

The Role of Tracheal Stenting As an Alternative Treatment in Cicatricial and Non-Operable Tracheal Stenosis

Reza Bagheri¹, Mohammad Bannazadeh², Seyed Ziaollah Haghi^{*1}, Seyed hossein Fattahi Masuom¹, Maryam Salehi³, Shima sheibani⁴

¹ Thoracic surgeon, Cardio-Thoracic Surgery & Transplant Research Center, Emam Reza hospital, Faculty of medicine, Mashhad University of Medical Sciences, Mashhad, Iran

² Thoracic surgeon, Valiasr Hospital, Tehran, Iran

³ Department of Community Medicine, Faculty of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

⁴ Medical student

ARTICLE INFO

Article type:
Original article

Article history:
Received: 1 Dec 2013
Revised: 14 Jan 2013
Accepted: 22 Jan 2013

Keywords:
Tracheal malignancy
Tracheal stenosis
Tracheal stenting

ABSTRACT

Introduction: Tracheal stenosis is normally caused by trauma, infection, benign and malignant tumors, prolonged intubation or tracheostomy. The best treatment for tracheal stenosis is resection and anastomosis of trachea. Yet the major surgical complication of tracheal surgery is postoperative stenosis. The goal of this paper is to study the result of tracheal stenting as a replacement therapy for patients suffering from tracheal stenosis who are not good candidates for surgery.

Materials and Methods: This study presents the results of stenting in patients with: Inoperable tumoral stenosis, Non-tumoral stenosis being complicated due to prior surgeries, Inability to undergo a major surgery. The study was performed between September 2002 and July 2011 and poly flex stents were used by means of rigid bronchoscopy.

Results: A total of 25 patients received stents during this study. Among them 15 patients suffered from benign and 10 suffered from malignant tracheal stenosis. The patients were followed up for at most 12 months after the stenting operation. The mean age of the patients was 35 years. The most common cause of stenosis was prolonged intubation (75%). The most common indication for stenting was the history of multiple tracheal operations. The most common complication of stenting and cause of stent removal was formation of granulation tissue. 30% of patients with benign tracheal stenosis were cured and about 10% improved until they could stand a major operation. Ten patients in benign group and 2 patients in malignant group (20%) needed T-Tube insertion after stent removal but other patient cure by stenting.

Conclusions: In benign cases stenting is associated with recurrence of symptoms which requires other therapeutic techniques, so the stenting may not be named as a final solution in benign cases. However, this technique is the only method with approved efficacy for malignant cases with indication.

Introduction

Tracheal stenosis is normally caused by trauma, infection, benign and malignant tumors, prolonged intubation or tracheostomy. The best treatment for tracheal

stenosis is resection and re-generation of the trachea. Yet the major surgical complication of tracheal surgery is postoperative stenosis for which the best treatment is re-resection of the trachea (1).

* Corresponding author: Seyed Ziaollah Haghi, Cardio-Thoracic Surgery & Transplant Research Center, Cardio-Thoracic Surgery & Transplant Research Center, Ghaem hospital, Faculty of medicine, Mashhad University of Medical Sciences, Mashhad, Iran, Tel: 0098-0915-116-3867, FAX: 0098-0511-8409612, E-mail: Haghiz@mums.ac.ir

© 2013 mums.ac.ir All rights reserved.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Sometimes, due to the following reasons the patient is not a good candidate for surgery and must go after other treatment methods and in such cases various treatments are recommended including tracheal stenting as an alternative therapy(2). These reasons include: 1.Patients who cannot undergo another tracheal surgery due to numerous surgeries before 2.Patients who cannot undergo tracheal resection surgery due to bad general conditions (CNS disorder, or bad cardiac or renal conditions) 3.Patients suffering from malignant tracheal problems who cannot undergo surgery due to paratracheal involvements or distant metastasis (3).The goal of this paper is to study the result of tracheal stenting as a replacement therapy for patients suffering from tracheal stenosis who are not capable of taking surgery.

