Original Article

Combining transcatheter arterial embolization with endoscopic debulking for hypervascular airway tumor management: a retrospective single center study

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Background: Airway obstruction due to tumor invasion or concurrent respiratory distress and hemoptysis poses a significant challenge in clinical management, often requiring prompt and effective intervention to alleviate symptoms and improve patient outcomes. This study aimed to evaluate the efficacy and safety of selective transcatheter arterial embolization (TAE) as a preparatory measure to mitigate airway obstruction before bronchoscopic debulking as an approach to address this clinical challenge.

Methods: The data of patients with airway obstruction due to tumor invasion or concurrent respiratory distress and hemoptysis treated at The First Affiliated Hospital of Zhengzhou University from January 2018 to August 2022 were analyzed. After computed tomography (CT) scans and bronchoscopic findings were assessed, selective TAE was performed as a preparatory measure to alleviate airway obstruction before bronchoscopic debulking, and the occurrence of hemorrhage-related complications, Karnofsky Performance Status (KPS) score, breathlessness index, and the extent of airway obstruction were evaluated.

Results: All 22 patients underwent selective TAE before bronchoscopic tumor debulking. The overall efficacy rate was 100%, with a significant improvement in the KPS score from preoperative (60.45±14.63) to postoperative (74.55±9.63) levels (t=−6.891; P<0.001). Similarly, there was a considerable reduction in the shortness of breath score from preoperative (2.91±0.81) to postoperative (1.73±0.63) levels (t=6.973; P<0.001). Airway obstruction decreased substantially from preoperative (79.14%±14.56%) to postoperative (21.27%±7.19%) levels (t=26.857; P<0.001). Furthermore, the severity classification of airway obstruction decreased from preoperative (4±0.82) to postoperative (1.36±0.49) levels (t=18.794; P<0.001). Among the patients, only one experienced moderate bleeding necessitating prolonged mechanical balloon compression and intracavitary lesion removal, while the other patients had minor and negligible bleeding.

Conclusions: TAE combined with endoscopic debulking can effectively control intraoperative bleeding and respiratory distress and achieve successful local resolution of endotracheal hypervascular tumors.

Keywords: Hypervascular tumor; central airway obstruction (CAO); transcatheter arterial embolization (TAE); interventional bronchoscopy

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Introduction

Malignant central airway obstruction (CAO) occurs when tumors obstruct the trachea, primary bronchi, bronchus intermedius, or lobar bronchi (1). The clinical manifestations of CAO include dyspnea and a decline in health-related quality of life (HRQOL) (2). Prior studies have demonstrated favorable short-term outcomes of therapeutic bronchoscopy for CAO (3). However, complications such as bleeding often restrict the treatment of airway obstruction in hypervascular tumors (4). CAO represents a life-threatening condition with a 5-year survival rate of 18.5%, primarily due to complications such as dyspnea, respiratory distress, infection, and bleeding (5). Various disorders can affect the airways, particularly intratracheal malignancies.

Approximately 30% of patients with lung cancer develop CAO of the central airways during disease progression. The lack of a standardized understanding and clinical management is attributable to its complex etiology and diverse treatment modalities. In addition, patients with CAO may exhibit symptoms such as dyspnea when the airway obstruction exceeds 50%, and without timely intervention, severe obstruction or hemoptysis may occur, potentially leading to asphyxia or death (6). Particularly concerning are the large tumors associated with bleeding, which markedly diminish ventilation and gas exchange function in both lungs while reducing systemic blood volume, exacerbating the condition. Therefore, prompt restoration of airway patency with adequate hemostasis is essential in managing these patients. Conventional treatments with systemic chemotherapy or radiotherapy have proven inadequate in rapidly restoring airway patency in patients with CAO (7).

Various palliative treatment modalities can effectively manage airway complications. Bronchoscopic treatment options for CAO include mechanical debridement of the airways, stenting (8), photodynamic therapy (9), electrocautery (10), argon plasma coagulation (10), and laser resection (11). Radiation therapies include external beam radiotherapy (12) and brachytherapy (13). These therapeutic options carry risks and are often temporary, leading to recurrent symptomatic CAO attacks (14). The most common complication is endobronchial hemorrhage, a critical factor affecting patient prognosis. Reports indicate bleeding complications in 10.0–20.9% of cases during bronchoscopic treatment (15), with the incidence of bleeding in endobronchial cryotherapy reaching as high as 33.5% (16). Thus, intraoperative bleeding may be unavoidable, particularly with large pieces of hypervascular tumor tissue, significantly increasing the risk of life-threatening asphyxia due to airway obstruction (17). Even with holmium laser therapy, which has a superior hemostatic effect, the risk of bleeding cannot be entirely eliminated (18).

