How to Overcome Laryngotracheal Stenosis

Weerachai Tantinikorn MD*,
Choladhis Sinrachtanant MD*, Paraya Assanasen MD*

** Department of Otolaryngology, Faculty of Medicine Siriraj Hospital, Mahidol University*

Objectives : *To review and evaluate the outcome of the treatment of laryngotracheal stenosis (LTS).*
Design : *Descriptive review cases.*
Setting : *Tertiary care university hospital.*
Patients*: Series of LTS patients who were treated by the first author (TW) from January 2000 to January 2003.*
Main outcome measures : *Leading causes of LTS, details of the lesions, therapeutic procedures, complications of treatment, time to and success in decannulation.*
Results : *Twenty-one patients (9 females and 12 males), ranging in age from 1 to 32 years old were included in the present study. Half of the patients were under 10 years old. The most common site of the lesion was the subglotic lumen (14 cases), followed by the cervical trachea (5 cases). Patients were treated using endoscopic methods (6 cases), laryngotracheal reconstruction (LTR) (9 cases), tracheal resection (3 cases), and partial cricotracheal resection (3 cases). Decannulations were achieved in 19 patients (90.5%). Endoscopic treatment succeeded within 2-4 procedures in properly selected cases. Despite LTR, multiple sessions of endoscopic laser surgery, and arytenoidectomy, decannulation was not achieved in two of the cases, both of whom had all-level laryngeal stenosis. Time to decannulation ranged from 2 to 210 days. The major causes of delayed decannulation were the presence of a large bare area of cartilaginous grafts and restenosis with granulation tissue formation*
Conclusion : *Appropriate LTS treatment, which is based on the description of the lesion, results in a high decannulation rate within a proper time. Multilevel LTS, especially in the supraglottic and glottic area, is refractory to various treatment modalities, and full function of the larynx may not be restored.*

Keywords : *Laryngotracheal stenosis, Laryngeal stenosis, Tracheotomy*

J Med Assoc Thai 2004; 87(7): 800-9

Nowadays, many complicated and severe diseases have been successfully treated using modern medical technology. This has resulted in an increased survival rate and an increase in the number of resuscitation procedures available, which includes prolonged endotracheal intubation. More patients survive the diseases, but still suffer from complications such as laryngotracheal stenosis (LTS). The duration of intubation and other factors such as type, size, and movement of endotracheal tube have been proven to be major contributing factors. Patients may present with failed extubation, recurrent croup, delayed onset of stridor after a few weeks of extubation and stridor since birth in cases of congenital pathology. Tracheotomy can save patients' lives by bypassing the obstruction; it cannot however, restore all functions of the larynx. Thoughtful management of this condition is necessary in order to achieve early decannulation and improve the patient's quality of life with a functional larynx.

Correspondence to : Tantinikorn W.Department of Otolaryngology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok 10700, Thailand. Phone: 0-2419-8040, Fax: 0-2419-8044, E-mail: Siwtk@mahidol.ac.th

Patients and Method

A retrospective chart review study was performed on patients who were diagnosed with laryngotracheal stenosis and personally treated by the first author "TW" from January 2000 to January 2003 in the Department of Otolaryngology, Faculty of Medicine, Siriraj Hospital, Mahidol University. The

patients included those who were primarily treated at our institute as well as patients who were referred from other hospitals. The upper airway passages of these patients were examined thoroughly with a rigid endoscope, and the optical magnification was achieved using a rigid Storz-Hopkins telescope. Fiberoptic flexible endoscopy was performed occasionally in order to evaluate the adequacy of the patient's airway without performing a tracheotomy while they were awake before general anesthesia. The information obtained from endoscopy includes vocal cord movement, and the degree, framework, length, and extension of the stenosis. The stenosis was graded according to the Myer and Cotton classification system[1-3]. A plan of treatment was designed for each individual based on the information obtained from the endoscopy. Tracheotomy was performed on the patients with severe upper airway obstruction and/or stenosis which required complicated laryngotracheal surgery. Management was divided into 4 categories: endoscopic methods including dilatation and laser surgery, laryngotracheal reconstruction (LTR) by expansion and augmentation, tracheal resection with primary anastomosis, and partial cricotracheal resection (PCTR). Underlying diseases had to be treated until stable before starting LTS treatment. Only cases of mature fibrosis in which all inflammation had settled were amenable for external surgical approaches. Using an endotracheal tube as a stent, a single-stage procedure without retention of the tracheotomy tube required ICU care for a time period ranging from a few days up to a couple of weeks. Most of the presented patients underwent a two-stage procedure and retained a tracheotomy tube after the primary operation. In the two-stage group, various sizes of medical-grade silicone tubes were used and tailored for stenting purposes. Stents were left in place, above tracheostoma up to the level of false vocal cords, for 1 to 6 weeks depending on the severity of the lesions. Post-operative endoscopy was scheduled 7-10 days after stent removal in order to examine the mucosal healing of the cartilaginous graft, assess the patency of the airway, and remove any granulation tissue. The decannulation program was started in the ordinary ward when all swelling had subsided, cartilaginous grafts covered with healthy mucosa, and all granulation tissues excised. The tracheotomy tube was changed to a smaller one and finally occluded using adhesive tape. If there was no breathing difficulty, patients were observed for an additional 24 hours before removing the tracheotomy tube. If patients developed dyspnea, the tape was removed and the patients needed reassessment. If the decannulation succeeded, follow-up endoscopy was performed 1- 3 months later.

