CASE REPORT

Tracheal Stent in the Treatment of Tracheal Stenosis

S Dipak, MBBS, N Prepageran, FRCS, O Rahmat, MS, R Raman, MS

Department of Otorhinolaryngology, Faculty of Medicine, University Malaya, 50603 Kuala Lumpur

Summary

The use of airway stents for the treatment of benign airway stenosis is increasingly advocated. However, the long term safety and efficiency of these devices has not been established. We present a case of tracheal stenosis, which persisted despite open surgical and laser correction. The patient required tracheal stent insertion and is currently well with no respiratory difficulty. The use of metallic or silicon intraluminal stent remains appropriate in cases in which there is defined and relative short-term end point of treatment.

Key Words: Airway stent, Resorbable stent, Stenosis, Tracheomalacia

Introduction

Symptomatic proximal tracheal stenosis can be treated with segmental resection and reanastomosis, various forms of tracheoplasty, often with cartilage grafting, or, as has been more recently reported, intraluminal placement of covered or uncovered metal mesh stents. Given the surgical accessibility of this portion of the airway, this latter option has historically been considered as a temporary method of airway maintenance to be used until a more definitive treatment can be performed, or as a form of permanent palliation in cases such as terminal cancer in which there is limited life expectancy[1]. The use of numerous internal (intraluminal) and external tracheal stents has been advocated for severe tracheomalacia, as a result of relative ineffectiveness of surgical repair such as Nissen Spanplasty and tracheal resection[2].

Case Report

A 34 years old Chinese man presented with severe biphasic stridor. His medical history included a head injury sustained in a motor vehicle accident. Long-term ventilation and tracheostomy were required and he was eventually decannulated 2½ weeks after his injury. Three weeks after decannulation an upper tracheal stenosis developed at the site of his tracheostomy cuff. It was corrected by open repair - "Shian Lee" tracheoplasty.

He presented a year later with stridor and was found to have a significant airway stenosis in two segments; 1st at 3.5 cm from the vocal cord (Figure I) and 2nd at 4 cm from the carina. Various form of dilation; laser surgery (CO2 / Nd YAG laser) was performed without success. He underwent placement of polyflex stent (Willy Rusch AG; 14 x 50mm) without any complications (Figure II).

Patient was initially given general anaesthesia via tracheostomy tube. At the same time suspension laryngoscopy was performed, followed by assessment of the extents of the two stenotic segments with the aid of video-telescopy. Temporary withrawal of the tracheostomy tube enabled the measurement of the exact sites and lengths of the stenotic segments to be taken. These values were taken from the incisor teeth. As adequate passage is required to introduce the stent introducer, the upper stenosis was earlier dilated by using CO_2 laser. Once the airway was restored, the tracheostomy tube was withdrawn slightly. This time

This article was accepted: 28 March 2005

Corresponding Author: S Dipak, Department of Otorhinolaryngology, Faculty of Medicine, Universiti Malaya, 50603 Kuala Lumpur

intermittent apnoeic anaesthesia was given to allow further dilatation using bougies until it reaches the lower stenotic segment (the length guided by the earlier measurement taken).

Polyflex stent (Willy Rüsch AG) with the dimension of 50mm length and diameter of 14mm was then mounted securely on the introducer tube rod. The measurement of site of lower stenosis was marked on the introducer rod. Nasopharyngeal airway was inserted and secured in place. With the suspension laryngoscope in place, the intoducer is slowly introduced by passing the upper stenosis until the mark of the introducer was reached and while the tracheostomy tube being totally withdrawn. To set the polyflex stent in place, the outer sleeve of the introducer is slowly withdrawn until the stent was fully ejected. Finally, the outer sleeve and the inner rod of the introducer were fully taken out. Further, patient ventilation was carried out through the nasopharyngeal airway.

The second stent is now inserted for the upper stenosis via the same technique. When the marked level on the introducer is reached and stent fully ejected. Care is taken to place the upper edge of the stent well below the vocal cord. Video-telescopy is repeated and stents placement rechecked, with minor manipulation done as necessary. The suspension laryngoscope was then removed with reversal of anaesthesia slowly undertaken. The two stents were successfully inserted within 5 to 10 minutes without undue airway harassment.

Literature Review

The treatment of serious airway obstruction caused by tracheobronchial stenosis or tracheobroncial malacia is often a great challenge. Because the type of stenosis differs from case to case, a variety of techniques must be available to the surgeon to ensure the most favorable outcome. Choice of stent in long-term stenting should be easy to insert endoscopically through the stenotic segment, expand to the diameter of the normal trachea and remain in place. They should not cause an inflammatory reaction, avoid growth of granulation tissue, be easy to remove and maintain a patent airway when in place and after removal. Dumon stent device composed of silicon plastic, rigid tube, which does not conform well within the trachea, resulting in tilting of the stent into tracheobronchial wall. This often gives rise to troubling retention of secretions, with subsequent potential airway obstruction. The lack of mucosalization leave this system prone to migrate but allow easy removal of this stent, should the need arise even years after initial placement[3].

