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Review Article

Management of laryngotracheal stenosis – Still remains a challenge for successful outcome



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ABSTRACT

Management of laryngotracheal stenosis (LTS) is still an enigma and remains a challenge even for an expert surgical team. The treatment of LTS is quite difficult and often associated with significant risk and complications. Even with the availability of many surgical options, proper selection of surgical technique in each clinical situation is the key behind successful outcome. Selection of appropriate surgical repair depends on the site of stenotic segment, severity, duration, and cause of functional impairment. It requires meticulous preoperative evaluation and planning. No single approach is ideal and often several techniques may be needed before decannulation can be achieved. The purpose of this review article is to discuss the pathophysiology, pre-operative evaluation, surgical principle, surgical technique, graft materials in reconstruction and prevention of LTS and optimum stress given on different suitability of surgical techniques with application of suitable one in relation to site of stenosis and other stenosis parameters.

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1. Introduction

Laryngotracheal stenosis (LTS) is defined as partial or complete cicatricial narrowing of the endolarynx or trachea. It has high morbidity. It is mostly iatrogenic (prolonged endotracheal intubation, tracheostomy, etc.) but can also be congenital. The complexity of the laryngotracheal airway, which contains delicate structures like vocal cords, recurrent

laryngeal nerve which manage the functions of respiration, deglutition, and phonation cause LTS, a difficult situation to manage. LTS is most commonly seen in the age group of 26–34 years.¹ Males are susceptible to road traffic accident, trauma to neck, resulting in increased chance of LTS among males.² The increasing survival of critically ill patients at intensive care units has also resulted in a dramatic rise of incidence of LTS. Endotracheal intubation is commonly performed at ICU on daily basis and LTS is a direct result of the mucosal injury

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caused by this procedure. Acquired tracheal stenosis may also be secondary to trauma from tracheostomy. Management for LTS continues to be challenging for the otolaryngologist and the outcome of the treatment is complicated due to relative rarity of the disease, heterogenous nature of the lesion, and varied treatment options available. Due to its numerous treatment options, this itself bears testimony to the complexity of the LTS. Acquired LTS is caused by prolonged intubation, high tracheostomy, polytrauma, or an idiopathic. The treatment of LTS is technically difficult and challenging because of the narrow space and complex function. A variety of surgical options are advocated for the LTS, but the exact indications for each procedure are often not clearly mentioned. There will be always patient, surgical team, resource factors influencing the choice of treatment with open, endoscopic, or combined approach. The surgical outcome of the LTS has been measured traditionally by survival and decannulation.³ But with increasing surgeon's expertise, the outcomes are added with other factors like voice quality, breathing, and swallowing. The surgical treatment of LTS has been progressively advancing since posterior cricoidotomy, first described by Rethi.⁴ Fearon and Cotton introduced the laryngotracheal reconstruction (LTR) in children with cartilage interpositional grafting. This technique has now become one of the popular techniques for expanding the stenotic laryngotracheal airway.⁵

2. Pathophysiology

The pathophysiology of the LTS is not clearly understood. There are many theories for explaining the LTS. The most accepted theory explains that LTS results from wound healing at laryngotracheal airway. The wound due to compression by an endotracheal tube or the cuff of a tube results in necrosis of the underlying mucosa and cartilage. This necrosis occurs due to ischemia from the pressure of the tube or cuff exceeding the capillary pressure of the mucosa at the airway. This results in disruption of the normal mucociliary flow, which leads to infection in the perichondrium and involve the cartilage. This makes the weakening of the cartilage, resulting in tracheomalacia. Healing of this involved segment proceeds by secondary intention and this involves three overlapping stages: an inflammatory stage, a proliferating stage, and phase of contraction and remodeling.⁶ The upper half of the subglottis differs from the lower subglottis and trachea as upper half is bordered by the under-surface of the vocal cords and cricovocal membrane. Scarring and stenosis at the upper half of the subglottis may lead to fixation of vocal folds. Surgical treatment at the lesions of the upper half of the subglottis remains difficult and often unsuccessful and may be complicated by complications such as aspiration.⁷

3. Pre-operative evaluation

Detailed clinical evaluation and endoscopic assessment of laryngotracheal airway is the mainstay in the management of LTS. Pre-surgical procedures like X-ray soft tissue neck and flexible fiberoptic laryngoscopy assess the site, grade of stenosis, and vocal cord mobility. CT scan of the neck with

virtual bronchoscopy is needed to assess cartilaginous framework and length of stenosis. CT scan may not be useful in case of isolated glottic stenosis.² In Myer-Cotton staging (Fig. 1), Grade I lesion has less than 50% obstruction, Grade II lesion has 51–70% obstruction, Grade III lesion has 71–99% obstruction, and Grade IV lesion has no detectable or complete stenosis.⁸ In Mc Caffrey system (Fig. 2), the LTS is classified into Stage I lesion which is confined to the subglottis or trachea and is less than 1 cm long, Stage II lesion is isolated to the subglottis and is greater than 1 cm long, Stage III lesion is subglottic/tracheal lesion not involving the glottis, and Stage IV lesion involving the glottis.⁹

4. Surgical treatment

LTS is a challenging situation that always demands a multidisciplinary approach performed by well-trained surgical teams in the field of LTR. The different treatment options in LTS are laser, repeated endoscopic dilatation, cryosurgery, prolonged stenting, LTR, and segmental resection with end to end anastomosis.¹⁰ No single treatment option gives predictably satisfactory results. The ideal treatment option of the LTS should be individualized and it is based on patient's clinical situation as each procedure has its own merits and demerits.

Cricoid cartilage is only complete ring in the laryngo-tracheo-bronchial airway – to be a sacrosanct structure, surgical insult to which is to be avoided. Injury to the cricoids during tracheostomy and cricothyroidotomy is believed to cause LTS.¹¹ So surgeons are always reluctant to avoid incision over the cricoids even during repair. Even posterior cricoids split and its augmentation by a costal cartilage free graft goes against conventional surgical wisdom, but this procedure has now become firmly established option. There are many reports favoring the posterior cricoids split and augmentation with or without additional anterior cricoids augmentation in the treatment of subglottic, glottic, and combined glottic-subglottic stenosis with successful decannulation rates in more than 90% cases.¹² Posterior cricoids split with rib cartilage augmentation is highly effective in expanding the subglottic airway, free from complications, and simple to execute. Now, it is the procedure of choice in high subglottic stenosis.¹³

LTR with the help of rib cartilage is technically demanding as the laryngotracheal airway is stabilized by the anterior and posterior cricoids split. Although the overall outcome is encouraging, this technique may be associated with physical and psychosocial problems along with the cost factors when failure of this technique occurs as patient may need re-tracheostomy.

High subglottic stenosis is presently treated by posterior cricoids split with use of costal cartilage augmentation. Webbing at the posterior commissure can cause vocal cord fixation which is a frustrating situation, managed effectively by same posterior cricoids split with augmentation by rib cartilage. Stenosis at inferior subglottis is treated by cricotracheal resection (i.e. resection of the cricoids arch and adjoining trachea if needed) and anastomosis of normal trachea to the thyroid cartilage anteriorly and posteriorly with cricoid lamina.¹³

The cricotracheal resection with end to end anastomosis has a fair success rate but the unpredictability of the fate of the

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