MANAGEMENT OF LARYNGOTRACHEAL STENOSIS BY USING MONTGOMERY SILICONE T-TUBE

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ABSTRACT

BACKGROUND AND AIMS

Airway stenosis is a congenital or acquired narrowing that obstructs the passage of air to the lungs. Upper airway stenosis has a significant impact on the quality of life and sometimes on life itself. The most common cause of acquired airway stenosis is endotracheal intubation resulting in 90% of cases Grenier PA et .al.[1] In prospective study at our centre (2012-2015,) we observe the clinical presentation of laryngotracheal stenosis at different levels and the efficacy of Montgomery silicone T-tube as treatment modality for laryngotracheal stenosis.

METHODS

In a prospective observational study, 32 patients with laryngotracheal stenosis were managed with silicone T-tube. Their clinical profiles were studied in detail and present treatment modality i.e. silicone t- tube stent with laser excision of stenotic segment, dilatation and Mitomycin-C application was done. Repeat management in the form of tracheal resection and anastomosis and silicone T-tube stent insertion were needed in patients who had breathlessness and stridor after removal of silicone t- tube stent. Outcome were measured in terms of improvement in symptoms clinically and by radiological evaluation.

RESULTS

In our study, males (66%) (21/32) were more in number and organophosphorus poisoning (69%) was found to be the common cause for prolonged intubation as compared to western world where trauma is most common cause. Silicone t- tube removal was done after one year in 29 patients (n=32). Out of 29 patients, silicone t- tube stent removal at one year with no repeat management in 15 (47%) patients. Repeat T-tube insertion in 11(35%) patients. Tracheal resection and anastomosis in 3 (9%) patients. 13 (41%) patients who underwent Mitomycin-C + laser excision + dilatation + silicone – t –tube insertion did not require repeat stenting.

CONCLUSION

Primary treatment with scar incision/excision with tracheal stenting by T-tube has proved to be useful at our centre with a minimum stenting period of one year. The success rate was found around 50% and there were no significant complications due to the stent itself. The procedure itself is easy and safe in the hands of an average otolaryngologist as compared to the major surgery of resection and anastomosis. Mitomycin-C is a useful adjunct to incision/excision of the scar during stenting procedure. In general, the stenosis in intrathoracic portion is difficult to tackle, occurs due to uncared for tracheostomy and has a worse outcome than cervical stenosis.

KEYWORDS

Laryngotracheal Stenosis, Silicone T-tube, Endotracheal Intubation.

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INTRODUCTION: Airway stenosis is a congenital or acquired narrowing that obstructs the passage of air to the lungs. Upper airway stenosis has a significant impact on the quality of life and sometimes on life itself. Symptoms include stridor, wheezing, hoarseness, shortness of breath, and respiratory distress.

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The most common cause of acquired airway stenosis is endotracheal intubation, resulting in 90% of cases Grenier PA et al.[1] Other causes include external trauma, thermal or caustic injuries, chronic inflammatory diseases, infection, and cancer.

Tracheal stenosis can occur following tracheostomy or translaryngeal intubation with inappropriate cuff pressure. It is due to pressure necrosis at the site of the cuff. Initially, there is inflammation of the damaged mucosa with increased secretion and secondary infection. Prolonged ischemia and secondary infection cause necrosis of the tracheal wall and exposure and sequestration of the cartilaginous rings. This damage results in the formation of granulation tissue and collapse of the tracheal wall.

Treatment options range from endoscopic techniques to open surgical procedures, depending on the nature and severity of the stenosis. Open surgical procedures involve either increasing the diameter of the stenosed segment with a graft or stent (expansion surgery) or removal of the stenotic area (resection surgery). Montgomery[2] in 1965, reported the use of the T-tube tracheal stent to repair tracheal injuries and post-tracheostomy tracheomalacia in an infant four and a half months old. In 1974, he reported the silicone T-tube in 94 cases of subglottic and tracheal stenosis.

We in our institute had used Montgomery silicone T-tube for 1 year with laser resection, dilatation and Mitomycin-C application. Silicone T-tube has less learning curve and less morbidity as compared to other surgical methods. This study helped me in investigating aetiology, incidence and outcome of silicone T-tube stenting in a group of 32 patients.

