Utility of Two-Stage Laryngotracheal Reconstruction in the Management of Subglottic Stenosis in Adults

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**ABSTRACT**

**Objective:** To evaluate the utility of two-stage laryngotracheal reconstruction (LTR) in the management of subglottic stenosis (SGS).

**Background:** Modern surgical procedures have been proposed for the treatment of SGS. Operative correction of this condition has been practiced with success in the pediatric population but with a 37% success rate in adults, the procedure has been considerably less successful in the adult population. To test, cricotracheal resection (CTR) and the LTR have been used as a common alternative to LTR in adults. CTR has had a higher rate of success in adults but also has a morbidity and mortality rate. Therefore, there are also reports in the literature of high morbidity and mortality.

**Methods:** The medical records at WSU OHSN were reviewed from 2003 to 2007. All patients who presented to the OHSN department with SGS who underwent LTR were included in the retrospective case notes.

**Results:**

- Of twelve patients identified were successfully reconstructed (25%).
- The majority of these patients had high-grade stenosis (HVS). Three patients required a second LTR prior to decannulation. The most significant source of morbidity seen in our patients was pneumonia and stenotis, which occurred in 42% of our patients.

**Conclusion:** It is our opinion that LTR is a viable and preferred option for adult patients with SGS. LTR is a viable and other performed procedure in children. It has the potential to be also used in adults as SGS with less modern laryngeal techniques. It has the added benefit of avoiding the pitfalls and complications of cricotracheal resection.

**METHODS**

After obtaining IRB approval, the medical records from WSU OHSN were reviewed from 2003 to 2007. All patients with subglottic stenosis who underwent laryngotracheal reconstruction were included in this retrospective case series.

**RESULTS**

Twelve patients with subglottic stenosis (Figure 1) who underwent laryngotracheal reconstruction were identified. The age range was 18 to 86 years with an average of 44 years. The study included one patient with Grade I stenosis (70%) stenosis, three patients with Grade II (60-90%), six with Grade III (90%), and one patient with Grade IV (complete obstruction) (Figure 2). These patients developed SGS secondary to burn injury and prolonged intubation, three were secondary to external trauma/motor vehicle accidents, and six were primary due to inborn errors of metabolism. Of the 12 patients, two required a second LTR prior to decannulation. Two of these patients had been previously identified as having high-grade stenosis (HVS) and underwent a second LTR to decannulate. The majority of these patients (75%) had high-grade stenosis (HVS). Three patients required a second LTR prior to decannulation. The most significant source of morbidity seen in our patients was pneumonia and stenosis, which occurred in 42% of our patients.

**CONCLUSION**

It is our opinion that LTR is a viable and preferred option for adult patients with SGS. LTR is a viable and other performed procedure in children. It has the potential to be also used in adults as SGS with less modern laryngeal techniques. It has the added benefit of avoiding the pitfalls and complications of cricotracheal resection.

**DISCUSSION**

With the continued use of prolonged intubation and ventilator-assisted respiration, patients with high-grade SGS have continued to present to otolaryngologists for management. While the treatment of pediatric patients with this condition by LTR techniques has been well established, the treatment of adults has been limited. This study evaluates the currently existing literature that in many had precluded success in treating high-grade SGS with reconstruction rather than resection. In this retrospective study, twelve patients with SGS who underwent LTR were identified and the results of their surgeries were evaluated for success, complication, and reoperation rates. The majority of our patients had high-grade stenosis. Eleven of the twelve patients were eventually decannulated (91.7%). The one patient who was unable to be decannulated had a history of tracheostomy failure after an MVA. As a result of the trauma he developed a trachea 4.6 cm with a concomitant phrenic nerve injury that was not known at the time of his LTR procedure. With this knowledge, the patient was treated for an atrophic trachea 4 cm and a severe grade C trachea 4 cm, and therefore could not be decannulated. In this unfavorable patient, the morbidity of our patients was decannulated with few or no complications. In the literature, these rates have continued to be relatively low but saw less than 60% for adults with high-grade SGS. There are reports of greater success with LTR in adults. However, these studies did not quantify the grade of stenosis in their patients; thus, the limitation of the article results for high-grade laryngotracheal stenosis repair. With this lack of consistent success in adults, it is no surprise that resection of the stenotic segment, as proposed by Mortelliti, is used more often for the treatment of adult patients with severe stenosis. Recent literature has seen a trend in the range of 90-95% in some reports. The procedure has been added benefit of often treating the stenotic airway with a single operation. It allows prompt decannulation, spares the patient complications, and avoids the complication of donor site morbidity seen in LTR ear cartilage grafts. Despite this, there has been several articles that have cited problems with the CTR technique. Complete resolution of the excision cartilage is a complex problem as it involves substantial risk of injury to the recurrent laryngeal nerves and esophageal mucosa, disruption of vocal fold function. Donates has reported 16/15 (71%) patients who failed primary resection and anastomosis, and a 27/25 (62%) mortality rate from CTR. Laro reported major complications in 31% of cases, including failed anastomosis, extra-tracheal airway, and death. After that report 2 of 59 (9%) patients died after the procedure, 2 of these patients with recurrent laryngeal nerve paralysis in 32% of cases. Debate is about the morbidity and complication, major complications occurred in 50% of cancer operated compared to 15% of primary CTR procedures. Overall, major complications are reported in 14-35% of patients. There are also limitations regarding anatomical constraints. In all cases, one of our tracheal rings is not sufficient. Though revision and re-resection is a possibility, the extent of re-resection is limited. On the contrary, the quoted complications from LTR are fewer and potentially much less severe. Two initial considerations are that the LTR procedure requires at least two separate planned procedures and has prolonged duration times when compared to CTR. In terms of the procedure itself, an autogenous graft is required. This introduces a second surgical site, the potential for donor site morbidity, and the concern of graft survival. In addition, the use of a foreign material to stent the tracheal lumen is required and the stent type, length, duration of placement, and how the stent is secured in the airway are all important concerns for the procedure’s viability. Overly prolonged stenting has been shown to lead to mucosal irritation, significant granulation tissue formation, re-stenosis, infection, and increase of the scar. Despite these potentially minor setbacks, LTR is currently the only available technique for patients with stenosis that exceeds the level of the vocal folds or above. Extent of stenosis cannot be treated by laryngotracheal resection. LTR can be more readily revised when compared to CTR. Should the patient initially fail decannulation, an additional LTR can be performed with a high possibility of decannulation. Due to the major complications of CTR listed above, we reconsidered our approach to the adult patient with subglottic stenosis. We applied our approach to pediatric patients with SGS to our adult patients. In addition, twelve patients were deemed to be appropriate surgical candidates. They were all able to be successfully treated with a single operation. Of particular interest, in addition to the high grade of subglottic stenosis, many patients had associated vocal cord palsy which complicated their surgical procedure course. Despite the significant airway compromise from high-grade stenoses and bilateral vocal cord palsy, only one of our decannulated patients had any residual airway symptoms with severe extubation. It is our opinion that our two-stage reconstruction is a viable and preferred option for high-grade subglottic stenosis. LTR is a safe and often performed procedure in children. It has the potential to be applicable in adults with SGS as well utilizing modern LTR techniques. It has the added benefit of avoiding the pitfalls and complications of cricotracheal resection. Success with LTR can be achieved by the appropriate assessment of the patient as a candidate for LTR, the appropriate choice of surgical reconstruction, and the appropriate close and postoperative follow-up.