Prior to bronchoscopy, bronchial artery embolization may reduce the risk of significant bleeding during treatment, as has been preliminarily demonstrated in the treatment of carcinoid and metastatic renal cell carcinoma (17). Although preoperative selective arteriography may reduce tumor blood supply to prevent bleeding during endoscopic treatment and potentially provide a sufficient field of view and operating time for endoscopic tumor resection, a systematic investigation in the context of malignant hypervascular airway obstruction with complex etiology remains is lacking. The systematic exploration of malignant bloody airway obstruction remains a gap in the literature.

We hypothesized that combining transcatheter arterial embolization (TAE) and bronchoscopic debulking might effectively relieve airway obstruction in endotracheal malignancies. Thus, we conducted this study to assess the efficacy and safety of this approach in patients with endotracheal malignancies to evaluate changes in airway obstruction, dyspnea severity, Karnofsky Performance Status (KPS) scores, and overall survival pre- and posttreatment. We present this article in accordance with the STROBE reporting checklist (available at https://qims.amegroups.com/article/view/10.21037/qims-24-187/rc).

Methods

Ethics statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by the institutional ethical review board of The

Table 1 Patients' characteristics

Characteristics	Value
Age (years)	
Mean ± SD	64.0±10.3
Range	40–84
Sex, n (%)	
Male	16 (72.7)
Female	6 (27.3)
Clinical symptoms, n (%)	
Dyspnea	18/22 (81.8)
Hemoptysis	12/22 (54.5)
Cough	17/22 (73.9)
Dyspnea score, mean ± SD	2.91±0.81
KPS, mean ± SD	60.45±14.63
Degree of airway stenoses, mean ± SD	4±0.82
Decrease (%) in cross-sectional area, mean ± SD	79.14±14.56
Pathological type, n (%)	
Squamous cell carcinoma	11 (50.0)
Adenocarcinoma	3 (13.6)
Adenoid cystic carcinoma	2 (9.1)
Carcinoid	2 (9.1)
Clear-cell renal cell carcinoma	2 (9.1)
Mucoepidermoid carcinoma	1 (4.5)
Neuroendocrine carcinoma	1 (4.5)
Atelectasis, n (%)	15/22 (68.2)
Location, n (%)	
LMB	5 (22.7)
RMB	8 (36.4)
BI	2 (9.1)
LLLB	3 (13.6)
Trachea	4 (18.2)
Responsible vessel, n (%)	
Bronchial artery	18 (81.8)
Thyrocervical trunk	5 (22.7)
Intercostal artery	3 (13.6)
Internal thoracic artery	4 (18.2)

Table 1 (*continued*)

Table 1 (*continued*)

Characteristics	Value
Degree of bleeding, n (%)	
Negligible	17 (77.3)
Minor	4 (18.2)
Moderate	1 (4.5)
Major	0 (0)

SD, standard deviation; KPS, Karnofsky Performance Status; LMB, left main bronchus; RMB, right main bronchus; BI, bronchus intermedius; LLLB, left lower lobe bronchus.

First Affiliated Hospital of Zhengzhou University (No. 2023-KY-1188). All patients provided signed written informed consent.

Patients

This retrospective analysis involved patients with endotracheal malignancies who underwent TAE combined with bronchoscopic debulking for airway obstruction between January 2018 and August 2022 at The First Affiliated Hospital of Zhengzhou University. Data from bronchoscopy, contrast-enhanced chest computed tomography (CT) imaging, clinical evaluations, and pathological results were retrieved from the hospital records. Clinical data and general conditions, including gender, age, shortness of breath score, airway obstruction grade, and KPS score, were recorded (*Table 1*).

Inclusion and exclusion criteria

Patients were included if they presented with symptomatic airway obstruction due to hypervascularized tumors with clearly visible feeding arteries on contrast-enhanced chest CT scans. Meanwhile, the exclusion criteria were nonhypervascular tumors, absence of a clearly visible feeding artery on CT angiography (CTA), and inability to tolerate the procedure due to severe comorbidities. The patients were assessed until discharge.

Diagnostic imaging

All patients underwent contrast-enhanced chest CTA before the TAE procedure to identify potential feeding arteries. Selective TAE was recommended based on multidisciplinary

Table 2 Baseline angiographic data

Responsible vessel	Abnormal concentration of contrast agent	Indirect sign			Embolization material			
		Vascular malformation	Peripheral vascular imaging	Negative	PVA	Gelatin sponge	Microsphere	Microcoil
Bronchial artery	18	12	6	–	12	6	4	0
Thyrocervical trunk	5	2	3	–	3	1	0	2
Bronchial artery and thyrocervical trunk	3	1	2	–	2	2	5	1
Intercostal artery	3	1	2	–	2	3	0	0
Internal thoracic artery	4	2	2	–	2	0	0	0

PVA, polyvinyl alcohol.

discussions if patients had recurrent hemoptysis, contrast-enhanced CT showing significant tumor vascularity, or bronchoscopic findings indicating high vascularity with visible trophoblastic vessels. Selective TAE was performed before bronchoscopy, as previously reported (19). Angiography was then performed to confirm these findings and guide the embolization process.

