

T-Tube Insertion for Tracheal Stenosis: A Single Centre Experience: 134 Cases

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Abstract

Introduction: Tracheal stenosis is a major late complication due to cicatrization of tracheal wall and is attributed to iatrogenic injury after prolonged intubation and post tracheostomy are well established. In symptomatic patients with benign tracheal stenosis, surgical resection and reconstruction is the optimal standard treatment of choice. Stenting is reserved for symptomatic patients where surgery is not possible due to local or general reasons. Other therapeutic options are dilatation and laser therapy, fulguration, brachytherapy, where therapeutic effects are of short duration and require repeated procedures. Stenting provides prompt and durable palliation to patients who are deemed to be inoperable. The objective of this study was to present our single centre long term experience of Montgomery T-tube in benign stricture as a temporary measure, alternative to definitive surgical reconstruction and also as a palliative management.

Patients And Methods: 134 patients underwent tracheal stenting with Montgomery T-tube for benign tracheal stenosis from Jan 1984 to Jan 2018 who were not suitable for definitive primary surgical reconstruction. T-Tubes were positioned under general anaesthesia with Ventilation through rigid bronchoscope. Flexible video bronchoscopic study was performed in all patients at regular intervals of 3 months whereas in few patients, on basis of symptoms, it was repeated as and when required in addition to 3 monthly regular intervals in the first year. On the basis of good effort tolerance and with no symptoms, stoma was closed permanently.

Observation and Results: Majority (90%) of patients were of post intubation tracheal stenosis followed by Head injury. Out of 134 patients, 54 (40%) patients were of age group 21-30yrs followed by 36 patients who were of age group 11-20 yrs (27%) with inclination towards male sex (75%). Organophosphorous compound (OP) poisoning was the commonest (48%) cause for prolonged intubation followed by polytrauma and head injury (24%) in our study. Out of 134 patients, 54 (40%) were treated initially with temporary dilatation before T-tube insertion. In 111 (83%) patients T-tubes were removed successfully. Out of these, 65% of patients were free of tubes by 12-36 months. In 18 (13%) patients, tubes were left as permanent after multiple attempts. They were assessed with bronchoscopy, CT/MR imaging and declared as candidates for permanent T-tube insertion. Excessive granulation tissue in 17 (12%) patients was the major factor for reinsertion of T-tube. Obstruction due to mucus stasis in 8 (6%), cutaneous surgical site infection in 15 (11%), Subcutaneous emphysema in 10 (7.5%), Voice disturbance due to vocal cord oedema in 8(6%) and 5 (4%) patients lost to follow up were expired due to associated co-morbid conditions not related to T-tube insertion in the late post-operative period.

Discussion and Conclusion: Ideally, the treatment option should be individualized based on patient characteristics as well as stent selection with serial evaluation of endoscopic data and other radiological methods. The use of silicone stents is a treatment of choice for patients who are not fit for surgery in benign tracheal lesions, as a definitive treatment, a bridge to definitive surgery, a Palliative method and a bridge to future treatments till new therapeutic options are available. Generally, T-tube placement is performed for palliation, proven to give satisfactory therapeutic results in majority of the patients.

Keywords: T-Tube; Organophosphorous Compound (OP) Poisoning, Tracheal Reconstructive Surgery.

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Introduction

Tracheal stenosis is an emergency situation needs immediate intervention in view of life threatening condition. Tracheal stenosis is a major late complication due to cicatrization of tracheal wall related to iatrogenic injury after prolonged intubation and post tracheostomy, which is well established. The lesions commonly occur at the cuff and stomal site resulting from pressure ulceration and subsequent healing, starting with granulation, progressing to cicatrization and finally scar contraction, presenting with air way obstruction [1].

Incidence of post tracheostomy stenosis is increased due to early performance of more tracheostomies in intensive care units compared to decreased incidence of post intubation stenosis [2,3]. The use of high volume low pressure cuffs reduces mucosal ischemia and subsequent injury [3,4]. Other less common causes are chronic granulomatous infections (eg. tuberculosis, histoplasmosis, Wegener's granulomatosis), inhalation burns and traumatic injuries.

In symptomatic patients with benign tracheal stenosis, surgical resection and reconstruction is the optimal standard treatment of choice [4,5,6]. Stenting is reserved for symptomatic patients where surgery is not possible due to local or general causes. General causes like age, poor general condition, associated medical, cardiac, neurological status and orthopaedic lesions where reconstructive surgery has to be delayed to avoid prolonged intubation on a freshly reconstructed trachea [6,7,8].

