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Role of Montgomery T-tube stent for laryngotracheal stenosis

Saravanam Prasanna Kumar [a,*], Arunachalam Ravikumar [a], Kannan Senthil [a], Lakshman Somu [a], Mohd Ismail Nazrin [b]

[a] Department of E.N.T. Head & Neck Surgery, Sri Ramachandra Medical College & Research Institute, Porur, Chennai 600116, India
[b] Resident in Otorhinolaryngology, Sri Ramachandra Medical College & Research Institute, Porur, Chennai 600116, India

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ABSTRACT

Objective: To identify the indications, complications and outcome of patients of LTS managed with Montgomery T-tube stenting and review the current literature about the role of stenting in LTS.
Methods: Retrospective chart reviews of 39 patients of laryngotracheal stenosis managed by T-tube stenting for temporary or definitive treatment during the period 2004–2011 were considered. The data on indications for stenting, type of stent, problems/complications of stenting, duration of stenting, additional intervention and outcome of management were collected, tabulated and analyzed.
Results: Of the 51 cases of laryngotracheal stenosis 39 patients were treated by Montgomery T-tube stenting. There was no mortality associated with the procedure or stenting. 82% of the patients were successfully decannulated. The problems and complications encountered were crusting within the tube in 44% and granulation at the subglottis in 33%. Two patients had complication due to T-tube itself: One patient developed tracheomalacia and the other had stenosis at both ends of the T-tube.
Conclusion: Stenting still has a role in management of inoperable or in some deadlock situations where resection anastomosis is not feasible. It is easier to introduce the stent and to maintain it. Complications are minor and can be managed easily. It is safe for long term use. We emphasize that the treating surgeon needs to use prudence while treating stenosis using stents.

1. Introduction

Laryngotracheal stenosis (LTS) can be a benign or malignant narrowing of the airway. Benign stenosis is mostly iatrogenic (prolonged endotracheal intubation, tracheostomy etc.). There are innumerable approaches to the management of laryngotracheal stenosis (LTS) described in literature. This in itself bears testimony to the complexity of the problem and its innumerable solution. No single approach gives predictably satisfactory results. The choice of the surgery has to be individually catered to the each patient.

At present the optimal treatment [1] and procedure of choice [2] for LTS is resection anastomosis. However certain conditions still warrant a more conservative approach like stenting of the airway. Stents need to be used intelligently [3]. They may be used for temporary stenting for restoration of airway or as a definitive permanent stenting to maintain airway. In this study we have reviewed the clinical data of patients who had been stented with Montgomery T-tube for management of laryngotracheal stenosis.

2. Objective of the study

To identify the indications, complications and outcome of patients of LTS managed with Montgomery T-tube stenting and review the current literature with regard to role of stenting in LTS.

3. Patients and methods

Retrospective chart reviews of 51 patients of laryngotracheal stenosis who were managed by us during this period 2004–2011 were included in the study. After a patient is diagnosed as a case of LTS, further evaluation is done by flexible and rigid endoscopy to assess the movement of vocal cord, type of stenosis, the grade of stenosis, length of stenosis, involvement of the posterior glottis and subglottis etc. CT scan with 3D reconstruction is also done. A decision is then taken as to the appropriate procedure to be followed.

One patient had a posterior glottic stenosis and was managed by laserisation of the cicatrical scar without stenting. Two patients who had suprastomal anterior wall collapse were managed by tracheoplasty without stenting. Two patients who had posterior glottic and subglottic stenosis had undergone excision of scar tissue followed by stenting with Hoods laryngeal stent. All these five patients were excluded from the study. Eight patients

* Corresponding author at: 65/2, East Colony, ICF, Chennai 600038, Tamil Nadu, India. Tel.: +91 9444413094.
E-mail addresses: sprasannakumar10@gmail.com (S. Prasanna Kumar), ravi_1954@hotmail.com (A. Ravikumar), drsenthilk@yahoo.co.in (K. Senthil), somu_l1496@yahoo.com (L. Somu), nazsams@gmail.com (M.I. Nazrin).

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Table 1
Indications of stenting in our study.

