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Evaluation of management of tracheal stenosis: our experience of 25 patients

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ABSTRACT

Background: This study was conducted at a tertiary referral centre. Tracheal stenosis is a relatively rare complication, the chief etiologies being prolonged intubation and trauma. The management is difficult and requires variety of skill based procedures which can be either endoscopic or open technique. Our objective was to determine factors for deciding on the type of surgery required for patients with tracheal stenosis.
Methods: 25 consecutive patients of tracheal stenosis referred to our department were selected after confirming the diagnosis by fibre optic examination and CT scan.
Results: All the patients were managed using various techniques. Long segment and circumfrential stenosis underwent resection and anastamosis. Other cases were managed by either endoscopic techniques or tracheoplasty.
Conclusions: The main factors for deciding the type of intervention are the length of stenotic segment and presence circumferential stenosis.

Keywords: Tracheal stenosis, Tracheoplasty, Tracheal resection and anastamosis

INTRODUCTION

Surgical management of tracheal stenosis is a challenging problem. Various available modalities of treatment can be broadly classified into (a) Endoscopic Techniques-LASER /Tracheal stents, (b) Open surgical Techniques-Tracheoplasty/ Resection and anastamosis. The procedure used for treatment of tracheal stenosis depends upon various factors like the site (cervical/thoracic), the extent of lumen involved, the length of trachea involved, aetiology of tracheal stenosis, surgical expertise or preference of the treating surgeon and the general condition of the patient. Since there are so many variables involved there is no consensus on the treatment of tracheal stenosis.

Grillo & Pearson obtained 90% satisfactory results in cases of tracheal stenosis treated with Resection & Anastamosis while Harel et al reported a series of 19 cases of tracheal stenosis treated between 1985 & 1992 with a success rate of 89.5% by tracheal resection & anastamosis. Mortality varied from 10% to 20% and morbidity from 20% to 50% according to these authors.[1,2]

Augmentation techniques (Tracheoplasty) are designed to expand the lumen and provide structural support and epithelial lining. McCaffrey reported that 16 of 21 (76%) patients were managed using costal cartilage graft interposition.[3] Burstein et al used composite hyoid sternohyoid interposition graft with 60% success.[4] Meyer et al described multistage technique, a three stage procedure that supplied a costochondral graft for rigid support and buccal mucosa for lining.[5] Permanent

stenting both covered and uncovered stents are also being used in select group of patients with short life expectancy.

Various workers devised various methods but none have laid down any criteria, based on which patients can be preoperatively selected for tracheoplasty or for Resection & Anastamosis. Moreover, there is no classification for tracheal stenosis taking the walls of trachea that are involved. Cotton's classification considers the available chink in relation to the normal trachea and do not consider the walls of trachea that are involved in the fibrosis. Hence, the present study was aimed to analyze the pre op findings and post op results to arrive at the selection criteria for Tracheoplasty as well as Resection & Anastamosis preoperatively.

METHODS

This study was conducted at the tertiary care hospital. All cases of symptomatic tracheal stenosis proven by FOB & CT scan were accrued into the study. Patients not willing for the definitive treatment and those not fit for definitive treatment were excluded from the study.

Evaluation included detailed history, general examination, Systemic examination and ENT examination followed by Fibreoptic endoscopic evaluation & CT scan to identify the etiology and to assess the severity of stenosis and co morbid conditions.

Tracheal stenosis was classified according to length of the stenotic segment. Upto 2 cms, the stenosis was classified as Short segment stenosis, 2 to 5 cms stenosis was considered as long segment stenosis and more than 5 cms was taken as extra-long segment stenosis. Tracheal stenosis was further classified into single wall stenosis, two wall stenosis or concentric stenosis (when more than 2 walls of trachea were involved).