Local causes such as extensive longitudinal damage (> 50% of the trachea and multifocal involvement), excessive subglottic involvement, severe inflammation and infection of mucosa are considered as absolute or temporary

contraindication for primary surgical reconstruction [7,8]. Stenting provides prompt and durable palliation to patients who are deemed inoperable [6,7,8,9,10]. Grillo recognized that "airway stents are a useful concept" highlighting their sensible use, that involves not only patient selection but also stent selection [1]. Indications for stenting include long tracheal stricture, inflammatory disease, post primary tracheal reconstruction surgical site stenosis, presence of ongoing disease process, tracheobronchomalacia, and tracheoesophageal fistula. In few patients temporary tracheal stenting allows a subsequent, safer, curative, resection and anastomosis, once the patient condition favours [6,7,8,9,10].

Other therapeutic options are dilatation and laser therapy, fulguration, brachytherapy, where therapeutic effects are of short duration and require repeated treatments [7,11]. Stent insertion may be combined with these procedures. In some patients, prolonged splinting achieve successful tracheal stabilization and subsequently allows definitive removal of stent [6,7]. Recently variety of airway stents have been developed, introduced and used with minimal information about, which one is ideal for patients where primary surgical reconstruction is not feasible [12]. Various descriptions in insertion technique and T-tube itself have been evolved after the original insertion by Dr. William W Montgomery in 1964 [5,9,13].

The objective of this study is to present our single centre long term experience of Montgomery T-tube in benign stricture as a temporary measure, alternative to definitive surgical reconstruction and as also as a palliative management.

Patients and Methods

134 patients underwent tracheal stenting with Montgomery T-tube for benign tracheal stenosis from Jan 1984 to Jan 2018, who were highly symptomatic and were not suitable for definitive primary surgical reconstruction at the time of evaluation. Patients with follow up shorter than 12 months after removal of T-tube were not included in this study.

Patients were chosen for stenting as a first line

of treatment rather than for tracheal surgery, which needed prolonged ventilation such as respiratory failure, head injury, neurological and psychiatric problems that were frequently encountered in our study due to referral from other emergency departments. Contraindications in this study included immediate subglottic stenosis, incompetent vocal cords with aspiration and difficulty in phonation.

Flexible or rigid bronchoscopes were first performed to assess the length of stenosis, the distance of the stenosis from vocal cords and carina, diameter of the trachea.

Patients who were presented with acute life threatening condition were stabilised before stenting by serial carrot type elastic bougie, gradual dilatation and evaluated with bronchoscopy to Reassess the adequate tracheal lumen followed by T-tube insertion. Patients who presented with stridor, not in critical condition were evaluated by either flexible and rigid bronchoscope, and in few patients complemented with CT/MRI images to assess the tracheal stenosis.

T-Tubes were positioned under general anaesthesia with ventilation through rigid bronchoscope. New stoma created in non-tracheotomised patients and patients who already presented with tracheotomy needed surgical exploration at stoma site to remove in growing excessive granulation tissue to facilitate insertion of proper sized stent.

We have adopted the Montgomery's original method that consisted of grasping the distal portion of the intraluminal limb with a haemostat and advancing it into place inferiorly, applying the same technique on the proximal portion in a superior direction, and finishing the procedure by pulling the extraluminal limb anteriorly to help direct the proximal portion of the intraluminal portion in place [13,14,15,16].

In previously tracheotomised patients flexible curved endotracheal tubes were used from stoma site along with rigid bronchoscope for ventilation. Bronchial secretions and excised excessive granulation were collected in all patients for culture sensitivity and histopathology. Treatment initiated according to sensitivity and pathology. Proper sized stent, distance from vocal cords and carina confirmed by flexible bronchoscope, if required. Size of tube changed and length of tube trimmed before completing the procedure. In all patients, horizontal stoma was closed except a few patients who required tracheal suctioning and toileting.

Flexible video bronchoscopic study was performed in all patients at regular interval of 3 months and in few patients as and when required during the first year.

Before T-tube removal adequacy of airway was accessed by bronchoscopy and in few cases complimentary information with CT/MRI imaging. Removal of T-tube done with steady anterior traction of extraluminal limb after surgically releasing the adhesions around the external limb. After removal of T-tube, stoma not closed permanently but closed temporarily by strapping with adhesive tape and observed for 3 days and if symptomatic, fresh T-tube reinserted. On the basis of good effort tolerance and with no symptoms, stoma closed permanently. If not tolerated and continued to be symptomatic, new tube reinserted and followed up.