METHODS: In a prospective study of 32 patients which was carried out in between 2012-2015, subjects with symptoms of laryngotracheal stenosis were taken into consideration i.e. breathlessness and stridor. Their clinical profile is studied in detail and present treatment modality i.e. silicone T-tube stent with laser excision of stenotic segment, dilatation and Mitomycin-C application was done as primary mode of management. Silicone T-tube was placed for one year. Repeat management in the form of tracheal resection and anastomosis and silicone T-tube stent insertion needed in patients who had breathlessness and stridor even after removal of silicone T-tube stent. Outcome measured in terms of improvement of symptoms, follow-up endoscopic & radiological evaluation.

SELECTION OF CASES (Inclusion & Exclusion Criteria):

Inclusion Criteria: Patients with symptoms of breathlessness and stridor and laryngotracheal stenosis confirmed on CT scan**.**

Exclusion Criteria:

1. Patients having symptoms mimicking laryngotracheal stenosis but stenosis not found on CT scan or endoscopy
2. Patients with airway cancers
3. Congenital- Tracheomalacia, laryngomalacia, vocal cord palsy, laryngeal clefts, congenital cysts, external compression of the airway due to mass lesion or vascular anomalies.
4. Infections/inflammation - Croup, Retropharyngeal abscess, tracheitis.
5. Neoplasms- Subglottic haemangioma and recurrent respiratory papillomatosis.
6. External compression, foreign body.

Procedure of silicone T-tube stenting with dilation, Laser excision of stenotic segment & Mitomycin-C application: Under general anaesthesia, patient placed in Rose's position. A tracheotomy opening is a prerequisite for the insertion of the T-tube and can be either pre-existing or created immediately before the procedure. A rigid tracheoscope is introduced under general anaesthesia and its bevelled distal tip is placed in the subglottic space above the tracheotomy stoma. In many cases, endoscopic interventions such as dilatation and laser application may be required before the placement of the T-tube. Microlaryngoscopic arrangement is needed prior to dilation and laser excision. Dilatation is done through grade metal bougies. We use diode laser to excise the stenotic segment at 5 kW. Radial incision is made over stenotic segment and finally joined together. Mitomycin-C is applied last. Mitomycin-C (MMC), a potent antibiotic derived from the Streptomyces caespitosus bacteria can modify wound healing at the molecular level. It is known to be a prodrug that is activated into toxic forms that produce oxygen free radicals creating DNA strand breaks. Mitomycin-C also induces apoptosis in fibroblast cells. We had used Mitomycin at a concentration of 2 mg/mL applied topically for 2 minutes. The diameter of the T-tube is chosen based on radiographic data such as computed tomography (CT) of the airways and through direct bronchoscopic evaluation. The ideal diameter would lead to a snug fit of the T-tube inside the airways with minimal anterior-posterior displacement. Likewise, the ideal length of the T-tube is attained with careful bronchoscopic measurements of the distance between the vocal cords and the tracheotomy stoma, as well as the length of the tracheal lesion distal to the tracheotomy stoma. A haemostat is used to clamp and advance the distal portion of the vertical limb through the tracheotomy stoma toward the distal trachea. The grasped portion of the T-tube can be made smaller by folding it in half on itself before grasping, therefore allowing an easier insertion. Once the distal portion of the vertical limb is inside the trachea, one operator advances the proximal portion of the vertical limb into the proximal trachea and is pulled by hemostat through tracheoscope.

