Case Report

Use of dedicated optical tracheal dilator for postintubation tracheal stenosis: First report from India

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ABSTRACT

Postintubation tracheal stenosis is preventable yet commonly occurring clinical condition. Early in the disease, nonspecific symptoms may predominate but once the stenosis reaches a critical stage life-threatening respiratory compromise may ensue. Bronchoscopic interventions are an invaluable tool in the management both as a primary treatment and as an interim procedure before the surgery. Optical dilatational tracheoscopy is a safe and minimally invasive procedure in the treatment of benign tracheal stenosis. Involvement of multidisciplinary team early in the treatment planning gives the best possible results.

KEY WORDS: Central airway obstruction, interventional pulmonology, optical dilatational tracheoscopy, surgical resection, tracheal stenosis

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INTRODUCTION

Postintubation tracheal stenosis (PITS) is a spectrum of airway narrowing at the glottis, subglottic area, and the trachea in varying combination. The site of the lesion and severity of airway narrowing influence the clinical symptoms, thus, a cross-sectional area of <30% of the normal corresponding to airway diameter of 5 mm or less is required before the patient is symptomatic at rest.[1] At times, the diagnosis of airway obstruction can be overlooked early in the disease due to nonspecific symptoms in the absence of physical findings. Earlier reports of incidences ranging from 10%–19% to 8%–65% for postintubation and posttracheostomy stenosis has declined significantly after refinement in the design and management of airway intubation devices during mechanical ventilation.[2-6] Amid the available options of interventional bronchoscopy, stent placement, and surgical correction, resection with end-to-end anastomosis is the best definitive management for benign stenosis.[7,8] However, the versatility of the bronchoscopic treatment is an invaluable tool for palliation when surgery is not feasible, or airway optimization is necessary before the surgery.[9,10] To the best of our knowledge, herein, we report the first use of dedicated optical tracheal dilator in a patient with tracheal stenosis from India.

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CASE REPORT

A 23-year-old man presented to us with a complaint of rapidly progressive breathlessness and cough of 3-week duration. There were no comorbid conditions, however, 4 months back; the patient received a mechanical ventilatory support for 5 days following a neuroparalytic snake bite. Physical and systemic examinations were unremarkable except for stridor on respiratory examination. Type I respiratory failure was evident on blood gas analysis while other blood reports were within normal range. Multidetector computed tomography of the thorax with two-dimensional (2D)

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and multiplanar reconstruction on coronal, sagittal and oblique planes, and 3D volume-rendered images showed cicatrizing stricture of 0.55 mm in diameter and 2.1 cm in length at 2.8 cm below the cords with cartilaginous involvement [Figure 1a-d]. Preprocedure video bronchoscopic (BF-190, Olympus Medical, Japan) examination showed Cotton-Myer Grade III circumferential stenosis 2 cm below the vocal cords with associated segmental tracheomalacia [Figure 1e].[11] Based on radiological and bronchoscopic assessment, a diagnosis of complex tracheal stenosis was made and surgical resection was planned. However, before the definitive surgery, the patient was subjected to a staged procedure with bronchoscopic dilatation of critical tracheal stenosis to establish an adequate airway patency.

Under general anesthesia with airway block, the optical dilation tracheoscope (Groningen Model, Karl Storz, GMbH and Co., KG Germany) with distal tapering, lateral holes for ventilation, and distance markings was introduced under telescope control through the cords [Figure 2]. With steady rotating pressure along the airway axis, the stenotic segment was negotiated using the tapered beveled tip of the tracheoscope [Figure 3a-d]. The conical tip of the scope was advanced further to the lower trachea while allowing a brief pause of 3–5 s at each external marking at the incisors [Figure 3e]. After keeping the wider part of the scope at the stenotic segments for 60 s, the scope was withdrawn to visualize the dilated part before its final removal [Figure 3f]. Total duration from the insertion of optical trachescope to its final removal was 100 s. Following an uneventful recovery, the patient underwent segmental tracheal resection of 2.5 cm and end-to-end anastomosis after 4 days of dilatation. The patient was decannulated on the 2nd postoperative day and following a short rehabilitation training and removal of drainage tube discharged from the hospital after 6 days. On the first follow-up, the patient was completely free of symptoms and is back to routine work.