	Post-endotracheal intubation stenosis	Post-tracheostomy tracheal stenosis	T-tube complication	Others
Temporary stenting				
1. High risk unfit for surgery	20	3	–	–
2. Local reasons				
a. Vocal cord palsy	1	–	–	–
b. Long segment stenosis	1	–	–	–
3. Financial constraints and Unwilling for surgery	7	3	–	–
Palliative or permanent stenting				
1. Multilevel tracheal stenosis	1	–	–	–
2. Long segment tracheal stenosis	1	–	–	–
3. Failure of resection anastomosis[a]	–	–	–	1
4. Tracheomalacia	–	–	1	–
5. Stenosis at the both end of the T-tube	–	–	1	–
6. Thyroid malignancy involving the trachea	–	–	–	1

[a] This patient is a case of post-intubation tracheal stenosis who had failure of tracheal resection anastomosis.

underwent tracheal resection anastomosis of which one patient had wound dehiscence and required T-tube stenting, hence seven patient were excluded from the study one was included in the study. A total of 39 patients who were stented with Montgomery T-tube either for temporary or for definitive treatment were further reviewed and analyzed in this study.

We use a very simple technique for insertion of T-tube. Initially a tracheostomy is performed to secure the airway; all attempts are made to open the trachea at the site of stenosis or just below it. 1–2 ml of 4% lignocaine is instilled in the trachea. The suprastomal trachea and the infrastomal trachea are inspected using a 70° nasal endoscope. Stenotic segment is addressed by splitting of the stenotic segment or by tracheoplasty. Granulation within the trachea is removed under vision, using adrenaline soaked patties over the granulations to reduce bleeding. The vertical limb of the T-tube is smeared with a little lignocaine gel. The lower part of the vertical limb is first introduced into the infrastomal trachea. We generally avoid splitting of normal tracheal rings as far as possible. Then the upper limb of the T-tube is held with a vascular forceps and introduced suprastomally. Using a 70° rigid nasal endoscope trough the T-tube, the placement of the T-tube is ascertained, care is taken that the T-tube does not impinge into the glottis (subglottis is avoided if it is disease free). This can be ascertained by visually seeing the vocal cord mobility and also observing for any change in voice. The T-tube can be readjusted if required. Post-operatively, our patients only required 1 of 2 days of hospitalization for observation.

These patient are regularly followed up, T-tube change is done at 6 monthly intervals and patient assessed for decannulation. We do not close the stoma immediately after decannulation, we observe the patient over a period of 10 days for any narrowing of tracheal lumen post-stent removal, flap reconstruction of the tracheal stoma is done when ever required. Most of our patients required secondary repair of the tracheal stoma.

The data on indications for T-tube stenting, problems/complications of stenting, duration of stenting and outcome of management were collected, tabulated and analyzed.

4. Results

Of the thirty-nine patients, thirty-two had developed LTS post-endotracheal intubation and 6 developed LTS post-tracheostomy. One patient had thyroid malignancy with infiltration into the trachea causing stenosis and had been managed by T-tube stenting for palliation. Of the thirty-two patient of endotracheal intubation, twenty-one had emergency intubation and 11 had elective intubation. The indications for Montgomery T-tube stenting in these thirty-nine patients is shown in Table 1. It is to be noted that two patients are included in both the temporary and in the permanent category. This is because to start with we used the T-tube stenting as the primary mode of treatment in both: but one of the patient developed stenosis at both ends of the tube and one patient developed tracheomalacia and required reinsertion of T-tube and had to be included in the permanent group also. The most common site of stenosis in the post-endotracheal intubation group was in the trachea (48.5%). All six tracheostomised patients had suprastomal stenosis (100%). Thirty-eight patients had normal vocal cord mobility at diagnosis. One patient had restricted mobility of the right vocal cord due to scarring and adhesions.

The problems that were encountered due to T-tube stenting is shown in Table 2. Crusting within the tube was a problem in 43.58% (Fig. 1), troublesome granulation were seen at the subglottis in 33.33% (Fig. 2), persistent cough in two patient (5.1%), surgical emphysema in the immediate post-operative period in two patients (5.1%) (Fig. 3), tracheomalacia in one patient (Fig. 4) and one had stenosis at both ends of the T-tube. One patient did not tolerate the T-tube because of excessive crusting hence we had to put her on permanent tracheostomy tube.