Surgical procedures

Resection & anastamosis

Two Endotracheal tubes were passed, one through the stoma and other transnasally with the lower end kept just above the stenosed trachea. Patient is positioned with extended neck. Low collar incision was given including the stoma. Subplatysmal flap was raised exposing superiorly hyoid & inferiorly sternum. Midline dissection of neck was done to expose the trachea and cricoid. Stenosed trachea was dissected free all around including 5mm of normal trachea above and below the stenotic segment. Dissection was done hugging closely to the lateral wall of trachea to prevent damage to the recurrent laryngeal nerve. Stenotic segment of trachea was excised avoiding injury to the oesophagus posteriorly. The distance between upper and lower segments of trachea measured.

Laryngeal drop was given at this stage if the defect is more than 2 cms by releasing both supra & infra hyoid muscles from the hyoid. Lower segment trachea was also mobilized to gain 2 cms by dissecting anterior and posterior walls of trachea preserving lateral vascular bundle as per the need. Stay sutures were given. Using 3'0' prolene starting posteriorly and proceeding laterally and finally anteriorly, the sutures are passed through the trachea extramucosally with the knots being extra luminal.

The lower endotracheal tube was withdrawn before anastamosing the anterior wall and upper tube was passed down in the trachea for ventilation taking care that the cuff is not at the suture line. Generally 12 to 16 sutures are needed for the anastamosis. Anastamotic suture line is checked by pouring saline over it and looking for any leak in form of air bubbles after deflating the endotracheal tube cuff. Wound is closed in layers after placing the subplatysmal drain. Mentosternal suture is applied and neck is kept in flexion for 2 weeks.

"T" tube placement

In cases of immature tracheal stenosis, Montgomary T tube was placed through the tracheostoma after excising granulations using CO_2 LASER or KTP LASER. The CO_2 Laser was used when the granulations were close to the stoma and in the other patients KTP LASER was used.

Tracheoplasty

In cases of mature tracheal stenosis, Trachea was exposed and opened vertically in midline. The fibrous tissues were excised submucosally using CO_2 LASER and trachea was closed over a Montgomary "T" tube. Neck was closed in layers.

Shian Lee tracheoplasty

Tracheoplasty was done as described above except that the mucosa with submucosa was sutured to platysma and neck was closed over the Montgomary 'T' tube.

Permanent stenting

ULTRAFLEX self-expanding stents both uncovered & covered were used. The fibre optic bronchoscope was passed and the stenotic area was identified. Then the guide wire was passed through the scope beyond the stenosis and the scope was withdrawn leaving the guide wire in situ. The stent was passed over the guide wire and was deployed taking care that the stent was placed extending for 1 cm both above and below the stenosed trachea. Check bronchoscopy was done thereafter to confirm the position of the stent. Daily evaluation was done for a week.

Follow up

Follow up was done one monthly for 03 months, 02 monthly for next 06 months and finally at the end of 01 year. All the data, findings and the results were entered into a structured performa.

Success rates

The following criteria were used for evaluating success rates of each procedure. Successful extubation at six months after completion of management. Failure of particular procedure, time of total management, number of sittings needed by patient to undergo management

RESULTS

Total number of cases accrued into the study were twenty five. Age wise distribution revealed 40% of cases belonging to 2nd & 3rd decades. It also revealed that 72% of patients belonged to 3rd decade and above (Table 1).

Table 1: Age wise distribution.

Age (yrs)	No of cases (n=25)
0-10	3 (12%)
1-20	4 (16%)
21-30	5 (20%)
31-40	5 (20%)
41-50	3 (12%)
>50	5 (20%)

Sex wise distribution showed male predominance. Males were seventeen (68%) and females were eight (32%). Etiological factors were analysed (Table 2) and it was found that maximum number of cases (48%) were due to prolonged endotracheal intubation and 24% each were due to accidental trauma and tracheostomy. Only one case was due to foreign body trachea.

Table 2: Etiological factors.

Etiological factors	No. of cases (n=25)
Prolonged endotracheal intubation	12 (48%)
Accidental trauma	6 (24%)
Post tracheostomy	6 (24%)
Foreign body trachea	1 (4%)

All 25 patients had stridor at presentation. Seven patients presented with stridor to us, out of them five had respiratory distress and two patients had mild stridor. Rest of the 18 patients presented with tracheostomy done elsewhere for stridor.

8 cases had immature stenosis (mucosal disease) in the form of granulations, erythema and oedema and the rest of the patients had mature stenosis.

