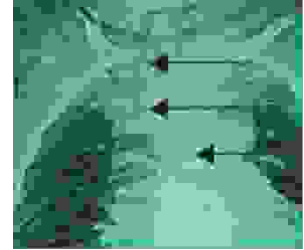


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CHRONIC LARYNGOTRACHEAL STENOSIS; SURGICAL MANAGEMENT



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ABSTRACT ... drshahident@hotmail.com **Objective:** To evaluate the surgical management of the patients suffering from chronic laryngotracheal stenosis. **Design:** Prospective study. **Setting:** ENT Department Combined Military Hospital Rawalpindi. **Period:** May 1998 to Aug 2000. **Materials & Methods:** Seventeen consecutive, diagnosed cases of chronic laryngotracheal stenosis were evaluated by history and thorough ENT examination. Direct laryngoscopy was performed in all the patients. CT scan was carried out in 12 of them. Patients were classified according to the McCaffery's system of staging. The surgical procedures performed ranged from endoscopic dilatation and CO₂ laser excision of stenosis to open reconstructive procedures. Mean period of follow up for each patient was 8.7 months, during which results of the repair were evaluated by the absence/recurrence of the symptoms and success in decannulation. **Results:** Eight patients (47%) had stage-3, three (17.6%) had stage-1, two (11.9%) had stage-2, and one (5.9) had stage-4 laryngotracheal stenosis. Three patients (17.6%) suffered from tracheal stenosis only. Five patients (29.4%, including all the patients with stage-1 stenosis) were subjected to endoscopic dilatations or CO₂ laser surgery; rest (70.6%, including all those with stage 2, 3 and 4 stenosis) required complex open reconstructive procedures. Laryngotracheoplasty was performed in 10 patients (58.8%). T-tube was placed in 8 of them. On the average each patient was subjected to 4.6 operations involving 1.5 different kinds of surgical techniques. All the patients with stage-1 stenosis remained asymptomatic during the period of follow up. Recurrence of stenosis was noticed in both the patients in whom T-tube was removed. Decannulation was successful in 3 out of 5 patients who were wearing tracheostomy. **Conclusion:** Treatment should be individualized. Milder form of stenosis requires relatively simple procedures. Multiple operations and more than one surgical technique are frequently required. Even then the results are not uniformly satisfying. Decannulation is not always possible. Recurrence rate is high. Long-term follow up is necessary. Careful preoperative evaluation, selection of most appropriate surgical technique, meticulous surgical skills and dedicated postoperative follow-up are essential for successful outcome.

Key Words: Laryngotracheal stenosis, Subglottic stenosis, Laryngotracheoplasty.

INTRODUCTION

Chronic laryngotracheal stenosis is said to be established if airway remains unsatisfactory 4 weeks after the injury¹. With increased mechanization of the day to day life, advent of newer and faster means of transportation, introduction of more violent sports, and wide spread adoption of prolonged intubation or tracheotomies for a variety of medical and surgical conditions, more and more cases of this hitherto little known entity are being encountered in the clinical practice^{2,3}.

Soft tissue stenosis occurs due to mucosal loss, mucosal adhesion or organization of haematoma. Cartilaginous stenosis is a more serious injury. Because of the inherent 'tissue memory', cartilage tends to realign itself to its previous scarred, altered position every time it is repaired⁴. Furthermore the variable dynamics of wound healing in the tubular structure can further deteriorate the minor stenosis.

These are the major challenges and dilemmas of the management, which can stretch the skills and the stamina of the surgeons to their limits.

The wide variety of the surgical techniques currently in vogue and mentioned in the literature clearly speaks of the frustration with the therapeutic results. In the recent past, however, the situation has improved almost dramatically.

This surge was possible because of the increased awareness about the pathogenesis, better investigation facilities, improved surgical and anaesthetic skills, technological advancements like of silicon T-tubes, CO₂ laser and artificial ventilatory support and sharing of experience between various centres indulged in such kind of surgery. The patients can now hope for a cure or at least a palliation.

MATERIAL & METHODS

This study, which spanned over 2¹/₄ years, comprised of 17 consecutive, diagnosed cases of chronic laryngotracheal stenosis. All were secondary to iatrogenic or accidental trauma. Seven patients with acute laryngotracheal trauma and 1 with congenital subglottic stenosis were excluded from the study. Two of the patients (11.9%) were treated previously at some other centres. One of them had 3 endoscopic dilatations and the other had a myo-osseous flap operation; however, the results had not been obliging in either case. Five of the patients (29.4%) were already wearing tracheotomy.