Thirty-two patients (82.05%) were successfully decannulated and are doing fine after 6 months of follow up. Three patients are still on T-tube and one is on a permanent tracheostomy. Three patients had died due to co-morbid conditions unrelated to

Table 2
Problems/complication due to T-tube stenting[a].

Immediate (within 24 h)	• Surgical emphysema (2)
	• Persistent irritant cough(2)
	• Respiratory distress
	  • The lower end of the tube is entered one bronchus(1)
	  • Clots and mucus plug (1)

Intermediate (Few days to weeks)	• Hoarseness of voice (1)
	• Respiratory distress
	  • Lower respiratory tract infection(3)
	  • Crusting and mucus plug (17)
	• Cough with expectoration
	  • Lower respiratory infection (3)
	  • Tracheobronchitis (3)
	  • Aspiration (4)
	• Granulations (14)
	  • Particularly in the subglottis and lower end of the tube

Late complications (Few months)	Tracheomalacia (1) Restenosis at the ends of the tube (1) Displacement of the tube (1)

[a] The number of problem/complications which we have seen in our patients is indicated within bracket.

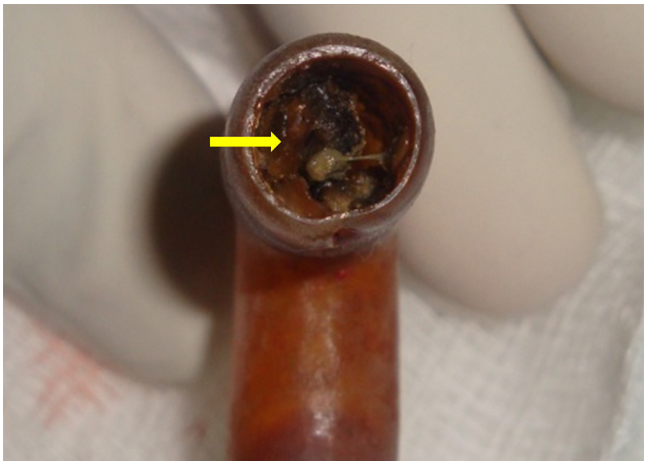


Fig. 1. Shows crusting within the T-tube.

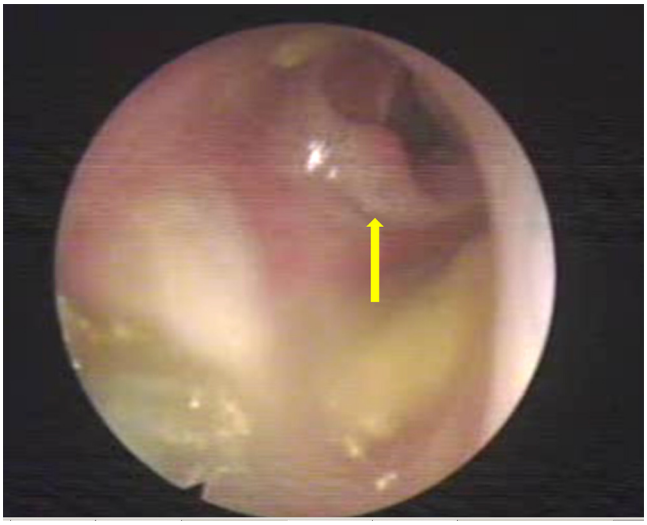


Fig. 2. Shows granulation in the upper end of T-Tube visualized via a 70° endoscope in the subglottis.

stenting. We had no procedure or stent related mortality. The average duration of stenting in thirty-two patients who were decannulated was 10.15 ± 8.6 SD months with a minimum of 2 months and a maximum of 36 months.

Fig. 3. Surgical emphysema 1st post-operative day involving the neck and face.

