Outcome of Post-intubation Tracheal Stenosis (PITS) with Primary Resection and Anastomosis

Farhan Ahmed Majeed¹, Yasser Saeed Khan², Nadeem Ahmed Sheikh³, Usama Zafar¹, Muhammad Ishaque⁴ and Sultan Muzaffar⁵

¹Department of Thoracic Surgery, Combined Military Hospital, Multan, Pakistan

²Department of Thoracic Surgery, Combined Military Hospital, Quetta Cantonment, Pakistan

³Department of ENT, Combined Military Hospital, Quetta Cantonment, Pakistan

⁴Department of ENT, Central Park Medical College, Lahore, Pakistan

⁵Department of General Surgery, Yusra Medical & Dental College, Islamabad, Pakistan

ABSTRACT

Objective: To ascertain the outcome of primary resection anastomosis in patients of post-intubation tracheal stenosis (PITS) and the associated morbidity.

Study Design: A case series.

Place and duration of study: Department of Thoracic Surgery, Combined Military Hospital, (CMH) Rawalpindi, Lahore and Multan from January 2010 to August 2018.

Methodology: Patients with tracheal stenosis due to prolonged intubation with functional were included. Exclusion criteria were patients having stenosis due to malignant cause, trauma and glottic stenosis involving vocal cords. Clinical examination, computerised tomography (CT) of neck plus chest and fiberoptic bronchoscopy were done in all the patients, while virtual bronchoscopy were done in 35 cases. Sharp dissection, aided by loupes, was the preferred technique. Thyroid tissue and strap muscle were used as flap for high cricoid lesion. Guardian stitch was applied to all cases. Postoperative elective bronchoscopy was performed after a fortnight.

Results: Among 43 patients, [26 (60.5%) men and 17 (39.5) women] 18 patients were intubated for days >10, 18 for <10 and 7 for <3 days. Thirty-four (79.1%) patients were under 40 years of age, while 23 patients had tracheostomy incorporated in surgery. Bronchoscopy evaluation of distance from vocal cords showed involvement of the first ring in six patients, 1st ring normal in 1, 2 rings normal in 17, while 3 or more rings spared in 19 patients. Length of stenotic segment was <2 cm in 17, between 2-3 cm in 21, and between 3-5 cm in five patients. All patients were successfully extubated. Two patients had twin lesions. Seven patients required hyoid bone excision and release. There was one recurrent stenosis managed successfully with dilatation and granulation removal.

Conclusion: Post-intubation tracheal stenosis (PITS) is curable disease. Primary resection and anastomosis remain the gold standard with acceptable morbidity and mortality.

Key Words: Tracheal stenosis, Intubation, Resection, Primary anastomosis.

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INTRODUCTION

Tracheal stenosis is a complex entity with challenging management. Imperative information beforehand about vocal cord status, glottic involvement, distance from vocal cord to stenosis, its length and exact location is the key to surgical planning.

Mapping gives the precise length of the segment without sacrificing the healthy trachea. Laryngotracheal stenosis is classified as cartilaginous and membranous. On the contrary, acquired stenosis of the region is predominantly membranous. Acquired stenosis of the larynx and trachea notably results consequent to a high prolonged intubation, surgical tracheostomy, a blunt or penetrating high velocity external insult to the neck and chemical or thermal contact. Universally the incidence of intubation related stenosis is 0.9% to 8.3%.¹⁻³ World over, nearly 90% of acquired subglottic stenosis occurs due to prolonged intubation, usually needed for mechanical respiratory support.⁴ Fortunately, the advent of large volume and low pressure cuffs has markedly reduced the occurrence of cuff injury.⁵ The condition may warrant multiple and staged operative interventions.⁶ The rationale of this study was to evaluate

Correspondence to: Dr. Farhan Ahmed Majeed, Department of Thoracic Surgery, Combined Military Hospital, Multan, Pakistan

E-mail: famajeed@yahoo.com

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the surgical management of PITS by tracheal resection and reconstruction in local settings and present it as a safe option for this condition.

The objective of this study was to identify the morbidity and mortality associated with tracheal resection and anastomosis, to compare it with conservative management; and to compare it with international data.