TAE

Selective TAE was performed prior to bronchoscopy to reduce tumor blood supply and minimize bleeding during the procedure based on relevant reports (20), and angiography was used to ensure accurate identification of the responsible vessel. Subsequently, 5-F catheters were inserted at the origin or proximal segment of the responsible vessel. For superselective placement, a 2.4- or 2.6-F microcatheter was used, and the choice of embolic agent, including polyvinyl alcohol (PVA) particles, gelatin sponge particles, microspheres, and microcoils, was used based on angiographic findings to ensure effective vessel occlusion. Postoperative pain relief was administered using abdominal hot packs and Dizocin (*Table 2*).

Interventional bronchoscopy

All patients underwent rigid bronchoscopy (Karl Storz, Tuttlingen, Germany) under general anesthesia within 24 to 48 hours after TAE (*Figure 1A-1E*). Thermal cauterization techniques, including laser (Ligenesis, Wuhan, China), argon plasma coagulation (APCapplicator, Erbe Elektromedizin, Tübingen, Germany), and electric trap (Olympus, Tokyo, Japan), were employed, followed by cryotherapy (Beijing Kooland Technology Co., Ltd., Beijing, China), with flexible forceps being used for tumor removal. Bleeding was managed using argon plasma coagulation, laser resection, hyperbaric balloon, cold saline, or blood coagulase, as required.

Assessments

The efficacy of airway obstruction recanalization (21) was assessed as follows: (I) completely effective (CE)—complete removal of intraluminal lesions and subsequent functional recovery; (II) partially effective (PE)—reopening of over 50% of the stenotic lumen, normalization of functional examination results, and generally improved subjective symptoms; (III) mildly effective (ME)—less than 50% improvement in obstruction with resolved inflammation in the distal part after drainage procedures such as aspiration or stent placement; (IV) ineffective (IE)—no evidence of subjective and objective improvement, with possible partial improvement in obstruction and resolved distal inflammation; and (V) not effective (NE)—no clinical evidence of improvement. The overall efficacy rate was calculated using the formula: overall efficacy rate = (number of CE cases + number of PE cases + number of ME cases)/ total number of cases.

Shortness of breath was assessed using the following American Thoracic Society shortness of breath grading criteria (22): grade 0, no shortness of breath during routine activities; grade 1, shortness of breath experienced with strenuous exercise; grade 2, shortness of breath during moderate activities; grade 3, shortness of breath while performing mild activities; and grade 4, shortness of breath at rest.

