and consist of sheets and nests of cells surrounding numerous vascular spaces (21). Therefore, they are easily mistaken for GTs. Our second patient underwent neoplasm resection because he was diagnosed with a carcinoid tumor via bronchoscopic biopsy. This diagnosis was confirmed via postoperative pathological examination. We identified three patients who exhibited similar presentations. As TGTs are easily missed and often misdiagnosed, we diagnose these tumors on the basis of their histopathological characteristics and immunohistochemical staining patterns (*Table 3*). GT cells are round or oval in shape and line up tightly. They exhibit strong positive staining for SMA, VIM and type IV collagen but do not stain positive for neuroendocrine and epithelial markers, including chromogranin, CK, desmin and S-100 protein. Carcinoid tumors have less vascular mass, and their cells are arranged as nests. These tumors stain positive for neuroendocrine markers, such as NSE, CgA, chromogranin and synaptophysin, but stain negative for SMA and VIM. Hemangiopericytomas usually consist of new blood vessels and stroma and display staghorn-like vascular features. These tumors stain positive for CD34, Bcl-2 and VIM but stain negative for desmin and SMA.

Treatment

Surgery is considered the first-choice treatment for GT. The currently available data indicate that 67.14% of the 70 reported patients were ultimately treated via surgical resection and that 32.86% of patients underwent endoscopic removal of their tumors. Currently, segmental tracheal resection with an end-to-end anastomosis is the preferred method of treating GTs surgically. However, some patients have been treated via tracheal sleeve resection or tracheal wedge resection. Wu *et al.* (22) proposed performing a longitudinal resection with spiral tracheoplasty. This method can significantly mitigate tracheal tissue injury and is therefore applicable for patients with larger lesions requiring more extensive tracheal resection. Endobronchial therapy can be administered to patients who are unfit for surgical excision or who refuse surgery. Common endobronchial therapy techniques include laser resection, high-frequency electrocoagulation and APC. Because TGTs have a rich blood supply, bronchoscopic biopsy with forceps should be avoided. In this study, patient 1 experienced severe bleeding during his fiberoptic bronchoscopy. Therefore, bronchoscopic resection was performed after BAE, during which the patient experienced only a small amount of intraoperative bleeding. However, the feasibility and necessity of this method remain unknown. Masoum *et al.* (23) reported the case of a 21-year-old male patient who underwent bronchoscopic GT resection who experienced postoperative recurrence after 1 year. The

patient underwent another resection and exhibited no signs of recurrence after 1 year of follow-up. Therefore, TGT patients should be treated with surgery instead of bronchoscopic therapy.

Prognosis

To date, the reports in the literature indicate that 2 of the 70 patients with GT died of postoperative complications, whereas the remaining patients have been followed for periods ranging from 1–5 years and have exhibited good recovery in most cases. Distant metastasis of MGT is the major cause of death. The rate of metastasis is 31.2–38.0% (20), and tumors often recur between 3 and 4 years after surgery (24). However, Choi *et al.* (25) reported a case of TGT in which a postoperative bronchoscopy performed 2 months after surgical resection demonstrated a white neoplasm at the anastomosis site. Pathological examination revealed the presence of a granuloma, although a malignant GT could not be completely ruled out. Therefore, a bronchoscopic en bloc resection was performed. There have been rare reports regarding the use of adjuvant chemotherapy after TGT surgery, namely, two reports by Koskinen *et al.* (26) and Xiong *et al.* (27), respectively, and the effectiveness of this therapy is currently unclear.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent: Written informed consent was obtained from the patients for publication of this manuscript and any accompanying images.

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