Figure 1 showing parts of silicon t-tube

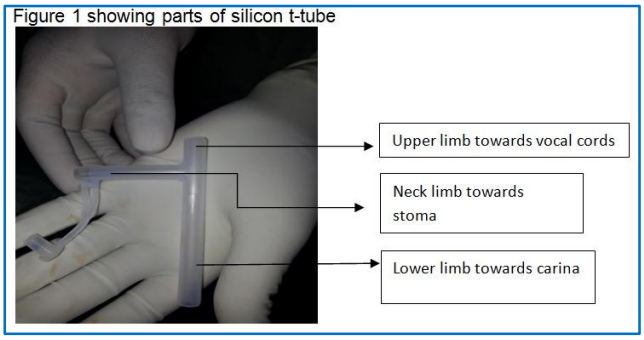


Figure 2: Showing Grade 3 Subglottic Stenosis

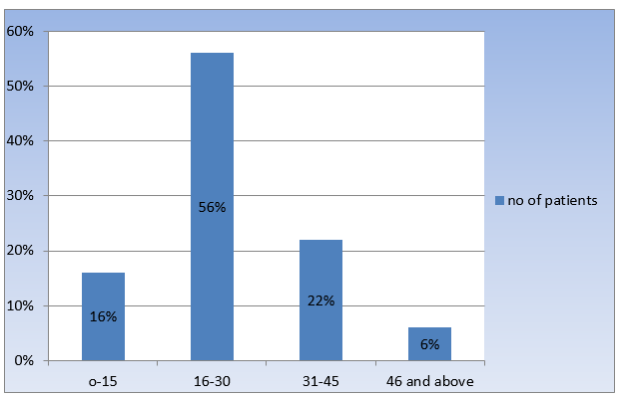
OBSERVATIONS AND RESULTS:

Age groups of patients (years)	Number of patients	Percentage
0-15	5	16
16-30	18	56
31-45	7	22
46 and above	2	6

Table 1: Showing Distribution of Patients in Various Age Groups

*Patients in the age group of 16-30 were most commonly affected in our study.

Graphical Representation:



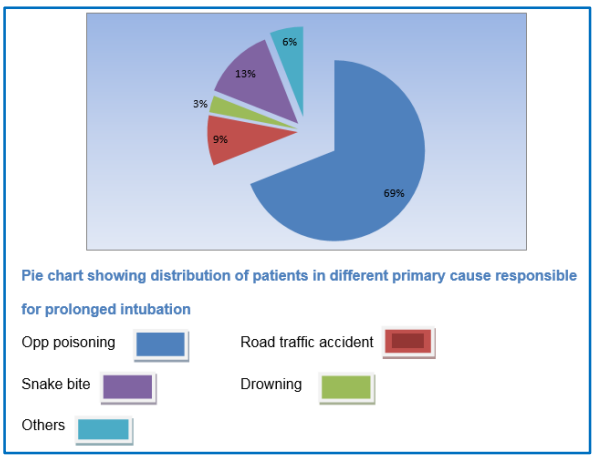
Graph 1: Showing Number of Patients in Different Age Groups

Prolonged intubation cause	No. of patients	Percentage
Organophosphorus poisoning	22	69
Snake bite	4	13
Road traffic accident	3	9
Drowning	1	3
Others	2	6

Table 2: Shows Different Causes for Prolonged Intubation

Organophosphorus poisoning is most common cause for prolonged intubation as most cases were suicidal.

Pie chart representation of data of table no. 2:

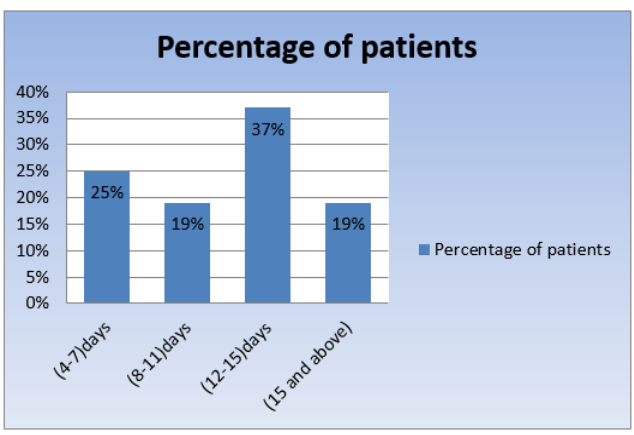


Days of intubation (ETT)	No. of patients	Percentage of patients
(4-7)days	8	25
(8-11)days	6	19
(12-15)days	12	37
(15 and above)	6	19

Table 3: Shows Number of Days of Prolonged Intubation

Minimum 4-7 days were sufficient for development of stenosis.