Type of stenosis

Type of stenosis were classified depending upon the location, length and also whether concentric or eccentric (anterior wall/posterior wall/lateral wall/combination).

Classification according to location is shown in Table 3 and according to circumference involved in Table 4.

Table 3: Site of stenosis.

Site of the stenosis	Cases (n=25)
Cervical tracheal stenosis	20 (80%)
Thoracic tracheal stenosis	5 (20%)

Table 4: Classification according to the circumference involved.

Type of stenosis	No of cases (n=25)
Single wall	8 (32%)
Two walls	11(44%)
Concentric (more than 2 walls)	6 (24%)

Procedures

Following procedures as listed in the table 5 were carried out. Some of the patients underwent multiple procedures.

Table 5: Types of procedures performed.

Procedure	No of cases (n=25)
Tracheotomy	5 (20%)
CO_2 LASER Excision and T-tube placement without neck exploration	6 (24%)
Endoscopic KTP Laser excision and T tube placement	2 (8%)
Tracheoplasty	11 (44%)
Shain lee trachoplasty	6 (24%)
Resection & anastamosis	4 (16%)
Permanent nitinol exapandable stent placement	3 (12%)
CO_2 laser excision & Lary tube stenting	1 (4%)

The number of patients who presented late with respiratory distress were 5 for whom emergency tracheostomy had to be performed. In 2 cases of thoracic tracheal stenosis KTP laser was used endoscopicaly and T-tube was placed as a temporary stent. Tracheal resection & anastamosis was carried out in 4 cases of cervical tracheal stenosis of concentric type.

Permanent expandable nitinol stents were placed in 3 cases viz a patient with extra-long segment tracheal stenosis of 7 cms, tracheal stenosis associated with intra thoracic to fistula (6cms diseased segment) & post laryngectomy tracheal stenosis extending upto 1 cm short of carina.

In patients who underwent tracheal resection & anastamosis out of 4 cases one patient developed stenosis at anastamotic site 4 weeks post op, and in rest of the 3 cases only one sitting was needed. Average time spent in hospital was 4 weeks.

Patients undergoing CO_2 Laser excision required multiple sittings, average sitting per patient were three. 12 cases were managed by placement of T tube out of which 10 have been successfully decanulated and 2 cases are still on regular follow up as they could not be decanulated by 6 months. Time for T tube placement varied between 3months to 18 months average being 6 months.

Endoscopicaly placed self-expanding nitinol stent was placed in 3 patients who are on regular follow up

Complications

Complications occurred in 5 patients as shown in Figure 1.

- One patient developed stridor two weeks after resection & anastamosis, and was detected to have restenosis at the suture line. The patient was managed with tracheostomy and placement of T tube.
- Second patient on T tube was accidentally decanulated but T tube was replaced without any complications.
- Third patient developed aspiration following placement of T tube. The tube was removed; upper limb was shortened and replaced.
- Fourth complication was exertion stridor in a patient in whom an uncovered Nitinol stent was placed one year ago. He developed granulations through the entire length of the stent and has undergone excision of granulations with KTP LASER twice once in five months.
- Fifth complication was in a patient of total laryngectomy with supra carinal stenosis in whom uncovered Nitinol stent was placed, developed recurrent significant crusting. She needs crust removal once in 4-6 weeks.

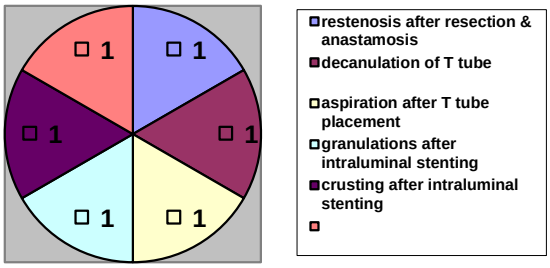

Figure 1: Types of complications.

DISCUSSION

There is no consensus on the optimal management of tracheal stenosis. We will be discussing the management of 25 patients of tracheal stenosis that were accrued into our study.