Observation and Results

1. Majority (90%) of patients were of post intubation tracheal stenosis followed by head injury. Only 15% of intubated patients were tracheostomised during prolonged ventilation.

Table 1: Indication for T-tube insertion

Indication	Total
Post intubation stricture	
With tracheostomy	20
Without tracheostomy	100
Traumatic injury	04
Trachea-oesophageal fistula	08
Carcinoma	01

2. Out of 134 patients (40%) of patients are of age group 21-30 yrs followed by 11-20yrs (27%) with inclination towards male sex. (75%).

Table 2: Age and sex distribution

Age group (yrs)	Male	Female	Total
<10	03	0	03(2%)
11 to 20	22	14	36(27%)
21 to 30	41	13	54(40%)
31 to 40	18	04	22(16%)
41 to 50	10	03	13(10%)
51 to 60	04	0	04(3%)
> 60	02	0	02(1.5%)
Total	100 (75%)	34 (25%)	134

3. Organophosphorous compound poisoning was the commonest (48%) cause for prolonged intubation followed by polytrauma and head injury (24%).

Table 3: Causes of prolonged intubation

Causes for prolonged intubation	Total (120)	%
Organophosphorous poisoning	65	48
Head injury and polytrauma	32	24
Cardiac and respiratory diseases	10	7
GuillainBarré syndrome	08	6
Cerebrovascular accidents	05	4

4. Out of 134 patients 54 (40%) were treated initially with dilatation before T-tube insertion (for interim relief and stabilisation).111(83%) patients in whom T-tubes were removed successfully. Out of them, 65% of patients were free of tubes in 12 -36 months. In 3(2%) of patients T-tubes were successfully removed within 6 months. In 56(42%) T-tubers were removed between 2-3 yrs followed by 23(17%) in 1-2 yrs. In 18(13%) patients tubes were left as permanent after multiple attempts of removal. These were assessed with bronchoscope, CT/ MR imaging and declared as candidates for permanent T-tube insertion.

Table 4: Time Interval for T-tube removal after insertion.

Time interval	No	%
<6 months	03	02
6 months - 1 yr	04	03
1 yr- 2yrs	23	17
2 yrsr-3yrs	56	42
3yrs- 4 yrs.	13	10
4yrs-5yrs	05	04
> 5yrs	07	05
Permanent T-tube	18	13
Lost to follow up.	05	04

5. Excessive granulation tissue in 17 (12%) patients was the major factor requiring surgery for reinsertion of T-tube after initial removal. More than half of them were within a week after removal.

Table 5: Duration for re-insertion of T-tube.

Duration	No
<5 days	10
5-10 days	0
10-20 days	3
20-30 days	2
>30 days.	2
Total	17(12%)

Complications

Minor complications observed in immediate post operative period were

- (1) Obstruction due to mucus stasis which needs replacement in immediate post-operative period in 8 (6%) patients
- (2) Cutaneous surgical site infection that was treated in 15 (11%) patients with culture and sensitivity as per sample taken during initial surgery
- (3) Subcutaneous emphysema in 10 (7.5%) patients which subsided on its own without any intervention
- (4) Voice disturbance due to vocal cord oedema in 8 (6 %) patients which was self-subsided within in a week time
- (5) Five (4%) patients who lost to follow up found to be expired due to associated co-morbid conditions not related to T-tube insertion in the late post-operative period.

Discussion

Single stage, surgical resection and reconstruction is the standard treatment of choice for benign tracheal stenosis [4,5,6]. Majority of patients in our study are young adults between 20-30 yrs with predominance in male sex. Where as in western studies, there is no sex predominance and patient age group was a decade older than our study group [3,6,7,10,13]. In this study OP poisoning is the commonest cause followed by polytrauma and head injury due to road traffic accidents. All patients with OP poisoning were of younger age group suffering from psychiatric disorders with suicidal tendencies. This shows only a tip of the iceberg of the mental health problems in younger age group in India. Again majority of patients with poly trauma were due to road traffic accidents in younger generation which reflects on laxity in implementation and adherence to proper road safety standards.