Amoxicillin-clavulanic acid (40 mg/kg/day) was prophylactically prescribed in all cases during the stenting period and for at least 2 weeks following surgical intervention. Although the authors did not routinely screen for gastroesophageal reflux (GER), a H2-blocker was prescribed in all patients according to the same protocol as antibiotic.

Results

Twenty-one patients (9 females and 12 males) with ages ranging from 1 to 32 years were included in this study. Half of the patients were under the age of ten. The most common leading cause of LTS was prolonged endotracheal intubation (16 cases). The common sites of stenosis were the subglottic lumen (14 cases) and the cervical trachea (5 cases). Of the 14 cases with subglottic stenosis, five cases had stenosis extending to the posterior glottic area. Two cases of stenoses, which were caused by caustic ingestion and a gunshot wound, involved all levels of subglottic, glottic and supraglottic areas. Six cases were treated primarily with endoscopic methods that included endoscopic dilatation, laser vaporization, and intralesional corticosteroid injection. Nine cases were treated with LTR using expansion and augmentation procedures. Three cases were treated with tracheal resection and primary anastomosis. Three cases were treated with PCTR (Table1). Decannulation was achieved in 19 cases (90.5%). Details of each patient are shown in Table 2.

Of the six patients who had endoscopic treatments, two cases were not tracheotomized. Decannulation was always achieved within 2-4 procedures. One patient (WC) failed to achieve decannulation from former endoscopic approach by

Table 1. Treatment options

Options of the treatment	Number of cases	Successful decannulation (%)
Endoscopic method	6	6 (100)
Laryngotracheal reconstruction	9	7 (78)
Partial cricotracheal resection	3	3 (100)
Tracheal resection	3	3 (100)
Total	21	19 (90)

Table 2. Summary of patients' case histories

Patients	Sex	Age	Diagnoses	Leading cause	Underlying cause	Grading	LOS (mm)	Frame	Tra	Treatment	Sources of grafts	TCT	CT	Final outcome	Remarks
DR	F	2 yrs 10 ms	SGS	prolonged intubation	near drowning	3	5	good	y	Endo	no	520	96	dec	3 procedures
CN	M	2 yrs 4 ms	SGS	prolonged intubation	pneumonia	2	7	good	y	Endo	no	146	50	dec	3 procedures
SD	F	23 yrs	SGS	prolonged intubation	pulmonary edema, DM, preg	2	10	good	n	Endo	no	_	_	dec	2 procedures
SP	M	3 yrs 7 ms	SGS, PGS	prolonged intubation	head injury	2	8	good	n	Endo	no	_	_	dec	4 procedures
KS	M	4 yrs 2 ms	SGS, PGS	prolonged intubation	pneumonia	1	7	good	y	Endo	no	30	3	dec, husky voice	1 procedure
WN	F	25 yrs	TS	prolonged intubation	attempted suicide by hanging	4	7	good	y	Endo	no	56	46	dec	2 procedures
SN	M	14 yrs 9 ms	SGS	prolonged intubation	head injury	4	14	NA	y	PCTR, ant graft	cricoid cartilage	4380	33	dec,left vc paralysis	_
CP	M	18 yrs	SGS	prolonged intubation	head injury	4	15	NA	y	PCTR, post graft	thyroid cartilage	220	38	dec	_
AW	M	3 yrs	SGS	congenital	TOF, imperforated anus	4	12	NA	y	PCTR, ant graft	costal cartilage	2190	210	dec	mitomycin C
AN	M	9 yrs 9 ms	SGS	idiopathic	polychondritis	3	15	fair	y	TSLTR, post graft	thyroid cartilage	113	55	dec	_
TT	M	3 yrs 1 ms	SGS	prolonged intubation	pneumonia	3	20	fair	y	TSLTR, ant graft	costal cartilage	1170	20	dec, stomal collapse	Rx with auricular cartilaginous graft
SC	M	3 yrs 7 ms	SGS, PGS	prolonged intubation	head injury	4	15	fair	y	TSLTR, ant graft, post graft	costal cartilage	270	130	dec, husky voice	_
PR	F	18 yrs	SGS, TS	prolonged intubation	head injury	3	25	fair	y	SSLTR, ant graft	costal cartilage	380	5	dec, dyspnea on exertion	_
JP	F	7 yrs	PGS,SGS	prolonged intubation	head injury	2	12	good	y	TSLTR, post graft	costal cartilage	600	35	dec, husky voice	_
PP	F	10 yrs	PGS,SGS	prolonged intubation	head injury	2	15	good	y	TSLTR, ant graft, post graft	costal cartilage	102	20	dec, husky voice	_
NC	M	4 yrs 3 ms	TS	tracheotomy	cystic hygroma	2	12	fair	y	SSLTR, ant graft	costal cartilage	1810	2	dec	_
NR	F	9 yrs	TS	prolonged intubation	head injury	4	20	NA	y	Tracheal resection	no	3755	35	dec	_
CN	F	30 yrs	TS	prolonged intubation	laryngeal papiloma	4	20	NA	y	Tracheal resection	no	542	11	dec	_
WC	M	31 yrs	TS	prolonged intubation	head injury	3	20	poor	y	Tracheal resection	no	51	10	dec	failed endo
NK	F	24 yrs	CALS	caustic ingestion	attempted suicide	4	10	NA	y	TSLTR, post graft, Endo	costal cartilage	_	_	stomal retainer, hoarseness	_
KJ	M	39 yrs	CALS	gunshot wound	accident	4	10	NA	y	TSLTR, post graft, Endo	costal cartilage	_	_	stomal retainer, hoarseness	_