In an effort to reduce migration rates, expandable stents were developed. All are introduced in a compressed form and expanded after placement into the trachea by dilation or by inherent elasticity. The palmaz (stainless steel) and strecker (tantalum) coiled stents unfolded with balloon dilation once they are positioned. The stent becomes integrated into the trachea owing to ingrowth of tissue between the tubular meshwork[3]. The design of the stents allows its diameter to expand while its length decreases. The

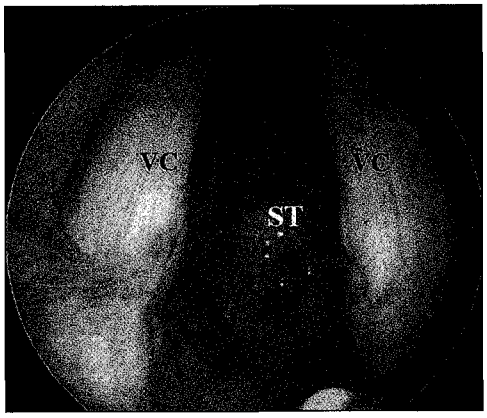

Fig. 1: VC - Vocal cord, ST - stenosis

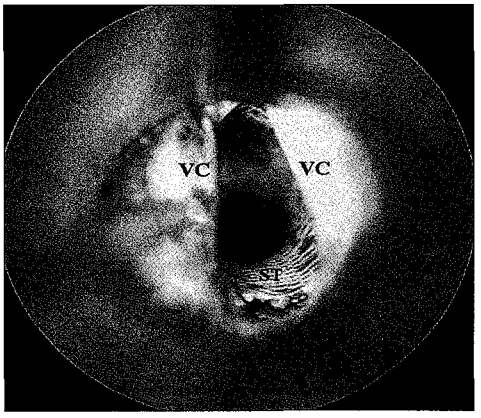

Fig. 2: VC - Vocal cord, ST - stent

stents are available in many internal diameter and lengths and are inserted in its closed format mounted on the outside of the appropriate sized balloon catheter. The selection of stents and balloon size was based on the estimate diameter of the airway and the length of the airway to be stented. When the stent was in the proper position as determined radiographically, it was expanded and deployed by inflating the balloon to its full diameter.

Gianturco and wall stent stenting system are similar to palmaz and strecker in term of composition and tissue ingrowths for retention[3]. However, once released from their introducers, the former two stents self expand to a present diameter owing to the uncoiling of the geometric structure. Self-expanding stents does not subject the tracheal wall to continual expanding pressure after it is in place. The tendency for the self-expanding stent to maintain its largest diameter makes its removal dangerous if not impossible. Polyflex stents are a variety of self-expanding stents made up of polyester wire mesh within layers of silicon. These stents have been used mostly in tracheal bronchial carcinoma secondary to infiltrating cancer, benign post Intubation strictures, mixed type obstruction (mucosal infiltration or intrinsic compression) and malacic airway.

Risk factors associated with polyflex stents are mucous retention, fracture of stent and infolding of inner silicon layer. Complications observed were infection 15.9%, obstructive granuloma 14.6% and migration 4.7%. Success rate of 97% has been observed in stents that were successfully placed in appropriate position[4].

All of the expandable metal stents elongate and compress during stent placement, causing mucosal damage. This is especially noted at the proximal and distal ends of the stent and may lead to the formation of webs and recurrent stenosis. The wall stent and Gianturco stent have been associated with migration, leading to airway obstruction and brachiocephalic artery perforation. All of the metallic mesh system have been plagued with formation of granulation tissue due to its ingrowths between the meshwork and often noted delayed mucosalization[3].

Nickel titanium alloys (Nitinol) are a super elastic biomaterial and compatible with the human body, has a temperature memory and the unusual ability to undergo large elastic deformation due to presence of a definite inflection point. Such an inflection point in the unloading of coiled nitinol implies the presence of an unloading plateau with near constant stress. Thus, a compact (coiled) system may be delivered to a small cross sectional area and released (unloaded). Nitinol tracheal stent have been utilized with success in the treatment of obstructing bronchial or tracheal tumours. They have been exceptionally well tolerated with no reported adverse reaction, delay in mucosalization, stent migration or restenosis[3].

External or resorbable tracheal stents for malacic airway may have much superior efficacy over internally placed stents in that they are easier to place and cause minimal mucosal tissue reaction, thereby allowing normal clearance of tracheal secretions and reducing the incidence of secondary infections[2]. The use of resorbable biopolymers (poly-L-lactic acid polyglycolic acid; PLPG) external stents was associated with rapid and consistent recovery of respiratory epithelium and normal cartilaginous growth. The applicability of PLPG stent in tracheomalacia as a temporary stent may ideally be used in children, because these patients typically develop increase tracheal stability and size with age, at which time a stent becomes unnecessary[2].

PLPG stenting of the trachea early in life would likely not create a long term impediment to tracheal growth as seen with traditional methods of stenting and would not create a long standing foreign body capable of transmural erosion or secondary infection.

References

1. Alan RB, Mark KW, Peter EA, Edwin CE. Metallic tracheal stents; complications associated with long term use in the upper airway. The Annals of Otology, Rhinology & laryngology 2002; 111 (4): 285.
2. Gregory KS, Thomas W, Nadine PC, Gregory KH. Comparison of resorbable poly-L-Lactic acid polyglycolic and internal palmaz stents for the surgical correction of severe tracheomalacia. The Annals of Otology, Rhinology & laryngology 2003; 112 (6): 512-21.
3. Ducic Y, Khalafi RS. Use of endoscopically placed expandable nitinol tracheal stents in the treatment of tracheal stenosis. Laryngoscope 1999; 109: 1130-3.
4. Saad CP, Murthy S, Krishmanich G, Mehta AC. Self expandable metallic airway stents and flexible bronchoscopy, long term analysis. Chest. 2003; 124 (5): 1993-99.