

# Stenting of critical tracheal stenosis with adjuvant cardio-pulmonary bypass

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## ABSTRACT

Severe and critical central airway obstruction causing impaired ventilation and/or oxygenation can impose tremendous challenges on the interventional pulmonologist. Near total airway obstruction can rapidly evolve into potentially fatal complete airway occlusion during bronchoscopic airway manipulation under moderate sedation; as well as during the induction of the general anesthesia. Although there are currently interventional pulmonary procedures available to tackle the critical airway obstruction in extreme situations, cardio-pulmonary bypass should be considered prior to the intervention to maintain the adequate gas exchange during the procedure. Orotracheal intubation with mechanical ventilation in this situation can be fatal itself if the obstructing airway lesion functions as a “one way valve” allowing air to follow distally during inspiration but impeding expiratory flow leading to gas trapping, high intrathoracic pressure, tension pneumothorax, and ultimately a cardiac arrest.

**KEY WORDS:** Airway stenting, cardio-pulmonary bypass, tracheal stenosis

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## INTRODUCTION

Severe central airway obstruction, irrespective of the etiology, is one of the most serious emergencies faced by the physicians. Near total central airway obstruction can hinder the patient from getting adequate ventilation and oxygenation leading to a fatal cardiopulmonary arrest. The maintenance of the airway is, in particular, challenging if the obstruction is present at the lower tracheal level or it involves both main-stem bronchi. Although various interventional procedures including airway stent placement and intra-airway tissue destruction are available to manage central airway obstruction; in extreme situations of “near total” central airway obstruction, the use of cardio-pulmonary bypass (CPB) should be considered before the induction of anesthesia or moderate sedation so that gas exchange can be maintained

if complete airway obstruction ensues.<sup>[1]</sup> We report the case of a 58-year-old patient who presented with critical distal tracheal obstruction caused by esophageal malignancy. The patient was successfully managed by the placement of a flexible bronchoscopy guided hybrid silicon/metal stent with the assistance of adjuvant CPB initiated prior to the induction of the anesthesia.

## CASE REPORT

A 58-year-old white male with a history of squamous cell esophageal cancer status postesophagectomy was referred to our institution with worsening shortness of breath for past several weeks. On admission, the patient was alert but in moderate respiratory distress with tachypnea at a rate of 26 breaths/min. He was noted to have an audible stridor.

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The patient was unable to lay supine due to worsening of his dyspnea upon lying down. Pulse oximetry revealed an oxygen saturation of 90% on room air. Hemodynamic parameters including blood pressure and pulse were stable. On auscultation, diminished vesicular breath sounds were heard bilaterally with bilaterally decreased air entry. Prominent stridor was again heard on auscultation of the central chest. Cardiac examination showed regular heart rhythm with normal first and second heart sounds and no murmurs. The abdomen was soft on examination without any hepatosplenomegaly.

Laboratory investigations revealed a normal complete blood count and basic metabolic panel. Arterial blood gas showed pH of 7.29, PaCO<sub>2</sub> of 64 mmHg, PaO<sub>2</sub> of 65 mmHg, and oxygen saturation of 90% on room air. Chest radiograph showed normal lung fields bilaterally. A computed tomographic scan of the chest revealed significant distal tracheal stenosis 2 cm above the carina [Figure 1] caused by the external compression of pars membranacea of the trachea due to the progression of his previously diagnosed esophageal cancer. The patient was started on heli-ox (80% helium and 20% oxygen) administered via a nonrebreathing mask without much improvement in the clinical status. A brief bedside flexible bronchoscopy was performed with the patient sitting upright which showed a critical “near total” obstruction of the tracheal lumen by external compression and intraluminal invasion of tumor [Figure 1]. Unfortunately, the procedure had to be aborted before the planned airway stenting due to the inability of passing the bronchoscope beyond the obstruction and significant hypoxia patient developed during the procedure. At this point, it was decided to attempt the stent placement in the operating room with adjuvant veno-venous (V-V) femoro-femoral CPB to maintain oxygenation during the procedure. After the initiation of CPB, suspension laryngoscopy was performed with the induction of the general anesthesia to secure access to the airway. Flexible bronchoscope was extended through the mouth, and a guide wire was extended beyond the obstruction through the working channel of the bronchoscope, and bronchoscope was removed with wire in place. Bronchoscope was reinserted for the direct visual guidance during airway stent deployment. An

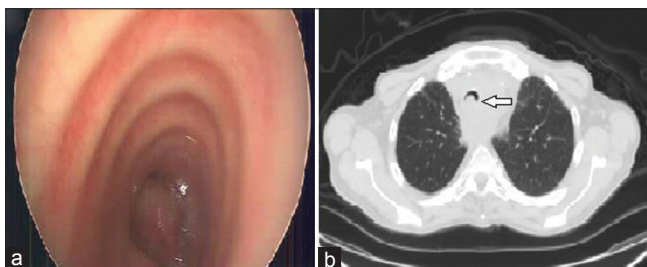
18 mm × 60 mm silicon covered metal stent (Alveolus™) was deployed over the wire under direct visual guidance of the flexible bronchoscope which resulted in the resolution of the tracheal obstruction [Figure 2]. The patient was successfully taken off the CPB. The procedure resulted in the complete resolution of the patient’s respiratory distress and stridor. He was discharged home the following day.

