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## Case Report

## The role of interventional bronchoscopy in the management of malignant central airway obstruction

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## ABSTRACT

Nearly a third of patients with primary lung cancer present with malignant central airway obstruction (MCAO), and some of them appear to have advanced disease. In these patients, accurate staging is crucial. Although the literature extensively outlines the role of interventional bronchoscopy in palliation, its contribution to refining the staging of patients with MCAO is noteworthy. Here, we present a case of a patient initially diagnosed with stage IV cancer due to a left mainstem tumor causing complete lung collapse. He was referred to our institution for palliative treatment of his cough. Following interventional bronchoscopy, the patient's staging was revised to T1a, and subsequently, he underwent lobectomy without complications.

## 1. Introduction

Accurate staging is paramount for achieving optimal outcomes in lung cancer patients. Historically, radiographic techniques and invasive staging procedures are utilized for this purpose. Invasive staging techniques include bronchoscopy with or without endobronchial ultrasound (EBUS), mediastinoscopy, and/or chamberlain procedures. When utilized appropriately, these invasive staging procedures are used to confirm or refute radiographic staging in the hopes of optimizing treatment.

Thirty percent of primary lung cancer patients present with malignant central airway obstruction (MCAO) [1]. After appropriate staging some of these patients undergo curative resection like pneumonectomy but some may be incorrectly overstaged and not offered surgical resection. Certain cases benefit from interventional bronchoscopy to refine both staging and treatment. While the role of palliative interventional bronchoscopy in patients with MCAO has been well described, its role in staging lung cancer patients is widely unrecognized [2]. We present a patient with complete left airway obstruction who was down staged by interventional bronchoscopy and subsequently underwent appropriate surgical resection.

## 2. Case presentation

A 70-year-old male (Body Surface Area 1.72) with a history of severe obstructive multivessel coronary artery disease, chronic obstructive pulmonary disease, and a 60-pack-year smoking history presented for the evaluation of a progressive cough for several months and 40 lbs. weight loss. The patient denied dyspnea, hemoptysis, chest pain, fever, family history of lung cancer, or any occupational exposure. Vital signs were within normal range, with an oxygen saturation of 96 % on room air. Physical exam revealed absent sounds in the left lung field, without signs of cyanosis, clubbing, or edema.

*Abbreviations:* Endobronchial ultrasound, (EBUS); Malignant central airway obstruction, (MCAO); Position emission tomography-CT, (PET-CT); Magnetic resonance imaging, (MRI).

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The initial workup included an electrocardiogram, which showed a history of myocardial infarction and ischemia. A chest x-ray demonstrated complete collapse of the left lung and mediastinal shift (Fig. 1). Computed tomography (CT) scan revealed a left mainstem tumor with complete obstruction bronchus and moderate emphysema in the right lung (Fig. 2A). The patient underwent cardiac catheterization and bronchoscopy prior to a position emission tomography-CT (PET-CT).

Cardiac catheterization showed severe triple vessel coronary disease with depressed ejection fraction of 40 % and right heart strain. Bronchoscopy demonstrated complete left airway obstruction (Fig. 3) and biopsies demonstrated squamous cell carcinoma. EBUS-guided biopsy at lymph node stations L4, L7, and L10 were negative for malignancy. No intervention for the coronary artery disease was done.

PET-CT demonstrated increased hypermetabolic activity in the area of the left mainstem bronchus ( $SUV_{max}$  13) and at the L11 lymph node station ( $SUV_{max}$  7), without any evidence of distant metastasis (Fig. 2B). Pulmonary function testing revealed a  $FEV_1$  of

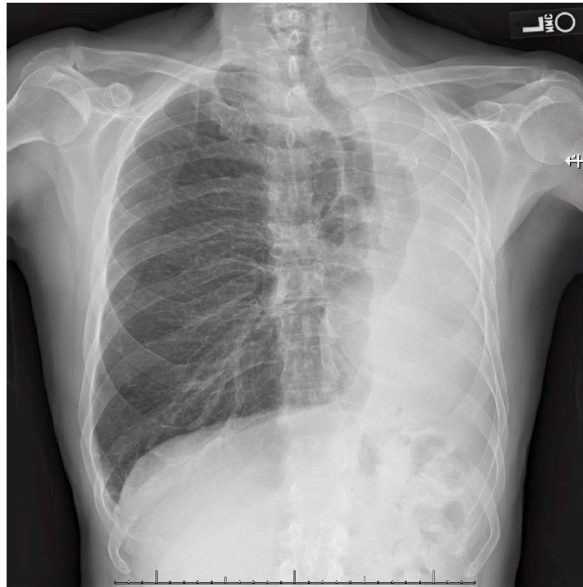


Fig. 1. Chest x-ray demonstrates complete collapse of the left lung.