SGS = subglottic stenosis,
TS = tracheal stenosis,
Endo = endoscopic method,
SSLTR = single-stage laryngotracheal reconstruction,
LOS = length of stenosis,
NA = cannot be assessed due to complete stenosis,
TCT = total cannulation time,
dec = successful decannulation,
PGS = posterior glottic stenosis,
CALS = complete all-level laryngeal stenosis
PCTR = partial cricotracheal resection,
TSLTR = two-stage laryngotracheal reconstruction
Frame = status of framework;
tra = tracheotomy status,
CT = cannulation time after treatment
lt vc = left vocal cord

our junior colleague. The patient had membranous grade-3 tracheal stenosis. The laser accidentally injured the tracheal cartilaginous framework, resulting in the collapse of the anterior tracheal wall. The patient was then treated using the external approach. However, he was finally decannulated after tracheal resection with primary anastomosis.

Two-cases of complete all-level laryngeal stenosis as a result of caustic ingestion and gunshot wound were not successfully decannulated. Both were treated surgically using LTR with posterior cricoid split and costal cartilaginous graft. In both cases, silicone tube stents were used for 6 weeks. Multiple endoscopic laser surgeries were performed in order to remove supraglottic scars. In addition to those procedures, NK underwent left arytenoidectomy and cordectomy, followed by right arytenoidectomy. KJ also underwent left cordectomy. Ultimately, both of them retained stomal buttons with an acceptable voice quality without aspiration. Their stomal buttons could not be plugged because of some dyspnea and noisy breathing.

Overall cannulation time was prolonged because of delayed proper treatment before and during the referral period. Cannulation time after treatment at our institute ranged from 2 to 210 days. In case of SC, prolonged cannulation time (130 days) was due to a large raw surface on cartilaginous grafts involving more than 70% of the luminal circumference. It took about 6 weeks for healthy respiratory mucosa to cover this area (Fig. 1). Cannulation time of DR was 96 days because her family lived in a rural area and she could not receive treatment according to the authors' schedule. AW had a problem with restenosis and development of granulation tissue at the anastomotic area, which resulted in prolonged cannulation time (210 days). Five consecutive endoscopic laser surgeries were performed before decannulation was finally achieved with application of topical mitomycin C.

Complications of therapeutic procedures were found in three cases. AW developed restenosis at the anastomotic site after having PCTR and anterior graft augmentation as previously mentioned. SN had complete subglottic stenosis and was treated with partial cricotracheal resection. Because of the high level stenosis, dissection of the cricoid accidentally injured the left RLN, resulting in a permanent paralysis of the left vocal cord. However, the patient had a good and functional voice without aspiration after a 10-year period of aphonia. TT had grade-3 subglottic stenosis and was treated with LTR. He developed breathing difficulty 24 hours after decannulation. Endoscopic examination revealed tracheomalacia at the stomal level. Tracheoplasty was then performed in order to remove the redundant soft tissue at the stomal region followed by augmentation using an auricular cartilaginous graft. He was successfully extubated after the operation without any complication. Follow-up endoscopy showed no tracheomalacia and a well-healed auricular cartilaginous graft on the native tracheal cartilage.