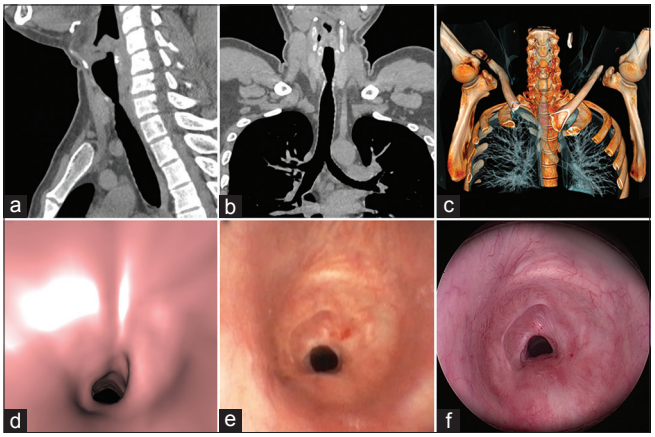

Figure 1: Tracheal Stenosis, (a) multidetector computed tomography sagittal plane, (b) multidetector computed tomography coronal plane, (c) multidetector computed tomography 3D volume-rendered, (d) virtual bronchoscopy, (e) video bronchoscopy, (f) rigid bronchoscopy. Image f also showing arborization of submucosal plexus

DISCUSSION

The index case highlights the importance of single stage atraumatic dilatation of the stenosis using a dedicated optical tracheal dilator in a shortest possible time. The index case also underscores the significance of multidisciplinary team approach to bronchoscopic intervention for interim relief and resection anastomosis for the definitive treatment of tracheal stenosis.

Pressure necrosis due to compromise in regional blood flow is the primary pathophysiological mechanism for the development of PITS. The segmental vascular supply of the trachea is through the submucosal plexus formed by the arborization of perforating branches at each intercartilaginous space from the lateral longitudinal anastomosis. As a result, the tracheal cartilages are exclusively supplied by these submucosal plexuses.[12,13] Local ischemia and subsequent necrosis as a result of luminal manipulation by artificial airways heal by secondary intention leading to transmural cicatrization and stenosis. The abrupt variation thus produced in the airway diameter causes a change in physiological laminar airflow to become turbulent. Due to high resistance created by the turbulent flow at the stenotic site, a higher pressure gradient is required to maintain the constant air flow rate.[14] Like in our case, at critical stenosis (<5 mm cross-sectional diameter), patients perceive the heightened requirement subjectively as air hunger and objectively manifest as stridor on examination.[15] As seen in our patient, the mucosal and cartilaginous injury due to cuff of an endotracheal tube causes circumferential stenosis which temporarily responds to bronchoscopic dilation before surgical resection.

Groningen optical dilatational tracheoscope is a simple, efficient, and stand-alone intervention with no requirement for additional procedures. In patients with subglottic or

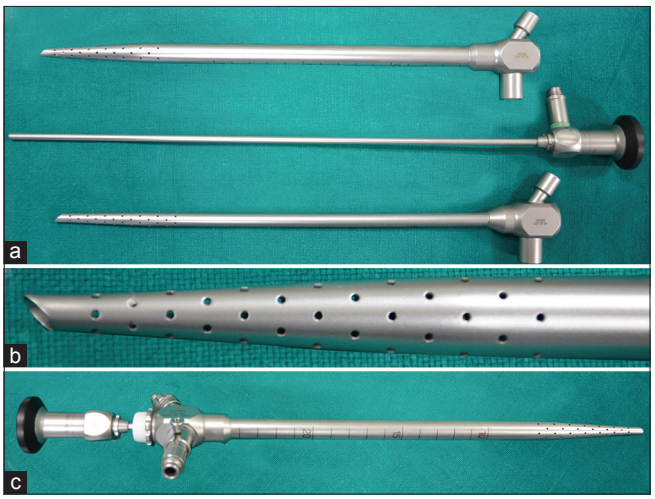

Figure 2: Optical dilation tracheoscope, (a) scopes of two sizes with dedicated telescope, (b) magnified view of tapered proximal end, (c) scope assembly

