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Outcomes of tracheal resection and anastomosis for post intubation tracheal stenosis: a study of 12 cases

Abstract

Post intubation tracheal stenosis is a severe clinical condition with an increasing prevalence due to the advances of critical care medicine.

This is a retrospective study including 12 cases of post-intubation tracheal stenosis managed by TRA in our head and neck surgery department between the years 2013 and 2019. All patients underwent preoperative clinical evaluation based on neck CT scan and endoscopy under general anaesthesia. Traffic road accidents and trauma were the main causes of prolonged intubation. Ten (10) patients required tracheostomy. According to the Cotton Meyer grading, 4 patients had grade II, 2 had grade III and 4 had grade IV. The mean length of stenosis was 16.2±5.6 millimeters. T-tube was inserted intraoperatively in 5 patients. 4 were successfully decannulated in a mean delay of 9.2 months. Early postoperative complications were subcutaneous emphysema, laryngeal edema, aspiration pneumonia, intra-tracheal migration of the T-tube, and vocal cord paralysis each complication occurred in 1 case. Late postoperative complications were granulation tissue formation observed in 5 cases and restenosis in 3 cases. The initial success rate of the TRA was 91.7%.

Management of Post intubation tracheal stenosis requires a skillful multidisciplinary team. TRA guided by a meticulous preoperative evaluation is the gold standard.

Keywords: tracheal resection, anastomosis, tracheal resection with end-to-end anastomosis, cervical computed tomography

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Mohamed Dhaha, Rim Braham, Alia Methnani, Souheil Jebali, Sawsen Dhambri, Skander Kedous, Said Gritli

Head and Neck Surgery Department, Salah Azaez Oncology institute Tunis, Tunisia

Correspondence: Mohamed Dhaha, Head and Neck Surgery Department, Salah Azaez Oncology institute Tunis, Tunisia, Tel +216 92 764 278, Email Dhaha.mohamed8@gmail.com

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Introduction

Acquired tracheal Stenosis is a severe clinical condition that continues to be a great challenge for head and neck surgeons. The advances in critical care medicine and the high prevalence of traffic road accidents led to an increased number of intubations. The continuous pressure applied by the tube's cuff and the stoma of tracheostomy results in injuries and ischemic necrosis. Superimposed local infections of the mucosa lead to perichondritis of the tracheal cartilage and enhance the fibroblastic activity.[1] Consequently, an altered inflammatory response followed by excessive scar formation occurs leading to threatening airway obstruction and narrowing of the tracheal lumen.[2] Site and mechanism of stenosis depends on whether the patients had and intubation tube's cuff or a tracheostomy. In the first situation tracheal stenosis generally occurs in the intubation cuff site while in the second situation granulation tissue formation occurs in suprastomal region, tip of tracheostomy and the cuff site.[3]

Management of tracheal Stenosis is challenging. It includes many therapeutic modalities and strategies. Endoscopic dilatation and tracheal stenting are usually described as temporary measures. The role of the laser is undeniable, it's preserved for thin or non–resectable Stenosis.[4,5] Since the stenosis process is usually transmural, tracheal resection with end-to-end anastomosis (TRA) is considered the best treatment for tracheal Stenosis since the works of Grillo in the late 70s.

This is a retrospective descriptive study including 12 patients who underwent TRA for post-intubation tracheal Stenosis in our department. Our purpose was to report our experience of managing post intubation tracheal stenosis with TRA in terms of post-operative outcomes and complications as well as the success rate.

Methods

This study was performed between the years 2013 and 2019 in the head and neck surgery department of Salah Azaez Oncology Institute. The medical records of 12 patients operated for post-intubation tracheal stenosis by TRA were retrospectively reviewed. Patients presenting post intubation stenosis of the cervical trachea candidates to TRA were included in this study. Patients diagnosed with true subglottic stenosis as well as those presenting stenosis from other causes (like neoplastic stenosis) were excluded from the study. A preoperative evaluation was realized in all cases including endoscopic examination under general anesthesia and cervical computed tomography (CT) scan allowing a detailed description of the stenosis. Endoscopic examination allowed the evaluation of the stenosis length. Two variables were measured using a ruler: DPS= distance between the glottic plan and the proximal limit of the stenosis and DDS=distance between the glottic plan and the distal limit of the stenosis. Length of the stenosis was equal to the difference between DDS and DPS. The aspect of the stenosis was described. The stenosis grade was assessed following the Cotton and Meyer classification relying both on endoscopy and imaging. Data relative to patients including age, associated comorbidities, life habits (especially cigarette smoking), clinical presentation before surgery, causes and duration of intubation were noted.

