



TRACHEAL RESECTION AND RECONSTRUCTION – A SINGLE CENTER EXPERIENCE OF 123 CASES IN 9 YEARS.

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ABSTRACT

The etiology of Tracheal stenosis is multifactorial. The most common acquired cause for tracheal stenosis is Post-intubation followed by inflammatory, traumatic and idiopathic etiology. The most effective surgical treatment is tracheal resection and reconstruction (TRR). Any symptomatic patient with air way obstruction should be considered for surgery. Benign tumors and malignant lesions either primary or secondary from nearby structures like thyroid may also require tracheal resection and reconstruction. In extreme situations, non-surgical treatments like repeated bronchoscopic dilatation, laser application and stenting with T tubes or other synthetic conduits are indicated in selective group of patients who are either unfit or unco-operative and to stabilize them before surgical intervention. Through this study over a period of 9 years, we aim to evaluate the various causes of tracheal stenosis, the outcome of surgery and analyze the ways to prevent dreadful complications.

KEYWORDS : Tracheal stenosis, Tracheal resection and reconstruction

Introduction:

Various pathological conditions lead to tracheal stenosis (TS) which may be congenital or acquired, benign or malignant and acute or chronic. The most effective surgical treatment for these conditions is tracheal resection and reconstruction (TRR). Through this study over a period of 9 years, we aim to evaluate the various causes of tracheal stenosis, the outcome of surgery and analyze the ways to prevent dreadful complications.

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Materials and methods:

Study period: Between August 2008 to July 2017. Study design: Prospective study. Study material: All symptomatic patients admitted in Cardiothoracic Surgery department with tracheal stenosis of varied etiology. 123 consecutive patients with tracheal stenosis posted for tracheal resection and reconstruction constitute the core group of study.

There were 74 (60.16%) males and 49 (39.84%) females, with a median age of 31 years (range 13 - 65 years). We divided them as per congenital/acquired category, among the acquired inflammatory/idiopathic, benign/malignant and acute/chronic sub-categories. Tables 1-3 illustrate the presentations.

All patients were symptomatic and presented with cough, dyspnea, stridor and we encountered hemoptysis in 16 cases. 9 patients with tracheoesophageal fistula had typical swallow-cough sign and some with wheezing. Preoperative assessment included endoscopic examination, chest X-ray and CT-scan to evaluate the extent of the airway involvement and distant metastases in case of tumoral lesions. Most of the lesions (113) were situated in the upper third of the trachea with 28 cases of laryngeal involvement. There

were six cases of stenosis in the middle third of the trachea and four patients with lower third lesions (Table 4).

Table 1 Age and Sex distribution

| Age | | Sex | |
|----------------|-----------------|-------|---------|
| Range in years | No. of patients | Males | Females |
| ≤ 10 | Nil | Nil | Nil |
| 11 - 20 | 30 | 14 | 16 |
| 21 - 30 | 43 | 28 | 15 |
| 31 - 40 | 22 | 16 | 6 |
| 41 - 50 | 14 | 6 | 8 |
| 51 - 60 | 10 | 6 | 4 |
| 61 - 70 | 4 | 4 | 0 |
| Total | 123 | 74 | 49 |

Table 2 Etiology

| Types | No. of patients |
|------------|-----------------|
| Congenital | Nil |
| Acquired | 123 |
| Acute | 21 |
| Chronic | 102 |

Table 3 Underlying pathology of TS

| Type | No. of patients | % |
|--|-----------------|-------|
| Traumatic/inflammatory/idiopathic | 116 | 94.30 |
| Postintubation stenosis | 105 | 85.37 |
| Tracheoesophageal fistula | 9 | 7.31 |
| Idiopathic | 2 | 1.62 |
| Tumoral stenosis | 7 | 5.69 |
| Benign tumor | 2 | 1.62 |
| Malignant tumor | 5 | 4.06 |
| Primary tracheal tumor | 2 | 1.62 |
| Secondary tracheal tumor (direct invasion from thyroid/thymic carcinoma) | 3 | 2.44 |

