ECRONICON OPEN ACCESS

EC PULMONOLOGY AND RESPIRATORY MEDICINE

Review Article

Medical Advances in Tracheobronchial Stenting

Rumi R Khajotia*

Consultant Respiratory Physician, Hospital Tuanku Ja'afar, and Associate Professor in Respiratory Medicine, International Medical University, Seremban, Malaysia

***Corresponding Author**: Rumi R Khajotia, Consultant Respiratory Physician, Hospital Tuanku Ja'afar, and Associate Professor in Respiratory Medicine, International Medical University, Seremban, Malaysia.

Received: July 24, 2017; **Published:** August 10, 2017

Abstract

Tracheobronchial stenting is carried out to relieve airway obstruction caused by a variety of lesions such as tumors, strictures, tracheomalacia and bronchomalacia, which may not be suitable for resection and reconstruction. Historically, airway stenting was first attempted in the early 19th century, and since then, tracheostomy tubes and Montgomery tracheal T-tubes have been extensively used to palliate benign and malignant lesions. As technological advances continue to be made in the field of invasive respiratory medicine, further improvements in the design and manufacture of stents will continue, thereby increasing the number of patients who can avail treatment using this procedure. Large airway stenting has been extensively used as a palliative treatment for malignant tumors obstructing the airways. However, with further advances in technology and operator skills, tracheobronchial stenting is now being increasingly used for a number of non-malignant conditions also, which at times has proved to be quite curative in nature.

Keywords: *Tracheobronchial Stenting; Silicone Stents; Metal Airway Stents*

Introduction

Tracheobronchial stents are basically cylindrical devices that are bronchoscopically inserted into the large airways for the treatment of a variety of conditions such as malignant large airway tumours in a patient already on treatment with palliative radiotherapy and/or chemotherapy, benign tracheal or bronchial stenosis, post-intubation subglottic stenosis, tracheoesophageal and bronchoesophageal fistulas, tracheomalacia, bronchomalacia and stenting of the trachea following surgical resection or reconstruction.

It has been recommended that metallic stents should preferably not be used for benign diseases unless absolutely necessary [1], so as to prevent operable cases from turning into inoperable ones [2]. However, stenting does have a role prior to surgery, in order to optimise a patient's functional and physical state prior to surgical intervention [3].

Tracheal stents for airway malacia should be considered an option only when patients are symptomatic and airway collapse is greater than 60%, as the dynamic radial forces in malacia lead to higher stent complications such as metal fracture [4]. Moreover, in such patients it is also very important to determine where to stent, as large segments of the airway may be involved. Higher blockage rates are known to occur due to extensive airway stenting as a result of widespread disruption in mucociliary clearance. In contrast, when a stent is too short for the involved segment of the airway, collapse of the distal unsupported airway may occur, which may consequently worsen the symptoms.

Tracheobronchial stenoses requires interventional bronchoscopy. Interventional bronchoscopy should ideally be performed by an experienced multi-disciplinary team in a speciality tertiary care center. It is most commonly performed using intravenous sedation, local anaesthesia and a flexible bronchoscope [3]. However, rigid bronchoscopy with the use of general anaesthesia is being increasingly used over the last two decades [5,6]. But its widespread use has been stymied by the lack of specialists skilled in the use of this procedure.

Tracheobronchial stenting

Tracheobronchial stents are used to provide structural support to the airway in order to maintain patency of the airways. However, since stents are foreign bodies they do disrupt mucociliary clearance.

Main classes of stents available are silicone, metal and hybrid stents.

Silicone stents

Silicone stents are most commonly used to treat central airway obstruction. They are firm, well tolerated, stable at high temperatures, do not break down, resist extrinsic compression from tumors and enlarged lymph nodes, and are able to repel water. Silicone stents also cause less local inflammatory response than metal stents, thereby reducing granulation tissue formation. Silicone stents are therefore easier to remove. However, the disadvantage of silicone stents is that they tend to migrate more commonly than other types of airway stents and may require repeated interventions for stent repositioning [7,8].

Insertion of a silicone stent usually requires rigid bronchoscopy and general anesthesia, although insertion via flexible bronchoscopy has been described [9,10]. Multiple stents can be inserted if the airway obstruction is long. Once a stent has been inserted, it can also be repositioned or removed using rigid grasping forceps. Silicone stents are available in various shapes, lengths and diameters.

There are several types of silicone airway stents, namely; smooth-walled Hood stent, Reynders-Noppen Tygon stent, studded Hood stent and the studded Dumon stent.

