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ORIGINAL ARTICLE

Experience of Resection and Anastomosis for Tracheal Stenosis in a Tertiary Care Public Sector Hospital

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ABSTRACT

Objective: To document etiological spectrum of tracheal stenosis and results of resection and primary anastomosis

Methodology: This prospective study was conducted in the Department of Thoracic surgery, Jinnah Postgraduate Medical center, Karachi from July 2019 to July 2021. All patients presenting with tracheal stenosis, fit for surgical resection were included.

Results: Study comprised of 36 patients with 24(66.7%) males and 12(33.3) females. Mean age was 22.67±5.8 (7-35) years. Symptom duration was 22.77±14.5 weeks (range 6-60). Twenty-eight (77.8%) were benign and 8(22.2%) were malignant. Benign strictures were seen more among males (22/24; 91.7%; p=0.005) and malignant in females (6/12; 50%; p=0.005). Stridor and dyspnea was the commonest presentation. Hemoptysis was seen in four patients with squamous cell carcinoma (p=<0.001).Tracheal stenosis occurred at C7–T1 in 12 (33.3%), at C6-C7 and C6-T1 in 8 (22.2%) each. Non-intubated anesthesia used in 16 (44.4%) patients; Cervical and cervico-sternal approach used in 28(77.8%) and 8(22.2%) cases, respectively. Post-operatively, luminal diameter increase was 8.89±2.3 mm. Tumor-free margins were obtained in all squamous cell carcinoma (p=<0.001) cases. On table extubation was successful in 34(94.4%). Commonest complications were restenosis 6 (16.6%) and anastomotic leaks with emphysema in 4(11.1%). Post-operative duration of stay was 13.3±9.37 days. One (2.8%) patient died due to respiratory failure. Another required permanent tracheostomy. Mechanical ventilation was required in 4 (11.1%) due to respiratory compromise (p=<0.001) and tracheomalacia.

Conclusion: A multidisciplinary approach in the management of tracheal stenosis produces the best outcome in operable cases with low morbidity and mortality.

Keywords: Tracheal stenosis, stridor, dyspnea, restenosis

INTRODUCTION

Tracheal stenosis (TS) is a challenging etiology faced by a thoracic surgeon as trachea is the only structure connecting the larynx with the distal airway[1,2].TS can develop secondary to both benign and malignant etiologies[1,3-6]. Benign causes include post intubation stenosis (PIS), blunt trauma, infection, inflammation and idiopathic laryngotracheal stenosis (ILTS) [1,3,4,7,8]. PIS remains the most common cause attributable to the disruption of mucosal blood supply secondary to cuff or tube pressure leading to circumferential fibrosis[4,8]. TS can occur anywhere from glottis to the tip of endotracheal tube (ETT). However, ETT cuff area and site of tracheostomy remain most commonly encountered locations[7].

Primary tracheal tumors are rare with a reported incidence of 0.2/100000[5, 6]. Squamous cell carcinoma (SCC) and adenoid cystic carcinoma (ACC) constitute two thirds of primary tracheal tumors[5], although metastatic tumors are more common than primary[6].

Dyspnea, cough and stridor following weeks after blunt trauma, intubation or tracheostomy removal remain the presenting complaint[4,9]. However, cases of tracheal tumors are often misdiagnosed and treated on the lines of chronic respiratory pathologies for prolonged periods of time till definitive diagnosis is made[5]. Symptoms are pronounced during exertion when luminal diameter reaches half of the true diameter and at rest when diameter is reduced to quarter of the true tracheal diameter[7,8]. Computed tomography with or without three dimensional reconstructions is a valuable investigation that defines the pathology and aids in planning for resection[1].

Various non-operative managements have been introduced over the years for TS such as dilation, cryotherapy, stenting and laser therapy[1,4,8]. Tracheal resection with primary anastomosis (TRPA) remains the gold standard with upto 90% success enabling early decannulation[1,4]. Malignant TS often requires post resectional adjuvant therapy[5].