Only 15% of intubated patients were tracheostomised during prolonged ventilation compared to other studies where incidence of post tracheostomy stenosis is commonly observed [2,3,4,6,10,14]. In patients with significant postintubation tracheal stenosis for whom surgery is not initially feasible, the treatment of choice is stenting. It is usually after dilatation with laser/ ballooning/bougie [2,7,18,19]. Tracheostomy opening is a prerequisite for insertion of T-tube either pre-existed or performed at the time of stent insertion. Diameter and length of tube is chosen based on bronchoscopic and radiological findings. Ideal diameter of the T-tube should be largest

diameter snugly fit into airway but not too tightly to avoid excessive pressure on the mucosa which subsequently causes granulation and stenosis, with minimal displacement and migration [5,9,13,14,15]. Ideally, tracheal stents should be easily available, economical, inert and biocompatible, which does not migrate, not causing significant inflammation /obstruction of airway, easy to place and remove with locally available surgical skill and resources [5,8,9,12,13,15]. Expandable metallic stents known to migrate, causes inflammation and obstruction due to in growing of granulation tissue and difficulty in removal. They are contraindicated in benign stenosis and preferred for palliative care [5,7,9,12,13,15,17,18,19]. Non availability of such ideal stents, T tube stents are still being used widely in clinical practice in treatment of tracheal strictures. The first T-tube described by Bondin 1891 was a metal tube with various modification till today. Currently available flexible silicon device developed by Montgomery in 1965 requires a tracheostomy for insertion [5,14]. It has a unique advantage of adaptable and fitting in to individual patient's needs. T-tubes are available in various diameter and adjustable lengths. There were minor complications like mucostasis, surgical emphysema, wound site infection that did not require any major surgical intervention [5,9,17]. Out of 134 patients, in 111 (83%) patients T-tubes were removed successfully. Majority of them 79 (65%) over a period of 12 months to 36 months. Only 7 (5%) patients T-tubes were removed within 12 months. Study by Gissert et al (80%), Angelo et al (71.8%) with similar success rates [2,5,8,9,17]. How long the stent should be kept in place before attempting its removal is not clearly defined by previous studies. However, some authors recommend keeping the stent in place for at least 6 to 24 months or more [5,6,7,15,20]. Key to satisfactory achievement is by correct interpretation of serial endoscopic data and other radiological methods tailored individually. Initial patency after stent removal should not be considered as definitive, since the stricture may gradually relapse [1,7]. In a case of diffuse circumferential granulation tissue, fibrous scar tissue is usually the result of extensive mucosal necrosis which requires a satisfactory mucosal healing process and complete re-epithelialization. The achievement in success of treating stenosis with T-tube depends on the partial lesion of tracheal wall with preservation of cartilaginous structure at the level of stenosis [5,7]. Stabilization of tracheomalacia is certainly much more difficult to understand, especially if the tracheal rings are totally destroyed. It was observed that Long-term

silicone stenting is an unpredictable improvement leading to stent removal. The foreign body, chronically contaminated by bacteria, may play a role in this process, causing perivisceral adhesions. Long-term stenting can produce resolution of active inflammatory mucosal changes, which gradually evolve into a full-thickness chronic infiltrate, the latter may be reversible after stent removal with fibrous healing [7,21].

The advantage of T-tube over total endoluminal stents are the presence of horizontal lumen, which allows suctioning and clearance of secretions, reducing obstruction. The risk of migration and dislocation is less due to external arm of tube, which can be utilised for flexible bronchoscope during follow up. T-tubes are easy to place and performed under sedation with flexible or rigid bronchoscope.

Conclusion

Single stage, surgical resection and reconstruction is the standard treatment of choice for benign tracheal stenosis, however the optimal management of postintubation tracheal stenosis which is not suitable for primary surgical repair is not well defined. Ideally, the treatment option should be individualized based on patient characteristics as well as stent selection with serial evaluation of endoscopic data and other radiological methods. The use of silicone stents is a treatment of choice for patients who are not fit for surgery in benign tracheal lesions, as a definitive treatment, a bridge to definitive surgery, a palliation, and a bridge to future treatments till new therapeutic options are available. Generally, T-tube placement is performed for palliation, proven to give satisfactory therapeutic results in majority of patients.