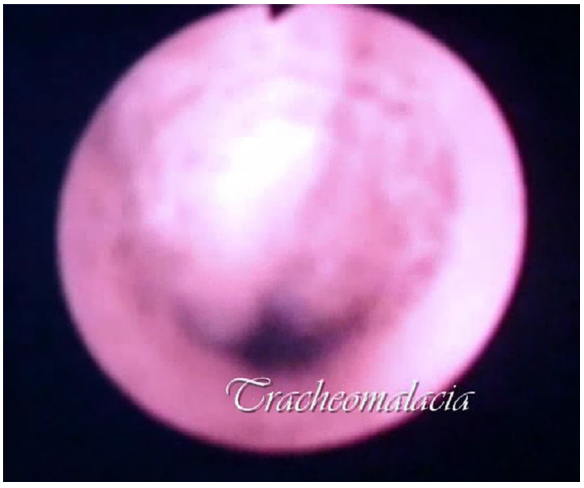


Fig. 4. Tracheomalacia in a patient who was on long term T-tube.

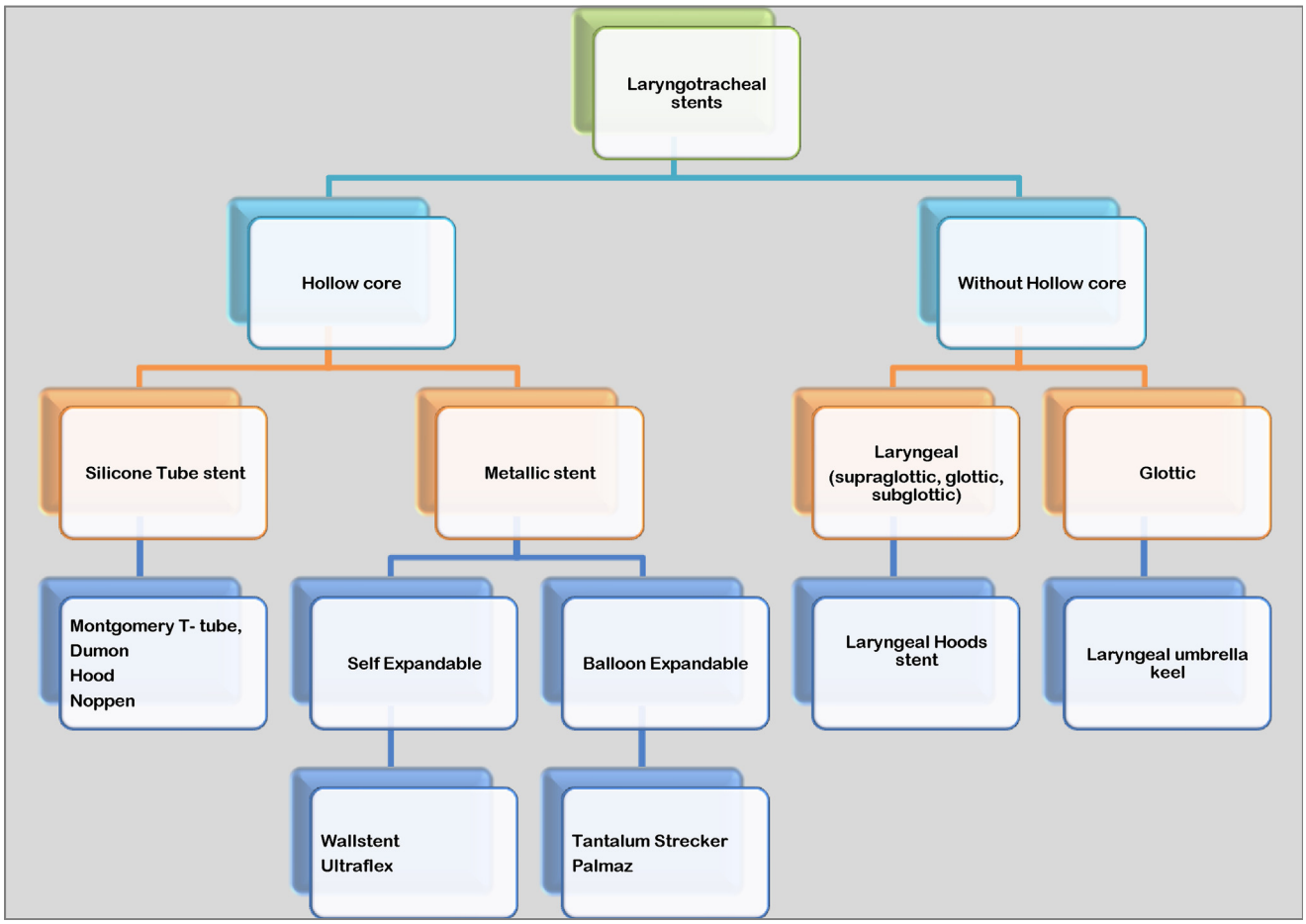
5. Discussion

In the year 1965, W W Montgomery had designed a silicone based T tube stent [4]. Later, Dumon in 1990 has described a dedicated tracheobronchial stent which was also made of silicone [5]. Since then there have been innumerable number of cases of LTS who have been managed successfully by stenting all over the world. There are a variety of laryngotracheal stents described in literature and the list of available stents in the market seems to grow by each passing day, yet there is no stent which would qualify as an ideal stent [6].

Lee et al. [6] have discussed in detail the different types of stent used for airway stenosis. Laryngotracheal stents can be grouped into two types based on the presence or absence of a hollow core. The stents based on the hollow core is usually cylindrical and allows for flow of air acting as a conduit and also stents the stenotic segment from within. The solid stents are usually used in the larynx and are used to prevent aspiration. Stents can further be grouped on the material, expandable or non-expandable, dedicated endotracheobronchial or external. Table 3 summarizes the currently available commercial stents. Newer designs have been described, but need further trials [7]. Experimental and clinical trials are being done using drug eluting and bioabsorbable stents [8,9].

Most authors have classified the indications for airway stenosis into three groups, i.e., those awaiting definitive surgery (Resection anastomosis), complications of resection anastomosis, and those that require definitive permanent stenting. The third group includes patients who are unfit for resection anastomosis due to local and systemic reasons [10,11]. In our study, majority (39/51) of the patients have had T-tube stenting. It has to be understood that most of the patients who have been treated were referred to us from the ICU and are usually unfit for major surgery. Secondly, ours being a tertiary care hospital, many of the patients referred from outside had already undergone multiple surgical procedures on the airway