Materials and Methods

This was a prospective study beginning from September 2002 and ending in July 2011 at Valiye Asr Hospital affiliated to Tehran University of Medical Sciences, Tehran, Iran. A poly flex stent with introducer system was used by means of rigid bronchoscopy. The patients were first underwent general anesthesia and the primary rigid bronchoscopy was done. Then the length and location of stenosis was determined and stenosis dilation was performed in one or two phases. This way the maximum size of dilation was known. The stent size was then determined by means of the following calculations:A. Proper length of the stent = 2 (mm) + stenosis length (mm).B.Proper diameter of the stent = Max size through which the stenosis could be dilated by means of rigid bronchoscopy (mm) + 4 (mm) (converting the internal diameter of the rigid bronchoscope to its external diameter) + 3 (mm) (to compress the stent inside the trachea walls and prevent it from displacement).Once the calculations were done and the proper size of the stent was known, the patients were once again anesthetized and the suitable stent was placed inside the trachea by means of rigid bronchosco-

py.Figure (1) show The technique of stent insertion and figure (2) Show radiologic view after stent insertion

Results

A total of 25 patients received stents during this study. Among them 15(60%) patients suffered from benign and 10(40%) suffered from malignant tracheal stenosis. The patients were followed up for at most 12 months after the stenting operation. Description in terms of the following criteria was shown in Table 1.The most common cause of stenosis was prolonged intubation (75%), followed by malignancy (16.6%) and inhaling of chemical gases (8.4%).

Stenosis occurs mostly from 16 to 30 days after intubation (55%). The internal diameter of the tracheal stenosis causing acute respiratory symptoms was 0.5 cm (50% of the cases) in 6 patients and between 0.5 and 1 cm (50% of the cases) in the other 6 patients. The length of the stenosis ranged from 2 to 5 cm among the patients.Efficacy of the stenting was studied through the following procedure:Clinical symptoms (treating stridor and dyspnea, making patients capable of handling their daily tasks),Spirometry improvement,Ability of taking peak flow meter.It was observed that all patients were relieved of stridor after the stenting procedure and had improved remarkably in handling of their daily tasks, their spirometry and peak flow metery abilities were improved as well. But only 50% of the patients showed such results after one month from the stenting operation. Once the stents were removed, 30% of the patients remained in the same good conditions, the rest unfortunately showed symptoms of relapse.Tracheal stents were used from 1 to 4 months, making an average of 2.6 months.A total of 9 patients (75%) suffered side effects. Based on the time such side effects emerged, the patients were classified into three groups:1.During Operation: Only one patient suffered this type and that was due to impossibility of fixing a long stent (11.1%) 2.Early: Occurred in one patient due to displacement of the stent, which was corrected (11.1%) 3.Late: Occurred in 7 patients (77.7%) due to sponta-

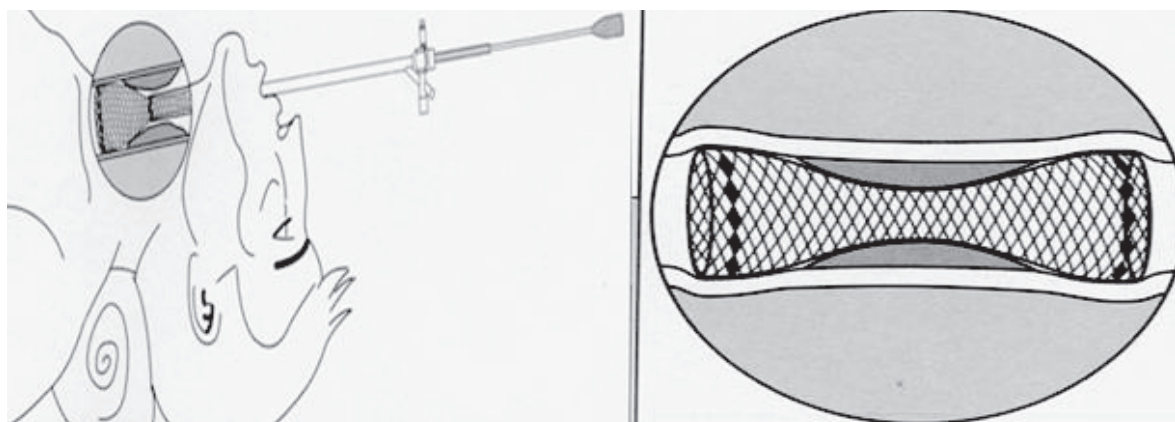
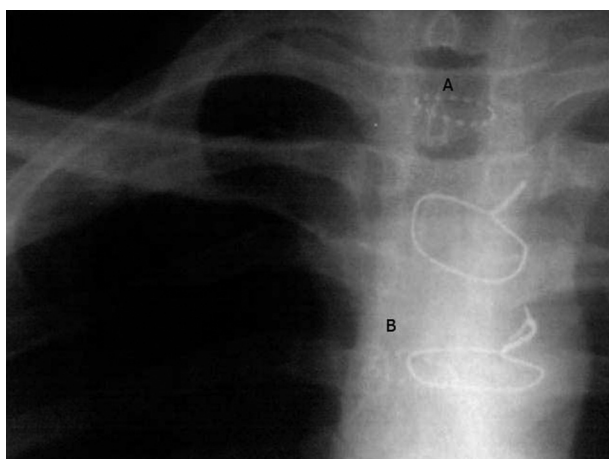


