Original Article

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Clinical Presentation and Outcome Laryngotracheal Stenosis: A Retrospective Analysis

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Abstract

Introduction: Laryngotracheal stenosis (LTS) is a complex condition that results in a compromised airway, involving trachea and/or larynx. LTS is recalcitrant, the management of which poses a significant surgical challenge.

Objective: To analyze the outcomes following surgical management of LTS.

Patients and Methods: Retrospective chart review of 53 patients diagnosed with LTS, managed by various surgical approaches over a period of 8 years from 2006 to 2014 were included. The following data, on etiology, site of the stenosis, the surgical outcomes and complications between various procedures performed in management of LTS were collected and analyzed.

Results: Among the 53 cases of LTS, majority (56%) were managed by Montgomery T-tube stenting (temporary and permanent), 20% underwent tracheal resection and anastomosis, and 6% cricotracheal resection and anastomosis. About 86% of the all the patients were managed successfully and decannulated, 6% failed and are on T-tube and 6% are on a tracheostomy tube, and 2% are awaiting decannulation. The others procedures, complications, and management are discussed.

Conclusion: Laryngotracheal resection and anastomosis should be the preferred procedure for managing LTS with a successful outcome of 90% in our case series. Surgical management has to be catered to the needs of the individual case and keeping in mind, the feasibility of the procedure.

Key words: Decannulation, Laryngotracheal stenosis, Resection anastomosis, T-tube, Tracheostomy

INTRODUCTION

Laryngotracheal stenosis (LTS) is a complex condition that results in a compromised airway, involving trachea and/or larynx. The etiology of LTS has changed over the years, the common cause now being iatrogenic; post-intubation and post-tracheostomy. The reported incidence of LTS following laryngotracheal intubation and tracheostomy ranges from 6% to 21% and 0.6% to 21%, respectively.[1,2] In the study by Herrak and Ahid, the incidence was as high as 55.17% post-intubation and 44.82% post-tracheostomy.[3] In another recent multicentric study, the incidence of post-intubation subglottic stenosis is reported to be as high as 11.38% in children.[4] Because the subglottis is the narrowest part of the laryngotracheal lumen in infants and children, it is more prone to injury.[4] This problem is compounded by the formation of a scab, granulation, or post-intubation edema, which leads to respiratory distress that requires emergent intervention. The other causes for LTS are tracheostomy, external trauma, an autoimmune process, and tumors.

In endotracheal intubation, LTS is caused either by the mechanical trauma of placement of an endotracheal tube or its contact pressure. Mucosal hyperemia and edema will result in mucosal necrosis secondary to compression of capillaries in the tracheal mucosa causing ischemia; which is observed within hours of intubation and can result in exposure of the perichondrium of the cricoid cartilage. The resulting perichondritis secondary to infection will lead to healing with scar formation. If it heals with fibrous tissue formation - this tissue contains fibrocytes that

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possess directional memory. Due to this memory, merely incising and separating scar tissue will only lead to tissue trying to replace itself in its previous and original scarred state. Myer *et al.*[5] devised a classification scheme from I to IV for grading circumferential subglottic stenosis. This grading system applies mainly to circumferential stenosis and does not apply to other types of subglottic stenosis Grade I: <50% luminal obstruction and Grade II: 50-70% luminal obstruction. Grade III: 71-99% luminal obstruction and Grade IV: Decannulation on the basis of the anatomic location of the stenosis. 90% Grades I and II, 70% of Grade III and 40% of Grade IV patients are successfully decannulated.

There is no "standard" recommended procedure that gives consistent results. Hence, various techniques and surgical procedures are described to manage LTS; this in itself bears evidence to the complexity of the problem. The goal of laryngotracheal surgery is to restore its function namely, airway patency, phonation, and glottic competence to prevent a cough and aspiration. The surgery can be performed by either endoscopic or external approach. The first described by Gerwat and Bryce in 1974 and later by Pearson and Andrews in 1975, resection and anastomosis was subsequently refined and popularized by Grillo *et al.*[2] Resection of the stenosis and end to end anastomosis as a single staged procedure is advocated by some as the initial procedure of choice though this procedure may not be possible in various scenarios.[6] It is performed for management of acquired inflammatory (mainly post-intubation and post-tracheotomy) tracheal or cricotracheal stenosis, idiopathic subglottic stenosis, and primary subglottic and/or tracheal tumors, as well as to cancers infiltrating the airway from adjacent sites. Endoscopic treatment includes laryngeal microsurgery, laser assisted excision, traditional dilation, and endoscopic stent insertion.[7] In order to maintain laryngotracheal patency, a Montgomery T-tube can be used following primary surgery or as a principle mode of treatment for patients in whom resection and anastomosis is not feasible.[2] The purpose of this study is to analyze the clinical presentation and outcomes, following surgical management of LTS in our center.