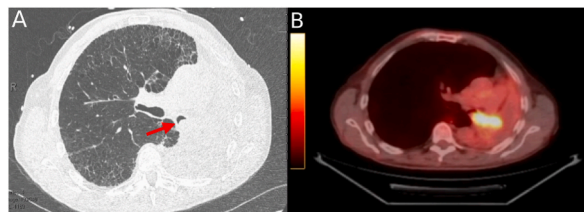


Fig. 2. (A) Axial chest CT scan demonstrating a 2.5 cm endoluminal tumor in the left mainstem bronchus with (B) increased metabolic activity on PET-CT.



Fig. 3. Bronchoscopy demonstrating an endoluminal tumor completely obstructing the left mainstem bronchus.

1.98L (70 % of predicted); DLCO could not be obtained due to the patient's inability to hold his breath. Magnetic resonance imaging (MRI) showed no evidence of metastatic disease.

The patient was considered stage IV non-small cell lung cancer (T4 due to size and involvement of the carina, N1, M0). Due to his perceived stage and coronary disease, he was considered non-curative and was advised to consider palliative radiation, with the potential to add chemotherapy and immunotherapy if he responded well. He was not offered intervention for his coronary artery disease. The patient declined this treatment but accepted a referral to our institution and thoracic surgery for palliative treatment of his cough.

The patient underwent an interventional bronchoscopy. Following induction with general endotracheal anesthesia, the bronchoscope was introduced, revealing a complete obstruction of the left mainstem bronchus and a patent right mainstem bronchus. Initially, the tumor was debulked using snare electrocautery (Fig. 4A) and an 8 cm mass was removed from the airway. The tumor was pulled into the distal end of the endotracheal tube and removed as the patient was extubated (Fig. 4B–C). A significant amount of secretions were visualized and suctioned, revealing a patent left mainstem bronchus. The left secondary carina was also pristine, but there was residual tumor in the distal bronchus of the left upper lobe (Fig. 4D–E). Argon plasma coagulation was used to open the remaining segments of the left upper lobe (Fig. 5F). The procedure lasted approximately 20 minutes and the patient tolerated it without complications.

Postoperatively, lung sounds were clear on auscultation bilaterally and the chest x-ray confirmed complete re-expansion of the left lung (Fig. 5). Pathology report was consistent with the prior biopsy, demonstrating an invasive and poorly differentiated squamous cell carcinoma with sarcomatous and basaloid changes, which was found to be PDL-1 positive. Two weeks later, chest CT scan demonstrated an expanded left lung with no tumor was seen (Fig. 6). Multidisciplinary case presentation and the patient was clinically staged as a T1a. Based on this staging, the patient underwent percutaneous coronary artery intervention with three drug eluting

