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:
Multiple surgical procedures have been proposed for the treatment of SGS. Operative correction of this condition has been practiced with success in the pediatric population, approaching a 97% successful decannulation rate. In the adult population, however, the procedure has been considerably less successful in the reported literature. In the past, cricotracheal resection (CTR) has been used as a more common alternative to LTR in adults. CTR has had a higher rate of successful decannulation with fewer planned procedures. However, there are also reports in the literature of high morbidity and mortality.

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

Results:
Eleven of twelve patients identified were successfully decannulated (92%). The majority of these patients (75%) had high-grade stenosis (III/IV). Three patients required a second LTR prior to decannulation. The most significant postoperative morbidity seen in our patients was pneumonia and atelectasis, 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 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.

METHODS

After obtaining IRB approval, the medical records from WSU OHNS 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 16 to 86 years with an average of 44 years. The study included one patient with Grade I stenosis (<70% stenosis), three with Grade II (70-90%), seven with Grade III (>90% with lumen present), and one patient with Grade IV (complete obstruction with no lumen) (Figure 2).

Three patients developed SGS secondary to burn injury and prolonged intubation, three were secondary to external trauma/motor vehicle accidents, and six were primarily related to prolonged intubation (Figure 3). Only one of the patients had a prior LTR surgery prior to being referred to WSU OHNS.

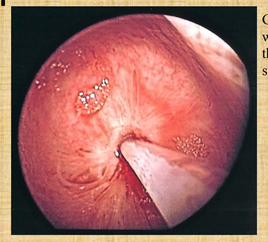
All of the patients in this study were treated by LTR with an anterior or anterior and posterior cricoid split with graft procedure. All but the earliest of these was a two-stage procedure. A costal cartilage graft was utilized for the seven earlier patients, and an auricular cartilage graft was utilized for the five later patients by surgeon preference. Three patients also underwent procedures for bilateral vocal cord paralysis at the same time as their initial LTR, including unilateral arytenoidectomy and vocal cord lateralization (Figure 4).

Three of the twelve patients required a second LTR prior to being decannulated, one of which had previously received a LTR by an outside surgeon prior to being seen by our department. Eleven of the twelve patients were eventually decannulated (91.7%), (Figure 5) with a range of 44 to 126 (average 66) days from surgery until decannulation (Figure 6).

The most significant postoperative morbidity seen in our patients was pneumonia and atelectasis, which occurred in 5/12 (42%) of our patients. 4/7 of the patients who underwent a costal cartilage graft developed iatrogenic post-operative pneumonia, compared to 1/5 of the patients who utilized an auricular graft (Figure 7). Major complications following LTR were few. Two patients developed respiratory distress and underwent a repeat tracheotomy after they stopped taking their GERD medications, but were later decannulated. A third patient, the patient with the prior LTR by an outside surgeon, had a persistent tracheocutaneous fistula upon initial presentation to this department that was closed by a local advancement flap approximately five months after decannulation.

The twelve patients have been seen for follow-up from two months to three and a half years, with an average of twenty-one months. Of the eleven decannulated patients only one has mild residual dyspnea on exertion with no stridor and one has residual dysphagia that was present prior to his LTR.

Figure 1



Grade 3 subglottic stenosis in a patient who underwent LTR. Note the catheter threaded through the small lumen of the subglottic airway

Figure 2

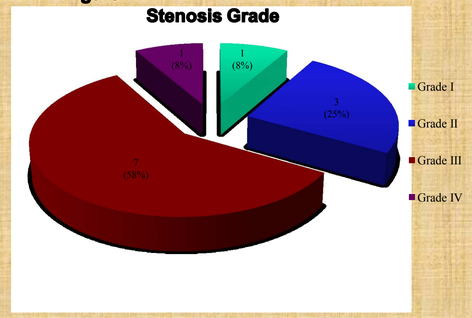


Figure 3

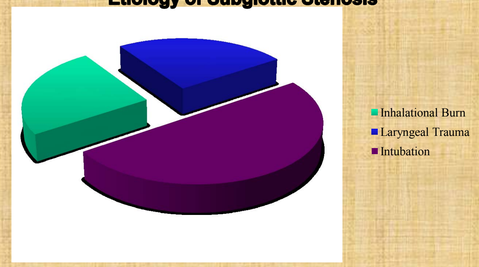


Figure 4

SS-LTR = Single Stage LTR, TS-LTR = Two Stage LTR, VC = Additional vocal cord procedure performed at time of LTR

