Case Report

High-flow nasal cannula for oxygenation during emergency tracheal stenting under flexible bronchoscopy guidance

Zubair Ahmed Thoker, Vijay Hadda, Pawan Tiwari, Saurabh Mittal, Karan Madan, Anant Mohan

Department of Pulmonary, Critical Care and Sleep Medicine, All India Institute of Medical Sciences, New Delhi, India

ABSTRACT

Central airway obstruction is a common complication of advanced esophageal carcinoma requiring bronchoscopic evaluation and intervention by a pulmonologist. Airway assessment by flexible bronchoscopy is crucial for the selection of the most suitable modality for the management of central airway obstruction. In such situations, flexible bronchoscopy may however be complicated by the development of hypoxemia. Oxygen therapy by high-flow nasal cannula (HFNC) has been used for the correction of hypoxemia for a number of conditions, including diagnostic bronchoscopy. This case report describes a successful use of HFNC for correction of severe hypoxemia during the placement of a metallic stent in a patient with tracheal obstruction due to esophageal carcinoma.

KEY WORDS: Airway stenting, central airway obstruction, flexible bronchoscopy, high-flow nasal cannula, hypoxemia

Address for correspondence: Dr. Vijay Hadda, Department of Pulmonary, Critical Care and Sleep Medicine, All India Institute of Medical Sciences, New Delhi - 110 029, India.
E-mail: vijayhadda@yahoo.com

Submitted: 20-May-2020 **Revised:** 28-Jul-2020 **Accepted:** 16-Aug-2020 **Published:** 30-Apr-2021

INTRODUCTION

Airway involvement is common in advanced esophageal carcinoma where bronchoscopic intervention as a part of multimodality management is very useful for symptomatic relief.[1] Bronchoscopy among patients with central airway obstruction is always challenging with high risk of complications during procedure. We present a case of esophageal carcinoma and central airway obstruction who developed hypoxemia during airway assessment that was successfully managed with oxygen therapy via high-flow nasal cannula (HFNC) and emergency airway stenting under flexible bronchoscopy guidance and discuss the challenges.

CASE REPORT

A 44-year-old male smoker with esophageal carcinoma presented to the emergency room of our hospital with stridor for the last 2 days. His other respiratory symptoms included dry cough and shortness of breath for 2-week duration. He denied a history of coughing of food particles or worsening of cough on swallowing, chest pain, hemoptysis, or fever. He was taking some antitussive and inhalers with minimal relief in dyspnea and cough. On evaluation, he had audible stridor. Although tachypnea was present (respiratory rate 28–30 breaths/min), his vitals were stable including SpO_2 of 96% on room air. Prior contrast-enhanced computed tomography (CT) scan of the neck and thorax done 2 days ago showed an esophageal mass (12 cm × 3 cm) extending from the C7 to T3/T4 vertebral level (just above the level of carina). The mass was infiltrating and causing near-complete occlusion of the trachea at the T1/T2 vertebral level [Figure 1a]. There

Access this article online

Quick Response Code:

Website: www.lungindia.com

DOI: 10.4103/lungindia.lungindia_395_20

How to cite this article: Thoker ZA, Hadda V, Tiwari P, Mittal S, Madan K, Mohan A. High-flow nasal cannula for oxygenation during emergency tracheal stenting under flexible bronchoscopy guidance. Lung India 2021;38:269-72.

was no evidence of tracheo-esophageal communication. A fibrocavitary lesion and few fibrotic nodules suggestive of infective sequelae were also noticed in the right upper lobe [Figure 1b]. The left lung was normal. In addition, a lytic lesion involving the C1 vertebra was noticed.

In the emergency room, he was initially evaluated by the ENT team for possible tracheostomy. Fiberoptic laryngoscopy examination was performed prior to taking up the patient for tracheostomy, which revealed bilateral vocal cord palsy and normal upper trachea and hence, tracheostomy was not performed. Subsequently, the patient was referred to us for bronchoscopic evaluation and further intervention to alleviate the symptomatic airway obstruction.