Table 4 Location of Tracheal stenosis

| Location | Lesion | No. of patients |
|-------------------------|---------------------------|-----------------|
| Upper third (113 cases) | Postintubation stenosis | 110 |
| | Carcinoid tumor (Typical) | 2 |
| | Adenoid cystic carcinoma | 1 |
| Middle third (6 Cases) | Post tracheostomy | 4 |
| | Post TEF repair | 2 |
| Lower third (4 cases) | Squamous cell carcinoma | 1 |
| | Thyroid carcinoma | 2 |
| | Thymic carcinoma | 1 |
| Total | | 123 |

All cases were investigated for co-morbid significant medical illnesses, posted for surgery after concerned specialist opinions and anaesthetic fitness. We followed the operative techniques described by Pearson et al. [1] and Grillo et al. [2]. Cervical approach by a collar incision was used in 111 cases (with the tracheostomy stoma included when present), cervical incision extended with partial sternotomy in five and posterolateral thoracotomy in seven cases. Strap muscles of neck are not divided but retracted. Isthmus of thyroid gland was divided and ligated. We performed 95 tracheal resections and 28 cricotracheal resections. The length of resection ranged between 1.5 and 5 cm. The range of resected rings was 2 to 10.

All patients except those on preop-tracheostomy were intubated initially with a small caliber endotracheal tube until the trachea was exposed and circumferentially dissected as long as the extent of the lesion, sparing the inferior laryngeal nerves and avoiding lateral dissection at the margins of reconstruction edges to preserve adequate blood supply. When there was laryngeal involvement only the antero-lateral portions of the cricoid cartilage were removed. During resection and anastomosis, ventilation was continued using a distal intubation tube/adequate caliber endotracheal tube pushed oro-tracheally by rail-roading technique. In few cases of the middle and lower third tracheal stenosis, high frequency jet ventilation was advocated. In case of tracheoesophageal fistula, after closure of the esophageal wall with 3-0 Polydioxanone/Polyglactin interrupted sutures, we used a local muscular flap (strap muscles of neck) to isolate it from tracheal anastomosis. For end-end tracheal anastomosis, we used 3-0 polyglactin (Vicryl) interrupted sutures at 2mm distance from the edge and between each bite. Knots were tied on the outside. To avoid tension at the anastomotic line, we used two traction sutures of 2-0 polyglactin taken well apart from the edges antero-laterally, held closer on each side during anastomosis and tied later by just approximation. Perfect haemostasis, adequate suction and cautious use of diathermy were maintained during the procedure. After cervical skin incision closure, two Guardian stiches (chin to chest) were applied with no.1 silk suture (with the neck kept in 30° flexion) to avoid undue neck extension in the postoperative period which were removed after 5 – 7 days. The patient was advised not to hyper-extend the neck for another 2 weeks. This helped in avoiding undue tension on the tracheal anastomotic line and prevented anastomotic leak in most of the cases.

There were a number of releasing maneuvers described in the literature for a tension-free tracheal anastomosis in case of long segment resections of more than 4 cms. We performed mostly with pretracheal mobilization, suprahyoid laryngeal release and cervical flexion. In selected few cases (5) where resection segment was > 4.5 cm, we had done hilar/pulmonary ligament release and pericardial incision over inferior pulmonary vein through right 4th intercostal space posterolateral thoracotomy.

In case of the two secondary tracheal tumors, from direct invasion of a thyroid cancer in one and thymic cancer in another, we performed 'en-bloc' resection of the specimen and checked for the absence of tumor tissue in the resected margin by frozen section. We achieved R0 in all malignant tumours except in one with thymic cancer where it was R1. We had performed complete cervical lymphadenectomy

in two cases of secondary tracheal tumors with our surgical oncologists but not performed any complete mediastinal lymphadenectomy. Patients with proven malignancy were given adjuvant treatment by our oncologists.

18 patients presented with acute stridor and severe dyspnoea due to critical tracheal stenosis were taken up for emergency resection and reconstruction after on table assessment and control of airway. In 22 such severe cases, emergency preliminary tracheostomy was done to control the airway and stabilize the patient before attempting surgical intervention later. In very few cases of benign tight stenosis, dilatation was performed with rigid bronchoscope and obstructing tumor cored out using biopsy forceps.

