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TRACHEAL RESECTION AND END-TO-END ANASTOMOSIS FOR TRACHEAL STENOSIS: ETIOLOGY AND OUTCOME

Abstract

Objective: To know the etiology of tracheal stenosis and assess outcome of tracheal resection and end-to-end anastomosis for tracheal stenosis.
Study Design: Descriptive prospective case series.
Place and Duration of Study: Department of Thoracic Surgery, Combined Military Hospital, Rawalpindi and Quetta from May 2005 to March 2010.
Patients and Methods: Twenty two patients were included in the study who underwent tracheal resection followed by primary tracheal reconstruction by same surgical team. Etiology was ascertained on the basis of available history and per-operative findings. End-to-end tracheal anastomosis was done using vicryl 3/0. Outcome of surgical technique was assessed using peak expiratory flow rate (PEFR) and flexible bronchoscopy.
Results: Twenty two patients were managed over a period of five years, of which 17 (77.3%) were male and 5(22.7%) female. Mean patient age was 27.31±9.61years. Seven (31.8%) patients had New York Heart Association grade (NYHA)-III and 15(68.2%) had NYHA grade-IV dyspnoea. Seventeen (77.3%) had stridor. All patients were already being managed by pulmonologists, ENT specialists or intensivists. Twelve (54.5%) had grade-V stenosis (91-100% luminal obstruction) and 9 (40.9%) had grade-IV stenosis (76-90% obstruction). Six (27.3%) patients had subglottic stenosis, 13 (59.1%) had cervical tracheal stenosis and 3(13.6%) had mediastinal tracheal stenosis. Six (27.3%) patients had partial cricoid resection followed by thyrotracheal anastomosis, 13(59.1%) patients underwent cervical tracheal anastomosis and 3 (13.6%) patients required mediastinal tracheal anastomosis. Patients were followed up post-operatively for the development of immediate and delayed complications. The follow up was carried out for a minimum period of 6 months to a maximum period of 2 years. Postoperative complications included neck pain, lung collapse, and superficial skin infection.
Conclusion: Tracheal resection with end-to-end anastomosis is a safe, reliable and permanent procedure for the treatment of tracheal stenosis.

Article

INTRODUCTION

Trachea is a pliable compressible tube traversing through neck and mediastinum. This wind pipe is specialized in air conduction, humidification, particulate trapping and mucociliary clearance1. Narrowing of this tube may result in tracheal stenosis; causes of which may be congenital or acquired; involving lumen, in the lumen or outside it2. Use of mechanical ventilation has contributed towards this relatively uncommon disease entity; primarily because of prolonged intubation or tracheostomy3. Patients develop progressively increasing dyspnoea, stridor or recurrent chest infections. Nonspecific symptoms are common; patients have been misdiagnosed and treated for refractory bronchial asthma.
Managing tracheal stenosis dates back to 1886; when Colles described 4 cases of tracheal stenosis after tracheostomy in 57 children with diphtheria4. Variety of procedures evolved including tracheal incision, exclusion, tracheoplasty, resection/anastomosis, grafts, flaps etc. In the era of minimal invasive surgery, dilatation, stenting and endoscopic/ laser resection flourished. The goal of treatment is a patent, uncollapsable tube of adequate lumen without any recurrence and associated injury. Resection of tracheal stenosis with primary end-to-end anastomosis remains the gold standard against which any other procedure can be evaluated5.
Tracheal resection/reconstruction is a delicate, technically demanding procedure requiring a team work; specially an expert tracheal surgeon, anaesthesiologist, pulmonologist and intensivist. Tracheal resection with end-to-end anastomosis was started in 2005 in department of Thoracic Surgery, Combined Military Hospital Rawalpindi. No original study on tracheal resection and end-to-end anastomosis has ever been published from Pakistan. Keeping in view of uncommon disease nature, its increasing incidence, lack of management facilities as well as lack of original studies from Pakistan, a prospective descriptive study was carried out with the objective to know the etiology of tracheal stenosis as well as to evaluate the outcome of tracheal resectional surgery in our centre.