Surgical technique

All patients underwent an anesthetic evaluation before surgery. The intervention was realized in the supine position with a shoulder roll beneath the shoulders to obtain an optimal extension. The operative technique described by Grillo and Pearson was followed[6,7]. Coordination between the anesthesiologists' team and the surgeons was maintained during the operation. Intubation through the trachea was performed in patients with tracheostomy otherwise they were intubated transorally. A cervical horizontal incision was performed at the level of the stenotic area or the tracheostoma in case of tracheostomy. Subplatysmal flaps were raised superiorly and inferiorly. The strap muscles were dissected and retracted laterally. The thyroid isthmus was individualized then divided and ligated using 3-0 Vicryl. The trachea was then dissected and exposed. Lateral

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dissection was close to the tracheal wall to avoid the laryngeal recurrent nerve. The stenotic area was identified. The trachea was resected on both sides of the stenosis using circumferential incisions. Careful posterior dissection using blunt instruments was realized to liberate the subjacent esophagus. In the case of transoral intubation, the anesthesiologists replaced the tube by a transcervical one put in the distal trachea. The shoulder roll was then removed to bring the tracheal edges closer. No release maneuvers were realized. End-to-end anastomosis was performed with Vicryl 2-0 beginning with the posterior portion. Posterior knots were first tied and put in the tracheal lumen while the anterior knots were placed outside the trachea. The strap muscles were then closed and the skin sutured after putting a suction drain. Patients were immediately extubated and removed to the postoperative care unit after the intervention (Figures 1–4).

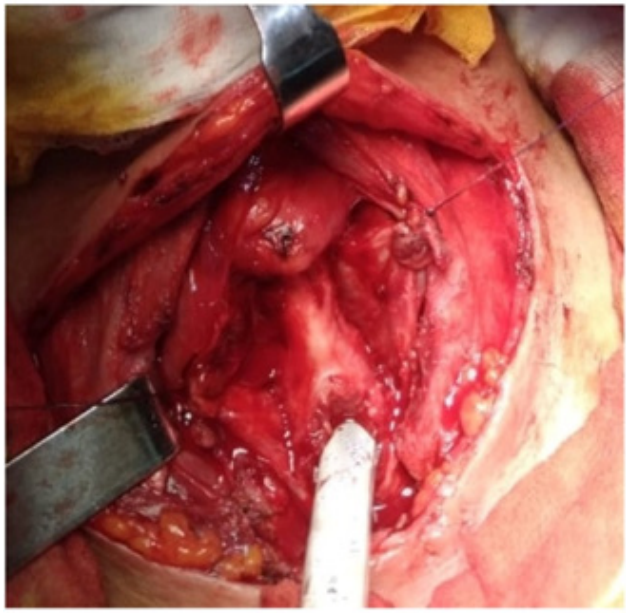

Figure 1 The trachea is exposed and dissected and the stenosis is defined.

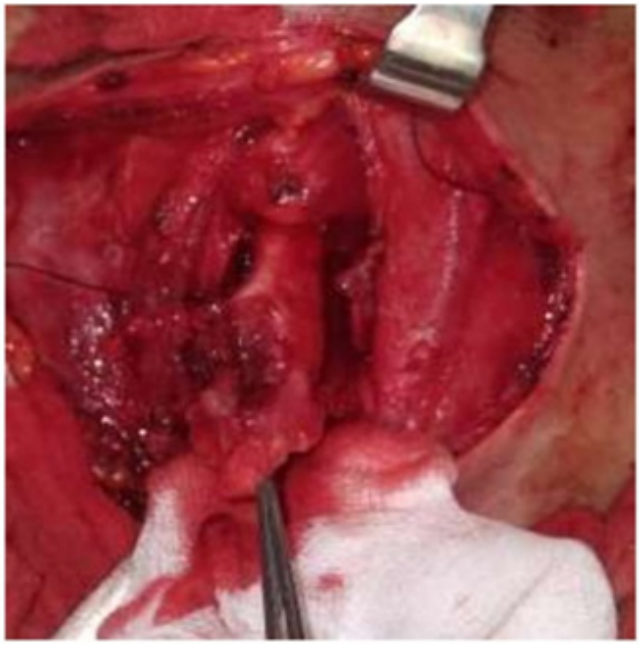

Figure 2 The part of the trachea containing the stenosis is resected with blunt instruments.