We had not used laser for any resection, as that facility was not available in our center.

Results:

Except in 4 cases (3.25%), we had extubated all other patients on table in the operating room. One case of TEF with bilateral patchy pneumonitis, 2 cases of secondary tracheal tumors (from thyroid and thymic primary cancers) and one case of long segment tracheal stenosis with pericardial patch tracheal reconstruction needed prolonged postoperative ventilation. Our early postoperative mortality rate was 3.25% (4 cases). 3 cases died due to postoperative pneumonia with poor respiratory compliance and one case as a result of anastomotic leak with mediastinitis and severe sepsis.

Postoperative hospitalization ranged between 6 to 11 days with a median of 8 days. Our short-term results were excellent with no complications in 111 cases (90.24%) and notable complications in 8 cases (6.50%). There were 6 cases of anastomotic leakage, 3 were mild and subsided after few days, 2 were reoperated and needed prolonged montgomery T tube insertion, the last one was severe with mediastinitis and died of sepsis later. There were no cases with recurrent laryngeal nerve injury. Follow-up period ranged from 2 months to 9 years.

At 1 year follow-up, one patient had developed recurrent stenosis and underwent a successful revision surgery with good result. All patients with benign tumors were alive with no recurrence. One patient with squamous cell carcinoma of trachea and other one with thyroid cancer developed metastatic disease at 2 years follow-up and succumbed. Table 5 illustrates our results.

Table 5 Results data

| Morbidity and Mortality | No. | % |
|----------------------------------|-----|-------|
| Short-term complications | 8 | 6.50% |
| Anastomotic leakage | 6 | 4.88% |
| Wound infections | 2 | 1.62% |
| Recurrent laryngeal nerve injury | Nil | |
| Long-term complications | | |
| Recurrence (metastasis) | 2 | 1.62% |
| Restenosis | 1 | 0.81% |
| Mortality | | |
| Early - Intraoperative | Nil | |
| - postoperative | 4 | 3.25% |
| Late (Metastatic cancer) | 2 | 1.62% |

Discussion

Multidisciplinary team approach is needed while managing tracheal stenosis of varied etiology. We have resected upto 5 cm length of trachea (10 rings) and made reconstruction without undue tension on the anastomotic line by various release incisions [4]. The international published series in the literature (Table 6) showed comparable good outcome in our study with low morbidity and mortality. The prime cause of stenosis in our study was postintubation tracheal injury. Emergency tracheal resection and reconstruction is the need of the hour in acute cases with good results shown in our study. We encountered only less number of

tumoral lesions out of which the results were good, when the resected margin was tumor free and no evidence of metastasis present. We had not used any other tracheal stents apart from silicone T tube [3]. We had no incidence of any tracheo-innominate arterial fistula in our study.

Table 6 Literature Data for comparison

| Study by | No. | Mortality (%) | Notable complications (%) |
|---------------------------------|-----|---------------|---------------------------|
| Grillo et al. [5] | 521 | 2.4 | 13.9 |
| Couraud et al. [6] | 217 | 3.2 | 4.6 |
| Rea et al. [7] | 65 | 1.5 | 12.3 |
| Amoros et al. [8] | 54 | 1.85 | 9.2 |
| Maruli et al. [9] | 37 | 0 | 8.1 |
| Auchincloss et al. [10] | 901 | 1.2 | 18.2 |
| Sivaraman A. et al. (our study) | 123 | 3.25 | 6.5 |

Conclusion

Careful surgical dissection of trachea without jeopardising its blood supply with adequate release maneuvers and cervical flexion, long segment tracheal resections can be done safely. Avoiding undue tension on the anastomotic suture line with traction sutures and reinforcing the site with vascularised local muscle flap or omentum yields good outcome. If there is circumferential mismatch during reconstruction, telescoping of edges gives an airtight anastomosis and avoids anastomotic leak. Emergency tracheal resections in acute stenosis can be performed with success as shown by our study. But our results in secondary tracheal tumors are not encouraging. In recurrent stenosis, tracheal stents or T tube can be used to stabilize the patient, before definitive surgical intervention.

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