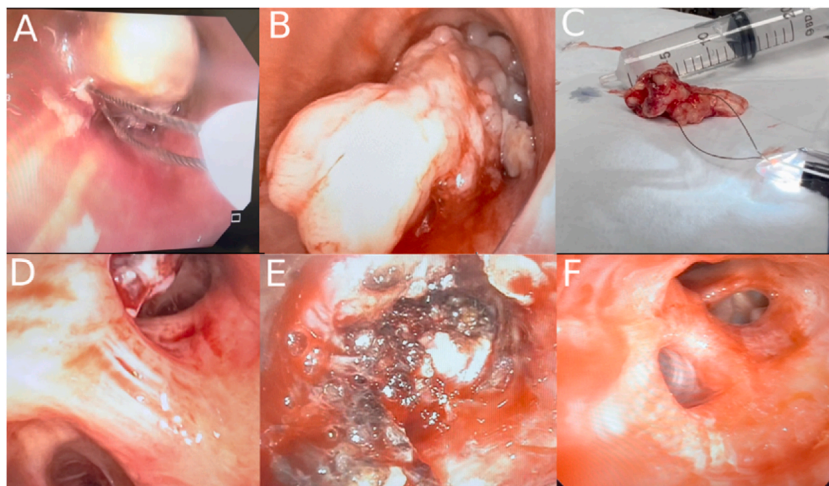


Fig. 4. During interventional bronchoscopy, (A) the mass in the left mainstem was debulked with a snare, (B) extracted into the distal trachea, (C) and removed. Bronchoscopy then revealed (D) an intact secondary carina. (E) Residual tumor in the left upper lobe was removed, revealing intact segmental bronchi.

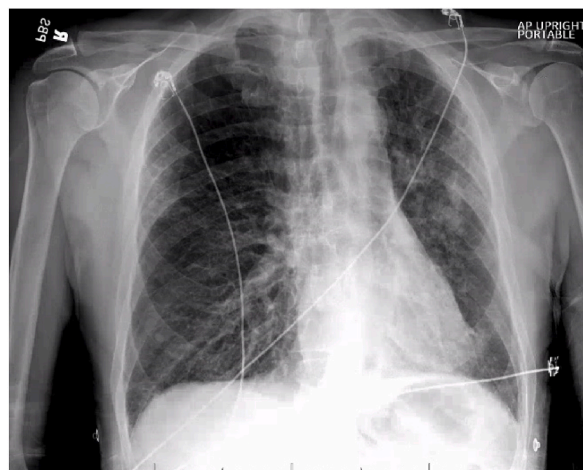


Fig. 5. Post-procedural chest x-ray demonstrates complete re-expansion of the left lung.

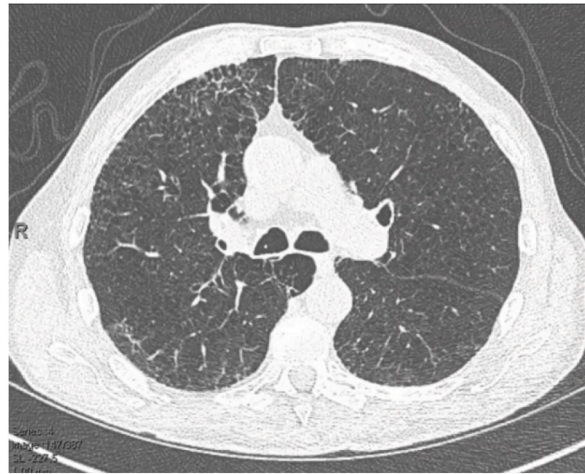


Fig. 6. Post-procedural chest CT demonstrates re-expansion of the left lung without residual tumor.

stents. He was started on a three-month course of dual anti-platelet therapy, during which he was offered and accepted chemotherapy and pembrolizumab.

Five months following his initial diagnosis, he underwent repeat radiographic staging, which was negative for any signs of tumor. The patient underwent a minimally invasive left upper lobectomy. Patient's postoperative course was uneventful and he was discharged in a hemodynamically stable condition on room air. Pathology demonstrated a complete response (ypTCR NO M0).

### 3. Discussion

In patients with MCAO, survival typically ranges from only 1–2 months without intervention [3]. Endobronchial procedures are commonly employed for MCAO located in critical areas, such as the trachea, carina, and primary bronchial branches, to alleviate symptoms of cough, hemoptysis, or dyspnea, and reduce the risk of asphyxia, ventilator requirements, and mortality [3,4]. Nevertheless, this approach is generally viewed as palliative [2,5]. In patients presenting with MCAO, as demonstrated in this case, interventional bronchoscopy can provide crucial staging insights and optimize stage-based treatment. So far, a few studies have documented the application of interventional bronchoscopy for enhancing resectability (see Table 1). However, none of these studies investigate the potential of this approach in down-staging patients with MCAO who were initially deemed non-resectable.