## DISCUSSION

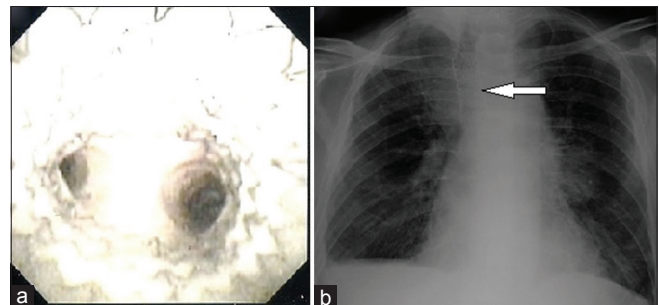
Central airways obstruction may result from various benign as well as malignant etiologies. It can be intrinsic when the obstructive lesion arises from within the lumen of the airways, extrinsic from external compression of the airways from surrounding structures, or a combination of intrinsic and extrinsic as in our patient. Severe central airway obstruction can result in critical hypoxia and/or hypercapnia resulting in fatal cardiopulmonary arrest. Several interventional pulmonary procedures, such as airway stent placement, balloon dilatation, laser therapy, argon plasma coagulation, photodynamic therapy, and cryotherapy, have recently become available for the management of the central airway obstructions. The choice of these procedures is usually subject to the stability of the patient, the nature of the obstructing lesion, patient’s overall prognosis, and the availability of the experienced clinician and equipment.

Airway stenting is an effective intervention used to re-establish airway patency in central airway obstructions caused by extrinsic compression and mixed extrinsic/intrinsic lesions. Stenting is frequently performed as a palliative therapy for patients with inoperable malignant tracheobronchial stenosis, and it is the intervention of choice for extrinsic central airway obstruction like in the patient presented here.<sup>[2]</sup> This intervention was first introduced in 1990 and can be performed using various stent designs, each with their own advantages and disadvantages.

Several types of self-expanding metal and hybrid metal/silicon stents can be placed using flexible bronchoscope but this procedure can be difficult and



**Figure 1:** (a) Flexible bronchoscopic image showing near total obstruction of the tracheal lumen due to external compression and intraluminal extension of the tumor. (b) Computed tomographic scan (without contrast) of the chest showing tracheal stenosis (arrow)



**Figure 2:** (a) Flexible bronchoscopic image showing patent tracheal lumen with resolved obstruction with deployed covered metal stent in view. (b) Chest radiograph (anteroposterior view) showing stent in place (arrow)

dangerous in patients with near total occlusion of the central airway lumen. In the settings of critical airway stenosis, any external airway manipulation can result in complete obstruction resulting in the loss of ventilation and respiratory arrest. Performing the procedure under general anesthesia and positive pressure ventilation does not necessarily resolve this problem. Anesthetic agents in general relax, the smooth respiratory muscles which itself can result in total occlusion of the airways during the induction of the general anesthesia.<sup>[1]</sup> All this may necessitate the use of CPB to maintain the adequate gas exchange during the induction and maintenance of general anesthesia in extreme cases like ours. Several authors have previously reported the use of CPB using extracorporeal membrane oxygenation to maintain oxygenation during complex airway interventions using either V-V or veno-arterial (V-A) CPB during complex airway procedures.<sup>[3,4]</sup> CPB can both provide adequate gas exchange during airway interventions and can also provide extra time to re-establish airway patency even if the ventilation is completely impossible.<sup>[5]</sup> CPB has been advocated as a safe and preferred method in cases of difficult airway or near total airway obstruction.<sup>[6,7]</sup> Some of the well-known complications specifically related to the CPB procedure include: The risk of air embolism during V-A CPB and the increased risk of bleeding from the anticoagulation (heparin) required during both V-A as well as V-V CPB.<sup>[5]</sup>

## CONCLUSION

Airway intervention for the critical central airway obstruction is an inherently risky procedure. Maintaining

an adequate airway during the intervention can be challenging, especially in patients of lower tracheal obstruction or with bilateral main stem bronchus occlusion. In extreme cases, the use of CPB should be considered before the induction of the anesthesia to maintain the gas exchange during the procedure. CPB not only protects the patient from life-threatening hypoxia and hypercapnia, but it also provides the operator with some additional time to consider additional strategies to re-establish the airway.<sup>[5]</sup>

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## Conflicts of interest

There are no conflicts of interest.

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