Use of Conchal Cartilages for Laryngotracheal Stenosis: Experiences at a Tertiary Care Hospital of Eastern India

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Abstract To describe the experience of anterior cricotracheal split with insertion of conchal cartilage graft in the treatment of subglottic and tracheal stenosis at a tertiary care hospital of eastern India. Six patients were included in the study, in the age group of 20–48 years. Out of which five patients were successfully decannulated after 3 months of laryngotracheal reconstruction with help of conchal cartilage. One case was undergone resection anastomosis after failure of the above technique. Successful restoration of the airway with decannulation in five cases and failure in one case. The subglottic and upper tracheal stenosis are successfully treated with anterior cricotracheal split and augmentation of the airway with conchal cartilage. It is a new technique of using conchal cartilage in the literature of laryngotracheal reconstruction.

Keywords Laryngotracheal stenosis · Conchal cartilage · Anterior cricotracheal split

Introduction

Laryngotracheal stenosis (LTS) is defined as partial or complete cicatricial narrowing of the endolarynx or trachea [1]. Despite the availability of different surgical options, management of laryngotracheal stenosis is still remains an enigma. LTS is a challenging problem, a known complication of prolonged intubation and tracheostomy [2]. Despite good quality of endotracheal tube used nowadays, its incidence is rising because of the large number of patients requiring intubation in the intensive care unit. It requires a highly skilled multidisciplinary team for adequate management. LTS is a recalcitrant disease with high morbidity. Treatment of LTS depends upon the severity, location and duration of the lesion. In the due course of time, there are different techniques developed for treating laryngotracheal stenosis. They are laser vaporization of the scarred tissue combined with luminal stenting, [3] to laryngotracheal reconstruction (LTR) with an anterior or posterior cricoid split and augmentation of the cricoid arch with an anterior costal cartilage graft [4, 5]. The result of laser surgery in case of extensive subglottic stenosis is disappointing. The prognosis of laser vaporization is also poor for subglottic stenosis with circumferential scarring, vertical scars with a depth of 1 cm or more and cases with arytenoids fixation [3, 6]. In Otolaryngologic practice, the traditional treatment of LTS has been laryngofissure and laryngotracheal reconstruction (LTR). However, the outcome with these approaches has not often been favorable in many patients [7]. In the present study, we report our experience and outcome following the surgical management of six adult patients with laryngotracheal stenosis of varied etiologies.

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Materials and Methods

All six cases of laryngotracheal stenosis treated at our tertiary care medical center with anterior cricotracheal split and conchal cartilage augmentation between January 2012 to December 2014. This study has been cleared by the Ethics Committee of our institute. All cases are post-intubated tracheal stenosis except case-4 which was due to blunt trauma. All had previously attempted for surgical restoration of airway with futile results. All six patients were tracheostomised at presentation. All cases had undergone preoperatively rigid endoscopic (70°) and fiberoptic laryngoscopy evaluation of the larynx and trachea. Radiological evaluation with X-ray soft tissue neck and non-contrast computed tomography (NCCT) of neck was done to assess site, size and grade of laryngotracheal stenosis. All cases had grade II to IV stenosis (Myer-Cotton grading) with mobile bilateral vocal cords except one case with immobile vocal cords which are fixed in the paramedian position. Care is taken at surgery to preserve the perichondrium on the conchal cartilage graft surface that is facing the subglottic lumen. The smooth perichondrium has been found to merge with the mucoperichondrium of the cricoid lamina and to contribute for formation of a mucosa lined lumen. The detail clinical profiles and outcome are given (Table 1).

Operative Technique

All patients underwent indirect laryngoscopy, fiberoptic laryngotracheoscopy and suspended microlaryngoscopy when needed before surgical procedure. Surgical procedure was done under general anesthesia. Anesthesia was given through tracheostomy tube. A horizontal incision was made

around two fingers above sternal notch followed by the larynx and the tracheas are exposed. Anterior midline incision made over cricotracheal stenotic segment. The fibrotic and granulations from the lumen was removed. The raw area was applied with Mitomycin C which reduces granulation tissue formation and prevents recurrence. The lumen was inserted with silastic stent (prepared from silastic block) which was tied with a silk suture and the silk passes to outside through tracheostomy stomal opening (Fig. 1). Then the conchal cartilage was placed between the edges of surgically created split in the anterior cricoid plate and anterior trachea for augmentation (Figs. 2 and 3). Perichondrium on the conchal cartilage graft surface will face the subglottic lumen. The smooth perichondrium has been found to merge with the mucoperichondrium of the cricoid lamina and to contribute for formation of a mucosa lined lumen. This procedure increases the subglottic and tracheal lumen diameter. In all cases surgery performed without manipulating vocal cords. The silastic stent was removed after 3 months of surgery by pulling the silk outward, which was sutured with the stent.

