

Single Stage Surgery for Cricotracheal Stenosis; The experience of Single Tertiary Center

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ABSTRACT

Background : Cricotracheal stenosis has become recognised as a pathological condition and remains a challenging problem for otorhinolaryngology. The aim of this work is to stress importance of single stage surgery for cricotracheal stenosis. **Methods:** The patients with cricotracheal stenosis who were treated with single stage surgery with cricotracheal or tracheal resection between 2009 and 2015 at Hacettepe University Hospitals Department of Otorhinolaryngology Head and Neck Surgery were evaluated retrospectively. Postoperative restenosis rate and additional intervention requirement for decannulation were compared with stenosis grade and comorbidity.

Results: This study included 24 males and 8 females aged between 18 and 76 years with a mean age of 38.8 years. Twenty seven (84.3 %) patients had a pre-existing tracheostomy at the time of surgery while in five (16.6%) patients surgery was performed without a preoperative tracheostomy. One patient had grade 2 (3.1%), 25 Patients had grade 3 (78.1%) and 6 patients had grade 4 (18.8%) stenosis according to Cotton-Myer grading system. All patients underwent single stage surgery and followed at ICU as an intubated. Overall decannulation rate was 93.7%.

Conclusions: Cricotracheal reconstruction techniques pose many challenging obstacle. Single stage surgery introduce best treatment option and is especially required multidisciplinary approach which is essential to manage the cricotracheal stenosis with high decannulation rates.

Keywords: Cricotracheal stenosis, cricotracheal resection, single stage surgery

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INTRODUCTION

Cricotracheal stenosis has become recognised as a pathological condition and remains a challenging problem for otorhinolaryngology. Cricotracheal stenosis increased due to advances in critical care medicine. The increased use of tracheotomy and nasal and orotracheal intubation may explain that the incidence of post-intubation or post-tracheotomy stenosis ranges from %10 to %19 [1,2]. Several treatment modalities have been used, such as endoscopic dilatation, endolaryngeal laser surgery, stent placement, laryngotracheoplasty with interposition grafting and major airway surgical resection and reconstruction. Life long tracheostomy is another management in some patients who are high surgical risk due to their comorbidities [3-5]. Tracheal/cricotracheal resection with primary anastomosis without tracheotomy (single stage surgery) is definitive treatment for benign cricotracheal stenosis and has been carried a high success rate, low morbidity rate and excellent results in carefully selected patients [6,7]. The purpose of this present study was to evaluate the experience of the Hacettepe

University Hospitals otolaryngology department applying single stage surgery in adult patients, and compare the outcomes to those reported in previously published case series.

METHOD

This study included 32 patients who underwent single stage cervical tracheal or cricotracheal resection. The surgeries were performed during the period between 2009 and 2015 in the otolaryngology head and neck surgery department; Hacettepe University hospitals. Data were obtained from each patient's medical chart, including: tracheal stenosis etiology; tracheal stenosis grade; length of stenosis; preoperative and postoperative tracheotomy conditions; overall decannulation rates; postoperative complications; and any required interventions or additional airway surgery.

Preoperative Assessment

Preoperative assessment included history taking ,associated morbidity,presence of tracheostomy,previous attempts of endoscopic or open surgical treatment, clinical examination, CT neck and laryngotracheal endoscopic examination to determine the degree of stenosis, to determine the integrity of the vocal folds, and to measure the length of the stenotic segment. The Cotton-Myer grading system was used to categorise the clinical severity of airway stenosis.

Explanations of treatment options were offered to all patients and discussed with them about the advantages and side effects of the different treatment regimens. An informed consent form, signed by the patient, was always obtained before surgery

Surgical Technique

Tracheal or cricotracheal resection were performed as a single stage procedure without postoperative tracheotomy [8,9]. General anesthesia was delivered via an endotracheal tube placed through the tracheostomy in those having a pre-existing tracheostomy. In patients having no tracheostomy, the stenotic segment was passed with a small caliber jet-ventilation tube and after opening the trachea ventilation was carried out via a tube placed in the distal tracheal segment to allow resection of the stenotic segment.

In all patients a Laryngofissure incision was made, a subplatysmal flap was elevated till the level of the hyoid bone superiorly and the flap was elevated inferiorly for a distance that is enough to allow exposure of normal trachea below the level of stenotic segment. The stenotic segment was incised in the midline to identify the upper and lower limits of the stenosis to avoid unnecessary resection of the trachea or the cricoid cartilage. The recurrent laryngeal nerve was not identified in any patient; injury to this structure was minimised by meticulous dissection of the area immediately adjacent to the tracheal surface. Dissection was continued posteriorly between the trachea and esophagus till the stenotic segment was completely removed. In cases of associated cricoid cartilage involvement, the anterior arch of the cricoid was removed. Tracheal and/or laryngeal release procedures were performed depends on the situation to ensure tension free anastomosis. The anastomosis was performed using log-term absorbable sutures in an interrupted manner with the knot always placed outside the tracheal mucosa to avoid granulation tissue formation around the knot. After completing the insertion of sutures in the posterior and lateral walls, the nasotracheal tube was advanced into the distal tracheal segment just before tying the anterior sutures , and the rest of the anastomosis was completed.