Objective of this Study

To analyze, the clinical presentation and outcomes, following surgical management of LTS and review of the current literature.

PATIENTS AND METHODS

A retrospective analysis and chart review of 53 patients, who were diagnosed as LTS and surgically managed by us over a period of 8 years from 2006 to 2014 were included in our study. Bearing in mind the possible etiology, any suspected case of LTS was evaluated initially by a rigid or flexible laryngeal endoscopy and the site of stenosis, degree of luminal narrowing, the length and type of stenosis and the involvement of glottis, supraglottis, or subglottis noted. In a tracheostomized patient, the stomal and supra or infrastomal were evaluated. Radiological data of computed tomography neck with a 3D reconstruction were obtained where necessary. Data relating to the type of intervention, complications, and outcome were documented and statistically analyzed. The quality of life outcome was assessed using a self-assessment questionnaire at the time of last follow-up.

RESULTS

The etiology of LTS in our case series was predominantly secondary to endotracheal intubation in 38 patients (71.69%), 11 patients (20.75%) were post-tracheostomy sequel, one patient had tracheal infiltration due to thyroid malignancy and had developed stenosis, was stented with Montgomery T-tube for palliative management and 2 patients (3.77%) developed stenosis following polytrauma (RTA). Of the 38 patients who underwent endotracheal intubation, 22 were elective and 16 were emergency intubations. Table 1a shows the site of the stenosis. The predominant site of stenosis in endotracheal intubated patients is the upper trachea (49.05%) and in post-tracheostomy stenosis is the suprastomal region (100%) (subglottis and upper trachea) (Tables 1b and c).

Of the 53 patients with LTS, 31 patients (58.5%) underwent T-tube stenting with Montgomery T-tube (temporary and permanent). Two of the temporarily stented patients had to be stented permanently secondary to the development of complications. One patient developed tracheomalacia

Table 1a: Site of stenosis in all patients

Site of stenosis	Supraglottis	Glottis	Subglottis and upper tracheal	Tracheal	Total
Total number of patients	0	4	23	26	53

Table 1b: Site of stenosis in endotracheal intubated patients

Site of stenosis	Supraglottis	Glottis	Subglottis and upper tracheal	Tracheal	Total
In intubated patients	0	4	8	26	38

and the second patient developed stenosis at either ends of the T-tube or both required reinsertion of the T-tube. Nine patients (16.9%) underwent tracheal resection and anastomosis, 3 (5.7%) underwent cricotracheal resection and anastomosis. Two patients had posterior glottic and subglottic stenosis and underwent excision of the scar tissue followed by Hoods laryngeal stenting. The other procedures performed were keel stenting, Bougie dilatation, Laser assisted scar excision, and anterior cricoid split with hyoid interposition as denoted in Table 2 and in Figure 1. One patient had posterior glottic stenosis and was treated with laserization of the cicatricial scar without stenting. Two patients had collapse of the anterior wall of the trachea in the suprastomal area and were managed with tracheoplasty.

Of the 30 patients who underwent T-tube stenting, the stent was successfully removed in 83% and are stable in 1-year follow-up period, 3% of them are awaiting decannulation and 14% failed decannulation secondary to tracheomalacia, development of stenosis at upper and lower end of tube after decannulation, one of them is on a permanent tracheostomy and one has granulation with Grade IV subglottic stenosis and refused further treatment (Figure 2).

Following resection and anastomosis, 90% had successful outcomes. One patient had wound dehiscence on post-operative days 5 and was put on Montgomery T-tube. The patients who underwent cricotracheal resection and anastomosis had a 100% successful outcome. Considering all the surgical procedures, 87% of the patients with LTS were managed successfully with a good outcome, 6% failed on tracheostomy, 6% failed on T-tube, and 2% awaiting decannulation. The overall success is more with resection and anastomosis procedures (Figure 3).

Table 1c: Site of stenosis in tracheostomized patients

Site of stenosis	Suprastomal (subglottis+ upper trachea)	Stomal	Infrastomal	Total
Post-tracheostomy	11	0	0	11

Table 2: Types of surgery

Procedure	Number of patients	Percentage
T-tube	31	58.5
Tracheal resection and anastomosis	9	16.9
Cricotracheal resection and anastomosis	3	5.7
Hoods laryngeal stent	2	3.7
Keel stent	2	3.7
Bougie dilatation	2	3.7
Tracheoplasty	2	3.7
LASER assisted	1	1.88
Anterior cricoid split with hyoid interposition	1	1.88

Quality of Life (QOL) Indicator

We used a subjective assessment of a 3-point scoring system devised to assess the airway, voice, and aspiration (cough). Figure 4 shows the QOL in post-surgery patients. The airway, voice, and laryngeal protective mechanisms were well preserved in above 85% of the patients with a satisfactory result.