METHODOLOGY

In this case series, 43 patients of iatrogenic tracheal stenosis of all ages were included who were treated surgically at Combined Military Hospital, Rawalpindi, Lahore and Multan from January 2010 till August 2018. All cases had tracheal stenosis consequent to endotracheal intubation and ventilation. Full range vocal cords mobility was confirmed in all patients on fiberoptic direct laryngoscopy. Patients having tracheal stenosis secondary to external trauma, thermal or chemical burns, or consequent to upper aero-digestive tract malignancy and glottic stenosis, involving vocal cords, were excluded. Standard tracheal resection and reconstruction was performed in all patients by the same surgeon. Specific preoperative work-up included a contrast enhanced computed tomogram (CT), fiberoptic bronchoscopy (FB) in all patients, and virtual (3-D) bronchoscopy in 35 patients. The surgical approach involved mediastinal tracheal mobilisation through the neck till tracheal bifurcation anteriorly in pretracheal space. Supercut scissors and loupes were used for sharp dissection and to remain close and parallel to the trachea. The segment was cut ensuring to be as close to lesion to avoid compromise of normal tracheal length, and primary resection with anastomosis in a cogwheel fashion was carried out using 3/0 and 4/0 Vicryl alternate sutures with knots outside. Low voltage bipolar galvanic coagulation was incorporated to secure hemostasis. Thyroid tissue and strap muscle were used as flap for high cricoid lesion.

Guardian suture was applied in all cases. An emergency operation was performed in six patients within 24 hours of presentation due to difficulty in breathing and desaturation. Postoperative bronchoscopy was performed at 2 to 3 weeks to see any narrowing or granulation tissue. Database was maintained for analysis in IBM-SPSS version-25. Descriptive statistics were applied to measure frequencies and percentages. Chi-square test was used as a measure of statistical association. A p-value <0.05 was considered as statistically significant.

RESULTS

In this study, 26 (60.5%) males and 17 (39.5%) females were included. Majority of the patients 79.1% (n = 34) belonged to younger age groups. Three patients (7.0%) belonged to 10-20 year age group and 72.1% (n=31) belonged to 21-40 years age group. Nine (20.9%) patients fell in the upper age stratum, i.e. 41-60 years. Eighteen (41.9%) patients were received with a more than 10 days history of endotracheal intubation/tracheostomy with ventilator support. Eighteen (41.9%) patients remained intubated for more than three but less than 10 days. Seven (16.2%) patients had a duration of intubation less than three days, out of which two just had intubation for the proce-

dure. Twenty-three (53.5%) patients had tracheotomy already in place before tracheal resection and anastomosis.

Table I: Tracheal rings spared from the vocal cord to stenosed segment.

	Frequency (n)	Percentage %
1 Ring involved	6	14.0
2 Ring spared	1	2.3
3 Rings spared	17	39.5
4 Rings spared	19	44.2
Total	43	100%

Peroperative evaluation confirmed a stenosed segment of shorter than 2 cm in 39.5% (n=17) patients, while 48.8% (n=21) patients presented with stenosed segment length of more than 2 cm, but shorter than 3 cm. Only 11.6% (n=5) patients had tracheal stenosis of larger than 3 cm, but less than 5 cm in maximum dimension. Architectural dimensions of individual stenosed airway segment are summarised in Table I. As evident from Table I inadvertent endotracheal intubation had resulted in structural distortion involving more than three tracheal rings in majority of subjects. The 1st tracheal ring was spared in most cases (86%, n = 37). The association between the duration of endotracheal intubation and the length of the tracheal segment involved in granulation and stenosis was not statistically significant (p = 0.280, Figure 1).

Figure 1: Correlation intubation history x length of stenosed segment.

Figure 2: Postoperative outcome.

Recovery remained uneventful in all patients as evident by successful decannulation and lack of stridor. Re-stenosis was observed in only one patient, who was managed successfully with dilatation and granulation tissue removal. Postoperative outcome and complications are shown in Figure 2.