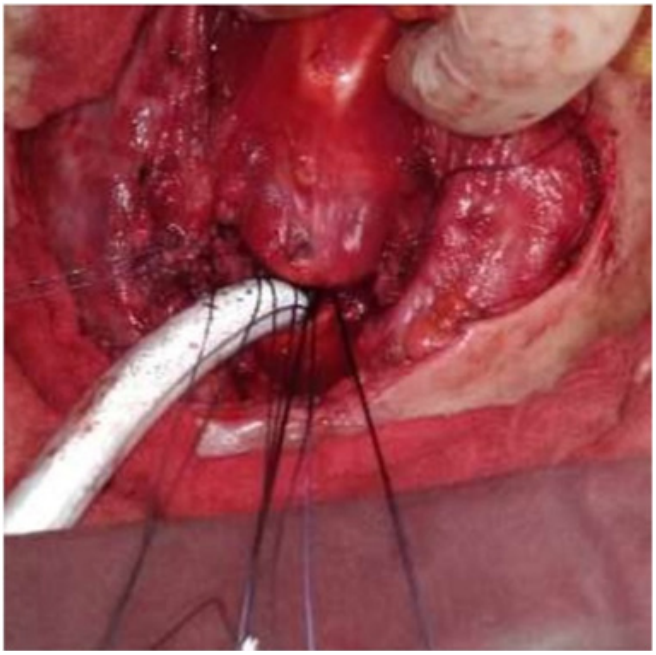

Figure 3 End to end anastomosis with Vicryl 2-0 beginning.

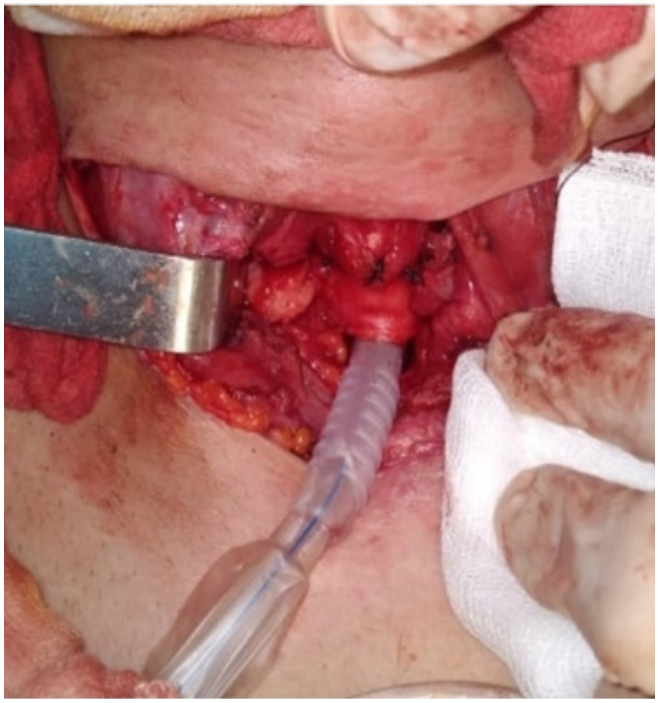

Figure 4 Insertion of Montgomery Tube after for calibration.

Postoperative period

During the postoperative period, a systematic antibiotherapy was initiated to prevent infections. Steroids and proton pump inhibitors were also administrated. All patients had beneficiated from laryngeal examination with office endoscopy before discharge. This allowed checking vocal cords mobility. The first control was performed 1 month after surgery. A postoperative bronchoscopy was systematically done 3 months after surgery. Patients were then followed every 6 months. Success was assessed clinically, results were considered satisfactory when the patient remains asymptomatic.

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Statistical analysis

Descriptive statistics were performed using SPSS 20 for windows. Means with SDs were displayed. Tables were used to summarize data. No statistical correlations were calculated considering the small number of patients in this report.

Ethical consideration

An ethical approval was obtained from our institution.