DISCUSSION

Management of LTS is a challenge. LTS is one of the most frequent complications associated with prolonged naso/orotracheal intubation and tracheostomy, such as in intensive care units.[7] Post-intubation tracheal stenosis was identified in 1880, after study by MacEwen.[8] Among intubated and tracheostomized patients, the reported

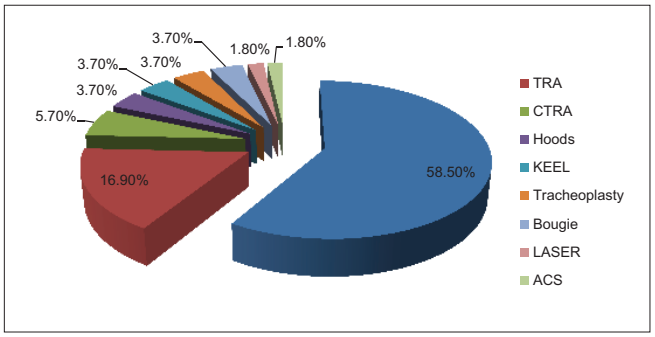

Figure 1: Types of surgery

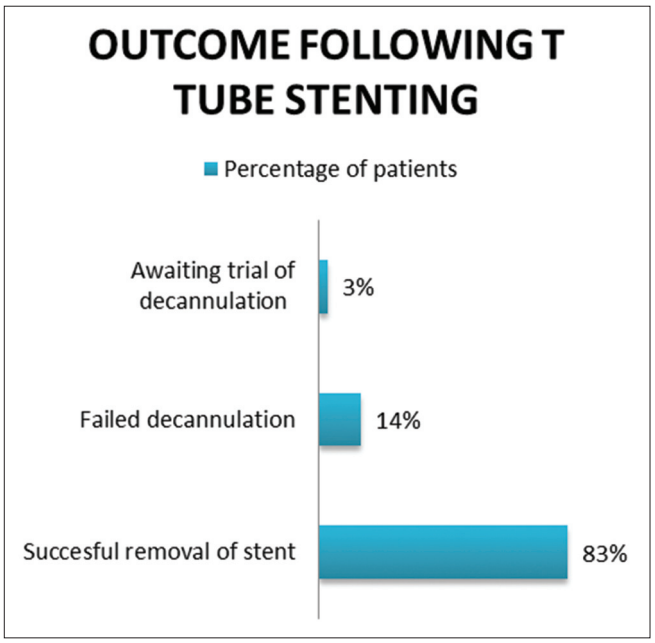

Figure 2: Outcomes following T- tube surgery

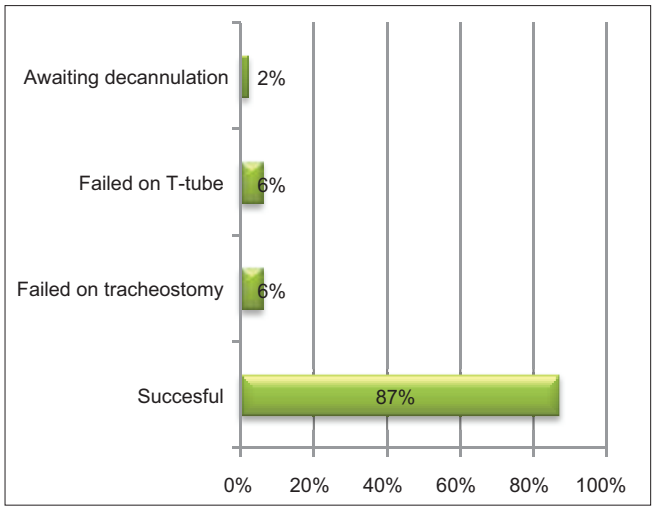

Figure 3: Outcomes following all surgery

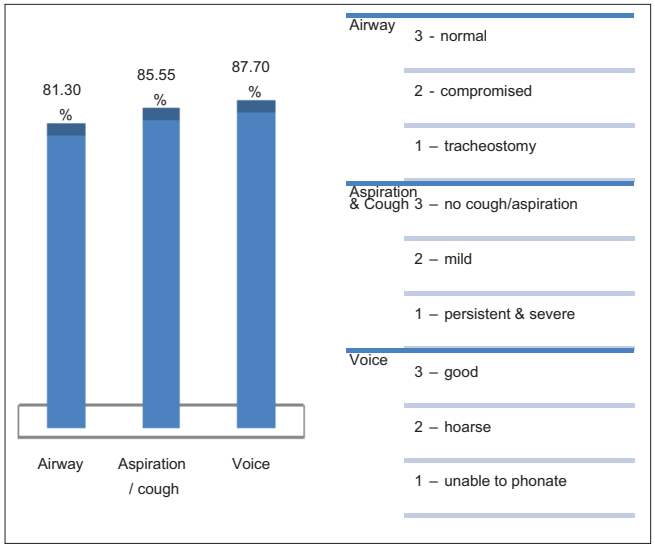

Figure 4: Quality of life outcome

incidence of stenosis varies from 10% to 22%,[8-10] but only 1-2% is symptomatic with severe stenosis.[11,12]

