



## Central Airway Obstruction Treated with Rigid Bronchoscopy

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### Abstract

Central Airway Obstruction (CAO) is a pervasive issue across subspecialties. Management is dependent on factors such as patient age, comorbidities, surgical risk, and pathology and disease involvement. If untreated, death from respiratory failure is common. Rigid Bronchoscopy is an increasingly used, minimally invasive alternative to managing CAO.

We present a case series of poor surgical candidates with a mixed pathology of central airway obstruction managed by rigid bronchoscopy techniques.

### Introduction

Central Airway Obstruction (CAO) is increasingly encountered in thoracic and pulmonary medicine. It may be secondary to malignant or benign diseases, but most frequently presents as a complication of advanced lung cancer. The exact prevalence of CAO is unknown, but it is estimated that up to 30% of patients with lung cancer develop complications of airway obstruction, such as post obstruction pneumonia and atelectasis, dyspnea, and others [1].

CAO is generally defined as >50% obstruction of the trachea, mainstem bronchi, bronchus intermedius, or lobar bronchi [2].

When characterizing CAO, distinguishing between quantitative and qualitative criteria is imperative. Qualitative criteria include histology (benign or malignant), dynamic features (fixed versus variable), and mechanism of obstruction (intrinsic versus extrinsic; compression or mixed). Quantitative criteria include the degree of narrowing as well as airway morphology and vertical involvement [2]. If untreated, death from Respiratory Failure (RF) is common.

Interventional alternatives in management continue to evolve. Flexible Bronchoscopy (FB) is limited for many technical reasons (working channel diameter, inability to achieve hemostasis, etc.) Rigid Bronchoscopy (RB) using a variety of debulking methods such as laser ablation, argon plasma coagulation, balloon dilation, and mechanical debridement as well as airway stenting are all acceptable approaches for the treatment of malignant CAO. RB is often described as the gold standard in managing malignant CAO with success rates of up to 90% [3,4]. In this series we sought to evaluate the effectiveness and success rates of RB in relieving CAO in the veteran population.

### Methods

A retrospective review of a prospectively collected database in a single Veterans Affairs (VA) medical center from March 2017 to May 2019. We received expedited Institutional Review Board (IRB) approval for the retrospective study. Inclusion criteria included patients older than 18 years of age with a diagnosis of CAO.

### Results

Thirteen patients underwent RB with a preoperative diagnosis of CAO. Mean patient age was 65.9 years. Eleven patients (85%) were male. Eleven (85%) had a smoking history. The majority of CAOs were caused by malignant tumors (85%) of which 82% were due to squamous cell carcinoma of the lung. One patient had stage IV pulmonary adenocarcinoma and one case was due to metastatic prostate cancer. There were two cases of benign tracheal stenosis: one due to an aberrant subclavian artery aneurysm and another case secondary to prolonged intubation at an outside hospital. Five

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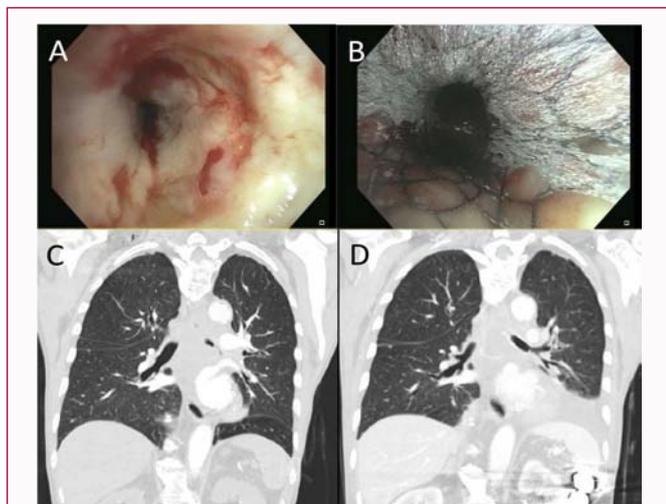
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**Figure 1:** Bronchoscopic and computed tomography images of invasive squamous cell carcinoma of the lung with resultant central airway obstruction. (A) Large left main stem bronchial occlusion secondary to squamous cell carcinoma of the lung with distal end narrowing to 3 mm. (B) Lesion fully stented using a 12 mm x 30 mm silicone covered stent showing full patency of left upper and left lower lobe bronchi. (C) Coronal Computed Tomography (CT) Images showing severe stenosis of the mid to distal left main stem bronchus. (D) Coronal CT image of one-week post-stenting of the left main stem bronchus, showing widely patent airway with no compromise to the left upper or left lower lobe bronchi.