making them unfit for resection anastomosis. Thirdly, these patients had already spent a lot of money on initial treatment, ICU care etc. and have a financial crunch and the burden of hospitalization and another major surgery was a little too much for them to bear. One patient had multilevel tracheal stenosis at presentation was due to accidental aspiration of corrosive agent he had to be put on permanent T-tube stenting. Some patients do not consent to resection anastomosis these patients also need to be considered for stenting. Hence, we have tabulated the indication for laryngotracheal stenting considering all these factors as shown in Table 4.

Table 3
Commercially available laryngotracheal stents.



Montgomery T-tube has been used successfully by many for the past five decades. This stent is easier to introduce and to maintain [6]. They are relatively cheap compared to other stents [6]. Most cases can be done under monitored anesthetic care/sedation via the tracheostoma. There are many techniques of introduction of the Montgomery T-tube described in literature [12,13]. T-tube stenting however has its own problems [14]. These can be classified into immediate, intermediate and late complications shown in Table 2. We have had two patients who developed surgical emphysema; in one case the emphysema progressed very rapidly to involve the neck, face and chest. Surgical emphysema can occur due to tight suturing of skin at the tracheal stoma or due to a smaller T-tube being used, this can be corrected by removing a few sutures near the stoma, keeping the T-tube plug open or reinserting the T-tube of the correct diameter and dimensions.

Persistent irritant cough can be very troublesome and is commonly due to one end of the T-tube impinging on the carina or the subglottis. It is essential to know the exact length of the trachea and adjust the length of the T-tube preoperatively to avoid this problem. we recommended that the trachea and the subglottis be examined using a 70° rigid nasal endoscope or a flexible fiber optic scope passed via the horizontal limb of the T-tube after removing the extension of the neck. If need be the length of the T-tube is to be trimmed and adjusted.