Figure 5

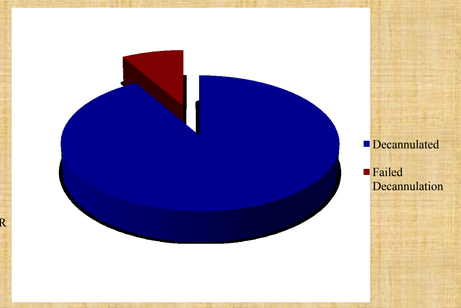


Figure 6

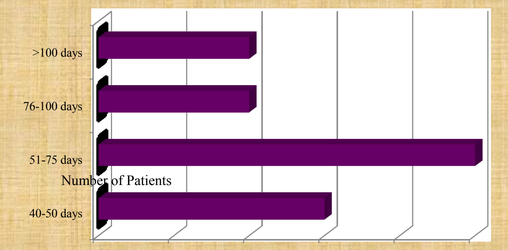
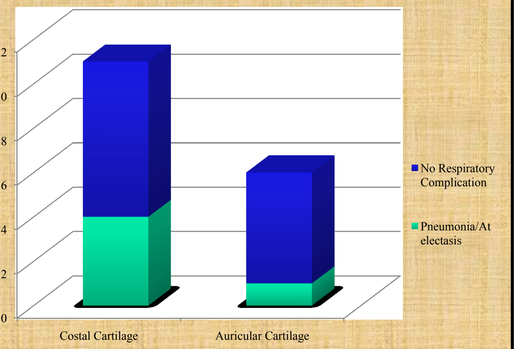


Figure 7



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 less certain. This study differs from the existing literature in that we have had considerable 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 successful decannulation and complication rates. The majority of our patients had high-grade stenosis. Eleven of the twelve patients were eventually decannulated (91.7%). The one patient that was unable to be decannulated had a severe Grade IV stenosis after an MVA. As a result of the trauma he developed quadriplegia at C4-5 with a concomitant phrenic nerve injury that was not known at the time of his LTR procedure. With this knowledge, the patient was deemed to be at an unfavorable risk for attempting a second LTR, and therefore could not be decannulated. Excluding this unfavorable patient, the remainder of our patients were decannulated with two or fewer reconstructions.

These results are considerably more successful than the extant literature on adult LTR. LTR success rates in the literature have generally been reported less than 80% for adults with high-grade SGS. There are reports of greater success with LTR in adults. However, these reports did not quantify the grades of stenosis in their patients; thus, limiting the application of their results for discussion 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 Monnier, is used more often for the treatment of adult patients with severe stenosis. Recent success rates for CTR are in the range of 90-98% in some reports. The procedure has the added benefit of often treating the stenotic airway with a single operative procedure. It allows prompt decannulation, spares the glottis from complications, and avoids the complication of donor site morbidity seen in LTR cartilage grafts.

Despite these benefits, there have been several articles that have cited problems with the CTR technique. Complete resection of the cricoid cartilage is a complicated problem as it involves substantial risk of injury to the recurrent laryngeal nerves and cricoarytenoid joints, jeopardizing vocal cord function. Donahue reported 16/75 (21%) patients who failed primary resection and anastomosis, with a 2/75 (2.6%) mortality rate from CTR. Lano reported major complications in 35% of cases, including failed anastomosis, cardiopulmonary arrest, and death. Ahn reported that 2 of 59 (3%) patients died as a result of CTR. Other authors noted recurrent laryngeal nerve paralysis in 2-3% of cases. For Donahue, major complications occurred in 39% of revised cases compared to 15% of primary CTR procedures. Overall, major complications are reported in 14-39% of patients. There are also limitations regarding anatomical constraints. In CTR, at least one tracheal ring is sacrificed. Though revision and re-resection is a possibility, the extent of repeated 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 it has prolonged decannulation 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 well 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 irritations, significant granulation tissue formation, re-stenosis, ischemia, and necrosis of the area. Despite these potentially minor setbacks, LTR is currently the only available technique for patients with stenosis that extends to the level of the vocal folds or above. This extent of stenosis cannot be treated by a CTR alone. In addition, 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 our study, eleven of twelve patients were deemed to be appropriate surgical candidates. They were all able to be successfully treated with a reconstruction procedure. In addition to the high grade of subglottic stenosis, three patients also had glottic injuries that complicated their surgical procedure course. Despite the significant airway compromise from high-grade stenoses and bilateral vocal cord paralyses, only one of our decannulated patients had any residual airway symptoms with heavy exertion.

It is our opinion that laryngotracheal reconstruction is a viable and preferred option for adult patients with 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 an LTR, the appropriate choice of surgical reconstruction, and the appropriate close and continued postoperative follow up.

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