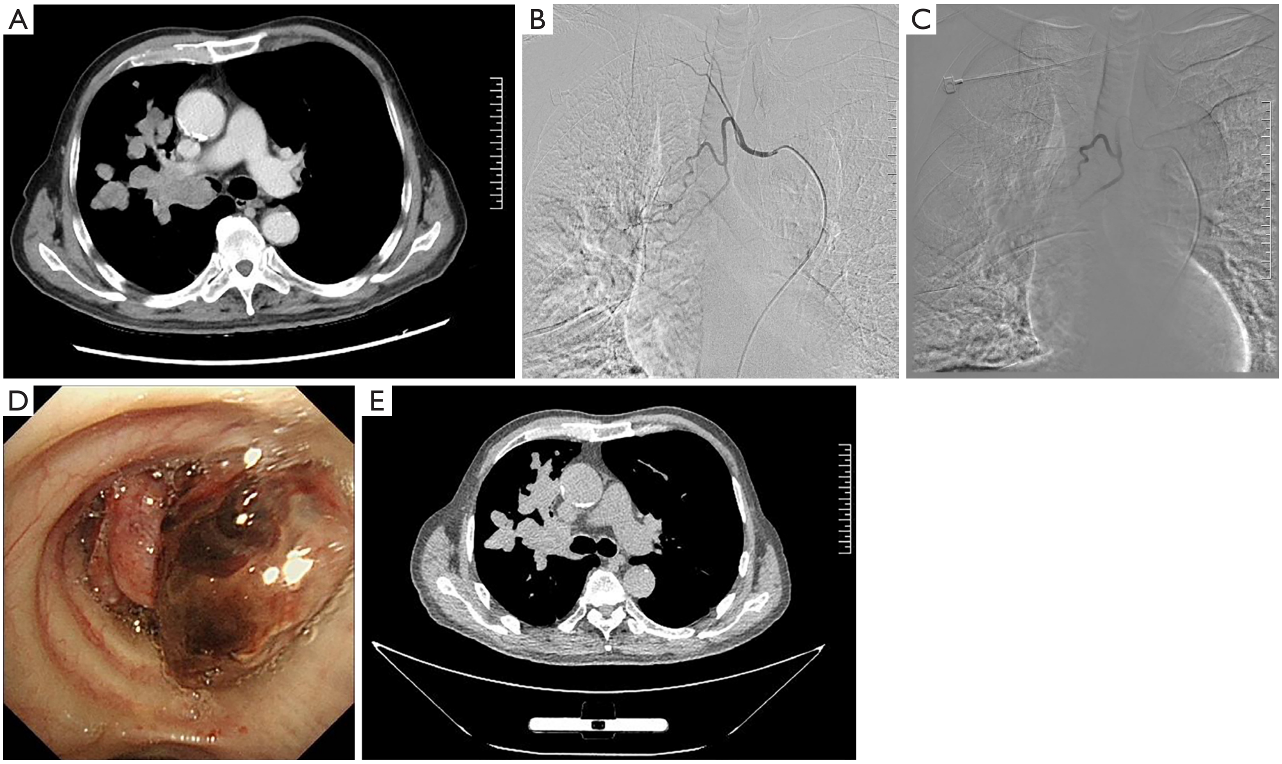

Figure 1 Radiographic and angiographic progression of endotracheal tumor treatment. (A) Thickening of the wall of the main right lung bronchus, upper lobe bronchus, and its branches, with local narrowing of the bronchial lumen. (B) The right bronchus was found to be share a common origin with the right intercostal artery, and flaky-shaped abnormal staining was observed in the right lung, indicating blood supply from the right bronchial artery. (C) Angiographic reexamination after embolization revealed complete embolization of tumor vessels. (D) Postembolization, the tumor tissue appeared dark red due to ischemia, with a slight reduction in total volume. (E) Postoperative CT imaging demonstrated significant improvement in patency of the right main bronchus compared to the preoperative status. CT, computed tomography.

The KPS scale (23) assigns points based on the patient's functional status as follows: 100 points for being completely normal, with no complaints of discomfort or symptoms of disease; 90 points for engaging in normal activities with minimal symptoms; 80 points for being able to perform heavy activities despite some manifestations of disease symptoms; 70 points for being capable of self-care but unable to engage in normal activities; 60 points for mostly being able to take care of oneself but requiring assistance for certain activities; 50 points for needing significant assistance and frequent hospital visits; 40 points for the loss of ability to live independently, necessitating specialized care; 30 points for the complete loss of ability to live independently and requiring hospitalization; 20 points for being critically ill and requiring active treatment; 10 points for being critically ill and at risk of death at any moment; and 0 points for being deceased.

Quality of life and dyspnea levels were assessed using the KPS and dyspnea scores, respectively. The severity of airway obstruction was determined using the obstruction grading system developed by Ong *et al.* (24), which categorizes luminal obstruction into five grades: grade I (≤25% luminal obstruction), grade II (25–50% luminal obstruction), grade III (50–75% luminal obstruction), grade IV (75–90% luminal obstruction), and grade V (>90% luminal obstruction).

Statistical analysis

Statistical analysis was performed using SPSS 26.0 software (IBM Corp., Armonk, NY, USA). Measurement data were expressed as the mean ± standard deviation ($\bar{x}$ ± s). A paired

Table 3 Analysis of treatment results

Time	KPS scores	Shortness of breath score	Degree of airway obstruction (%)	Obstruction grading
Pretreatment, mean ± SD	60.45±14.63	2.91±0.81	79.14±14.56	4±0.82
Posttreatment, mean ± SD	74.55±9.63	1.73±0.63	21.27±7.19	1.36±0.49
T	−6.891	6.973	26.857	18.794
P	<0.001	<0.001	<0.001	<0.001

KPS, Karnofsky Performance Status; SD, standard deviation.

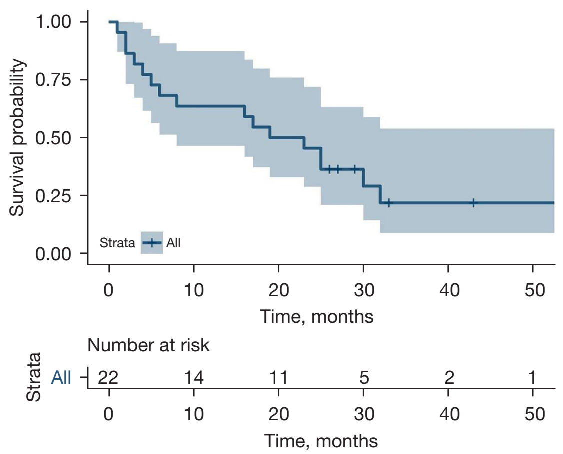

Figure 2 Overall survival curve of the study population.

samples *t*-test was used to compare the KPS score, shortness of breath score, and degree of airway obstruction before and after treatment. A significance level of P<0.05 was considered statistically significant, while a significance level of P<0.01 was considered highly statistically significant.