References

1. Grillo HC. Stents and sense, *Ann Thorac Surg.* 2000;70:1142.
2. Lim SY, Kim H, Jeon K, et al. Prognostic factors for endotracheal silicone stenting in the management of inoperable post-intubation tracheal stenosis. *Yonsei Med J.* 2012;53:565-70.
3. Samuel S Kim, Zain Khalpey, Charles HSU, and Alex G. Little, Changes in Tracheostomy -and Intubation -related Tracheal Stenosis: Implications for surgery. *Ann thorac surg.* 2017;104:964-70.
4. Grillo HC, Donahue DM, Mathisen DJ, Wain JC, Wright CD. Post intubation tracheal stenosis: treatment and results. *J Thorac Cardiovasc surg.* 1995;109:486-3; Discussion 492-3 *Cardiovasc Surg*

- 1996;8:370-80.
5. Angelo Carretta, Monica Casiraghi, Giulio Melloni, Alessaandro Bandiera, Paola Ciriaco, Luca Ferla, Armando Puglisi, Piero zannini, Montgomery T-tube placement in the treatment of benign tracheal lesions. *European Journal of cardio-thoracic surgery* 2009;36:352-56.
 6. Jerome Plojoux, Sophie Laroumagne, Thomas Vandemoortele, Philippe J. Astoul, Pascal A. Thomas, and Herve Dutau, Management of Benign Dynamic "A-Shape" Tracheal Stenosis: A Retrospective Study of 60 Patients. *The Annals of Thoracic Surgery*. 2015 Feb;99(2):447-53.
 7. Francesco Puma, Mark Ragusa, Nicola Avenia, Moira Urbani, Andrea Droghetti, Niccolò Daddi, Giuliano Daddi. The Role of Silicone Stents in the Treatment of Cicatricial Tracheal stenoses; *The Journal of Thoracic and Cardiovascular Surgery*, 2000 Dec;120(6):1064-69.
 8. Kosmas Tsakiridis, Kaid Darwiche, Aikaterini N. Visouli, Paul Zarogoulidis, Nikolaos Machairiotis, Christos Christofis, Aikaterini Stylianaki, Nikolaos Katsikogiannis, Andreas Mpakas, Nicolaos Courcoutsakis, Konstantinos Zarogoulidis; Management of complex benign post-tracheostomy tracheal stenosis with bronchoscopic insertion of silicon tracheal stents, in patients with failed or contraindicated surgical reconstruction of trachea; *Journal of Thoracic Disease. J Thorac Dis*. 2012 Nov; 4(Suppl 1):32-40.
 9. M.M. Wahidi, A. Ernst, The Montgomery T-tube Tracheal stent; *Clin Chest Med*. 2003;24:437-43.
 10. Arjun Dass, Nitin M Nagarkar, Surinder K Singhal, Hitesh Verma; Tracheal T-Tube Stent for Laryngotracheal Stenosis: Ten Year Experience; *Iranian Journal of Otorhinolaryngology* 26(74):37-42.
 11. Maddaus M, Pearson FG. Postintubation injury. In: Pearson FG, editor. *Thoracic surgery*. New York: Churchill Livingstone; 1995.pp.251-65.
 12. Brooks Udelsman, Douglas J. Mathisen, Harald C. Ott; A reassessment of tracheal substitutes –a systematic review; *Ann Cardiothorac Surg* 2018;7(2):175-82.
 13. Pinedo -Onofre et al; How I do it Montgomery T-tube insertion for subglottic stenosis; *Ann Thorac Surg* 2010;89:2044-6.
 14. Montgomery WW. T-tube tracheal stent. *Arch Otolaryng*. 1965;82:320-1.
 15. Cooper J D, Todd T R, Ilves R, Pearson FG. Use of the silicone Tracheal T-tube for management of complex tracheal injuries. *J Thorac Cardiovasc Surg*. 1981;82(4):559-68.
 16. Montgomery WW, Montgomery S K. Manual for use of Montgomery laryngeal, tracheal and oesophageal prosthesis; update 1990. *Ann Otol Rhinol Laryngol*. 1990;150 suppl;2-28.
 17. Gaissert HA, Grillo HC, Wright CD, Donahue DM, Wain JC, Mathisen DJ. Complication of benign tracheobroncheal strictures by self expanding metal stents. *J Thorac Cardiovasc surg*. 2003;126;744-7.
 18. Chin CS, Litle V, Yun J, et al. Airway stents. *Ann Thorac Surg*. 2008;85:S792-6.
 19. Dutau H. Airway stenting for benign tracheal stenosis: what is really behind the choice of the stent? *Eur J Cardiothorac Surg*. 2011;40:924-5.
 20. Dumon JF. A dedicated tracheobronchial stent. *Chest*. 1990;97:328-32.
 21. Puma F, Farabi R, Urbani M, Santoprete S, Daddi N, Di Meo A, et al. Long-term safety and tolerance of silicone and self-expandable airway stents: an experimental study. *Ann Thorac Surg*. 2000;69:1030-4.
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