Postoperative follow up

The patient was kept under observation in the hospital for at least 1 week. Every patient kept sedated in the postoperative intensive care unit with the nasotracheal tube in place for ventilation at least 24 hours. Extubation

is carried out when the patient is awake. Antibiotic prophylaxis and Antireflux treatment was continued for 1 week after surgery. Patients were followed up monthly up to 6 months. Endoscopic examination was performed if symptoms of airway obstruction developed at any time. The anastomosis success was assessed by the presence or absence of airway obstructive symptoms, bronchoscopic demonstration of restenosis, and the need for and type of reintervention. Anastomosis success was considered in the following situation ; non symptomatic patients or symptomatic patients with bronchoscopically confirmed restenosis who were successfully managed with endoscopic or open revision surgery and provided symptom free afterwards. Anastomosis failure was considered in patients having symptomatic restenosis with failing endoscopic or open surgery and required permanent airway appliance ,like stent or tracheostomy.

Statistical Analysis

The statistical analysis was performed using SPSS (statistical package for social science) version 16 for Windows. Between-group comparisons were done with Kruskal-Wallis and Mann-Whitney U tests in independent groups.

RESULTS

This study included 24 males and 8 females aged between 18 and 76 years with a mean age of 38.8 years. 32 patients with severe upper tracheal or subglottic stenosis were identified and treated at the Hacettepe University Hospitals Otolaryngology Head and Neck Surgery Department. The etiology of stenosis was postintubation in all cases , in 7 (%21.9) patients intubation less than 10 days in 25 (%78.1) patients it was prolonged more than 10 days. The reason for intubation were non airway trauma (n = 15) major surgery (n = 4) stroke (n = 3) status epilepticus (n = 3) post MI (n = 3) suicidal attempt (n = 1) CO poisoning (n = 1) myasthenia gravis (n = 1).

Eight patients had previously undergone unsuccessful attempts for treatment of stenosis in the form of several trials of endoscopic balloon dilatation (n = 5) , endoscopic laser surgery (n = 3) and laryngotracheoplasty (n = 5) , both in another institution and our department.

Twentyseven (84.3 %) patients had a pre-existing tracheostomy at the time of surgery while in five (16.6%) patients surgery was performed without a preoperative tracheostomy

Use of the Cotton-Myer grading system allowed methodical classification of the degree of tracheal stenosis. Our patients stenoses were graded as follows : grade 2 (n = 1 / % 3.1) , grade 3 (n = 25 / % 78.1) , grade 4 (n = 6 / % 18.8) . The length of resected stenotic segment was ranged from 1.2 – 4.5 cm with the mean 2,7 cm, representing one to five tracheal rings. Table 1 summarizes the demographic features of the patients.

According to the site and extension of stenosis 22 patients had trachea-tracheal anastomosis (%68.7) and

10 patients had crico-tracheal anastomosis (%31.3). The follow periods ranged from 6 months to 12 months. Thirty out of the 32 patients were finally without tracheotomy reflecting an anastomosis success rate was 93.7%. Among patients who developed restenosis, Four patients (%12.5) were successfully managed with endoscopic balloon dilatation and/or endoscopic laser surgery and remained without tracheotomy. The remaining two patient (6.3%) required tracheotomy or a permanent airway appliance. One of these patients had DM and another had Wegener Disease. All patients had normal vocal fold mobility preoperatively and there were no vocal fold paralyse or dysphagia even after the surgery and/or endoscopic intervention (Table 2).

Restenosis rate was significantly higher in patients with comorbidity(DM,Wegener Disease) and grade 3 stenosis (p<0.01). Gender was not related with restenosis rate while presence of the preoperative tracheotomy boosted the restenosis rate but this finding is not statistically significant (p<0.1). Crico-tracheal anastomosis had higher restenosis rate than tracheo-tracheal anastomosis yet this is not statistically significant (p<0.1) (Table 3)

Table 2. Operative and Postoperative

Variable	Restenosis	No Restenosis	P Value
Sex			
Male	4	20	
Female	2	6	
Comorbidity			
No	7	13	p<0.01
Yes	2	10	
Preoperative Tracheotomy			
No	1	10	
Yes	4	17	p<0.1
Grade			
2	-	1	
3	9	16	p<0.01
4	-	6	
Anastomosis			
Tracheo-tracheal	6	16	p<0.1
Crico-tracheal	3	7	

Table 1. Preoperative details

Variable	N	%
Age (mean)	38.8 years	
Sex		
Female	8	25
Male	24	75
Duration of intubation		
Mean (days)		
>10 days	25	78.1
<10 days	7	21.9
Comorbidity No	19	59.3
Comorbidity Yes	13	40.7
Previous treatment attempts		
Yes	8	25
No	24	75
Baloon Dilatation	5	
End.Laser Surgery	3	
Laryngotracheoplasty	5	
Preoperative tracheostomy		
Yes	27	84.3
No	5	16.7
Grade 2	1	3.1
Grade 3	25	78.1
Grade 4	6	18.8