PATIENTS AND METHODS

Tracheal resectional surgery in Combined Military Hospitals of Rawalpindi and Quetta was started on regular basis in 2005. History of present illness with severity, duration, association of dyspnoea, stridor, cough, sputum and fever was obtained. Past history of airway intervention (trauma, tracheostomy, endotracheal intubation and dilatation) was taken. Associated co morbidities like recent mechanical ventilator support, polytrauma, head injury, diabetes mellitus, pneumonia and neurological disease were also noted. Detailed systemic examination of throat, neck and chest was done.
All patients were admitted and routine baseline investigations were done. Neck/chest x-rays and CT scan with 3D reconstruction of tracheobronchial tree were requested. Airway stenosis classification system by Freitag et al6 was used. Flexible/rigid bronchoscopy was done in all patients and length, site, severity of stenosis, distance from vocal cords and cord mobility was noted. Bronchoscopic evaluation of confounding variables like webs, edema, acute granulation, tracheal tear and cartilage fracture was carried out. Only patients with confirmed tracheal stenosis were included and patients with tracheal webs, edema, acute granulation, acute tracheal trauma and cartilage fracture were excluded.
Chest physiotherapy, incentive inspirometry and nutritional build up were started as per departmental protocol. Pre-anaesthetic workup was done. Patient counselling was done and informed written consent was taken. General anaesthesia was administered through smallest endotracheal tube or tracheotomy. Trachea was approached and exact site/type of stenosis was ascertained. Tracheal stenosis was dissected within pretracheal fascia. No attempt was made to identify recurrent laryngeal nerves. Trachea distal to stenosis was opened and endotracheal tube passed (Figure 1).

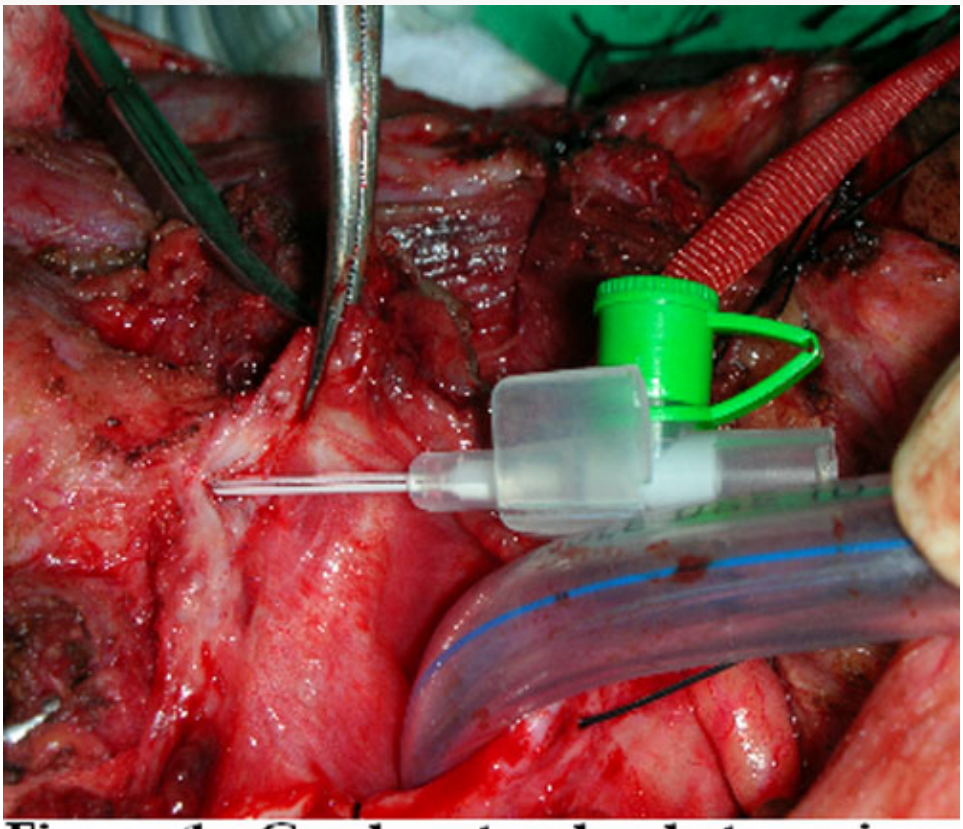

Figure 1: Grade-v tracheal stenosis with 18-g cannula.

Stenotic portion with tracheostomy was excised upto proximal healthy trachea. Anteroposterior/ Suprahyoid release was done where deemed necessary. Posterior tracheal anastomosis was done using interrupted full thickness 3/0 Polygactin sutures with knots outside with neck flexed to 45º (Figure 2).