Figure 1. Technique of stent insertion

Table 1. Shows result of stent insertion in 2 groups of patients

Type of stenosis N(%)	Age (mean±SD)	Sex N (%)		The cause of stent removal		Result of stenting		
		Female	Male	Granulation tissue	Halitosis (Bad oral odor)	Stent Migration	Good	Poor
Benign 15(60)	51.13±8.1	6(60)	9(60)	4(26.7%)	1(6.7%)	1(6.7%)	5(33.3%)	10(66.7%)
Malignant 10(40)	22.5±1.4	4(40)	6(40)	0(0%)	0(0%)	1(10%)	8(80%)	2(20%)
Total 25(100)	39.68±15.6	10(40)	15(60)	4(16%)	1(4%)	2(8%)	13(52%)	12(48%)

**Figure 2.** Radiologic image after stenting
(A),(B): White arrows show proximal and distal dashed-lines of stent.

neous stent removal (11.1%), cumulated secretions (44.4%), oral odor (11.1%), formation of granulation tissues (77.7%), and tumor growth (11.1%).(Table 1) Shows result of stent insertion in 2 groups of patients. 10 patients in benign group and 2 patients in malignant group (20%) needed T-Tube insertion after stent removal but other patient cure by stenting.

Discussion

Tracheal stenosis occurs for various reasons such as prolonged intubation, prolonged tracheostomy, infections, benign/malignant tumors of the trachea (4). The best treatment for tracheal stenosis is surgery and resection of involved parts and the remaining tracheal anastomosis (4). One of the problems of surgeries on tracheal stenosis is the postoperative recurrence of stenosis, for which the best treatment is re-resection and anastomosis of the trachea (5).

Sometimes tracheal surgery and regeneration are impossible, such as when a patient has a history of previous surgeries with complications due to insufficient length of remaining trachea or associated tracheomalacia that render the tracheal regeneration and recovery impossible, or when a patient suffers from malignant tracheal

problems and the surrounding tissues are involved or there is a distant metastasis that render surgery impossible(5). Various treatment techniques are recommended for such cases, one of them being tracheal stenting (6). Of course other techniques (e.g. Nd:YAG.Laser) are also recommended and studied for such cases (7).

At first, surgeons used metallic stents which were not removable and was mostly used for airway tract malignancies where the stent was not supposed to be removed after surgery (8,9). At present the stents are mostly made of silicon. (A form of these stents are made of poly flex and self-expand materials, which are easy to remove and take out and mostly used for benign cases) (10).

Numerous studies have provided a good bulk of literature on good and side effects of tracheal stents for treatment of malignant tracheal stenosis (3). The widest study was done by J.F. Dumon et al which took 7 years and included about 200 stenting operations for benign conditions, using silicon poly flex stents. Taking into account the side effects of this method (formation of granulation tissues, stent displacement, cumulated secretions, and recurrence of stenosis after removal of the stent), the authors introduced and recommended the technique as a good method with small side effects and effective for benign stenosis (11). Other studies by JI. Mortinez-Ballarín and M. Noppen described this method as having limited side effects and good for benign stenosis cases (12).

Nevertheless, due to varying results in different studies the final position and standing of the treatment method for benign cases is still in discussion, but its efficacy for tracheal malignancies has been established (13). In another study performed by Cosau Puredam et al. In 2005, laser therapy, balloon dilation, electrocutere and stenting were proposed as therapeutic alternatives to cure airway stenosis which reduces symptoms and is associated with a less mortality rate. They reported stent migration and formation of granulation tissue most common complications of stenting (14).