Majority of our patients were between 2nd & 4th decade (56%). As compared to study of 60 patients by Javier Gavilan where mean age of patients was 29 years, mean age in our study was 32 years, which was quite similar.[6] This age group is most active age group confronting more exposure to trauma & various diseases. Also loss of precious man hours attributable to tracheal stenosis in this age group makes early treatment even more important.

In our study 17 patients were males (68%) while 8 patients were females (32%). This sex ratio is also comparable to study of laryngotracheal stenosis by Wolf Micheal & Shapira et al where 65% males and 35% females were present.[7] The reason behind male preponderance is that males are more prone to accidental trauma than females.

Etiological factor in most of the cases (48%) was due to prolonged intubation in our study comparable to study by Gravilian et al (41.7%) & HC Grillo (66.6% including post tracheostomy tracheal stenosis).[8] In paediatric age group incidence of post intubation tracheal stenosis is higher (66.6%) than adults which is comparable to study of laryngeotracheal stenosis in pediatric age group by Rami T Younis et al where incidence is 80%, this shows that pediatric age group is more vulnerable to post intubation tracheal stenosis.[24]

Post traumatic tracheal stenosis was present in 24% of our cases which is higher than Gavilian et al (15%) & HC Grillo (10%). Post tracheostomy tracheal stenosis was present in 24% of our cases as compared to 35% cases by Gavilian et al. This is probably because of strict protocols for tracheostomy care being followed in armed forces as well as patient education and active participation by patients and their relatives in care of tracheostomy being followed in our institutions. In addition, usage of good quality tracheostomy tubes is also a factor in reducing the incidence of post tracheostomy tracheal stenosis.

There were 2 cases of carcinoma larynx who underwent total laryngectomy and had thoracic tracheal stenosis which were attributable to prior tracheostomy. Out of these, one patient had stenosis extending one cm short of carina where CO_2 laser excision was not feasible and hence self-expandable nitinol stent was placed in situ. The second patient had stenosis 2.5 cms below the stoma and managed with CO_2 laser excision followed by placement of lary tube which worked as silicone tracheal stent. KTP LASER was not available at that time.

In our study there were 20 cases (80%) of cervical tracheal stenosis while 5 cases (20%) were of thoracic

tracheal stenosis. The length of stenosis varied between 5mm to 70 mm as compared to study of 28 patients of tracheal stenosis by Mohammed Mandour et al where length of stenosis varied between 5 mm to 50 mm.[10] Majority of cases (80%) had less than 40 mm stenotic length, mean length of stenosis being 22mm comparable to 22.3 mm in study by Mohammed Mandour et al. In 11 cases (44%) there was combined stenosis of anterior & lateral walls while in 6 cases (24%) there was concentric stenosis. Rest (32%) showed single wall stenosis.

Plan of treatment also depended upon the state of mucosa at the time of presentation. Mucosal disease in form of granulation & erythema was present in 8 cases (32%) whereas 17 cases (68%) presented with mature stenosis. In cases of mucosal diseases in whom tracheostomy was already done only T tube was placed after removing unhealthy granulations through tracheostomy with CO_2 LASER using telescopes and microforceps without exploration of neck. In cases of mature stenosis some form of excising the fibrous tissue was applied.

Overall 37 procedures were carried out in 25 patients- 1.48 procedure per patient as compared to study of Gavilian et al who performed 117 procedures in 60 patients (1.95 procedures per patients). Tracheostomy as an emergency procedure was carried out in 5 cases (20%). Rest of the patients had tracheostomy performed elsewhere. 23 patients (92%) had tracheostomy before definitive procedure was carried out.