Each patient was subjected to thorough history, systemic and ENT examination with special reference to the findings on the indirect laryngoscopic examination. x-ray neck lateral view for soft tissue shadow and direct laryngoscopy under general anaesthesia with careful recording of the findings was carried out in every case. CT scan was done in 12 patients in whom loss of cartilaginous framework was suspected. Barium swallow was done in 2 patients having additional problem of aspiration. Patients were classified according to McCaffery's system of staging⁵.

The treatment included both internal (close) procedures like endoscopic dilatations and excision of stenosis/ removal of granulations using CO₂ laser and the external (open) operations. The latter category included laryngotracheal reconstruction using T-tube stenting or hyoid/ myo-osseous flap interposition, thyroplasty and total laryngectomy etc. The average period of follow-up for each patient was 8.7 months. The criteria of determining the success of the treatment were, firstly, the extent in the relief of the symptoms and the duration for which it was maintained and secondly, the success in decannulation of the patients already wearing the tracheostomy.

RESULTS

Analysis of all the data of our study revealed the following results. The age incidence ranged from 12-60 years, mean age being 37.5 years (Fig-3).

On clinical evaluation the stenosis was seen to involve both trachea and larynx in 14 cases (82.4%). In the rest of the 3 (17.6%), the stenosis was limited to the trachea only

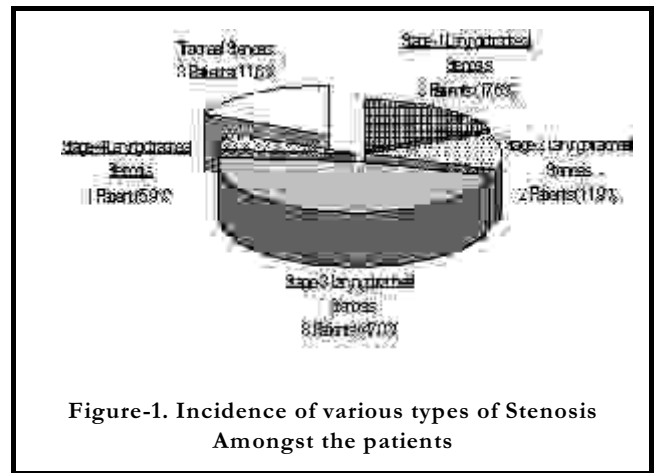
Stage - 1 Laryngotracheal Stenosis	Stenosis < 1cm in length, limited to subglottis
Stage - 2 Laryngotracheal Stenosis	Stenosis > 1 cm in length, still to subglottis.
Stage - 3 Laryngotracheal Stenosis	Subglottis stenosis with extension to the trachea but healthy glottis.
Stage - 4 Laryngotracheal Stenosis	Stenosis involving the glottis in addition to subglottis and trachea.

Surgical procedures	No of Pts	No of times the procedure was carried
Endoscopic dilatation	4	53
Laser excision of stenosis /removal of granulaations	4	10
Laryngotracheoplasty /tracheoplasty	10	10
Tracheostomy	3	3
Thyroplasty	2	2
Cricopharyngeal Myotomy	1	1
Total laaryngectomy	1	1

The only patient with stage-4 stenosis had bilateral

vocal cord paralysis and tracheo-oesophageal fistula as well.

All the 17 patients were subjected to surgery. Selection of the procedure was generally based upon the clinical findings and the type and the stage of the stenosis. Repeated endoscopic dilatations and excision of stenosis/ granulations with CO₂ laser were performed in all the 3 patients with stage-1 stenosis and 2 patients with tracheal stenosis.



All the 8 patients with type-3 stenosis and one each with stage-2 stenosis and tracheal stenosis were subjected to laryngotracheoplasty/ tracheoplasty. T-tube stenting was done in 8, while hyoid /myo- osseous flap interposition was carried out in 3 of them. The second patient with stage-2 stenosis and the only patient with stage-4 stenosis underwent cricopharyngeal myotomy with permanent tracheostomy and total laryngectomy respectively.

As a whole 5 patients (29.4%) were subjected to internal and 12 (70.6%) to external surgical procedures. Laryngotracheoplasty was the most common procedure, carried out in 58.8% of the population. Endoscopic dilatation was the most frequently repeated procedure.

