Resection and Reconstruction of Cervical Tracheal Stenosis

Adil Khamees Abdul-Hameed[*], Waleed Mustafa Hussen[**], Akeel Salman Yuser[***]

ABSTRACT:

BACKGROUND :

Tracheal resection and primary re anastomosis for tracheal stenosis or tracheal tumor is not uncommon operation .

OBJECTIVE:

To assess the aetiology of stenosis of cervical trachea and their surgical reconstruction .

PATIENT AND METHODS:

This is a retrospective study of forty patients with cervical tracheal stenosis ,who were treated at Ibn Al Nafees Hospital during six years period from January -2006 to October -2012 .It illustrates the diagnostic methods and the surgical techniques of reconstruction .

RESULTS:

Most of the patients ,were male (80%) and only (20%) were female .The most common etiological factor was post intubation stenosis (70%),less common cause was traumatic stenosis and the least was neoplastic stenosis . Progressive dyspnea was the most common presenting clinical feature .The mean length of resection was three rings .Seven patients developed complications , and dealt with successfully with one mortality .

CONCLUSION:

Bronchoscopy and radiography remain the main diagnostic tool for evaluating it .Resection and end to end anastamosis is the best method of treatment In special cases .Some cases can be treated by endoscopy and laser therapy .

KEY WORDS :cervical tracheal stenosis , post intubation ,bronchoscopy .

INTRODUCTION:

Cervical tracheal stenosis was first recognized as an entity in 1880, after MacEwen instituted prolonged endotracheal intubation in four patients with upper airway obstruction. Since then post intubation stenosis and later post tracheostomy stenosis has been rare but serious complications [(1)]. Kuester performed the first human tracheal resection and primary reconstruction in 1884[(2)].Because of the presumed limits of resection and primary anastomosis, efforts at prosthetic replacement of the trachea were undertaken [(3)].

In the past, tracheal stenosis was managed with dilatation alone, and success was measured by the ability to wean patients from their tracheostomy tubes. Surgical resection and end to end anastomosis was considered the only definitive treatment for tracheal stenosis. Grillo and Mathisen have reported low (1.8%) mortality rates associated with surgical intervention but others have reported mortality rates up to 5% [(4)] . Interventional bronchoscopy procedures can serve as a bridge to surgical treatment but most importantly, can constitute definitive therapy for many patients, including these that are not surgical candidates [(5)].

Tracheal Injury

1-Injury secondary to endotracheal intubation is most commonly the result of over inflation of the cuff. Although high-volume/low-pressure cuffs are now ubiquitous, they can easily be overinflated, and pressures can be generated that are high enough to cause ischemia of the contiguous airway wall. In some patients, periods of ischemia as short as 4 hours may be all that is required to induce an ischemic event significant enough to lead to scarring and stricture [(6)].

Tracheal stenosis is nearly always iatrogenic. It is secondary to either endotracheal intubation or tracheostomy. Collectively, such tracheal injuries are referred to as post intubation injuries. Clinically significant tracheal stenosis is common

[*]Specialist Thoracic and Cardio-Vascular Surgeon. Medical City Teaching Hospital.

[**]Consultant Thoracic and Cardio-Vascular Surgeon. College of Medicine ,University of Baghdad & Medical City Teaching Hospital .

[***]Specialist Thoracic and Cardio-Vascular Surgeon .Ibn Al-Nafees Hospital .

after tracheostomy due to 2-scarring and local injury, and occurs in 3 to 12% of cases[7] . Factors associated with an increased risk of tracheal stenosis include incorrect placement of the tracheostomy through the first tracheal ring or the cricothyroid membrane where the airway is narrowest, use of a large tracheostomy tube, and transverse incision on the trachea. However, even a properly placed tracheostomy can lead to tracheal stenosis secondary to scarring and local injury .[8]

Clinically, inspiratory and expiratory stridor and dyspnea on exertion are the primary symptoms of tracheal stenosis. The length of time to onset of symptoms after extubation or after tracheostomy decannulation varies, usually ranging from 2 to 12 weeks; however, symptoms can appear immediately or after a period 1 to 2 years later[8].