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This interventional study aims to objectively describe results of TRPA due to a varied etiological spectrum resulting in tracheal stenosis. There is a scarcity of local literature on TS and role of primary resection and anastomosis. Therefore, this paper focuses to add to both local and international literature.

METHODOLOGY

This prospective study was conducted in the Department of Thoracic surgery, Jinnah Postgraduate Medical Center, Karachi from July 2019 till July 2021 after approval of Institute Review Board (IRB).

Inclusion criteria: All patients presenting with clinical and radiological evidence of tracheal stenosis were include in this study. Grades 1 to 3 (McCaffrey classification) tracheal stenosis were included in the study[10].

Exclusion criteria: Patients medically unfit for surgery secondary to neurological deficit, on ventilator or anticipated ventilatory support. Long length TS and metastatic tracheal tumors were excluded.

Procedure: Pre-operative multi-disciplinary consultation including diagnosis confirmation, anesthesia planning, risk stratification, counselling and written consent were obtained. All procedures were performed by the same surgeon. Rigid bronchoscopy performed before and after procedure.

Anesthesia: Initiation of induction and maintenance of airway via tracheostomy tube or small cuffed/uncuffed oro-tracheal ETT followed by cross field ventilation with Armor tube. Nasogastric tube was placed in all cases. In selective cases nonintubated anesthesia was employed.

Surgical technique: Modified surgical techniques described by Grillo[11,12] was used for resection and anastomosis. Patients were in supine position with hyperextended neck and shoulder roll applied. Cervical collar incision made 2-4 cm above the suprasternal notch. When tracheostomy was present incision was along the tracheostomy tube transversely. Subplatysmal flap elevated superiorly up to thyroid cartilage and inferiorly up to sternal notch. Strap muscles separated in midline, trachea mobilized proximally,

with dissection at all times close to trachea while palpating esophagus via NG placed. Stenosis was confirmed by palpatory method or via needle aspiration. Trachea was incised distal to pathology and two stay sutures placed. Armor ETT was inserted into the distal lumen allowing cross field ventilation. Stenosis or malignant part was resected and relation to vocal cords noted. Distal trachea mobilized up to 1-2 cm from planned anastomotic margins, shoulder roll removed and neck flexed to check for need of any release procedure. Posterior wall of trachea repaired with 3/0 vicryl interrupted sutures. Neck was flexed on completion of posterior wall repair; an oro-tracheal ETT was advanced beyond the tracheal anastomosis and armor tube removed. Anterior trachea was repaired in a similar manner.

Any air leak from anastomotic line was ruled out with a positive pressure of 30cm H_2O. Hemostasis secured, wound closed in layers, and Guardian suture applied with neck at 45 degree flexion. Most patients were extubated on table and shifted to surgical intensive care unit (SICU) for overnight monitoring.

Post-operative: Vocal cord function was assessed in patients when extubated in OR or SICU. On the first post-operative day patients were shifted to ward. On Seventh post-operative day guardian sutures were removed. Majority were discharged after first week of surgery and bronchoscopy was performed after 14 days. Patients were followed up bimonthly for first year.

Analysis of data: Relevant data of the patients such as age, gender, level of stenosis, procedure and relative outcomes in pre devised data form. SPSS for Windows version 22.0 (IBM SPSS, Chicago, IL, USA) was used for statistical analysis. Mean with standard deviation (SD) were used for continuous variables. Categorical variables were presented as frequencies and percentages. For statistical correlation Chi square was applied.

RESULTS

A total of 36 patients were included in this study. Twenty-four (66.7%) were males and 12(33.3%) females. Mean age was 22.67±5.8 (7-35) years. Duration of symptoms prior to presentation was 22.77±14.5weeks (range 6-60). Out of 36 cases 28(77.8%) were benign and 8 (22.2%) were malignant. Benign etiologies were seen more in males (22/24; 91.7%; p=0.005) and malignant more in females (6/12; 50%; p=0.005). Stratification of causes of stenosis are presented in table 1.