Results

The cohort consisted of 16 males and 6 females who were aged between 40 and 84 years, with an average age of 64±10.3 years. Their baseline characteristics and CT and bronchoscopic features are summarized in *Table 1*. Among these patients, 18 had progressive dyspnea, with 12 cases (54.5%) experiencing hemoptysis and 17 cases (77.3%) reporting cough. The distribution of histological types included 11 cases of squamous cell carcinoma, 3 of adenocarcinoma, 2 of adenoid cystic carcinoma, 2 of carcinoid carcinoma, and 2 of clear cell renal cell carcinoma. Notably, 68.2% of patients exhibited grade IV or V obstruction.

Interventional therapy efficacy

The overall efficacy of airway obstruction recanalization was 31.8% (7/22) in CE, 59.1% (13/22) in PE, 9.1% (2/22) in ME, and 0% in NE, with a total effective rate of 100% (22/22). Preoperative KPS scores increased significantly from 60.45±14.63 points to 74.55±9.63 points postoperatively, representing a statistically significant difference (t=−6.891; P<0.001) (*Table 3*). Comparison of pre- and posttreatment shortness of breath scores revealed a significant decrease from a preoperative value of 2.91±0.81 to a postoperative value of 1.73±0.63 (t=6.973; P<0.001). Similarly, the degree of airway obstruction decreased significantly from preoperative levels of 79.14%±14.56% to postoperative levels of 21.27%±7.19% (t=26.857; P<0.001). The degree of airway obstruction postoperatively 1.36±0.49 was significantly lower than that preoperatively (t=18.794; P<0.001), indicating considerable improvement in postoperative airway obstruction compared to preoperative levels. *Figure 2* shows the overall survival curve for patients who underwent bronchoscopic debulking following TAE. The median overall survival for this group was 21.0 months [95% confidence interval (CI): 6.5–26.5].

Complications

Interventional embolization-related complications were observed, with 11 patients experiencing nonspecific embolization complications such as nausea, vomiting, and fever, which improved following symptomatic treatment. These symptoms are collectively referred to as postembolization syndrome, which is a known consequence of embolization procedures. Notably, no patients had severe complications such as spinal artery embolism or tracheoesophageal ischemic necrosis. However, three patients experienced a transient drop in oxygen saturation to less than 90%, which promptly recovered to more than

95% following a rapid increase in oxygen concentration adjustment or intracavitary lesion removal. The most common intraoperative complication was bleeding. Surgery-related bleeding occurred in all 22 patients: 17 patients (77.3%) experienced negligible minor bleeding, 4 patients (18.2%) had minor bleeding requiring a single repeat laser application, and 1 patient encountered moderate bleeding necessitating prolonged balloon compression and intracavitary lesion removal with a rigid bronchoscope. No patient experienced severe bleeding.

Discussion

This retrospective study revealed that our proposed approach before bronchoscopy effectively mitigated the risk of moderate-to-severe bleeding in patients with CAO attributable to tumor growth. Furthermore, the study demonstrated that this preemptive embolization approach could lower the incidence of poor bronchoscopic visibility, bleeding episodes, and hypoxic events, thereby streamlining the surgical procedure by reducing intraoperative bleeding. This safe and feasible intervention enhances the prospects of TAE before bronchoscopy in managing this aggressive disease.

Individuals with CAO, characterized by airway masses in the trachea, carina, left and right bronchi, and middle segment bronchus, frequently experience symptoms of chest tightness, dyspnea, and respiratory distress (19). Severe cases may result in compromised respiratory function, escalating to severe dyspnea and potentially fatal outcomes. Traditionally, lesions at advanced stages pose challenges for surgical intervention. However, with advancements in endoscopic interventional therapy and techniques such as endoscopic freezing, holmium laser, argon knife, balloon dilatation, and internal stent placement, endoscopic bronchoscopic interventional therapy has emerged as a significant treatment modality for airway masses. Bleeding, among the most acute complications of endoscopic treatments, can precipitate life-threatening airway obstructions, necessitating urgent reventilation. The therapeutic solution is to restore and sustain airway patency; achieve stability of endobronchial lesions; facilitate additional cancer therapies to alleviate symptoms; and enhance lung function, functional status, and quality of life (25). Numerous studies have revealed that in individuals diagnosed with unresectable obstructive cancer, an initial effective debulking of the airway through laser photoresection or cryotherapy before irradiation can mitigate morbidity by reducing the incidence of local complications such as postobstructive infection, respiratory insufficiency, and hemoptysis (19).