A study by Schmidt et al. 2001, showed that stenting resulted in good outcomes in the next two years from the procedure and prolonged stenting was not required (15). In another study in 2000, Puma F et al concluded that sili-

con stents are well tolerated by patients and that stenting is a successful treatment in benign tracheal stenosis (16).

Conclusion

Considering the fact that complications often result in stent removal in benign cases, Using T-Tube (silicon stent) seems to be more appropriate, and in patients with malignancies it is considered as a credible therapeutic alternative. However, a more valid conclusion requires further studies.

Aknowlegement

The authors would like to thank vice chancelleries of Research of Mashhad University of Medical Sciences, Mashhad, Iran and Tehran University of Medical Sciences, Tehran, Iran for their valuable support.

Conflict of interest: The authors declare no conflict of interest.

References:

- Kastanos N, Estopá Miró R, Marín Perez A, Xaubet Mir A, Agustí-Vidal A. Laryngotracheal injury due to endotracheal intubation: incidence, evolution and predisposing factors; a prospective long term study. *Crit Care Med* 1983;11:362-367
- Schmidt B, Olze H, Borges AC, John M, Liebers U, Kaschke O, Haake K, Witt C. Endotracheal balloon dilatation and Stent implantation in benign stenoses. *Ann Thorac Surg* 2001;71:1630-4
- Brichet A, Verkindre C, Dupont J, Carlier ML, Darras J, Wurtz A, et al. Multidisciplinary approach to management of postintubation tracheal stenoses. *Eur Respir J* 1999; 13:888-893
- Grillo HC, Donahue DM. Post intubation tracheal stenosis. *Semin Thorac Cardiovasc Surg* 1996;8:370-80
- Stauffer JL, Olson DE, Petty TL. Complications and consequences of endotracheal intubation and tracheostomy: a prospective study- in 150 critically ill adult patients. *Am J Med* 1981; 70:65-76
- Weber AL, Grillo HC. Tracheal stenosis: an analysis of 151 cases. *Radiol Clin North Am* 1978; 16:291-308
- Kastanos N, Estopá Miró R, Marín Perez A, Xaubet Mir A, Agustí-Vidal A. Concentric tracheal and subglottic stenosis: management using the Nd-YAG laser for mucosal sparing followed by gentle dilatation. *Chest* 1993;104:673-677
- Nashef SA, Dromer C, Velly JF, Labrousse L, Couraud L. Expanding wire Stents in benign tracheobronchial disease: indications and complications. *Ann Thorac Surg* 1992; 54:937-940
- Dasgupta A, Dolmatch BL, Abi-Saleh WJ, Mathur PN, Mehta AC. Self-expandable metallic airway Stent insertion employing flexible bronchoscope. *Chest* 1998; 114:106-109
- Miyazawa T, Arita PC. Airway Stenting in Japan. *Respirology* 1998;3:229-34
- Dumon JF, Cavaliere S, Diaz-Jimenez JP, Vergnon JM. Seven year experience with the Dumon prosthesis. *J Bronchol* 1996;3:6-10
- Noppen M, Meysman M, Claes I, D'Haese J, Vincken W. Screwthread vs Dumon endoprosthesis in the management of tracheal stenosis. *Chest* 1999; 115:532-535
- Wood DE. Airway Stenting. *Chest Surg Clin N Am* 2001;11:841-60
- Cosano Povedano A, Muñoz Cabrera L, Cosano Povedano FJ, Rubio Sánchez J, Pascual Martínez N, Escribano Dueñas A. Endoscopic treatment of central airway stenosis: five years' experience. *Arch Bronconeumol*. 2005;41:322-7
- Schmidt B, Olze H, Borges AC, John M, Liebers U, Kaschke O, et al. Endotracheal balloon dilatation and stent implantation in benign stenoses. *Ann Thorac Surg*. 2001;71:1630-4
- Puma F, Ragusa M, Avenia N, Urbani M, Droghetti A, Daddi N, et al. The role of silicone stents in the treatment of cicatricial tracheal stenoses. *J Thorac Cardiovasc Surg*. 2000;120:1064-9