Table 1: Stratification of cause of stenosis (n=36)

	Cause	Number(n)	Percentage (%)
1	Benign	28	77.8%
A	Post intubation	18	64.3%
B	Blunt trauma	10	35.7%
2	Malignant	8	22.2%
A	Squamous cell carcinoma	4	50 %
B	Adenoid cystic carcinoma	4	50 %

All patients presented with stridor and dyspnea while hemoptysis was seen in four (11.1%) patients with squamous cell cancer (p<0.001). Tracheal stenosis was seen at C7–T1 in 12 (33.3%), at C6-C7 and C6-T1 in 8 (22.2%) each (Figure 1). Stenosis secondary to prolonged intubation was seen at C6-C7 in 38.9% cases (7/18; p=0.016), and at C7-T2 in 11.1% cases (2/18; p=0.035).

Anesthesia prerequisites included pre operative bronchoscopy in all patients with addition of dilation in 14(38.9%) cases. Non-intubated anesthesia (NIA) was used in 16 (44.4%) patients. Post operative bronchoscopy was performed in 34 patients.

Cervical approach was used in 28(77.8%) while in 8(22.2%), a cervicosternal approach was used. Cervicosternal was used predominantly in C7-T2 stenosis (p<0.001). Preoperative stenosis length assessment was 3.05±0.54 cm, however post resection length was 3.71±0.75cm. Preoperative intraluminal diameter was 6.13±2.54mm, post-operative diameter 14.81±3.98mm with a difference of 8.89±2.34mm. Free tumor margins was seen in all squamous cell carcinoma (p=<0.001). On table and SICU extubation was successful in 34 (94.4%) patients. Complications were seen in 10 (27.7%) patients with restenosis being the commonest (6; 16.7%) followed by anastomotic leak leading to emphysema in 4(11.1%) patients. Figure 2 shows all complications encountered.

Figure 1: Level of stenosis (n=36)

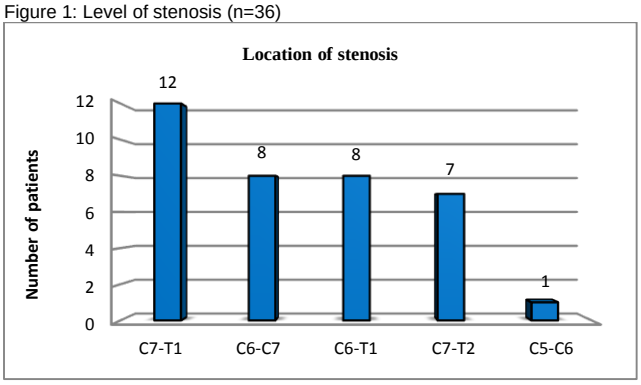
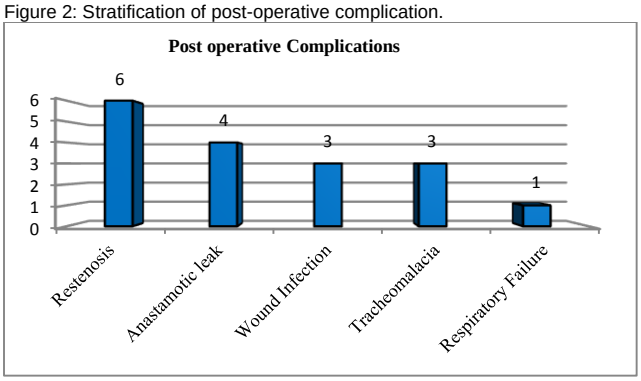


Figure 2: Stratification of post-operative complication.