The incidence of significant bleeding during endobronchial tumor resection varies, making it challenging to establish clear boundaries. Although some sources claim an absence of significant bleeding after the excision superficial endobronchial tumors (23), there are isolated reports of persistent bleeding or even mortality (26). For instance, in a study of adults with CAO undergoing bronchoscopic treatment, one patient succumbed to uncontrolled intraoperative bleeding, resulting in respiratory failure (15). Although TAE has proven effective in managing hepatocellular carcinoma, lung malignancies, and liver metastases, its application in bronchoscopic resection of intraluminal carcinoid and renal cell carcinoma metastases warrants further investigation (17). As large tumor tissues are excised, the destruction of the tumor's surface mucous membrane and nourishing blood vessels can lead to secondary vessel rupture and significant bleeding. Even minor bleeding can precipitate asphyxiation in patients with severe airway obstruction. Although 1.4% to 6.5% of spinal artery embolisms include bronchial artery embolism (27,28), we found that arterial embolization is advantageous for controlling bleeding and lesions, markedly reducing intraoperative bleeding, shortening surgical duration, and mitigating surgical complexity. Among the 22 patients, only 1 experienced moderate bleeding, necessitating balloon compression to arrest bleeding, while the remaining cases had negligible bleeding. Hence, selective TAE prior to surgery can diminish tumor blood supply, forestall massive bleeding during surgery, and streamline bronchoscopic procedures. Additionally, embolization can complement local chemotherapy in managing malignant tumors, facilitating better tumor control and reducing the incidence of tumor recurrence (29).

Currently, surgical treatment is considered the primary approach for managing early tracheal tumors, while bronchoscopic interventional therapy serves as a direct palliative option for patients with midstage to advanced tracheal tumors (7). Among the 22 patients included in this study, 11 had squamous cell carcinoma, 3 had adenocarcinoma, 2 had adenoid cystic carcinoma, 2 had carcinoid tumors, and 2 had renal clear-cell carcinoma metastases. Following a comprehensive assessment, all patients were deemed unsuitable for surgery and were eligible for bronchoscopic resection. However, some patients exhibited compromised respiratory and circulatory function, rendering them unable to tolerate bronchoscopic intervention, and their contrast-enhanced CT scans revealed significantly enlarged endotracheal masses with abundant blood supply. Thus, direct bronchoscopic resection in this subgroup posed a high risk of hemoptysis. Three patients experienced ruptures and subsequent bleeding episodes, with uncontrollable massive bleeding during endoscopic resection posing a severe threat to their safety and lives. Therefore, ensuring adequate hemostasis and reducing tumor blood supply emerged as the primary treatment strategy, with TAE employed for therapeutic purposes.

From a pathophysiological perspective, both the bronchial and pulmonary arteries play crucial roles in supplying blood to the airways and lungs. In particular, the bronchial artery serves as the primary blood supply vessel for pulmonary metastases, with blood supply increasing in proportion to the number of metastatic sites, extending from the lung's central region to the intrapulmonary region (30). Theoretically, bronchial artery embolization represents a potential method for reducing blood supply during the resection of endotracheal hematogenous tumors. Yoon *et al.* (27) reported that employing TAE before bronchoscopy significantly reduced bleeding in two patients with intrabronchial renal cancer. In a comparative study evaluating the efficacy of TAE in reducing bleeding during bronchoscopic treatment, it was found that TAE significantly decreased the incidence of moderate and severe bleeding compared to non-TAE procedures (19). TAE facilitated faster and technically simpler ablation during bronchoscopic procedures. Furthermore, TAE may mitigate the hypoxia and visual impairment induced by significant bleeding during bronchoscopy.

After bronchoscopic intervention, notable improvements were observed in the clinical symptoms, signs, KPS score, shortness of breath score, and degree of airway obstruction among the 22 patients. TAE played a significant role in reducing intraoperative bleeding, thereby enabling quicker and technically simpler resection. Patients at risk of substantial bleeding were identified preoperatively through enhanced CT scans revealing arterial involvement within the tumor. Subsequently, these patients underwent selective embolization, resulting in considerable improvements in ventilatory function and survival. Additionally, this study suggests that the optimal therapeutic outcomes for tracheal tumors involve lesion eradication and relief of airway obstruction. However, in cases in which achieving both simultaneously is challenging, employing various methods to alleviate airway obstruction and ensuring patient safety is imperative. Moreover, facilitating smooth transitions for patients in this manner enhances their progression to subsequent phases of tumor-related treatment (31).