Graphical representation of data of table no 3:

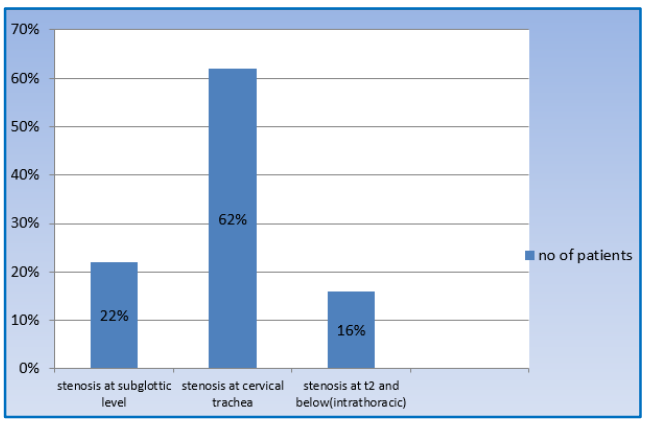


Level of stenosis	No. of patients	Percentage of patients
Subglottic trachea (C5-C6)	7	22
Cervical trachea (C7-T1)	20	62
T2 & below (Intrathoracic trachea)	5	16

Table 4: Shows Level of Stenosis

- Most common level of stenosis in our study was at cervical trachea level. (C7 - T1)
- Infrastomal tracheal stenosis (intrathoracic) present in 5 patients (16%).

Graphical representation of data of table no 4:



Sl. No.	Outcome of management	Detail explanation	No. of patients
1	Silicone T-tube stent removed at 1 year (29) patients	Silicone T-tube stent removed at 1 year with no repeat management	15(47%)
		Repeat silicone T-tube insertion	11(35%)
		Tracheal resection and anastomosis	3(9%)
2	Silicone T-tube stent not removed at 1 year but patient in followup		3(9%)

Table 5: Shows Overall Outcome of Management

- Silicone t- tube stent removal at 1 year in 29 patients.
- Silicone t- tube not removed in 3 patients but patients were in followup after 1 year.

Figure 3 silicon t- tube in situ

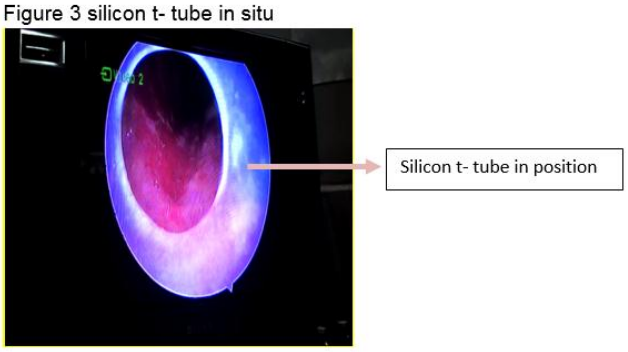


Figure 4 Showing patent trachea after removal of t-tube

DISCUSSION: In our study, 66% patients were male & 34% patients were female. Patients in the age group of (16-30 yrs.) were most commonly affected. Most of the cases were attempted suicide. Males were most commonly affected because farming is dominant occupation in males coming from villages of Maharashtra.

In our study, majority of patients had history of organophosphorus poisoning followed by snake bite. A study by M.C. Bhise et al[3] found that organophosphorus is most common source of poisoning in Indian farmers as compared to western world where accidental trauma is most common cause for tracheal stenosis.

The reason for stenosis in all the cases was prolonged intubation and post-tracheostomy lesion. Our study showed maximum no of patients were intubated for 2 weeks but minimum (4-7) days of intubation was enough to cause tracheal stenosis in 25% of patients. Lorenz et al[4] in his article clearly said that most common cause for tracheal stenosis had changed from external trauma and infection to iatrogenic trauma due to prolonged intubation. In other study done by Pookamala S et al,[5] intrinsic trauma secondary to prolonged intubation was the most common cause of laryngotracheal stenosis, seen in 23 (38%) cases followed by post-traumatic stenosis, strangulation-18 (30%), blunt injury-15 (25%), penetrating neck injury-4 (7%). These findings were in support of our observations. Our results showed similarity with above studies.

The pathological consideration for cuff related tracheal stenosis was better understood by studies of Miller et al[6] and Joel D Cooper et.al. Miller et al in their study of 7 patients observed the gross and microscopic changes due to prolonged intubation. They found that at 36 hrs. erosion of cartilage starts, 72 hrs. circumferential deep erosion and exposure of cartilage, at around 10th day necrosis starts.

Tracheal stenosis due to cuff of endotracheal tube results from:

1. Pressure necrosis caused by cuff.
2. Irritative quality of tube and cuffs.
3. Irritative substances produced by gas sterilisation.
4. Change in position of head of patient also changes position of cuff and subsequent injury.