Preoperative tracheostomies were present in 8 (22.2%) patients and were associated with wound infection (3/8; 37.5%; p=0.001) and tracheomalacia (2/8; 25%; p=0.05). Restenosis (6/36; 16.6%) was associated with wound infection (2/6; 33.3%; p=0.015). Pre-operative steroid use was seen in 8 (22.2%) patients and was associated with anastomotic leak in 3 (3/8; 37.5%; p=0.007), wound infection in another 3 (3/8; 37.5%; p=0.001) and restenosis in 4 (4/8; 50%; p= 0.004).

Out of 36 patients there was only one (2.8%) mortality due to respiratory failure as a result of complete anastomotic dehiscence. Permanent tracheostomy was performed in one case secondary to wound infection and anastomotic failure. Mechanical ventilation was required in four (11.1%) patients with associated tracheomalacia and respiratory compromise (p=<0.001). Post-operative duration of stay was 13.3±9.37 days.

DISCUSSION

Tracheal resection with primary anastomosis (TRPA) is by far the best management option with excellent long term outcome[1,4,7, 13-15].In the present study benign etiologies for TS accounted for far more surgeries as compared to malignant etiologies (77.8% vs 22.2%). Similar indications and distribution were seen in three other studies[3,4,16]. Idiopathic laryngotracheal stenosis was reported in one series as the most common indication for TRPA, whereas other authors reported PIS in 65% to 67% patient requiring surgery[3,4,16]. In our study findings were similar to the latter studies. We do not report any idiopathic larygotracheal stenosis. Among neoplasms, occurrence of ACC and SCC were similar (4 each) whereas different data has been reported by other authors[3,5].

Anesthesia for TRPA is challenging- the two most popular methods include the conventional ETT and non-intubated anesthesia with utilization supraglottic devices (SGD)[17-19]. ETT after induction of general anesthesia followed by cross field ventilation is the most frequently used technique[20,21]. We utilized the conventional technique in 20 (55.6%) and the non-intubated technique in 16 (44.4%) patients with similar results. A SGD used in conjunction with intravenous medication is a worthy substitute to ETT for TRPA in cases of severe and proximally located stenosis[18,19,22]. Using SGA alongside high frequency jet ventilation is a safe approach for maintaining adequate oxygenation.[22]

Cervical incision approach is a well-defined and widely accepted technique first introduced in 1975 by Pearson [11], and further modified by other surgeons over years[1,3,11,23]. In our study, cervical approach was used in 28 (77.8%) cases, while cervico-sternal approach was required in 8 (22.2%). The reason for sternal extension was low lying strictures at C7-T2 (p<0.001) also reported in literature[7, 11, 15, 23].

Pre-operative bronchoscopy is a widely used strategy to define the stenosis[7,15,24]. It helps to identify the level, the diameter and ability to intubate the patient. We performed rigid bronchoscopy in all our patients similar to Ulusan et al[15]. Rigid bronchoscopy with dilation was performed in 14 (38.9%) patients. Previously, it was encouraged to perform pre-operative dilation to maintain lumen diameter of more than 5 mm[7,11]. A lumen that allowed easy passage of rigid bronchoscope was considered to allow passage of 5.5 mm sized ETT[24] .Wright et al, recently proposed that dilation on the day of surgery was associated with unwanted bleeding and injury to tissue that affected surgery adversely[24]. With recent advances of anesthesia such dilation is not necessary.

TRPA has high success rates reported in literature. Wright et al, reported the highest success rate of 95% [25]. Similar rates of upto 91% have been reported by Kanlikama[1] and Bibas[14]. In 83 to 97% operated cases patient is discharged with a patent airway without any tracheostomy or T tube[3,4,14,24,25]. We also report a comparable success rate of 94.4% where we were able to discharge 34 of 36 patients without the need of a tracheostomy or a T tube.

Following TRPA, various complications can develop. Some of the reasons associated with them are length of stenosis resected, redo surgery, younger age group, pre-operative tracheostomy (POT), diabetes mellitus , tension at site of anastomosis and prolonged corticosteroid use[1,7,16,26].The complication rates of the procedure have been reported ranging from 9%-44.6% [4,11,14,16,24]. Our complication rate is modest at 27.7% (10 patients). Careful selection of patients determines the complication rate.