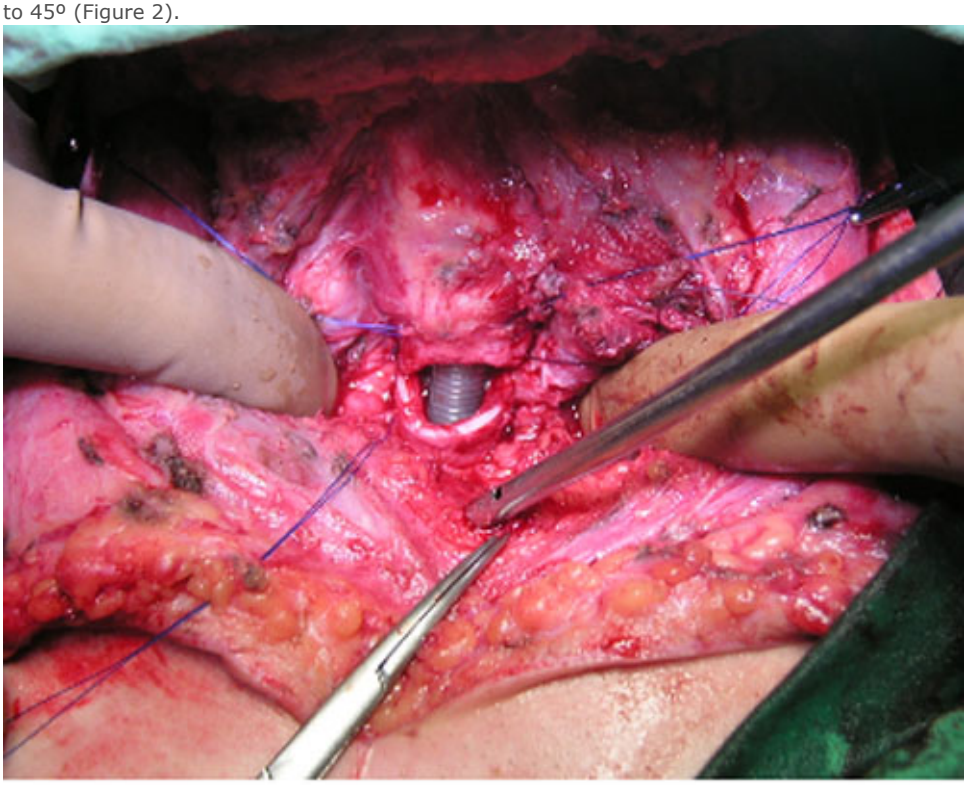

Figure 2: Posterior tracheal anastomosis done with orotracheal armour tube in place

Oral armored endotracheal tube was passed and anterior tracheal anastomosis completed (Figure 3).