patients had stenotic lesions located in the right mainstem bronchus, six in the left mainstem bronchus (Figure 1), and two with tracheal lesions. Eight patients (62%) underwent balloon dilation, four (31%) underwent argon plasma coagulation, three (23%) underwent laser ablation, and six patients (46%) received a stent. Stenotic relief was achieved intraoperatively in eleven patients (85%). Complications included all-cause 30-days mortality in four (31%) patients, three (23%) cases of readmission for airway compromise, one (7.7%) case of stent migration, and one (7.7%) case of hemodynamic compromise. There were no procedural mortalities.

## Discussion

Veterans with advanced pulmonary malignancies may present with CAO and increased surgical risk. A multidisciplinary approach is necessary to achieve the best possible outcomes [5]. Several studies have shown that RB in the hands of an experienced operator is a minimally invasive approach that can safely and effectively relieve airway compromise [6].

In our sample, RB effectively relieved CAO in 85% of patients. This is in line with the 93% success rate that has been reported previously in the literature [7]. It is estimated that 50% of the airway compromise needs to be relieved in order to achieve symptomatic relief, which is the primary goal of treatment in CAO [8]. Stenting was necessary in almost half of our cohort in order to achieve these results. Choice of stent, whether silicone versus hybrid, silicone-covered self-expanding metal, is dependent on a variety of factors, which include pathology, anatomy and projected life expectancy. Silicone stents can only be placed via rigid bronchoscopy while silicone covered stents may, in some instances, be placed with a flexible endoscope, using guidewire and fluoroscopy. The main operator's preference is the silicone stent, as it provides options for optimization of positioning such as a smaller diameter on one side of the stent and the ability to trim the stent to be the appropriate length or create fenestrations to allow for ventilation

of lobar bronchi [8]. It is important to note that both Stent types have inherent advantages and disadvantages and as such choice of stent type is tailored to each patient.

The complications from RB observed in our series were also similar to those seen in other reports. Ost et al. [9] reported a complication rate of 3.9% in a series of 1,115 procedures for CAO, with complications including bleeding, pneumothorax, airway injury, respiratory failure, death, and others. Our complications consisted of hemodynamic instability, airway compromise, and stent migration. Our complication percentage was higher, which can likely be attributed to the small sample size.

Complication rate notwithstanding, the treatment of CAO is important for several reasons. A large percentage of CAO is caused by malignant disease, but even when benign it can be life limiting and has a profound effect on quality of life. A prospective cohort of 37 patients by Oviatt et al. [10] found a significant improvement in spirometry and dyspnea at 30 days after treatment of CAO with bronchoscopy, when compared to baseline. It can also be lifesaving treatment in many situations when employed in a timely fashion, and it has been shown to decrease healthcare costs by lowering the level of care needed and reducing the need for mechanical ventilation [11,12].

It is our belief that RB is the ideal instrument for airway control in patients with airway obstruction, especially those in respiratory failure. The main advantage is the large lumen of the bronchoscope and ventilating port which allow ventilation to continue while airway procedures are performed through the channel. Flexible bronchoscopes, if required can be introduced through the rigid bronchoscope. In case of centrally obstructing tumors in the trachea, quick recanalization can be achieved using the mechanical coring method directly with the rigid bronchoscope itself. It allows all airway interventions to be performed safely and efficaciously. However, adequate training is a must and it requires teamwork between the assisting staff, anesthesiologist, and the interventional pulmonologist.

There are several weaknesses in our series. For one, it is a retrospective review, which has its own inherent shortcomings. In addition, the sample size is small and does not have the power to achieve statistically significant analysis. Furthermore the operators in this series are experienced and well versed in RB and other interventional pulmonology techniques, and it was a single operating team series; therefore the results are likely not generalizable to standard practice. Flexible bronchoscopy in our series was only used in conjunction with RB and was not used alone, so we cannot compare efficacy of each method used independently.

## Conclusion

As the prevalence of lung cancer continues to increase, advanced bronchoscopic techniques will undoubtedly have a significant role in the palliation of airway obstruction in nonsurgical patients. Our series showed that RB is an effective method for treating CAO in the veteran population. It is vitally important to individualize management based upon the patient's pathology, and to employ a multidisciplinary approach, to achieve optimal success rates. More research in the veteran and civilian population is needed to compare different modalities and their respective outcomes.

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