Case-1

A 22 year old male indulged organophosphorus poisoning and admitted at medical ICU of outside hospital where he was intubated for 2 weeks. After extubation, he developed immediate breathlessness for which he admitted to our department for emergency tracheostomy. After tracheostomy, X-ray neck showed stenosis extending 5 mm below the vocal cords to 2nd tracheal ring. The bronchoscopy picture showed grade-III stenosis. The patient was taken for anterior cricotracheal split with removal of stenotic fibrous tissue and conchal cartilage augmentation of laryngotracheal airway. The thickness and convexity of

Table 1 Clinical profiles and final outcomes of individual patients

Serial No.	Age/gender	Type of injury	Previous surgical procedure	Laryngoscopy findings	Outcome
Case-1	22/Male	Prolonged intubation	Tracheostomy	Grade-III subglottic stenosis	Successfully decannulated, adequate airway, no aspiration and normal voice
Case-2	28/Male	Prolonged intubation	Tracheostomy	Grade-III stenosis at subglottis and upper trachea	Decannulated and normal voice
Case-3	24/Male	Prolonged intubation	Tracheostomy	Grade-III subglottic stenosis	Decannulated and weak voice with difficulty during shouting
Case-4	32/Female	Blunt trauma(RTA)	Tracheostomy	Grade-IV stenosis at glottis. Immobile vocal cords at paramedian position	Difficult decannulation. Resection anastomosis done
Case-5	18/Male	Prolonged intubation	Tracheostomy	Grade-II stenosis at upper part of trachea	Decannulated and normal voice
Case-6	48/Male	Prolonged intubation	Tracheostomy	Grade-III stenosis at upper part of the trachea	Decannulated and hoarse voice

Fig. 1 Endoscopic view of the silastic stent seen from the subglottis

Fig. 2 Placement and suturing of the conchal cartilage with margin of anterior cricotracheal split

the conchal cartilage are well fitted with margin of anterior cricoid split. A piece of silicon block made a cylindrical shape similar to diameter of trachea and fitted with neolumen of trachea and tied with silk suture. The silicon stent kept for 3 months.

Case-2

A 28 year old male referred to ENT OPD for breathing difficulty. Laryngeal endoscopy showed normal larynx with pinhole subglottis (Grade-III). X-ray of soft tissue of neck showed stenosis at subglottis. He had undergone immediate tracheostomy. He had history of prolonged

Fig. 3 Diagram showing the conchal cartilage fitting with the margin of cricotracheal split for augmentation of laryngotracheal airway

intubation following cerebral malaria, who admitted in ICU 3 months back. He had undergone anterior cricoid split with excision of fibrotic tissue and augmentation by conchal cartilage. The pre-operative and post-operative bronchoscopic pictures are given (Figs. 4 and 5).

Case-3

A 24 year old boy presented with stridor just after extubation following prolonged (3 weeks) intubation at medical ICU for road traffic accident. Intensivist could not intubated again immediately for which emergency tracheostomy done. After imaging the stenosis (Grade-III) was identified at subglottis area (Fig. 6a, b).

Case-4

A 32 year old lady suffered a road traffic accident with blunt trauma to the laryngeal framework resulting in fractures of laryngeal cartilage. She had undergone tracheostomy and repair of laryngeal cartilages. After few weeks she faced difficult decannulation and finally diagnosed as subglottic stenosis (Grade-IV) after radiological test (Fig. 6a, b).

Case-5

A 18 year old boy attempted suicide by taking oleander poison for which he was admitted at medical ICU. After

Fig. 4 Pre-operative bronchoscopic picture showing grade-III subglottic stenosis

Fig. 5 Post-operative bronchoscopic picture showing widened laryngotracheal airway

extubation he developed stridor and finally diagnosed as stenosis at upper one-third of trachea. She had taken for anterior tracheal split with conchal cartilage augmentation.