This case demonstrates the advantages of interventional bronchoscopy in the management of patients presenting with MCAO versus treatment based on radiologic staging alone. Initially diagnosed with stage IV disease, this patient underwent successful debulking of his tumor, resulting in complete re-expansion of the left lung postoperatively, with no detectable signs of disease on subsequent chest CT scans. Additionally, we effectively alleviated the patient's symptoms and mitigated the risk of potential complications, such as breathlessness and obstructive pneumonia. The bronchoscopy also enabled the patient to undergo percutaneous coronary stenting, and was subsequently eligible for surgical resection, now classified as stage I disease. By employing this approach, we gained a more precise assessment of the disease stage, allowing us to offer the patient stage-based treatment. The value of induction chemotherapy and immunotherapy versus other approaches is up for debate. Arguably, the patient could have had non-drug eluting stents placed, which would result in a substantially lower long-term patency in a patient who is likely cured of his lung cancer.

Although certain patients with MCAO may initially seem to have advanced disease, a subgroup of them, such as this patient, might not actually possess advanced malignancy. This necessitates a comprehensive evaluation. For instance, in this particular patient who presented with complete left lung collapse and a tumor in the left mainstem bronchus, PET-CT imaging did not reveal any signs of intrapulmonary or extrathoracic metastasis. Furthermore, the brain MRI was negative, and subsequent lymph node biopsies did not re-

**Table 1**  
Studies exploring the role of interventional bronchoscopy in lung cancer staging.

Study (year)	No. patients	Technique	Conclusion(s)
Chhajed (2006) [6]	NR	Laser resection, mechanical debulking, argon plasma therapy, electrocautery	Intervention may permit parenchyma-sparing surgery
Venuta (2002) [7]	13	Laser resection	Intervention may restore airway, improve staging, and enable resection
Crosta (2001) [8]	2	Argon plasma therapy	Intervention enabled radical surgical resection after chemotherapy
Cavaliere (1996) [9]	39	Laser resection	Intervention enabled better assessment of tumor, surgical resection in previously non-operable patients, and/or lung-sparing surgery

NR, not reported.

veal malignancy. Therefore, the patient was thought to benefit from interventional bronchoscopy to relieve MCAO and reassess his tumor.

Overall, the risk of therapeutic interventional bronchoscopy is low, resulting in procedural complications in 3.9 % and procedural death in up to 1.3 % [4]. Our patient was deemed to be at a low risk for any complications, which tend to be more prevalent in patients with moderate sedation, high ASA status, urgent/emergent/redo bronchoscopy, bleeding, pneumothorax, worsening hypoxia, ventilator requirement, airway injury [4]. Additionally, endobronchial tumors tend to be associated with a better prognosis than those with MCAO from extrinsic obstruction or mixed lesion [4]. The location of the patient's tumor within the left mainstem bronchus appeared to be endoluminal, further enhancing the potential effectiveness of interventional bronchoscopy.

Typically, therapeutic bronchoscopy in patients with MCAO achieves a 93 % success rate, defined as reopening of the lumen by more than 50 % [4]. This often involves employing a combination of modalities, including mechanical debridement, bronchial dilation, airway stenting, and ablative techniques, such as laser, electrocautery, argon plasma coagulation, and cryotherapy [10]. In this case, we initially utilized snare electrocautery to remove a significant portion of the tumor, followed by argon plasma coagulation which enabled us to completely reopen his left upper lobe. Ultimately, interventional bronchoscopy in this patient resulted in complete resection of a ypTCRNoMo tumor with a 5-year cancer-specific survival of 78 % [11].

#### 4. Conclusion

Some patients presenting with MCAO may initially appear to have more advanced disease. Palliative interventional bronchoscopy is frequently utilized in patients with MCAO. However, interventional bronchoscopy may have a larger role in staging a subset of patients with MCAO, thus optimizing their management and overall outcome.

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#### CRediT authorship contribution statement

**Nika Samadzadeh Tabrizi:** Writing – review & editing, Writing – original draft, Resources, Methodology, Data curation. **Perry A. Stout:** Writing – review & editing, Visualization, Methodology, Investigation. **Tyler Fabian:** Writing – review & editing, Writing – original draft, Visualization, Data curation. **Thomas Fabian:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Conceptualization.

#### Declaration of competing interest

None.

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