In most cases, an endobronchial tumor extends beyond the lumen, a phenomenon often referred to as the *iceberg phenomenon*, wherein only a small portion of the tumor's "tip" is visible within the lumen. There is a possibility that bronchial artery embolization can induce critical ischemia in residual tumor tissue within the bronchial wall following resection, thereby reducing the rate of complete endobronchial resection and hindering effective intervention in the tumor beyond the lumen. TAE regulates the blood supply to the intracavitary mass and occludes tumor vessels within the intracavitary tissue, allowing for combination with local chemotherapy treatment to better manage tumor progression.

This study involved certain limitations which should be addressed. The retrospective design and small sample size of 22 patients may introduce selection bias and limit generalizability, and the single-center nature of the study may hinder the reproducibility of results in other clinical settings. Moreover, the absence of a control group precludes direct comparison with patients not receiving TAE before bronchoscopic debulking. Additionally, the reliance on medical records and subjective assessments such as the KPS score might have introduced information bias. These factors could lead to an overestimation or underestimation of the efficacy and safety of the combined approach. Future prospective, multicenter studies with larger sample sizes are needed to validate these findings.

Conclusions

In conclusion, our study provides evidence for the efficacy and safety of combining TAE and bronchoscopic debulking for relieving airway obstruction in endotracheal malignancies. The results showed significant improvements in dyspnea severity, KPS scores, and airway obstruction degree posttreatment, as well as enhancements in patients' quality of life. The absence of severe complications indicates the potential safety of this intervention. Collectively, TAE combined with bronchoscopic debulking could be a valuable therapeutic option, emphasizing the importance of multidisciplinary approaches. Nonetheless, larger prospective studies are needed to validate and refine treatment protocols.

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Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at https://qims.amegroups.com/article/view/10.21037/qims-24-187/rc

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://qims.amegroups.com/article/view/10.21037/qims-24-187/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work and ensure that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013) and was approved by institutional ethical review board of The First Affiliated Hospital of Zhengzhou University (No. 2023-KY-1188). All patients provided signed written informed consent.

References

1. Mudambi L, Miller R, Eapen GA. Malignant central airway obstruction. J Thorac Dis 2017;9:S1087-110.
2. Leiter A, Veluswamy RR, Wisnivesky JP. The global burden of lung cancer: current status and future trends. Nat Rev Clin Oncol 2023;20:624-39.
3. Siegel R, Naishadham D, Jemal A. Cancer statistics, 2013. CA Cancer J Clin 2013;63:11-30.
4. Yarmus L, Mallow C, Akulian J, Lin CT, Ettinger D, Hales R, Voong KR, Lee H, Feller-Kopman D, Semaan R, Seward K, Wahidi MM. Prospective Multicentered Safety and Feasibility Pilot for Endobronchial Intratumoral Chemotherapy. Chest 2019;156:562-70.
5. Freitag L, Ernst A, Unger M, Kovitz K, Marquette CH. A proposed classification system of central airway stenosis. Eur Respir J 2007;30:7-12.
6. Hazuka MB, Bunn PA Jr. Controversies in the nonsurgical treatment of stage III non-small cell lung cancer. Am Rev Respir Dis 1992;145:967-77.
7. Dalar L, Özdemir C, Abul Y, Karasulu L, Sökücü SN, Akbaş A, Altn S. Therapeutic bronchoscopic interventions for malignant airway obstruction: A retrospective study from experience on 547 patients. Medicine (Baltimore) 2016;95:e3886.
8. Ross P Jr, Grecula J, Bekaii-Saab T, Villalona-Calero M, Otterson G, Magro C. Incorporation of photodynamic therapy as an induction modality in non-small cell lung cancer. Lasers Surg Med 2006;38:881-9.
9. Wahidi MM, Unroe MA, Adlakha N, Beyea M, Shofer SL. The use of electrocautery as the primary ablation modality for malignant and benign airway obstruction. J Thorac Oncol 2011;6:1516-20.
10. Morice RC, Ece T, Ece F, Keus L. Endobronchial argon plasma coagulation for treatment of hemoptysis and neoplastic airway obstruction. Chest 2001;119:781-7.
11. Li CH, Huang SF, Li HY. Bronchoscopic Nd-YAG laser surgery for tracheobronchial mucoepidermoid carcinoma--a report of two cases. Int J Clin Pract 2004;58:979-82.
12. Lee JW, Lee JH, Kim HK, Shim BY, An HJ, Kim SH. The efficacy of external beam radiotherapy for airway obstruction in lung cancer patients. Cancer Res Treat 2015;47:189-96.
13. Mallick I, Sharma SC, Behera D. Endobronchial brachytherapy for symptom palliation in non-small cell lung cancer--analysis of symptom response, endoscopic improvement and quality of life. Lung Cancer 2007;55:313-8.
14. Chung FT, Chou CL, Lo YL, Kuo CH, Wang TY, Wang CH, Huang HY, Lin HC, Chang CH, Lee CS, Chen HC, Lin SM. Factors affecting survival in patients with endobronchial malignant mass after flexible Bronchoscopic cryotherapy: a cohort study. BMC Pulm Med 2019;19:101.
15. Schumann C, Hetzel M, Babiak AJ, Hetzel J, Merk T, Wibmer T, Lepper PM, Krüger S. Endobronchial tumor debulking with a flexible cryoprobe for immediate treatment of malignant stenosis. J Thorac Cardiovasc Surg