3-It occurs primarily in patients with an indwelling nasogastric tube who are also receiving prolonged mechanical ventilator support. Cuff compression of the membranous trachea against the nasogastric tube leads to airway and esophageal injury and fistula development. Clinically, saliva, gastric contents, or tube feeding contents are noted in the material suctioned from the airway[9]. Distention of the stomach secondary to positive pressure ventilation can occur. Diagnosis of a suspected TEF is by bronchoscopy. Withdrawal of the endotracheal tube with the bronchoscope inserted allows the fistula at the cuff site to be seen. Alternatively, esophagoscopy will enable visualization of the cuff of the endotracheal tube in the esophagus. First and foremost, treatment of a TEF requires weaning the patient from the ventilator and then extubating[9]

4- Malignant cases of cervical tracheal stenosis .

AIM OF THE STUDY:

The aim of this study is to assess the aetiological factors of tracheal stenosis and evaluate the surgical outcome of tracheal reconstruction .

PATIENTS AND METHOD:

This is a retrospective study of forty patients with benign and malignant tracheal stenosis, who were admitted and surgically treated at the Thoracic Surgery Department in Ibn Al Nafees Hospital during the period from January 2006 to October 2012 .The data were collected from patients` ward and theatre records .

Patients after full preoperative assessment(history ,clinical features and diagnostic imaging) , underwent flexible or rigid bronchoscopy to have a direct look on the lesion ,its site ,and relation to larynx and in three of them rigid bronchoscopy was used for dilatation aiming for temporary relief of symptoms prior to surgery as it could pass the stenotic segment to and fro , and in two of them tracheostomy had been used also for those patients with severe symptoms , as an emergency procedure to overcome the stenotic area of the trachea .

Operative procedure

A collar neck incision had been used . Skin flaps were created superiorly to the thyroid prominence and inferiorly to the suprasternal notch. The anterior length of the cervical trachea was exposed . Limited circumferential dissection was performed around the trachea .Two silk stay sutures were placed on either side below and later above the lesion. The trachea was transected just below the stricture or tumor. Then the endotracheal tube changed from oral position to be placed across the operative field into the distal trachea. The diseased trachea was dissected superiorly and then transected above and below the lesion. Posterior mobilization and neck flexion were performed. Posterior sutures were placed with knots on the outside, and the patient was reintubated through the larynx. Anterior sutures were then placed and tied. The chin was sutured to the anterior chest to prevent tension across the anastomotic site. No tracheostomy was performed post-operatively.

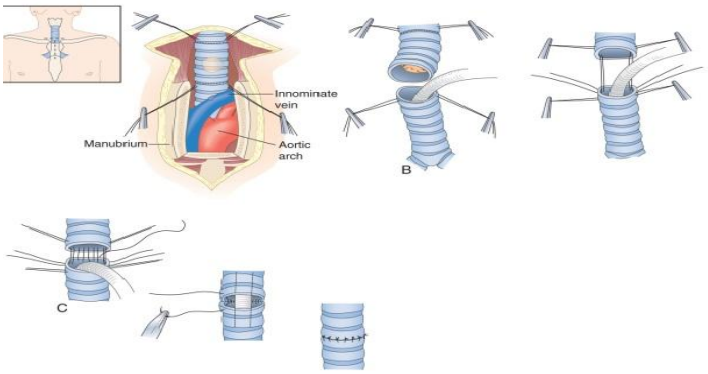

Fig 6: Steps of the surgery.

A formula was used to divide patients as regard their gender, age, presenting clinical features, preoperative investigations , details of surgery , per and postoperative complications and follow up.

RESULTS:

40 patients were studied in this retrospective study and were categorized according to their age , gender , etiology , presenting clinical features , diagnostic technique , surgical modality , peri-operative complications and outcome of surgery , results were as follows

Regarding sex and age distribution of the patients , 32 patients (80%) ,were males and eight patients (20%) were females, the oldest patient was aged 68 years old, and the youngest was 11 years old with a mean age of 39.5 years. The age and gender distribution of these patients is shown in figure 8.