Tracheostomy related stenosis is due to;

1. Granulation tissue formation.
2. Poor tracheostomy care.
3. Tip injury.
4. Overenthusiastic suctioning.

Tracheal stenosis is classified according to Cotton-Myer grading and McCaffrey's staging system. All 32 patients were categorised as grade 3 stenosis on Cotton-Myer grading system. Seven patients (22%) had stenotic segment in subglottis only (C5-C6). They were categorised as stage 1 of McCaffrey's. Rest of 78% patients included in stage 3 of McCaffrey's.

All patients coming to us had grade 3 stenosis. Patients were symptomatic. Most common symptom in all patients were breathlessness at rest (none of the patients had cardiovascular risk). Second most common symptom in 90% patients was stridor. Urgent CT scan & Emergency tracheostomy was done to relieve stridor. Prolonged intubation may cause tracheal stenosis, with progressive dyspnoea and wheeze easily misdiagnosed as asthma as found in study of Nicholas Spittle.[7]

There are various sites where stenosis can take place. In our study of 32 patients, 20 patients had tracheal stenosis at cervical trachea (C7-T1) which were highest. The postulated reason for most of the stenosis at C7-T1 i.e. cuff of endotracheal tube when inflated causes pressure necrosis and subsequent ischaemia of the region. While stenosis at subglottis i.e. above the cuff can be due to tracheal injury, repeated attempts of intubation, high placement of cuff when full length of endotracheal tube is not inserted.

Tracheal stenosis below T1 was found in 5 patients. These patients had poor prognosis and required repeat stenting. Previous tracheostomy, tip injury and suction injury are some of the known cause for infrastomal tracheal stenosis. Nair et al[8] in his study found that 85% patients developed stenosis post-intubation or post-tracheostomy. 65% patients developed true stenosis of which 35% had web like stenosis and 30% had complex stenosis due to post-tracheostomy granulation tissue, poor care and tip injury. In other study by MJ Andrews et al,[9] functionally significant tracheal stenosis occurred in 32 patients out of 153 patients. Almost 50% patients had stenosis around cuff level and remaining 50% had lesion around stoma and region around tip i.e. intrathoracic. Our findings are similar with the above studies in determining the cause for infrastomal tracheal stenosis.

In our prospective study of 32 patients, 15 patients were completely decannulated in a period of 12 months i.e. almost 50%. The results were at par with other studies in past. 11 patients required repeat silicone stenting, while 3 patients underwent tracheal resection and anastomosis. Repeat silicone T-tube required due to granulation tissue formation at that site.

In a similar study by Chang Jer Huang MD,[10] eleven patients with tracheal stenosis were managed with silicone T-tube. The silicone T-tube was removed in one year in all patients with satisfactory results. One patient was excluded from the study because of death. T-tubes successfully removed in all patients. Among them 2 patients had granuloma over subglottic area which was treated by CO2 laser 2-4 times.

Pereszlenyi, et al[11] in his study of 163 patients of tracheal stenosis. Silicone T-tube was inserted in 65 cases. 27 patients (41.5%) were successfully decannulated. 19 patients (29.2%) still continuing but they are candidates for extraction of tube in near future.

Our study had similar to better results with other studies and supports the use of silicone T-tube as primary modality of treatment in tracheal stenosis.

CONCLUSION: Laryngotracheal stenosis is a significant problem causing high morbidity in majority of the patients and mortality in a significant number. Prevention through appropriate care during intubation may reduce the incidence but till such time it happens we ought to search for better modalities of treatment for this malady.

Primary treatment with scar incision/excision with tracheal stenting by T-tube has proved to be useful at our centre with a minimum stenting period of one year. The success rate was around 50% and there were no significant complications due to the stent itself. The procedure itself is easy and safe in the hands of an average otolaryngologist as compared to the major surgery of resection and anastomosis. If even after one year of stenting the stenosis recurs, then resection anastomosis should be advised. Mitomycin-C is a useful adjunct to incision/excision of the scar during stenting procedure. In general, the stenosis in the intrathoracic portion of trachea is difficult to tackle, occurs more often due to uncared for tracheostomy and has a worse outcome than cervical portion of trachea. Bad complications like tracheopleural fistula, mediastinitis, etc happen with this portion of trachea.

The evaluation of various treatment modalities for laryngotracheal stenosis is a long drawn process and has to be done for prolonged periods and at various centres.

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