DISCUSSION

The inflated bulb of an endotracheal tube induces pressure necrosis of respiratory epithelium, leading to edema and mucosal ulceration. Impediment to normal ciliary flow tends to deepen the ulcers with bacterial colonisation and establishment of erosive chondritis. The overwhelming cascade of pressure necrosis and erosive chondritis ends up in collapse of the cartilaginous framework and this is the reason that low pressure high volume cuffed intubation tubes have been recommended.⁷⁻¹⁰ Reason for subglottic region as a site of predilection in tracheal stenosis is the signet ring anatomy of the cricoid cartilage preventing outward expansion in progressing edema, simultaneously prompt accumulation of mucosal edema, granulating mucosal ulcers, and scar formation resulting in severe airway compromise characterised by stridor.^{11,12} Criteria for classification of laryngotracheal stenosis had been proposed by McCaffrey in 1992, whereupon he predicted the rate of successful decannulation.¹³ Stage-1 lesions were confined to sub-glottis or trachea and were less than 1cm long. Stage-2 lesions were sub-glottic and longer than 1 cm, but did not extend into glottis or the trachea; these study cases were mostly in stage 2. Stage-3 stenosis was confined to upper trachea, sparing the glottis. Stage-4 stenosis involved paralysis or fixation of one or both vocal cords.

Diagnostic assessment of the condition commences with scrupulous history and a thorough clinical examination. The duration of intubation is pivotal. Indirect laryngoscopy and fiberoptic laryngoscopy provide crucial details. In this study, fiberoptic bronchoscopy was performed. Endoscopy in general anesthetic with video documentation is the mainstay investigation, although imaging may contribute to the diagnosis to a certain limit. Nair *et al.* demonstrated the highest (45.7%) regionwise preponderance of stenosis to be confined to the sub-glottic region as is in this study where all cases had sub-glottic stenosis.⁶ Nair *et al.* had 48.6% of their patients operated upon by placement of Montgomery t-tube; whereas 71% subsequently underwent successful decannulation.⁶ They achieved 100% decannulation success in supra-glottic and glottic stenosis. However, the success rate was 68.8% for sub-glottic stenosis.

The ultimate objective of treating tracheal stenosis is to ensure luminal restoration, while preserving phonation and lower respiratory passage protection against aspiration.¹⁴ To achieve these goals, many patients have to undergo more than one treatment modalities. The myriad of treatment modalities range from LASER ablation, possibly combined with dilatation and intraluminal placement of stent. Endoscopic radial cuts in scar tissue with diathermy are still another option. Some surgeons advocate endoscopic local application of corticosteroids or Mitomycin-C with an aim to inhibit scar formation.¹⁵ Open surgery remains the most favored treatment where stenosis is refractory to endoscopic measures. These include stenosed segments longer than 1 cm, or have glottic or extensive tracheal involvement, as well as near complete stenosis; all call for an open tracheal resection and end-to-end re-anastomosis. Lano *et al.* showed 60% to 70% success rate of primary laryngotracheal reconstruction in adults.¹⁶

Pervez *et al.* evaluated the outcome of endoscopic dilatation,¹⁷ CO₂ LASER excision and open reconstruction in a series of seventeen cases suffering from chronic laryngotracheal stenosis. They concluded that all stage-1 patients were dealt with either endoscopic dilatation or CO₂ LASER excision had uneventful follow-up. However, 10 patients with stage 2, 3 and 4 underwent open resection and reconstruction. Montgomery T-tube was placed in eight patients. Recurrent stenosis took place in two patients in whom t tube had been removed. Decannulation failure was observed in 30% (n=3) of surgically operated patients.¹⁷ Fifth or 6th costal cartilage with intact perichondrium has also been used for tracheal repair. As cited by Mizokami *et al.*, inferiorly based pedicled hyoid bone has given promising results.¹⁸ Tracheal resection and anastomosis can address stenosed segment up to 5 cm, provided the latter does not lie close to carina. Others have shown that tracheal resection and anastomosis, as in this study, has low morbidity and mortality in expert hands and can be done with almost 90% success.¹⁹⁻²¹

CONCLUSION

Treatment of PITS remains a surgical dilemma. It is a curable disease. Tracheal resection and anastomosis remains the gold standard with acceptable morbidity and mortality.

ETHICAL APPROVAL:

Ethical approval was obtained from the Ethical Committee of CMH Multan before the initiation of research work.

PATIENTS' CONSENT:

Informed consents were taken from all the patients to publish the data.

CONFLICT OF INTEREST:

The authors declared no conflict of interest.

AUTHORS' CONTRIBUTION:

FAM: Data collection, data analysis.

YSK: Literature review, statistical activity, manuscript writing.

NAS: Data analysis, literature review.

UZ: Data collection, analysis, picture contribution.

MI: Data collection, result compilation.

SM: Literature review, data analysis.

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