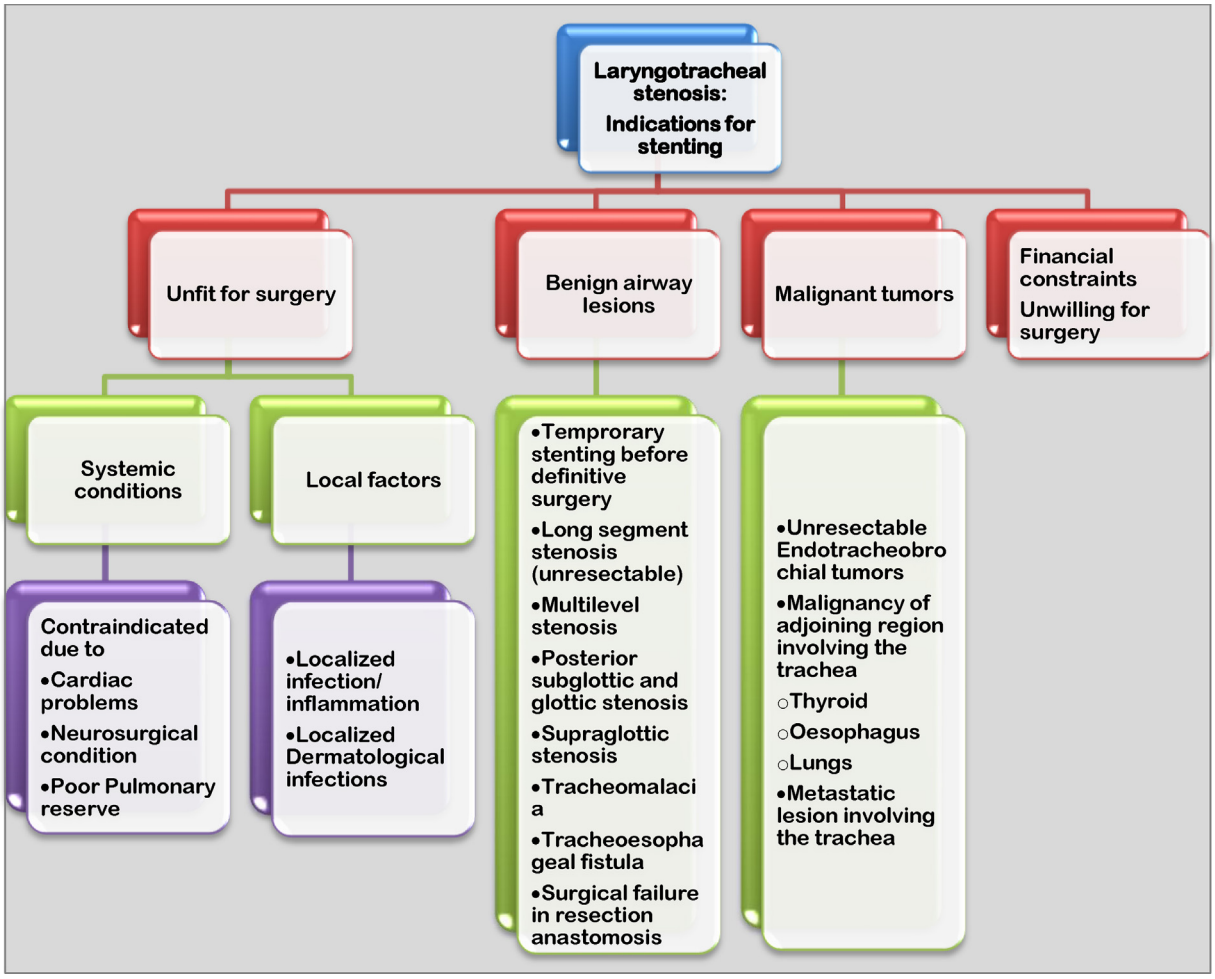
Respiratory distress occurring in the immediate post-stenting period may be due to lower end of the tube entering one of the bronchi or due to blood clots within the lumen which can be corrected by readjusting the tube length and by suction clearance respectively. Distress occurring a few days later is usually due to mucus plug or crusting within the tube or due to lower respiratory tract infection. In one of our patients there was such severe crusting within the tube that we were left with no choice but to replace the T-tube with a tracheostomy tube. Phillips et al. [15] have also reported similar experience in children.

Cough with expectoration is usually because of tracheitis or because of lower respiratory tract infection. This occurs because the T-tube interferes with the normal mucociliary clearance resulting in mucostasis and secondary infection which needs to be managed with antibiotics and bronchodilators. Regular chest physiotherapy and exercises especially in the early days is mandatory to prevent or reduce this problem.