In the bronchoscopy suite, flexible bronchoscopy was performed using 6.0 mm scope (Olympus, BF TYPE 1T 180, Olympus Medical System Corporation, Tokyo, Japan) via nasal route under topical anesthesia with lignocaine (1%) following standard protocols.[2] Bilateral vocal cord palsy and tracheal narrowing (approx. 80%) were seen, predominantly due to extrinsic compression, extending from 6 cm distal to the vocal cords to about 3 cm proximal to the carina [Figure 2a]. Infiltration of the posterior tracheal wall by the tumor was also noticed. The carina and bilateral bronchial tree were normal.

During examination, scope manipulation resulted in moderate bleeding from the diseased segment of the trachea. Hemostasis was achieved after a few minutes by instillation of cold saline over the lesion and intravenous tranexamic acid (1 g). Suctioning of the distal segments was performed. However, the patient developed progressively worsening stridor and hypoxemia (lowest SpO_2 around 72%) despite giving 15 L/min flow of oxygen through an 8 Fr nasopharyngeal catheter. The decision to put a straight, covered, self-expanding metallic stent under flexible bronchoscopy guidance was taken to restore the tracheal lumen. The patient was started with high flow oxygen via HFNC through MonnalT75 ventilator (Air Liquide Medical System, Paris, France) with an FiO_2 of 1.0 and flows of 60 L/min. The SpO_2 improved quickly within 1 min to 99%.

The patient was given intravenous fentanyl (50 μg) and midazolam (2 mg) as premedication. Flexible bronchoscopy was performed via oral route through the mouth guard. The scope was navigated beyond the tracheal narrowing to the left main bronchus. Subsequently, a guidewire was passed through the working channel of the scope, and the tip of the guide wire was positioned in the distal left main bronchus. The scope was then withdrawn carefully, leaving the guidewire in the left main bronchus. The stent deployer (outer diameter 6 mm) was threaded over the guidewire and under flexible bronchoscopy guidance passed through the vocal cords. The deployer and scope were advanced further and negotiated through the narrowed tracheal segment. Under direct vision, a straight, covered, tracheal self expanding metallic stent (18 mm × 60 mm, tracheobronchial stent, Mitra Industries, Faridabad, Haryana, India) was deployed with the distal end approximately 2 cm above the carina. The stent deployer was withdrawn, and stent position was checked and was found to be covering the tracheal narrowing well with adequate luminal patency [Figure 2b]. This resulted in immediate relief of stridor.

Postprocedure, the patient received intravenous antibiotics and oxygen supplementation using ordinary nasal cannula. He improved in the next 3 days and had SpO_2 of 95% on room air and was discharged 5 days postprocedure with advice for follow-up in the oncology department.

DISCUSSION

The current case highlights the utility of the HFNC during emergency bronchoscopic placement of tracheal self-expanding metallic stent for central airway obstruction secondary to esophageal carcinoma.

Central airway obstruction produces symptoms of breathlessness, stridor, or obstructive pneumonia, which are usually severe and require urgent symptomatic management. Carcinoma esophagus frequently presents with central airway obstruction due to extrinsic compression or direct invasion of the central airways, with or without tracheo-esophageal and/or broncho-esophageal communication.[3-5] Airway involvement indicates advanced, inoperable, and metastatic esophageal carcinoma that is associated with a poor prognosis.[4,5]

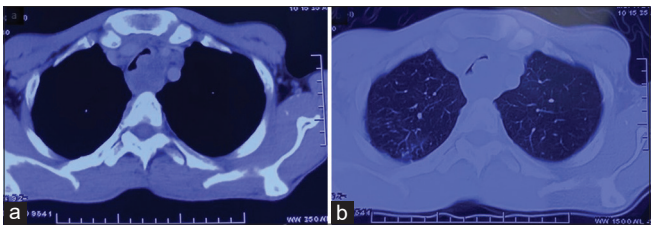

Figure 1: Computed tomography scan of the thorax. (a) Mediastinal window showing a mass lesion in the vicinity of the esophagus. The mass was compressing, infiltrating, and causing near complete occlusion of the trachea at the T1/T2 vertebral level. (b) Corresponding lung window shows few nodules in the right upper lobe