The site of the stenosis varies according to the etiology. Post-intubation stenosis tends to develop web-like fibrous stenosis at the cuff site while tracheostomy patients develop stenosis due to granulation tissue around the stoma site.[11] Furthermore, patients in the elective tracheostomy group would be intubated for longer periods, thus exposing them to more traumas at the tracheal stoma site, and risk of infection.[11] The cuffed endotracheal tube will cause mucosal erosion, pressure necrosis, and if *in situ* for a long time may cause perichondritis. Once withdrawn, the mucosa heals completely within a month and is replaced by metaplastic squamous epithelium and underlying fibrosis. In very severe ulceration involving prolonged intubation and superadded secondary bacterial infection, the risk of LTS is very high. With the advent of high-volume low-pressure cuff, tracheal stenosis at cuff site has reduced.

In this study, 38 patients developed LTS secondary to prolonged intubation in the subglottis, upper trachea and also in the glottis. 11 patients developed LTS secondary to tracheostomy and the stenosis involving the suprastomal region (subglottis and upper trachea) in 100% of the patients. Two patients had developed LTS secondary to injury to the neck, one of them sustained a blunt injury to the neck following attempted suicide by hanging and the other had polytrauma with a fracture of the cricoid cartilage. LTS following blunt injuries and automobile accidents are very meager in our series, due to the secondary to road safety measures.

The most common used classification in evaluating the severity of LTS is Myer–Cotton grading system. The patients with Myer–Cotton Grades I and II were managed conservatively did not undergo any surgical intervention and were therefore not included in our study.

Most authors mention two basic modalities for treatment of LTS - endoscopic and external approach.[13] The procedure of choice is tracheal resection and anastomosis for tracheal stenosis.[6] However, when the glottis and/or the subglottis is involved this surgical approach may not be applicable; moreover it may not be feasible due to the extent of stenosis, underlying disease and general health of the patient.[14] Most of the patients in our series were from the intensive care set up with a poor general health condition and multiple comorbidities where extensive/ major surgeries such as resection and anastomosis could not be performed. The second, some patients had already undergone multiple surgeries before they presented to us, and some patient had economic constrains. These patients were managed by either a temporary or permanent stenting with Montgomery T-tube.

The tracheal T-tube was introduced in 1965 by Montgomery,[15] which acts as stent maintaining airway patency and a tracheostomy tube, made of silicone. It does not harden at body temperature.[13] It is easy to introduce and maintain and cheaper compared to other stents.[16] The ideal duration of T-tube stenting according to Cooper *et al.*[17] is 6-12 months whereas Martinez-Ballarin *et al.*[18] has recommended usage up to 18 months. In our practice, we inspect the tube every 6 months and change it every 12 months. However, there are some complications with T-tube. We experienced surgical emphysema, severe crusting of the tube in another, where we replaced the tube and formation of granulation at either ends of the tube or sometimes resulting in restenosis. We had to reintroduced the T-tube for one patient in view of granulation at the ends of the tube. One of our patients

who had multiple comorbid conditions with T-tube *in situ* for 1-year developed tracheomalacia which was noted during tube change. We did not experience any mortality directly related to T-tube stenting. We were able to successfully decannulate 83% of our patients who were using T-tube. Two patients required flap reconstruction of the tracheal stoma. Nine patients (16.9%) underwent tracheal resection and anastomosis. On 5th post-operative day, one patient developed wound dehiscence. He was put on a temporary T-tube, and the wound explored and reconstructed. 90% of patients were managed successfully.

In our case series, we were able to successfully manage and decannulate 87% of the patients. Results obtained are similar to those published in the literature.[19] The patients with Myer-Cotton[5] Grade IV had difficult decannulation. Low grade stenosis and stenosis inferior to 50% of total tracheal extension seem to be decisive for a better prognosis.[13,20] The majority of the patients have a good quality of life following the surgical procedures assessed by the 3-point scoring system.

CONCLUSION

The outcome following procedures for LTS was successful in 87% of patients in our cases series. We have also shared our experience and complications encountered. Resection and anastomosis are the preferred procedure of choice. A cafeteria of choice is available for surgical options, but the surgical procedures need to be catered to the needs of an individual patient.

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