All but 2 patients required multiple operations. The maximum number of operations carried out in a

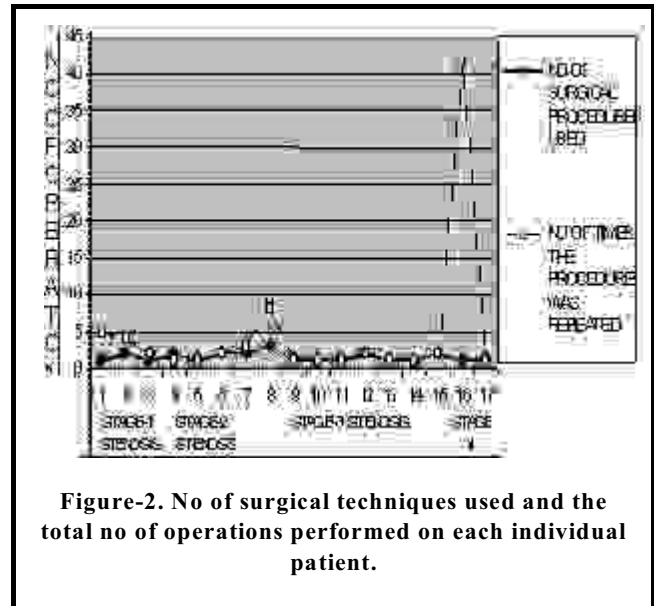
single patient was 42 (Fig-2). This particular patient had lower tracheal stenosis (during the course of treatment he developed pneumothorax which was managed with chest tube).

Table - III No. Of operations performed and no. of surgical techniques in different groups of patients.

Types of stenosis	No. Of Patients	Operations performed	Operations Performed / Patient	Surgical Techniques used / Performed
Stage - 1 Laryngotracheal Stenosis	3	11	3.7	1.3
Stage - 2 Laryngotracheal stenosis	2	2	1	1.5
Stage - 3 Laryngotracheal Stenosis	8	19	2.4	1.6
Stage - 4 Laryngotracheal Stenosis	1	1	1	1
Tracheal Stenosis	3	45	15 (1.5)*	1.3
Total	17	78	4.6(2.2)*	1.5

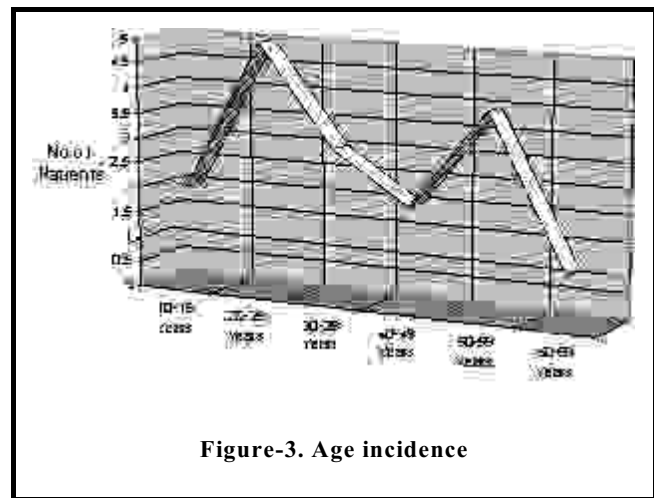
* Excluding the patient who had 42 endoscopic dilations

In majority of the patients (58.8%), a single surgical technique (laryngotracheoplasty, endoscopic dilatation or CO₂ laser surgery) was used as a sole modality of treatment. However significant number (35.3%) required two different kinds of surgical procedures (e.g., laryngotracheoplasty combined with laser surgery or with thyroplasty). One patient (5.9%) with stage-3 stenosis needed even three procedures (laryngotracheoplasty, laser surgery and endoscopic



dilatations).

All the 3 patients with stage-1 stenosis remained asymptomatic during the follow up period. The patient with lower tracheal stenosis, who had a marathon run of dilatations, was still admitted in the ward.



Silicon T-tube was placed in 8 patients (47.0%). In two of them it was removed 6 months after the

surgery. Both developed recurrence of the symptoms after an average period of 6.5 months. They were managed by laser excision of the granulations. In the remaining 6 patients T-tube was still in place. In one of them the outer stump of the tube had been blocked with satisfactory airway and acceptable quality of voice.

Decannulation was successful in 3 of the 5 patients, who were wearing tracheotomy.

DISCUSSION

Reconstruction of the laryngotracheal stenosis remains a formidable challenge in head and neck surgery⁶. Our experience in the management of 17 patients is discussed in the following paragraphs.

It was observed that although people belonging to almost all age groups were affected, majority of the patients were the young adults with mean age of 37.5 years. Another minor peak was also noted in the 5th decade.