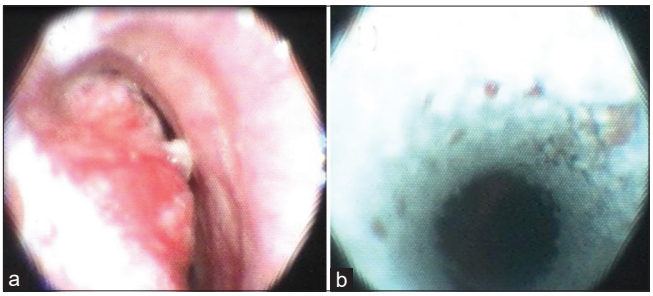

Figure 2: Bronchoscopic images showing (a) near complete occlusion at the level of the mid trachea and (b) tracheal luminal patency achieved following self expanding metallic stent placement

Flexible bronchoscopy is an indispensable tool for airway assessment for patients with esophageal carcinoma presenting with central airway obstruction.[4,5] Flexible bronchoscopy provides accurate information regarding the extent and dimensions of the lesion. It is also diagnostic for tracheo-esophageal/broncho-esophageal fistula. Stent placement is an effective and quick intervention to restore lumen patency in cases of malignant central airway obstruction. Selection of type (straight tracheal or Y) and dimension of stent is based on flexible bronchoscopy findings. The index case was also subjected to flexible bronchoscopy with the same objectives; however, he developed hypoxemia during the procedure.

Hypoxemia may affect up to 25% of patients with tracheal stenosis; severe stenosis (>75% occlusion of tracheal lumen) and presence of dyspnea or stridor further increase this risk.[6] Usually, hypoxemia can be managed with supplemental oxygen via nasal cannula or catheter. Noninvasive ventilation (NIV) and HFNC are other potential options for correction of hypoxemia during bronchoscopy when low-flow oxygen therapy fails.[7-9] HFNC is a specialized oxygen delivery system that can deliver heated, humidified (100% relative humidity), and controlled FiO_2 (0.21–1.0) with flows of up to 60 L/min and effectively improve oxygenation.[10] Lucangelo *et al*. reported the effects of HFNC on gas exchange and cardiovascular parameter among patients subjected to bronchoscopic broncho-alveolar lavage.[11] Simon *et al*. described the successful use of HFNC during flexible bronchoscopy for diagnosis of pneumonia, retained secretions, alveolar hemorrhage, and malignancy among hypoxemic patients.[7] Other workers have also published their observations related to HFNC use among patients with hypoxemia.[8,9] Chung *et al*. reported the use of HFNC for endobronchial ultrasonography, cryotherapy, and/or clot removal in three patients with acute hypoxemia.[9]

We found no published report describing the use of HNFC during the placement of airway stent. The greatest advantage of HNFC is the correction of hypoxemia without the need for any oral interface that may interfere with the procedure. In the index case, the hypoxemia was corrected within 1 min of the onset of HFNC and throughout the procedure SpO_2 remained 99%. The ability of HFNC to maintain optimal oxygen saturation throughout the therapeutic bronchoscopy procedure coupled with both patient and operator comfort is unique. How HFNC improves oxygenation is not well elucidated. However, it is believed that there is an interplay of several mechanisms such as heat and humidification, high flow to meet inspiratory demand, increased functional residual capacity, minimum inspiratory oxygen dilution, reduced dead space, and provision of positive end expiratory pressure, resulting in the correction of hypoxemia.[12]

NIV also improves oxygenation during diagnostic bronchoscopy in hypoxemic patients.[7-9] However, dedicated NIV masks that allow the use of flexible bronchoscopy may not be available at many centers. NIV masks also pose difficulty in the manipulation of scope and may be associated with the risk of damage to the outer sheath. Nontolerance of NIV is another challenge, which precludes its use in many patients. Notably, the currently existing NIV masks do not have a separate opening for insertion of stent deployer, making it unsuitable for this particular purpose.