Metal stents

Metal airway stents have several advantages over silicone stents, namely; they can be inserted via flexible bronchoscopy which requires only topical airway anesthesia and procedural sedation [11], they rarely migrate within the airway tract and they are self-expanding thereby generating sufficient force to distend even the firmest of strictures, which is useful if the airway cannot be dilated before stent insertion.

Metal airway stents also have significant disadvantages as compared to silicone stents: there is greater risk of airway perforation due to their expansile force, they are more difficult to remove or reposition following insertion and granulation tissue or the tumor easily grows through the spaces between the uncovered metal struts, which may lead to subsequent obstruction [12,13]. As a result of these significant complications of metal stents, a black box warning from the United States Food and Drug Administration has been issued, and most physicians avoid their use in patients with benign strictures. When absolutely necessary, most medical professionals will only use covered metal airway stents [14].

There are several types of metal airway stents. They include the Ultraflex stent, Wallstent (also called the Schneider stent) and the Cook-Gianturco stent.

Hybrid stents

As the name implies, these airway stents incorporate two or more different materials so as to remedy the disadvantages of both silicone stents and metal stents. A hybrid airway stent may consist of expandable metal struts (to resist tumour compression), covered by a silicone membrane (which retards the ingrowth of tumor or granulation tissue) [15-17]. However, hybrid stents are more expensive than airway stents which are made of only one material.

There are several types of hybrid stents. These include, Dynamic Y stent, Covered Wallstent, Polyflex stent, Leufen stent, Hanarostent and aAero stent.

Stent Insertion technique

Techniques used to treat tracheobronchial stenosis include, airway dilatation, tissue destruction and stent insertion.

Airway dilatation

If a stenotic lesion cannot be resected, dilation should be performed prior to stenting. This allows the stent of greatest diameter to be inserted. Dilatation can be done with lubricated bougies of increasing diameter by applying radial pressure circumferentially to the narrowed airway. Balloon dilatation may also be used as an alternative method. The flexible then rigid bronchoscope can be used to perform blunt dissection and dilatation of stenosed areas under direct vision [3]. While dilating, it is imperative to identify the path of the true airway lumen because, when the trachea is distorted it is easy to lose sight of the true lumen, thereby risking airway perforation. Preoperative imaging may also be useful in such cases.

Tissue destruction

Once the true airway lumen has been identified, it is usually preferable to destroy and physically remove diseased tissue. The simplest method of tissue destruction employs the use of forceps to mechanically remove tissue from the trachea. However, more effective techniques used to effect tissue destruction include electrocautery, cryotherapy, laser therapy, argon plasma and brachytherapy.

Endotracheal stenting

Endotracheal stents are used to provide structural support to the airway and to maintain airway patency. They are, however, foreign bodies in the airway and disrupt mucociliary clearance.

Prior to the stent insertion procedure, the distance from the vocal cords to the lesion, the length of the lesion, and the diameter of the lesion should be measured. Once this is done, the type and size of the airway stent can be selected and insertion planned. The choice of an airway stent is usually based upon physician preference. The choice usually depends on the cost, availability, and experience of the operator. Insertion of the airway stent may be part of a bronchoscopic intervention (e.g. dilatation, electrosurgery, laser resection or cryosurgery) or may also be done days or weeks later as a palliative measure, if the lesion recurs [18].

When selecting a tracheal stent, it is desirable to use the greatest diameter stent possible. Selection will depend on disease extent and patient size, after optimal airway remodelling. In general, airway stents deployed in tracheal disease are between 40 - 120 mm in length and 14 - 24 mm wide [3].

A stent should not be placed when there is active infection as this will promote granulation tissue formation. Also, treatment of bacterial colonisation in long term airway stents appears useful [19]. Hence, prophylactic antibiotics post-stent placement is commonly advised.

Sometimes, identification of the most narrowed segment of the airway is difficult during bronchoscopy. In such cases, assessment of the area of critical narrowing can be done using ultrathin bronchoscopy, endobronchial ultrasound and spirometry. This may help to guide placement of the stent over the area of critical narrowing, but this method is difficult and needs further study to actually determine its usefulness [20,21].

Complications of endotracheal stent insertion [22]

These include: stent migration, obstructing granulation tissue formation, mucous plugging, stent fracture due to broken wires or metal fatigue, bacterial colonization and recurrent infections, fistula formation, airway malacia (after removal), cough and occasionally, halitosis.