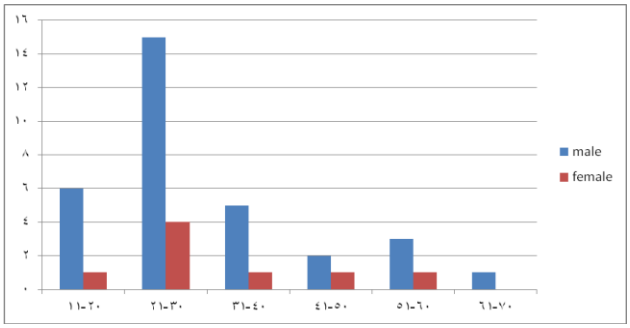

Figure 8 : Gender and age distribution.

Regarding the etiology of the stenosis , in 28 (70%) patients it was a post intubation stenosis , seven (17.5%) cases were caused by tracheal trauma and the remaining five (12.5%) were caused by a neoplastic process as shown in table 1.

Table 1 : Etiology.

Etiology	No. of patients
Postintubation	28 (70%)
Trauma	7 (17.5%)
Neoplasm	5 (12.5%)

Regarding the presenting clinical feature , progressive dyspnea was the presentation in 27 (67.5%) of the patients , stridor in six (15%) patients , hoarseness in four (10%) patients and other symptoms (namely dysphagia , hemoptysis) were seen in three (7.5%) patients mainly due to neoplasm , as shown in table 2

Table 2 : Presenting clinical feature.

Presentation	No. of patients
Progressive dyspnea	27 (67.5%)
Stridor	6 (15%)
Hoarseness	4 (10%)
Other symptoms	3 (7.5%)

Regarding the preoperative investigations , routine soft tissue X ray and CT scan of the neck had been done to all the patients and in 10 (25%) patients it showed narrowing in tracheal air column ,while in the remaining patients it showed ill-defined tracheal stenosis .In 30 (75%) patients flexible bronchoscopy, and in 10 (25%) patients rigid bronchoscopy was done and showed tracheal stenosis in form of scar tissue in 35 (87.5%) patients and tumor in five (12.5%) patients .Neck or chest CT scan was done in seven patients (17.5%) patients as shown in table 3 .

Table 3 : Preoperative investigations.

Preoperative investigations	No. of patients	findings
Neck X-ray	40 (100%)	Narrowing in tracheal air column 10 (25%)
CT scan	7 (17.5%)	Tumor mass 5 (12.5%) Stenosis in 2 (2.5%)
Bronchoscopy		
Flexible	30 (75%)	Scar tissue 35 (87.5%) / Tumor 5 (12.5%)
Rigid bronchoscopy	10 (25%)	

Regarding the surgical details , all patients were accessed via a collar incision with resection of variable length or segments from the trachea , total laryngeal release was done in six (15%) patients , pre-operative emergency tracheostomy was done in four (10%) patients .

Table 4 : Surgical details.

Surgical details	No. of patients
Rescted segments • 2 rings • 3 rings • 4 rings	 • 30 (75%) • 6 (15%) • 4 (10%)
Total laryngeal release	6 (15%)

Regarding the post-operative complications , recurrent partial stenosis found in four (10%) patients and treated by bronchoscopic dilatation , aspiration was encountered in two (5%) patients and treated by antibiotic cover with good physiotherapy , wound infection occurred in one patient and treated by daily dressing and antibiotic therapy according to result of the culture /sensitivity test .Death encountered in 1 (2.5%) patient the distribution of these complications is shown in table 5.

Table 5: Post-operative complications.

Complications	No. of patients
Recurrent partial stenosis	4 (10%)
Aspiration	2 (5%)
Wound infection	1 (2.5%)
Death	1 (2.5%)

DISCUSSION:

The purpose of this study is to assess the etiological factors of tracheal stenosis and to evaluate the surgical outcome of tracheal reconstruction.

Forty patients with tracheal stenosis were studied . 32 of our patients (80%) were males and the remaining eight (20%) patients were females, with a male to female ratio of 4:1 , which is more than the studies done by Reza Bagheri et.al.[10] (2.5:1) , Shahryar Hashemzadeh et.al.[11] (1.7:1) and Woong Sang Sunwoo et.al.[12] (1.5:1). All can be explained to higher male vulnerability to trauma .Our high percent may be related to small number of our patients .