In the present study, restenosis was the most common complication seen (6/36; 16.7%). Various authors have reported rates between 16% and 32.4% [1, 14]. Factors that were found to be associated were tension at anastomotic site and use of non-absorbable sutures[7], previous surgery that causes peritracheal fibrosis[1,14,25] and excessive dissection around trachea[15]. Various techniques help reduce tension at the anastomotic site like neck flexion maintained with suture[11,15], pretracheal dissection and laryngeal and hilar releases[15,23]. The use of absorbable sutures, controlled dissection and release procedures decrease restenosis risk[7, 11, 15, 23].

Wound infection has been reported as non-anastomotic complication in literature. It has been seen in 10.6% to 39.2% cases undergoing any form of tracheal surgery[14,16,24,26]. We encountered wound infection, treated with indicated antibiotics, in 3 (8.6%) patients. Wound infection was associated with extended steroid use (p=0.0010), anastomotic leak (p=0.007) and restenosis (p=0.004). Corticosteroid use causes poor healing and therefore increases chances of infection and anastomotic leak[16,24]. It has been proposed to stop steroid use at least one month prior to surgery and use muscle flaps to improve local vascularization[16,24].

Hoarseness or voice change after surgery of trachea can be due to airway or vocal cord edema, or nerve injury[4]. This can be avoided by keeping dissection close to the tracheal wall, avoiding use of diathermy and preservation of nerve in case of identification[4]. We did not encounter any neurological injury but rates as high as 17% are reported[4,14,24]. We saw anastomotic leaks in 4 (11.1%) patients with dehiscence in one managed with re do tracheostomy. It is encouraged to avoid redo surgery at least for few months in order to allow inflammation to settle[24]. Later tracheostomy was maintained as a permanent conduit due to dense fibrosis and poor tissue planes. Smaller leaks were managed with infection control, neck flexion maintenance, rest and chest care that can be compared to existing literature [16].

Re-intubation with mechanical ventilation (MV) was needed in 4 (11.1%) of our patients. Grillo et al reported that 2 out of 4 patients required MV[11] whereas Wright et al reported re-intubation in 4.8% cases[24]. Poor surgical technique, edema of airway and surgical site infection are common risk factors for re-intubation[24]. Among our patients MV was needed in a young patient (7 years) having tracheomalacia due to long-standing tracheostomy tube and respiratory compromise (p=<0.001). Tracheomalacia was seen in patient undergone POT (0.001). Acquired tracheomalacia can develop in patient with ETT or tracheostomy[27]. POT is strongly associated with anastomotic as well as non-anastomotic complication[1,7,16,24]. This can be attributed to the fact that POT causes tissue reaction and fibrosis around surgical site warranting undesirable dissection. Surgical area can also be harbouring infected granulation tissue in patients with POT therefore causing complications[1,7,16,24]. POT was associated with wound infection (p=0.001) and tracheomalacia (p=0.05).

We lost one (2.8%) patient due to respiratory failure. This was a result of sudden hyperextension of neck with loss of guardian suture leading to complete anastomotic dehiscence. Immediate attempt to maintain distal airway was made but patient developed significant respiratory difficulty and eventually died of respiratory failure. Wright et al reported such an event of neck hyperextension[25]. Various authors have reported a mortality rate ranging from 0.8% to 10%.[1,4,15,16,24]. Our results compare favourably with other reported rates.

CONCLUSION

It can safely be concluded that TRPA offers excellent definitive treatment for patients with tracheal stenosis. A multidisciplinary approach should be the way forward when offering surgery to these patients in order to keep morbidity and mortality to a minimum.

Limitations of study: Authors would like to acknowledge that it is a single centre study with a rather small sample size. Furthermore, results obtained by us may not necessarily be reproduced by other centres routinely performing TRPA due to indigenous conditions and expertise available.

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