Although rigid bronchoscope is preferred over flexible bronchoscope for tracheal stent deployment as it provides better airway control and allows the use of other instruments, such stents are frequently deployed under flexible bronchoscopy guidance with conscious sedation.[13,14] We use this approach for stable patients who present with lesions that have low risk of bleeding. Importantly, we always keep rigid bronchoscope as a backup. The index patient had good oxygenation (SpO_2 around 96%) at the start of procedure and thus we chose flexible bronchoscopy.

CONCLUSIONS

This case report adds to the expanding list of uses of HFNC in day-to-day clinical practice as a rescue modality for hypoxemia during interventional bronchoscopy procedures. However, caution needs to be exercised and interventionists should have a rigid bronchoscopy backup available, in case required.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Lagergren J, Smyth E, Cunningham D, Lagergren P. Oesophageal cancer. Lancet 2017;390:2383-96.
2. Mohan A, Madan K, Hadda V, Tiwari P, Mittal S, Guleria R, *et al*. Guidelines for diagnostic flexible bronchoscopy in adults: Joint Indian Chest Society/National College of Chest Physicians (I)/Indian Association for Bronchology Recommendations. Lung India 2019;36:S37-89.
3. Carreiro A, Dionísio J, Matias D, Almodovar T, da Costa JD. Bronchoscopy and esophageal cancer. Eur Respir J 2013;42:P3778.
4. D'Journo XB, Thomas PA. Current management of esophageal cancer. J Thorac Dis 2014;6 Suppl 2:S253-64.
5. Egyud MR, Tseng JF, Suzuki K. Multidisciplinary therapy of esophageal cancer. Surg Clin North Am 2019;99:419-37.
6. Chumpathong S, Tscheikuna J, Boonsombat T, Muangman S,

Luansritisakul C. Incidence and risk factors of hypoxemia during interventional rigid bronchoscopy under spontaneous-assisted ventilation. J Bronchology Interv Pulmonol 2017;24:268-74.
7. Simon M, Braune S, Frings D, Wiontzek AK, Klose H, Kluge S. High-flow nasal cannula oxygen versus non-invasive ventilation in patients with acute hypoxaemic respiratory failure undergoing flexible bronchoscopy – A prospective randomised trial. Crit Care 2014;18:712.
8. Saksitthichok B, Petnak T, So-Ngern A, Boonsarngsuk V. A prospective randomized comparative study of high-flow nasal cannula oxygen and non-invasive ventilation in hypoxemic patients undergoing diagnostic flexible bronchoscopy. J Thorac Dis 2019;11:1929-39.
9. Chung SM, Choi JW, Lee YS, Choi JH, Oh JY, Min KH, *et al*. Clinical effectiveness of high-flow nasal cannula in hypoxaemic patients during bronchoscopic procedures. Tuberc Respir Dis (Seoul) 2019;82:81-5.
10. Nishimura M. High-flow nasal cannula oxygen therapy in adults: Physiological benefits, indication, clinical benefits, and adverse effects. Respir Care 2016;61:529-41.
11. Lucangelo U, Vassallo FG, Marras E, Ferluga M, Beziza E, Comuzzi L, *et al*. High-flow nasal interface improves oxygenation in patients undergoing bronchoscopy. Crit Care Res Pract 2012;2012:506382.
12. Lodeserto FJ, Lettich TM, Rezaie SR. High-flow nasal cannula: Mechanisms of action and adult and pediatric indications. Cureus 2018;10:e3639.
13. Madan K, Venkatnarayan K, Mohan A, Hadda V, Khilnani GC, Guleria R. Flexible bronchoscopic insertion of self-expanding metal stents in malignant tracheal lesions without fluoroscopic guidance. J Assoc Chest Physicians 2016;4:56-62.
14. Mohan A, Shrestha P, Madan K, Hadda V, Pandey RM, Upadhyay A, *et al*. A prospective outcome assessment after bronchoscopic interventions for malignant central airway obstruction. J Bronchology Interv Pulmonol 2020;27:95-105.