T tube placement without neck exploration was done in 6 cases (24%) in our study. These cases had few granulations involving one or two walls of trachea which were vapourised using CO_2 laser and T tube placed in situ thereafter. There is delay in scar formation in wounds treated with CO_2 laser. Maniglia reported largest patient series using T tube as primary treatment for lower airway obstruction.[11] He treated 53 patients with good results in 85% of cases. We were able to decanulate all the patients after 6 months. Shapsay et al, Simpson et al, Ossof et al have also used CO_2 laser excision of granulation and T tube placement with excellent results.[12,13,28]

Open neck exploration with CO_2 laser excision of stenosis and T tube placement was carried out in 11 cases (44%). Out of these 7 patients were decanulated after 6 months. Two cases with thoracic tracheal stenosis could not be decanulated after 6 months and are still on T tube. Other two patients had recurrent concentric stenosis of cervical trachea and underwent resection & anastamosis successfully. Our success rate was 63.6% as compared to Dedo & Sooy with success rate of 90%.[14] One of the cause for low success rate in our study is the criteria to decanulate the patient after 6 months whereas authors such as Gavilian et al suggest T tube placement for 18 months to 24 months. The other cause for low success rate was that in our series, even patients with concentric stenosis were taken up for tracheoplasty. There were 2 complications, one patient while changing clothes got accidentally decanulated, and the T tube was repositioned later without difficulty. In other case patient developed aspiration following T tube placement and was managed by reducing the length of upper limb.

Shain Lee technique of anterior tracheoplasty was done in 6 patients. These patients were decanulated after 6 months following which 2 cases (33.3%) developed restenosis. On analyzing pre op findings, we found out that failures had concentric stenosis and the successful cases had only anterior wall collapse. Probably the reason is that Shain Lee technique addresses the correction of anterior wall stenosis alone as platysma pulls the anterior wall only. These two failures were later taken up for tracheal resection and anastamosis.

Endoscopic KTP laser excision with T tube placement was done in 3 cases (12%) of tracheal stenosis. KTP laser is available in our institution in the later part of our study hence it was not used earlier. All the cases were decanulated after 6 months. Endoscopic laser treatment was done by Ossof et al with success rate of 67.14%, low success rate can be because he has not used any form of stenting post laser treatment.

Resection & anastamosis was carried out in 4 (16%) patients of cervical tracheal stenosis of concentric type. All cases were failures of other forms of tracheoplasties. Length of stenosis varied from 3-5 cms. Successful cases on follow up for six months were 3 (75%). One of the patients developed stridor 3 weeks post op due to formation of granulations at the anastamotic site for whom emergency tracheostomy had to be performed. None of the cases developed recurrent laryngeal nerve paralysis dissection was carried out close to the tracheal wall. Grillo et al & Pearson et al had success rate of 90%, Har El et al 9.5%, Biller & Munier- 90% & Peskind et al- 86% in cases of tracheal resection & anastamosis.[15,16] Granulations at anastamotic site remained most common complication of tracheal resection & anastamosis. One case (25%) in our study developed this complication as compared to 13% in study by Wolf Micheal & Shapira et al. In our series we had only 4 cases of tracheal resection & anastamosis hence our results cannot be compared with the studies mentioned above as they had far more number of cases.

Endoscopicaly placed expandable nitinol stenting was carried out in 3 patients (12%). Out of these 2 cases (66.6%) developed crusting and granulations and have to be reviewed after every 4 weeks for follow up & removal of crusts. Study of 16 patients by Badr Eldin Mostafa showed 5 patients (31.9%) developed crusting & granulations.[17] Overall results of endoscopically placed nitinol stenting have not been satisfactory in our series.

In our series mucosal disease responded with simple measures of removing granulations and temporary stenting for 3-6 months. Stenosis involving the anterior wall responded well with Shain Lee technique. However

patients in whom 2 walls were involved especially anterior & lateral wall responded well to tracheoplasty in form of exploration of neck, excision with laser and temporary stenting with Montgomery T tube. Patient with concentric stenosis failed with tracheoplasty in spite of using CO_2 laser and resection & anastamosis gave good results in these cases. Long segment thoracic tracheal stenosis responded well with endoscopic laser excision followed by temporary stenting thus avoiding mediastinal dissection and pulmonary hilum release. Permanent stenting, due to complications is not favored and it is probably better to stent these patients for a year or more with temporary Montgomery T tube. Last word is not yet written in the management of tracheal stenosis. Tissue friendly, non-reactive stents which can be easily placed and removed when developed will change tracheal stenosis management stratagem.