Follow-up of patients after tracheobronchial stenting

Following tracheobronchial stenting, if a patient develops respiratory symptoms such as cough, breathlessness and hemoptysis, he should be subjected to bronchoscopy in order to check whether there is renewed blockage of the airway and/or whether the stent has

migrated from its proper position [23]. Some pulmonologists recommend a routine follow-up bronchoscopy two to three months after stent placement. However, this is debatable, as it usually does not reveal any major stent-related complications in patients who are essentially asymptomatic [21,24].

Bibliography

1. Shultz D. "FDA public health notification: complications from metallic tracheal stents in patients with benign airway disorders". Open URL: Services DHH (2005).

2. Gaissert HA., *et al*. "Complication of benign tracheobronchial strictures by self-expanding metal stents". *Journal of Thoracic and Cardiovascular Surgery* 126.3 (2003): 744-747.

3. Bacon JL., *et al*. "Indications and interventional options for non- resectable tracheal stenosis". *Journal of Thoracic Disease* 6.3 (2014): 258-270.

4. Filler RM., *et al*. "Tracheobronchial stenting for the treatment of airway obstruction". *Journal of Pediatric Surgery* 33.2 (1998): 304-311.

5. Wahidi MM., *et al*. "State of the art: interventional pulmonology". *Chest* 131.1 (2007): 261-274.

6. Madden BP., *et al*. "Experience with Ultraflex expandable metallic stents in the management of endobronchial pathology". *Annals of Thoracic Surgery* 73.3 (2002): 938-944.

7. Bolliger CT., *et al*. "Silicone stents in the management of inoperable tracheobronchial stenoses. Indications and limitations". *Chest* 104.6 (1993): 1653-1659.

8. Wood DE., *et al*. "Airway stenting for malignant and benign tracheobronchial stenosis". *Annals of Thoracic Surgery* 76.1 (2003): 167-174.

9. Strausz J., *et al*. "Tracheobronchial silicone stent implantation with the flexible bronchoscope". *Journal of Bronchology* 1 (1994): 123.

10. Nomori H., *et al*. "Dumon stent placement via endotracheal tube". *Chest* 115.2 (1999): 582-583.

11. Coolen D., *et al*. "Insertion of a self-expandable endotracheal metal stent using topical anaesthesia and a fibreoptic bronchoscope: a comfortable way to offer palliation". *Thorax* 49.1 (1994): 87-88.

12. de Mello-Filho FV., *et al*. "Endoscopically placed expandable metal tracheal stents for the management of complicated tracheal stenosis". *American Journal of Otolaryngology* 24.1 (2003): 34-40.

13. Lunn W., *et al*. "Endoscopic removal of metallic airway stents". *Chest* 127.6 (2005): 2106-2112.

14. Fortin M., *et al*. "Safety and Efficacy of a Fully Covered Self-Expandable Metallic Stent in Benign Airway Stenosis". *Respiration* 93.6 (2017): 430-435.

15. Bolliger CT., *et al*. "Use of studded Polyflex stents in patients with neoplastic obstructions of the central airways". *Respiration* 71.1 (2004): 83-87.

16. Bolliger CT., *et al*. "Covered Wallstent insertion in a patient with conical tracheobronchial stenosis". *Journal of Bronchology* 2.3 (1995): 215.

17. Freitag L., *et al*. "Theoretical and experimental basis for the development of a dynamic airway stent". *European Respiratory Journal* 7.11 (1994): 2038-2045.

18. Dumon JF., *et al*. "Seven year experience with the Dumon prosthesis". *Journal of Bronchology* 3.1 (1996): 6.

19. Holden EL., *et al*. "Bacterial colonisation of endobronchial stents: a precursor to granulation tissue formation? A retrospective review from one stenting centre". *American Journal of Respiratory and Critical Care Medicine* 183.1 (2011): A1561.

20. Miyazawa T., *et al*. "Stenting at the flow-limiting segment in tracheobronchial stenosis due to lung cancer". *American Journal of Respiratory and Critical Care Medicine* 169.10 (2004): 1096-1102.

21. Colt HG., *et al*. "Airway stents". *UpToDate* (2017).

22. Thornton RH., *et al*. "Outcomes of tracheobronchial stent placement for benign disease". *Radiology* 240.1 (2006): 273-282.

23. Colt HG and Dumon JF. "Airway stents. Present and future". *Clinics in Chest Medicine* 16.3 (1995): 465-478.

24. Matsuo T and Colt HG. "Evidence against routine scheduling of surveillance bronchoscopy after stent insertion". *Chest* 118.5 (2000): 1455-1459.

Volume 4 Issue 4 August 2017