Results

Among the 12 patients who participated in this retrospective study, there were 10 males and 2 females: sex ratio 5:1. The mean age was 30.8±16.4 ranging between 15 and 61 years. Associated comorbidities were noted in 4 patients. Diabetes mellitus was recorded in 1 patient, asthma and chronic bronchitis each in 1 patient, and epilepsy in 1 patient. Six patients (50%) were cigarette smokers. Causes of intubation in the intensive care unit were dominated by medical causes (5 cases) followed by trauma and traffic road accident (4cases), intoxication (2 cases), and suicide attempt (1 case). The duration of intubation ranged between 3 and 40 days with a mean of 14.2±12.4. The delay between extubation and onset of symptoms ranged between 7 and 60 days with a mean of 22.4±16.2 days. All patients presented hoarseness and dyspnea. Ten among them needed tracheostomy. Three among our patients underwent less invasive treatment using T-tubes before resection but all of them failed.

Clinical examination based on office laryngoscopy showed unilateral arytenoid paralysis in 2 cases and diplegia in one case. Endoscopy under general anesthesia and CT scan of the neck allowed evaluation of the stenosis. According to the Cotton Meyer scale, 4 patients had grade II, 2 had grade III, and 6 had grade IV. The mean length of stenosis was 16.2±5.6 millimeters ranging between 8 and 25 millimeters. Preoperative data are summarized in Table 1.

Table 1 Pre-operative data

Parameter	Number
Sex	
Male	10
Female	2
Cigarette smoking	
Yes	6
No	6
Associated comorbidities	
Diabetes	1
Asthma	1
Chronic bronchitis	1
Epilepsy	1
Causes of intubation	
Medical causes	5
Trauma and traffic road accidents	4
Intoxication	2
Suicide attempt	1
Tracheostomy	
Yes	10
No	2
T-tube	
Yes	3
No	9
Arytenoid mobility	
Normal	9
Unilateral paralysis	2
Diplegia	1
Cotton Meyer grade	
Grade I	0
Grade II	4
Grade III	2
Grade IV	6

The number of resected tracheal rings was 1 ring in 1 patient, 2 rings in 4 patients, 3 rings in 6 patients, and 4 rings in 1 patient. Placement of T-tube during the operation was a frequent procedure and was performed in 5 patients. 4 among these patients were later successfully decannulated in a mean period of 9.2 months ranging between 3 and 18 months. The remaining patient failed to decannulation and kept the T-tube. Altogether, 91.7% of our patients were successfully decannulated.

The postoperative period was uneventful for 7 patients. The 5 remaining patients presented postoperative complications. One patient presented dyspnea after accidental intratracheal migration of the T-tube. The tube was reinserted and fixed during an emergency intervention. One patient presented subcutaneous cervical emphysema. A cervical CT scan was performed showing no evidence of a gap in the tracheal anastomosis line. Spontaneous gradual resolution of the emphysema was observed. Another patient presented laryngeal edema which responded well to steroid therapy. Iatrogenic vocal cord paralysis occurred in 1 patient. One patient presented aspiration pneumonia that was successfully treated with antibiotherapy based on cefotaxime. The mean hospital stay was 11±2 days ranging between 9 and 16 days.

The follow-up period ranged between 13 and 65 months with a mean of 33.2±12.8 months. Granulation tissue formation was observed in 5 cases. Restenosis occurred in 3 patients. T-tube placement and CO2 laser vaporization sessions were advocated for these patients. The success rate of TRA considering cases of restenosis reached 66.7%. Intraoperative and postoperative data are summarized in Table 2.

Table 2 Intraoperative and postoperative data

Parameters	Number
Number of resected tracheal rings	
One ring	1
Two rings	4
Three rings	6
Four rings	1
Anastomosis details	
Crico-tracheal	6
Tracheal	6
T-tube	
Yes	5
No	7
Early complications	
T-tube migration	1
Sub cutaneous Emphysema	1
Aspiration pneumonia	1
Laryngeal edema	1

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Table Continued..