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Twenty five patients of tracheal stenosis were managed by tracheoplasty, tracheal resection & anastamosis and permanent stenting with self-expandable nitinol stents. Analysis of results gave following conclusions:

- Tracheal stenosis presenting with mucosal disease alone, responds well to excision of granulations & diseased mucosa followed by temporary stenting for 3-6 months.
- Mature anterior wall stenosis can be treated with either Shain Lee tracheoplasty or by exploration of neck and laser excision of stenosis followed by stenting with T tube for 3-6 months.
- In cases where two walls of trachea are involved by stenosis Shain Lee tracheoplasty alone leads to failure in some cases. Hence exploration of neck. Excision of tracheal stenosis with laser followed by stenting with T tube prevents recurrence.
- Concentric tracheal stenosis upto 5 cms can be safely treated with resection & anastamosis as a single stage treatment.
- Thoracic tracheal stenosis can be managed by endoscopic laser excision and T tube placement for prolonged period of more than one year.
- Permanent stenting by self-expanding nitinol stents has high incidence of granulation & crusting necessating repeated endoscopic management and are best avoided.

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REFERENCES

1. Grillo HC, Zannini P, Michelassi F. Complications of tracheal reconstruction, incidence, treatment and prevention. Thoracic Cardio Vascular Surg. 1986;91:322-8.
2. Har-El G, Shaha A, Chaudry R, Lucente FE. Resection of tracheal stenosis with end to end anastomosis. Ann Oto Rhino Laryngol. 1993;102:670.
3. Mc Caffrey TV. Management of subglottic stenosis stenosis in adults. Annal Oto Rhino Laryngol. 1991;100;90.
4. Burnstein FD, Canalis RC, Ward PH. Composite hyoid-sternohyoid interposition graft revisited – laryngoscope.1896;96:516.
5. Meyer R. New concepts in laryngotracheal reconstruction. Trans Am Acad Opthalmol otolaryngol. 1972;76:758-65.
6. Laccorrreye O, Bransu D, Seckin S, Hans S. Cricotracheal anastomosis for assisted ventilation induced stenosis. Arch otolaryngol Head & Neck surgery. 1997;113:1074-77.
7. Dedo HH, Fishman NH. Laryngeal release and sleeve resection for tracheal stenosis. Annals of otology, Rhinol Laryngol. 1970;78:295.
8. Naficy S, Esclamando RM, Clevena RA. Reconstruction of rabbit trachea with vascularised auricular perichondrium. Ann Oto Rhino Laryngol. 1996;105:356-62.
9. Casiano RA, Patete M, Lindquist T. Tracheoplasty using titanium reconstructive plates with strap muscle flap. Otolaryngol Head & Neck Surg. 1994;111:205-10.
10. Grillo HC. Primary reconstruction of airway after resection of subglottic laryngeal and upper tracheal stenosis. Ann Thorac Surg. 1982;33:3-18.
11. Younis RT, Lazar RH. Laryngotracheal reconstruction without stenting. Otolaryngol Head Neck Surg. 1997;116(3):358-62.
12. Pearson FG, Filomino B, Cooper JD. Experience with partial cricoid resection and thyrotracheal anastamosis. Ann Otol rhinol laryngol. 1986;95:582.
13. Mandour M, Remacle M. Chronic subglottis and tracheal stenosis: endoscopic management vs surgical reconstruction. Eur Arch otorhinolaryngology. 2003;260:374-80.
14. Maniglia AJ. Conservative surgical management of tracheal stenosis. Otolaryngol. 1978;86:380.
15. Shapsay SM, Beamis JF, Dumon JF: total cervical tracheal stenosis: treatment by laser, dilatation & stenting. Ann oto Rhino Laryngol. 1989;98:890.
16. Simpson GT, Strong MS, Healy GB. Predictive factors of success or failure in the endoscopic management of laryngeal and tracheal stenosis. Ann Oto Rhino Laryngol. 1982;91:384.
17. Ossof RH, Tucker GF, Duncavage JA. Efficacy of bronchoscopic CO_2 laser surgery for benign strictures of trachea. Laryngoscope. 1985;95:1220.

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