These findings are consistent with the results of another study comprising of 60 patients, which too showed that the young adults were affected most commonly. The mean age in the latter study was 29 years⁷.

In a large series involving 101 patients, 45 % of the population was found to be suffering from stage-3 stenosis, 32% had stage-2 and 23 % had stage-4 stenosis⁸. In our study we also noticed that stage-3 stenosis was the commonest type of stenosis, affecting 47% of the patients. Stage-1 stenosis and tracheal stenosis were the next most prevalent types (Fig-1).

The ideal goals of treatment in these patients are to achieve an adequate lumen for respiration, to continue without tracheostomy and to provide a voice capable of communication. The key to the success is to obtain an adequate rigid circular support with normal mucosal lining. Because of the variability

in the complexity and the degree of laryngotracheal stenosis and the challenge of wound healing in a contaminated tubular structure, the ideal reconstructive technique has not been found⁶. As a general principle the treatment plan should be a realistic one, conforming to the severity of the symptoms, type, site and the extent of the stenosis, general condition and emotional and professional needs of the individual patient.

The endoscopic dilatation and resection of the stenosis with CO₂ laser alone or in combination with other surgical procedures, has shown encouraging results in the early or mild stenosis. A success rate of 61% has been reported in a study in which 14 patients with stage-1 stenosis were treated with Nd:YAG laser and were followed up for 8 months⁹. The single patient (with stage-1 stenosis) in our study, who was treated with CO₂ laser alone, was followed up for 9¼months. He remained asymptomatic throughout this period.

Subglottis is the most common site involved in stenosis and the key to subglottis is the cricoid, the only complete ring in the respiratory tract¹. No satisfactory answer has yet been found to restore and preserve the integrity of damaged cricoid. It has been observed that with such advanced stages of stenosis, the treatment becomes more arduous, requiring complex surgical procedures, results of which are very variable and unpredictable¹¹. In severe subglottic stenosis, the traditional approach is to undertake some form of laryngotracheal reconstruction¹⁰. Indeed all the subjects of our study with stage 2, 3 and 4 stenosis did require one or the other type of open reconstructive procedures.

During the treatment each patient was, on the average, subjected to 4.6 operations under general anaesthesia. This number is considerably high compared with the average figure of 1.9 operations/patient quoted in another study⁷. This significant statistical difference can be accounted for if we keep in mind the unusually high number of operations (i.e.,

42) performed on a single patient with lower tracheal stenosis. If particular patient is excluded, the average number of operations/ patient drops to 2.2.

It is generally said that patients already wearing tracheostomy have about 50% chances of getting rid of it¹². Our rate of success in decannulation was 60%. Gavilan has reported 70% success in such cases⁷.

During the last 1 decade or so, single stage laryngotracheoplasty has steadily gained popularity¹³. In one series 95% success rate has been claimed with this technique¹⁴. We have no comparable results as none of our patient was subjected to this kind of surgery.

Because of the continuous evolution of diagnostic instruments, surgical techniques and new advancements in the critical care medicine, the management of chronic laryngotracheal stenosis has taken a new course. Vitallium alloy miniplates have been used successfully to reconstruct the laryngotracheal framework in 13 patients¹⁵. These plates present a unique dual advantage of accurately approximating the tissues and providing external support to the airway at the same time. Experiments have been carried out in animal models to reconstruct the stenosed upper airway segment with non-absorbable microplates and to cover the defect with revascularised perichondrium¹⁶, or with transplantation of mucosal graft by stamp technique¹⁷. Similarly expandable endoscopic stents (introduced endoscopically and inflated for 4-8 weeks)¹⁸ and topical application of Mitomycin has been used to reduce the severity of stenosis¹⁹. All these experiments shown promising initial results and present a viable alternative to more traditional methods of repair.

CONCLUSION

The plan of management and the operative techniques should be tailored according to the nature and extent of the disease of each individual patient. Laser surgery promises excellent results in cases of

soft tissue and milder stenosis; however, nothing short of open procedures would suffice if the cartilaginous framework has been damaged. Repeated operations using multiple techniques are commonly required. Though reconstructive procedures may fail secondary to factors that are not under surgeon's control, many failures can be avoided by accurate preoperative and intra operative assessment of the stenosis, correct choice of surgical procedure and close postoperative monitoring²⁰. Because of the high rate of recurrence, long term follow up is necessary to evaluate the real success of the treatment and to set the guidelines for future²¹. Still we feel that it is preferable, though not always possible, to prevent the acquired laryngotracheal stenosis by adapting more careful techniques of endotracheal intubations and tracheostomy.

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