The youngest patient was 11 years old male , while the oldest was 68 years old .The mean age was 39.5 years .This result is comparable to the study done by Takishi Shiraishi et.al.[10] in which the mean age was 41 years ,but different from the studies done by Reza Bagheri et.al.[10], and Hesham Negm et.al.[14] in which the mean age was (23.5) and (26.2) years respectively .This difference may be due to delayed diagnosis and management .

The most common cause of tracheal stenosis in our study was the post intubation stenosis , which was seen in 28 (70%) patients .Less common cause was traumatic stenosis in seven (17.5%) patients ,and the least was neoplastic stenosis which was seen in five (12.5%) patients ,which is comparable to Grillo study in his historical review part 2 2003[15] in which he stated that post intubation lesions are the most common indication for tracheal resection and reconstruction (79%),then the other indication was trachea-esophageal and trachea- innominate fistulae. These results also agree with the study done by Shahryar Hashemzadeh et.al.[11] (77.8%) ,but it is higher than the study done by Christopher J. Mutrie et.al.[16]in which he reported only (54%) of his patients with tracheal stenosis were due to post intubation .

Progressive dyspnea was the most common presenting clinical feature in our study which was seen in 27(67.5%) patients .A comparable results were seen in Takeshi Shiraishi et.al.[13] and Celine Pinsonneault et.al.[17] whom reported a percent of (66.6%) and (57%)respectively .

The mean length of the surgical resection of the stenotic segment in our study was three rings which is comparable to the study done by Takeshi Shiraishi et.al.[13] in which the mean length of resection was (3.6 rings).Shahryar Hashemzadeh et.al.[11]reported mean length of resection to be 5 rings .

Postoperative complications was seen in seven (17.5%) patients in the form of recurrent partial stenosis in four (10%) patients, aspiration seen in two (5%) patients and wound infection in one (2.5%)patient , while Ioan Cordos[18] reported less post operative complications in his study (1.6%).Higher complication rates reported by Hesham Negm et.al.[14] and Reza Bagheri et.al.[10] studies whom reported (33,3%) and of (25%) respectively .Only single death (2.5%) in the post operative follow up reported in our study while mortality rate was reported to be 5.6%, 1% and 0% in Takeshi Shiraishi et.al.[13], Christopher J. Mutrie et.al.[16] and A. Gallo et.al. [19] studies respectively.

A follow up of our patients during one year post-operatively showed that 36 (90%) patients were free of symptoms and only four (10%) developed partial re-stenosis of the trachea , which had been

managed by bronchoscopic dilatation ,this result agree with that of Christopher J. Mutrie et.al.[16] which showed (93%) of their patients were free of symptoms post-operatively and (7%) of the patients were with partial re-stenosis and also treated by bronchoscopic dilatation . Shahryar Hashemzadeh et.al.[11] study showed a nearly comparable result of (95.9%) of the patients were free of symptoms post-operatively .

The interventional bronchoscopy utilizing laser or cautery or stenting in the treatment of cervical tracheal stenosis can be used in special cases with immediate effect [20] , Such facility is not available at our center.

CONCLUSION:

Tracheal stenosis is not an uncommon complication in our country .

Post intubation stenosis remains the most common cause of stenosis. Bronchoscopy remains the main diagnostic tool for evaluating the degree of the stenosis and it is also used sometimes for short term relief of symptoms through bronchoscopic dilatation .

Surgery of the cervical trachea in form of resection and end to end anastomosis gave a very good outcome in long and multi segment tracheal stenosis.

REFERENCES:

1. Guerrier Y, Nichet L, Dejean Y: [Tracheal stenosis treated by discontinuous dilatation.].*Ann Otolaryngol Chir Cervicofac* 1963;80:222-23.
2. Brandt RH: [Permanent dilatation treatment of tracheal stenosis].*Hno* 1968;16:83-86.
3. Rea F, Callegaro D, Loy M, Zuin A, Narne S, Gobbi T, Grapeggia M, Sartori F: Benign tracheal and laryngotracheal stenosis: surgical treatment and results.*Eur J Cardiothorac Surg* 2002; 22:352-56.
4. Grillo HC, Mathisen DJ: *Surgical management of tracheal strictures. Volume 68*. Edited by Farrell EM, keon WJ. Philadelphia: WB Saunders; 1988: 511-24.
5. F. Brunicardi, Dana Andersen : Schwartz's Principles of Surgery, Ninth Edition.2010; chapter 19.
6. Maassen W, Greschuchna D, Vogt-Moykopf I, Toomes H, Lullig H: Tracheal resection – state of the art.*Thorac Cardiovasc Surg* 1985;33:2-7.
7. Strausz J: Management of Postintubation tracheal stenosis with stent implantation , Oct. 2010.
8. Andrews, M. J. and Pearson, F. G. (1971). The incidence and pathogenesis of tracheal injury following cuffed tube tracheostomy with assisted ventilation: an analysis of a two-year prospective study. Annals of Surgery, Jan.2011;173:249.
9. Cantrell, J. R. and Folse, J. R. The repair of circumferential defects of the trachea by direct anastomosis: Experimental evaluation. Journal of Thoracic and Cardio-vascular Surgery, 1961; 42: 589.
10. Bagheri, Reza, and Mohammadreza Majidi. "Outcome of surgical treatment for proximal long segment post intubation tracheal stenosis." *J Cardiothorac Surg.*. 8. 10.1186/1749-,2013; 35:8090-8-35.
11. Shahryar Hashemzadeh Khosrow Hashemzadeh Farzad Kakaei Raheleh Aligholipour Kamyar Ghabili "Surgical treatment of postintubation tracheal stenosis: Iranian experience of effect of previous Tracheostomy"International Journal of General Medicine 2012;5: 93–98.
12. Woong Sang Sunwoo, Wonjae Cha, Chang Myeon Song,Myung-Whun Sung, Kwang Hyun Kim & Tack-Kyun Kwon "Tracheal growth after airway stenosis surgery: Serial radiographic comparative study" Acta Oto-Laryngologica, 2012; 132: S124–29.
13. Takeshi Shiraishi, Jun Yanagisawa, Takao Higuchi, Masafumi Hiratsuka, Daisuke Hamatake, Naoyuki Imakiire, Toshiro Ohbuchi, Yasuteru Yoshinaga, and Akinori Iwasaki "Tracheal Resection for Malignant and Benign Diseases: Surgical Results and Perioperative Considerations "Surg Today 2011;41:490–95.
14. Negm,Hisham; Mosleh, Mohamed;et.al."circumferential tracheal resection with primary anastamosis for post-intubation travheal stenosis :study of 24 cases "Eur.Arch.of Oto-Rhino-Laryngology, Sep.1 2013: 270 Springer journal
15. Grillo H.C.Development of tracheal surgery :historical review .part (2):Treatment of tracheal disease .Ann Thoracic Surg.Mar 2003;75:1039-47.
16. Christopher J. Mutrie, MD, Shady M. Eldaif, MD, Caleb W. Rutledge, MS, Seth D. Force, MD, William J. Grist, MD, Kamal A. Mansour, MD, and Daniel L. Miller, MD"Cervical Tracheal Resection: New Lessons Learned"(Ann Thorac Surg 2011;91:1101– 6. 2011 by The Society of Thoracic Surgeons.

17. Ce1ine Pinsonneault ; Joanne Fortier ; Franqois Donati "Tracheal resection and reconstruction "accepted for publication February 25, 1999 Can J Anesth 1999;46: 439-55.

18. Ioan Cordos, Ciprian Bolca, Cristian Paleru, Radu Posea, Radu Stoica "Sixty tracheal resections – single center experience" *Interactive CardioVascular and Thoracic Surgery8* 2009:62–66.

19. Gallo, G. Pagliuca, A. Greco, S. Martellucci, A. Mascelli, M. Fusconi, M. de Vincentiis "Laryngotracheal stenosis treated with multiple surgeries: experience, results and prognostic factors in 70 patients" ACTA otorhinolaryngologicaitalica 2012;32:182-88.

20. C.T. Balliger , T.G.Sutedja , J.Strausz and L.Freitag; Theraputic bronchoscopy with immediate effect : Laser , electro cautery , argon plasma coagulation and stents ; European Respiratory Journal, June 1 , 2006 ;27:1258-71.