Case-6

A 48 year old man suffered a severe stroke and admitted at Neurology ICU with history of prolonged intubation for more than 2 weeks. After extubation he developed breathing difficulty and under gone tracheostomy for subglottic stenosis (Grade-III). He had undergone anterior cricoid split with conchal cartilage augmentation.

Results

All 6 cases had a silicon stent after surgery for duration of 3 months. After 3 months, silicon stent removed and demonstrated an adequate laryngeal airway and were decannulated. Case-4 developed breathing difficulty after 2 weeks for which she again undergone tracheostomy. Later on this case had taken for resection and anastomosis. The successful five cases in their follow up period from 6 months to 1 year since decannulation, all continue to be free from airway obstruction. Out of five cases, the voice of three patients were normal (Case-1, 2, 5), one patient had weak voice and difficulty during shouting (Case-3) whereas last case had a hoarse voice (Case-6) (Table 1).

Discussion

The goal of laryngotracheal reconstruction is always decannulation and re-establishment of an airway, with preservation of adequate laryngeal function for airway protection, voicing and swallowing [8]. LTS is common among the age group of 26–34 years [9, 10]. In majority of cases, acquired stenosis of the subglottis and trachea is due to prolonged intubation and tracheostomy. This can be due to increasing use of prolonged mechanical ventilation in the intensive care units with or without tracheostomy. MacEwen in 1880 first described laryngotracheal stenosis due to prolonged intubation [2]. Tracheal stenosis is the most common late complication following prolonged intubation and tracheostomy with 10–22 % develop post intubation and post tracheostomy stenosis [11]. Among them only 1–2 % develop symptomatic and severe stenosis which require intervention [12]. Prolonged intubation is still the commonest cause of laryngotracheal stenosis in our practice. Other causes of LTS are external trauma, cricothyroidotomy, high tracheostomy, infections, burns, tumors and dystrophic cartilage [13]. Gastroesophageal reflux disease is also another important cause of acquired LTS. The assessment of LTS is done by fiberoptic as well as rigid laryngotracheoscopy, imaging like CT scan and MRI. Spiral CT scan with three dimensional reconstructions has an excellent resolution of laryngotracheal lumen as well as outer wall. Rigid laryngotracheoscopy provide direct visual assessment with performance of diagnostic and therapeutic procedures and is classically considered as gold standard investigation for intraluminal assessment of the upper airways [14].

A variety of techniques are advocated for treatment of LTS. Surgical treatment of LTS can be divided into two groups; Endoscopic and external approach. Endoscopic approaches include laser fulguration and balloon dilatation

Fig. 6 CT scan of the neck with **a** sagittal cut and **b** axial cut showing the stenosis is at upper part of the trachea

with or without stenting. External approaches include tracheostomy, anterior cricoid split with or without cartilage graft, subglottic resection with the thyrotracheal anastomosis. Administration of steroids, use of stents, rigid bronchoscopy and dilatation, use of laser (CO₂, Nd YAG, KTP) and open surgical treatment have been used in the treatment of LTS [15].

Currently subglottic stenoses are managed by cricoid split with costal cartilage augmentation. Insulation of conchal cartilage in the anterior cricoid split and augmentation of airway is done in our cases which seems to be effective and new in laryngotracheal reconstruction. Convexity of conchal cartilage helps to augment the airway, thickness of conchal cartilage similar to tracheal cartilage and it is easily harvested. All these factors make conchal cartilage to be a very good option for laryngotracheal reconstruction.

Topical application of Mitomycin C has shown to be a potent inhibitor of human fibroblasts inhibiting vigorous granulation response noted after laryngotracheal injury [16]. In all our cases, we applied Mitomycin C at raw area of laryngotracheal airway during reconstruction.

We found anterior cricoid split with conchal cartilage augmentation is remarkably efficacious in expanding the laryngotracheal airway and also to be free from complications over follow up period ranging from 6 months to 1 year. The procedure is technically very simple to perform. Restenosis and relapse are the most common problem of any modality of treatment with recurrences after 1–3 months of procedure which may need further intervention [17]. Among six patients, one developed

restenosis who undergone tracheal resection and anastomosis later on.

Conclusion

LTS is really a challenging condition which requires a highly skilled multidisciplinary team for proper management. Anterior cricoid split and conchal cartilage augmentation is a reliable and effective technique for patients with LTS. In our cases successful decannulation are done in five out of six patients. This technique is simple, effective and first in literature of the laryngotracheal reconstruction which is successful for providing adequate airway in laryngotracheal stenosis.

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