Granulation commonly occurs at the ends of the tube or at the stoma, these are managed conservatively by using systemic antibiotics and inhalational steroids. Sometimes troublesome granulations need to be removed surgically.

We had one patient who developed tracheomalacia. This patient was an elderly female who had multiple co morbid illnesses such as diabetes, chronic kidney disease and hepatitis C infection. She was on the T-tube stenting for 1 year, when changing the tube we realized that she had developed tracheomalacia. One patient who developed stenosis at both ends of the tube after stenting for 6 year and had not come for review or tube change in the interim period. Both these cases required reinsertion of T-tube. Phillips et al. [15] have reported a case of supraglottic stenosis following stenting in a child which was managed by using a longer stent. Srirompotong et al. [16] have reported one unusual case of a T-tube being dislodged into the trachea. Shinkwin et al. [17] have reported one unusual case of inhalation of the t-tube plug. Liu et al.

Table 4
Indication for stenting in general.



[18] have reported two cases of severe tracheal hemorrhage following stenting. Though these cases are extremely rare one needs to be aware of all potential complication while dealing with the airway.

Patients can be educated and taught how to maintain and deal with Montgomery T-tube stenting. Since, many of our patients were from faraway places; we felt it was easier for our patients to maintain the T-tube in case of respiratory distress or to get medical help. The T-tube can be handled by the patient themselves or by any medical practitioner who knows how to handle a tracheostomy tube. The dynamic Dumon's silastic stent is also used widely [5]. Dumon's stent is a complete endotracheal or endobronchial tube and problems of displacement of the tube; crusting etc. has to be addressed by the concerned specialist. The expandable metallic stents are costlier and have fallen into disrepute with a number of unwarranted complications. Recently the FDA has issued a warning on use of these stents [19].

The ideal duration of T-tube stenting is not known and is debatable. Dumon [5] and Cooper et al. [20] have recommended the use of silastic stent for 6–12 months. Martinez-Ballarin et al. [21] have recommended the use of silastic stent for 18 months. Caretta et al. [11] have recommended the inspection and change of T-tube once in 9–12 months. It is our practice to inspect the tube every six months and change the T-tube every 12 months. Saghebi et al. [22] have doubted the role of long term stenting for more than 6 months in stabilizing the trachea and aid in decannulation. The duration of stenting primarily depends on the indications for which stenting has been done, whether it is for temporary or permanent/palliation. In our study average period of stenting for the patient who had been decannulated was 10.12 ± 8.6 months. We agree with Puma et al. [23] that the duration of stenting has to be individualized and to be based on clinical, endoscopic examination. Long time stenting does provide a more stable airway. We recommend that the patient is regularly followed up on a weekly basis for a month and monthly for 3 months post-decannulation. This helps in early detection of restenosis and also in instituting early intervention.

82.05% (32/39) of our patients have been successfully decannulated after using T-tube stenting. Flap reconstruction of the tracheal stoma was required in two patients, wherein we had freshened the margins of the tracheal stoma by elliptical excision of the skin around the stoma, two parallel subcutaneous flaps are elevated on either sides of the stoma and these flaps where brought in midline and sutured. Three patients died due to co-morbid conditions unrelated to the procedure or stenting. One patient succumbed to chronic kidney disease, one had cerebrovascular accident and one succumbed to complications of thyroid malignancy. The three patients who are on T-tube are the one who had a failure of resection anastomosis, one patients had multilevel stenosis at presentation and one patient developed stenosis at both ends of the T-tube following prolonged period of stenting.

At this point we would like to emphasis that laryngotracheal/tracheal resection anastomosis remains the first choice of treatment for resectable stenosis. Stenting is a useful option in indicated cases, it is safe and complications are minor which can be easily managed. One must fully understand the concepts of stenting, be prudent in choosing the cases and the type of stent.

6. Conclusion

The objective of this article is to share our experience in using Montgomery T-tube stenting for laryngotracheal stenosis. Stenting still has a role in management of inoperable or in some deadlock situations where resection anastomosis is not feasible. It is easier to introduce the Montgomery T-tube stent and to maintain it. Complications are minor and can be managed easily. It is safe for long term use. We emphasize that the treating surgeon needs to use prudence in selecting cases for stenting.

Conflict of interest

None declared.

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