Parameters	Number
Vocal cord paralysis	1
Late complications	
Granulation tissue formation	5
Restenosis	3

Discussion

Laryngotracheal stenosis (LTS) is currently a frequent iatrogenic complication of prolonged intubation in intensive care units. Almost 21% of patients under mechanical ventilation develop LTS.[3] Fortunately, only 1 to 2% of these patients require surgical intervention.[8]

TRA is the gold standard in the management of thick and extended tracheal stenosis. In this case series, 91.7% of the patients were successfully decannulated. The success rate in the literature ranged between 83 and 93% according to series.[1,5,9,10]

TRA is a complex procedure and requires a skillful team both in endoscopic and open surgery. The creation of a tension-free anastomosis line is crucial for successful operation.[11] We used Grillo stitch and neck flexion to reduce tracheal tension. Supralaryngeal release techniques have been used by some authors to decrease the tension in the anastomosis level[5,12]. We judged these procedures were not necessary since the stenosis length didn't exceed 20mm for the majority of our patients (only 2 patients had 22 and 25mm tracheal stenosis length). In fact, many authors believe that end to end anastomosis without release techniques is sufficient to manage stenosis of 20mm and less.[5,13] Besides, due to the fixation of the larynx in a relatively low position after release procedures, many patients presented postoperative dysphagia[14]. Lager tracheal defect exceeding 3cm often requires a double cervico-mediastinal approach with release maneuvers of the distal trachea[11,15].

An accurate preoperative evaluation is fundamental for a successive TRA. CT scan with tridimensional reconstruction and tracheal endoscopy are the best tools classically used by most surgeons to explore tracheal stenosis.[5,9,10,16] Recently, Matsumoto proposed the use of a patient-specific organ model as a surgical simulator before TRA.[17] He successfully managed 2 cases of tracheal stenosis using this model.

All our patients were immediately extubated after surgery. Like Nandakumar et al.,[5] we thought that intubation cuff presents an extra risk of injury to the anastomosis. Other authors preferred keeping patients intubated in the intensive care unit for 24 to 48 hours.[9,16] This allows protection of the anastomosis line from intratracheal positive pressure.

The insertion of T-tubes was a frequent procedure before, during, or after TRA in our patients. T-tubes could be used as temporary stenting before surgery or in case of surgical failure 18. Patients unfit for surgery, presenting multilevel stenosis or associated subglottic stenosis are also candidates for T-tube insertion.[18] Three among our patients had Montgomery tube before surgery. Five T-tubes were inserted during operation and kept for a mean time of 9.2 months. One among them failed to decannulation. Three other patients needed stenting after restenosis. Nair et al.,[1] reported their experience of TRA performed in 20 patients. The T-tube placement was performed in 18 patients. Fifteen among them were inserted after surgery and kept for sa period ranging between 3 and 47 months.

In this series, 5 patients (41.7%) presented postoperative complications. This same rate was reported by Marques et al as they reported 41.7% of immediate and early postoperative complications.[10] Migration of T-tube is a rare but life-threatening complication and occurred in 1 patient in this case series. No known causes leading to this complication were reported.[19] We think this might be caused by coughing and inspiration efforts during postoperative recovery. One patient kept vocal cord paralysis as a permanent post-operative iatrogenic complication. This complication was frequently reported and ranged between 6 and 11% of postoperative complications.[10,16,20] Temporary postoperative complications such as wound infection, laryngeal edema, subcutaneous emphysema, pulmonary atelectasis and respiratory infection were recorded according to series.[9,10,12,16] However, the mortality related to TRA remains low within a rate not exceeding 3.3%.[20]

Restenosis and granulation tissue formation are the major late complications of TRA. Kanlikama et al reported 5.9% and 26.5% respectively of complete and partial restenosis in their patients.[9] The same authors studied the predictive factors of restenosis. They found an association between the development of restenosis and the following parameters: diameter of the narrowest part of the trachea, the distance between the cricoid and the narrowest part of the trachea, grade of stenosis, and smoking.[9] Marques et al reported 4 cases (33.3%) of granulation tissue formation and 1 case of restenosis (8.3%) as late complications of TRA.[10] Three cases of restenosis were recorded in our report. Factors associated with development of restenosis were not studied because of the small number of patients.

Conclusion

Management of post intubation tracheal stenosis remains challenging and requires usually a skillful multidisciplinary team of otolaryngologists, thoracic surgeons, and anesthetists. As shown in this report, TRA is an effective and safe surgical procedure to treat the vast majority of tracheal stenosis with reasonable complication rate and satisfying success rate. The restenosis is the major issue encountered after TRA and its rate remains relatively high. In addition advanced surgical skills during are usually needed. The major weakness of this study is the small number of cases. Likewise, the current literature lucks large series and meta-analysis allowing more understanding of the results of TRA especially predictive factors of restenosis. Future multicenter studies involving larger number of patients could be interesting.

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Conflicts of interest

No conflicts of interest.

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