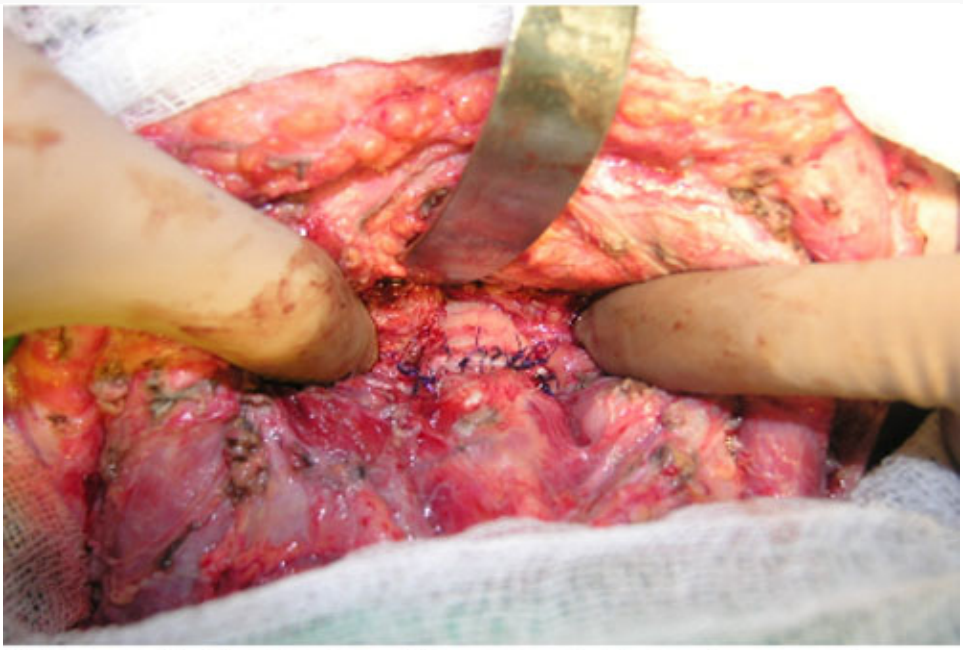

Figure 3: Anterior Tracheal Anastomosis

Puncture test was done to confirm air-tight anastomosis. Anastomosis was covered with thyroid isthmus or muscle flap. Layered closure was done and guarding stitches in 45º neck flexion were applied. Bronchoscopic suction clearance of tracheobronchial tree was done before extubation. Extubation was done either in operating room on-table or after few hours in ITC. Neck staples were removed after first week and guarding stitches after three weeks. Regular follow-up was ensured and all pertinent data was maintained on SPSS 15.

RESULTS

Twenty two patients of confirmed tracheal stenosis were managed in Combined Military Hospitals of Rawalpindi and Quetta over a period of five years. Seventeen (77%) were male and 5 (23%) female. Mean patient age was 26.31±9.61 years. Eleven (50%) had tracheal stenosis of less than 10mm. Twelve (54.5%) had grade-V luminal obstruction, 9 (40.9%) had grade-IV obstruction and 1 (4.5%) had grade-III obstruction. Etiology of stenosis in our patients is shown in figure 4.

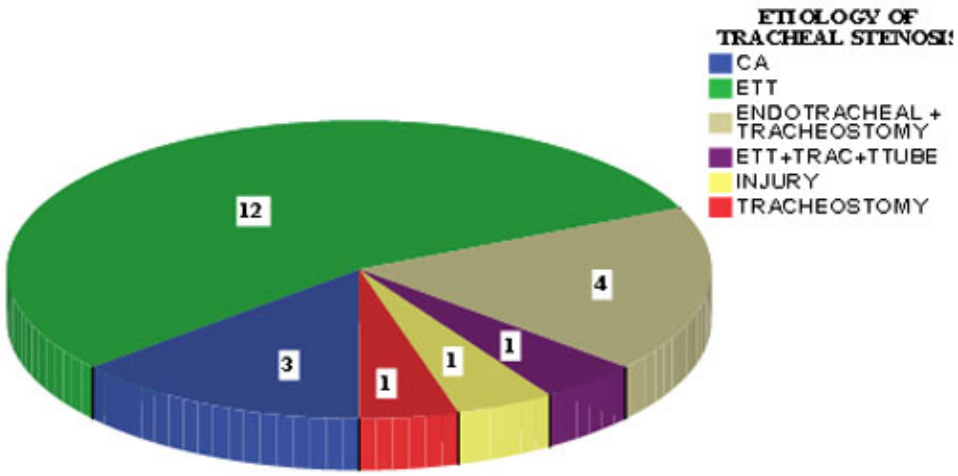

Figure 4: Etiology of Tracheal Stenosis

Ten patients (45.5%) had ETT passed for anesthesia/mechanical ventilation. Five (22.7%) had endotracheal intubation as well as tracheostomy done; making it difficult to ascertain the exact cause of stenosis. Tracheal tumors (2 x adenoid cystic carcinoma, 1x schwannoma) were obstructing the lumen critically in 3 (13.6%) patients. Tracheostomy was the only cause of stenosis in 2 (9.1%). One (4.5%) had endotracheal intubation for ventilator support after head injury; followed by tracheostomy. Attempts for decannulation of tracheostomy failed multiple times; after which a T-Tube was placed in addition to tracheostomy. One (4.5%) had primary laryngotracheal trauma resulting in stenosis

Resection of tracheal stenosis followed by primary end-to-end anastomosis was carried out in all patients. Eighteen (81.8%) patients were approached through cervical collar crease incision. Three (13.6%) patients required sternal-split for mediastinal tracheal resection /anastomosis. One (4.5%) patient was approached through right thoracotomy for stenosis caused by lower tracheal tumor. Crico-tracheal anastomosis for subglottic stenosis was done in 6 (27.3%) patients. Tracheo-tracheal anastomosis for upper cervical stenosis was done in 13 (59.1%) patients. Mid/lower tracheo-tracheal anastomosis was done in 4 (13.6%) Antero-posterior tracheal release was done in all patients while supra-hyoid release was done in 15 (67.7%) patients.