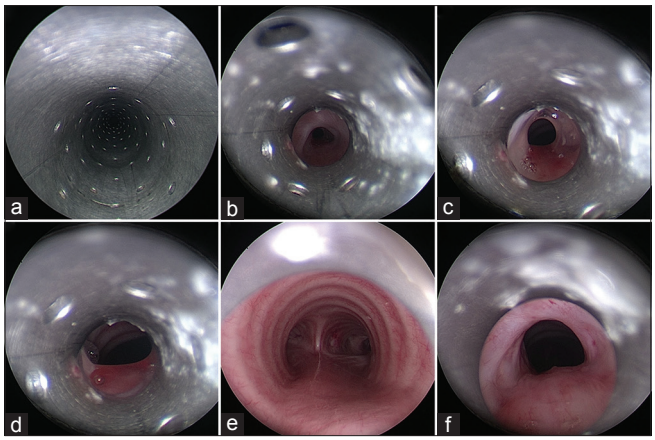

Figure 3: Dilatation procedure, (a) inner view of scope, (b) stenotic segment, (c and d) stenosis negotiation, (e) complete passage of scope, (f) atraumatic postdilatation image with arborization of submucosal plexus

tracheal stenosis of various etiology, Schokkenbroek *et al*. performed 22 dilatation tracheoscopy in nine patients. In 25.4 ± 14.1 months of follow-up, 2 patients never required additional procedure and six patients who needed the second dilation had no recurrence.[16] Likewise, Halmos *et al*. showed 80% success rate with one or more dilatation tracheoscopy without supplementary treatment for the stenosis.[17] Similar to them, we also encountered no complications during or after the procedure. The main advantage of this instrument in our observation is atraumatic dilatation of the stenotic segment [Figure 1f before dilatation and Figure 3f after dilatation] within a brief procedure time under a short anesthesia without any associated complications. Logically, multiple inflation-deflation sequences with varying pressure and use of increasing sized balloon during balloon dilation and passage of numerous increasing sized rigid scope through the vocal cord, and the stenotic segment during rigid dilation seems more traumatic than a single passage of optical dilation trachescope. In our opinion, the benefit of this instrument lies in its simplicity, safety, efficacy, ease of use, minimal patient discomfort, and reduced need to perform redo procedure. However, prospective comparative studies remain to be explored for a scientific answer.

The right balance between the minimally invasive bronchoscopic intervention and surgical resection is often difficult to ascertain. Bronchoscopic treatments are simple and attractive with the favorable outcome but limited by the temporary results with frequent revisions and the probability of lengthening the scar. Similarly, the surgical treatment which offers a definitive treatment has a higher complication rate, significant morbidity to the patient and if unsuccessful, the revision surgery is very demanding. At our institution, we perform bronchoscopic intervention alone when the noncircumferential stenotic segment is <1 cm, and cartilaginous support is present or as part of palliation when surgical treatment is not feasible. In complex lesions, the frequency of recurrences with the necessity of redo procedures and danger of expanding the area of injury with these interim techniques outbalance the benefits. Consequently, the patient should be managed as part of multidisciplinary treatment as described in this report.

CONCLUSIONS

The use of optical dilatation tracheoscopy is minimally invasive, effective, and comfortably repeatable method in the treatment of benign tracheal stenosis. Involvement of multidisciplinary team in the management algorithm definitely improves the outcome.

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.

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Conflicts of interest

There are no conflicts of interest.

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