Table 3. Statistical correlation between different variables and the development of Restenosis using Mann-Whitney Test

Variable	N	%
Anastomosis		
Tracheo-tracheal	22	68.7
Crico-tracheal	10	31.3
Lenght of resected segment (cm)		
Range (between)	1.2-4.5 cm	
Mean	2.7 cm	
Release Procedure		
Laryngeal release	10	31.3
Tracheal release	32	100
Restenosis		
No	26	81.2
Yes	6	18.8
Healing with interventions	4	67
No healing	2	33
Outcome		
Anastomatic Success	30	93.7
Anastomatic Failure	2	6.3
Vocal fold paralyse	0	0
Dysphagia	0	0

DISCUSSION

Single stage surgery is quite a standardised and effective procedure for cricotracheal stenosis with a reasonable success rate in terms of decannulation. In the present study, 30 patients were decannulated and we achieved an overall success rate of 93.7%. Several series reported success rates ranging between 74 and 97 %. [6-11]

Despite improved patient care, laryngotracheal stenosis remains an important iatrogenic complication of tracheal intubation. Severe cricotracheal stenosis represents a major therapeutic challenge. Pre operative assessment must define the exact location and length of stenosis. Rigid endoscopy represents the best pre-operative diagnostic procedure for patients with cricotracheal stenosis. Computed tomography with thin section allows high quality multiplanar reconstruction for detailed evaluation of the stenosis [12]. In our study we performed rigid endoscopy on all patients to evaluate the airway and to detect the grade of stenosis before the surgery. CT can be performed in case of grade 4 stenosis because rigid endoscopy is not helpful to evaluate distal segment of trachea and we performed CT on six patients who had grade 4 stenosis.

Complete resection of the stenotic segment, preservation of vascularisation and innervation and careful submucosal suturing are importance for surgical success [13]. To achieve this aim, some were related to mobilizing the distal tracheal and the proximal segment by suprahyoid and infrahyoid laryngeal release, should be considered [14]. Some reports suggested that stenotic segment of 2 cm or less can be managed by primary anastomosis alone without laryngeal release techniques [15]. In our study we performed distal tracheal release on all of the patients while laryngeal release were performed on just ten patients. Mean length of excised stenotic segment was 2,7 cm in our study and we suggested that stenotic segment up to 3 cm can be managed by primary anastomosis with only tracheal release. Laryngeal release should not be performed if tracheal release is enough for anastomosis because postoperative dysphagia may occur due to the abnormal position of the larynx with impaired elevation during swallowing because of laryngeal release [16].

Single stage surgery must include the resection of preoperative tracheotomy and should allow the primary anastomosis. Insertion of nasotracheal entubation tube that serves as a stent, is necessary for single stage surgery. Twenty four hours after the surgery, patient can be extubated and positive airway pressure should be given patients to support their own breathing. Multidisciplinary

approach has more important role in case of single stage surgery because of the necessity of sedation during the period when the patient is intubated. Overall decannulation rate of this technique was reported between 70%-90% in the literature [17]. In our study all of our patients underwent single stage surgery and after the extubation, 93.7% of patients were decannulated

Restenosis does not always mean that the surgery is fail. For instance, the patients who had no airway obstruction symptoms or who were symptom-free with minor endoscopic interventions can be decannulated after surgery even if they were developed restenosis. In our study we had 6 patients who developed restenosis, four of them needed endoscopic intervention and they were asymptomatic after the balloon dilatation. Two patients who had obstructive symptoms and seconder interventions were failed. So that they required tracheotomy or permanent prosthesis (T-tube) to relief airway obstruction. Wright et al. categorized anastomotic failure as requiring a permanent airway appliance, reoperation or who died from the procedure. We suggested that postoperative tracheotomy should take its place in the failure list. Development of anastomotic restenosis related to several factors such as diabetes, presence of preoperative tracheostomy, high grade of stenosis and lengthy resection and they supported the evidence of that longer resections are associated with increased anastomotic failure rate [18]. In our study we found that restenosis rate is related with grade of the stenosis and comorbidity. The patients who had grade 3 stenosis and/or comorbidity showed high restenosis rate after surgery. We found that presence of preoperative tracheotomy increased restenosis but this finding is not statically significant

CONCLUSIONS

Cricotracheal stenosis is one of the most common complications of endotracheal intubation. The standard diagnostic procedures include computed tomography, rigid and flexible laryngoscopy. Careful pre-operative assessment, preparation and multidisciplinary approach together with surgical technique are mandatory to obtain good results. Based on our results the management procedure for severe cricotracheal stenosis is single stage surgery which represents the best treatment option and this surgical technique should be in the armamentarium of an airway surgeon.

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