Outcome of our surgical technique was evaluated with immediate and late results. Initially patients were electively ventilated for 24-48 hours. However with growing experience, on-table extubation was done in the last 12 (54%) patients without need for re-intubation postoperatively. All patients were encouraged incentive inspirometry after three weeks, once neck guarding stitches were removed. Postoperative PEFR was noted at that time; which in our series showed remarkable improvement. All patients underwent flexible bronchoscopy at three months to evaluate tracheal lumen, suture line and any complication. All patients had almost normal tracheal lumen except for two patients who required temporary tracheostomy. Patient-convenient follow-up was done in our series for a minimum period of 6 months to a maximum period of 2 years. After two years, six monthly telephonic follow-up of each patient is maintained todate.

Post-operative complications included neck pain in 10 (45%) patients; probably due to flexed neck posture for 2-3 weeks. Two patients (9%) had lung collapse (1 x lobar, 1 x complete) which were managed conservatively by antibiotics, bronchoscopic lavage and physiotherapy. One (4.5%) patient with subglottic stenosis had laryngeal edema, managed with tracheostomy for two weeks. One diabetic patient had anastomotic granulation, managed successfully with tracheal T-Tube placement for three months. Pneumonia and sacral bed sore were noted in one patient each. One patient developed radial artery thrombosis after arterial line insertion, which responded well to anti-coagulation. No mortality or major complication like anastomotic leak, fistula or recurrent stenosis was noted.

DISCUSSION

Development of tracheal stenosis has increased in recent years due to iatrogenic airway trauma by intubation, tracheostomy and mechanical

ventilator support7. After intubation, stenosis commonly occurs at cuff site8. A cuff pressure above mucosal capillary refill pressure (more than 30 mm Hg) leads to ischemia, ulceration,cartilage damage, chondritis, fibrosis and scarring9. Despite invent of low pressure-high volume endotracheal tubes, it remains a major contributing factor in development of stenosis with an incidence of 6-21%10.
Tracheal cartilage damage at stoma site, tube tip and posterior curve alongwith large size tube, too much force applied, large stoma, wound sepsis are the leading causes of stenosis after tracheostomy with an incidence range 0.6-21%11. Any patient with a history of mechanical ventilator support in recent past and developing upper airway obstruction has tracheal stenosis unless proved otherwise12.
Many classifications evolved over time to grade severity of stenosis including Cotton-Myers, Grundfast, McCaffrey etc; however, we used tracheal stenosis grading by Freitag et al in our study13. Flexible/rigid bronchoscopy through nasal/tracheostoma route is required to ascertain site, length, grade of stenosis and vocal cord function. Recently tracheo-bronchial CT scan with virtual bronchoscopy is becoming a popular non-invasive tool with high sensitivity14,15.
Reconstructive tracheal surgery developed very late because of disease being relatively uncommon, poor healing capacity of tracheal cartilage, difficulty in maintaining ventilation during tracheal resection and shortage of surgeons practicing tracheal surgeries16,17. Uncommon nature of tracheal stenosis is mentioned in various studies in international literature. To date, no local study on the primary tracheal resection and reconstruction is available in Pakistan. Airway surgery is a team work of expert tracheal surgeons and anesthetists. All patients in our study underwent tracheal resection followed by primary end-to-end anastomosis using the basic principles of tracheal surgery18. Success rate of 100% was achieved by our surgical technique and is comparable to many international studies19,20. Regarding minimal invasive techniques like serial dilatation, lasers, cryotherapy, micro-cauterization, intra-lesional steroids and stents which are usually reserved for patients unfit for general anaesthesia, elderly, minimal stenosis, recurrent stricture following surgery and non-compliant patients but none of these was experimented in our study21,22.
The limitations of our study were small sample size due to multiple factors, like lack of awareness about development of stenosis amongst patients as well as physicians, inability to compare resection with other minimal invasive techniques and poor and late referral in our health system. All these issues need to be addressed future studies.

CONCLUSION

Meticulous preoperative planning, careful dissection, excellent perioperative airway control and communication between operating surgeon, anaesthetist and intensivist are mandatory for safe and successful outcome after tracheal resection and primary end-to-end anastomosis.

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