2010;139:997-1000.
16. Hetzel M, Hetzel J, Schumann C, Marx N, Babiak A. Cryorecanalization: a new approach for the immediate management of acute airway obstruction. J Thorac Cardiovasc Surg 2004;127:1427-31.
17. Jeong JH, Kim J, Choi CM, Ji W. Clinical Outcomes of Bronchoscopic Cryotherapy for Central Airway Obstruction in Adults: An 11-Years' Experience of a Single Center. J Korean Med Sci 2023;38:e244.
18. Squiers JJ, Teeter WA, Hoopman JE, Piepenbrok K, Wagner R, Ferguson R, Nagji AS, Peltz M, Wait MA, DiMaio JM. Holmium:YAG laser bronchoscopy ablation of benign and malignant airway obstructions: an 8-year experience. Lasers Med Sci 2014;29:1437-43.
19. Tao M, Zhang N, Wang H, Ma H, Gao H, Wang Z. Bronchial arterial embolization may reduce the risk of severe bleeding in central airway obstruction due to renal cell carcinomas during bronchoscopic procedures. Ther Adv Respir Dis 2020;14:1753466620976012.
20. Papaporfyriou A, Domayer J, Meilinger M, Firlinger I, Funk GC, Setinek U, Kostikas K, Valipour A. Bronchoscopic diagnosis and treatment of endobronchial carcinoid: case report and review of the literature. Eur Respir Rev 2021;30:200115.
21. Salamonsen M, Tazi-Mezalek R, López-Lisbona R, Cubero N, Baixeras N, Dominguez J, Dorca J, Rosell A. Combined Bronchial Artery Embolization and Endobronchial Resection for Bronchial Carcinoid: A Safety and Feasibility Pilot Study. Respiration 2016;91:63-8.
22. Murray JF, Nadel JA. Textbook of respiratory medicine. Philadelphia: Saunders, 1994:511-2.
23. Mehta HJ, Begnaud A, Penley AM, Wynne J, Malhotra P, Fernandez-Bussy S, Cope J, Shuster JJ, Jantz MA. Restoration of Patency to Central Airways Occluded by Malignant Endobronchial Tumors Using Intratumoral Injection of Cisplatin. Ann Am Thorac Soc 2015;12:1345-50.
24. Ong P, Grosu HB, Debiane L, Casal RF, Eapen GA, Jimenez CA, Noor L, Ost DE. Long-term quality-adjusted survival following therapeutic bronchoscopy for malignant central airway obstruction. Thorax 2019;74:141-56.
25. Bergler W, Hönig M, Götte K, Petroianu G, Hörmann K. Treatment of recurrent respiratory papillomatosis with argon plasma coagulation. J Laryngol Otol 1997;111:381-4.
26. Cavaliere S, Venuta F, Foccoli P, Toninelli C, La Face B. Endoscopic treatment of malignant airway obstructions in 2,008 patients. Chest 1996;110:1536-42.
27. Yoon W, Kim JK, Kim YH, Chung TW, Kang HK. Bronchial and nonbronchial systemic artery embolization for life-threatening hemoptysis: a comprehensive review. Radiographics 2002;22:1395-409.
28. Neyman K, Sundset A, Naalsund A, Espinoza A, Solberg S, Kongerud J, Fosse E. Endoscopic treatment of bronchial carcinoids in comparison to surgical resection: a retrospective study. J Bronchology Interv Pulmonol 2012;19:29-34.
29. Hussain SMA. Tumor embolism and acute arterial occlusion: A systematic review. Surg Open Sci 2022;10:216-22.
30. Bolliger CT, Sutedja TG, Strausz J, Freitag L. Therapeutic bronchoscopy with immediate effect: laser, electrocautery, argon plasma coagulation and stents. Eur Respir J 2006;27:1258-71.
31. Baile EM. The anatomy and physiology of the bronchial circulation. J Aerosol Med 1996;9:1-6.

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