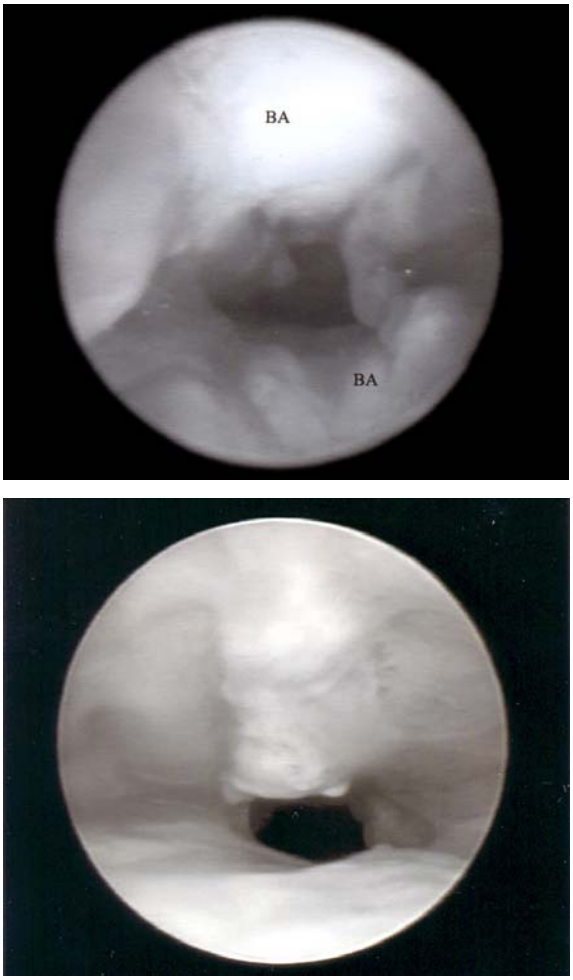

Fig. 1 Endoscopic findings after laryngotracheal reconstruction in which anterior and posterior cartilagenous grafts involved more than 70% of luminal circumference: (Upper) Shows a large bare area (BA) of cartilaginous grafts without mucosal covering 2 weeks postoperatively, (Lower) Complete mucosal healing 6 weeks postoperatively

Discussion

Endoscopy is the gold standard for diagnosis and an aid in the treatment of LTS. A fiberoptic endoscope and rigid rod-lens telescope magnify visualization and help the surgeon to better manage LTS. The use of a tracheotomy with a "wait and see" attitude should be the last option for treatment of LTS, used only if there are no better alternatives. Early decannulation is essential in order for the patients to have a good quality of life. No single option of treatment is suitable for all cases of laryngotracheal stenosis, thus patients should be assessed individually. Modalities of treatment should be properly selected based on assessment of the lesions, not the surgeon's preference. The surgeon should be armed with up-to-date knowledge, available equipment and skills necessary to perform various surgical procedures.

Endoscopic treatments include dilatation and laser surgery. Judicious use of endoscopic dilatation can establish an adequate laryngeal lumen and prevent complete laryngeal stenosis for a future reconstruction. Dilatation of a thin fibrosis separates the scar at the point of lowest resistance, providing the correct pathway for further laser surgery. Laser surgery in the wrong direction may destroy the laryngeal cartilaginous framework, leading to formation of a worse fibrotic scar. Inappropriate dilatation using too large a bronchoscope causes more traumatic injury to the soft tissue and cartilage, resulting in more stenosis or even microfracture of the cricoid. Dilatation is contraindicated in the following conditions: 1) the tracheal lumen beyond the stenosis can not be examined, 2) the presence of a severe and hard stenosis, long-segment stenosis and the loss of rigid laryngotracheal framework. Dilatation in such conditions may create a false tract for bronchoscope insertion, the disruption of the laryngotracheal complex especially at the posterior membranous part of the trachea, and finally, loss of the airway control. The tip of the bronchoscope may enter into the mediastinum, where the normal tracheal landmarks cannot be found.

Laser surgery is limited to soft tissue stenosis with a good framework. It is difficult to assess the outline of the framework in patients with severe-degree stenosis (grade 3-4) except for a thin segment. Laser surgery should be discouraged in these cases because of the high risk of injuring the cartilaginous framework, which would preclude future LTR by expansion and augmentation procedures. For example, in the case of WC, cartilaginous injury from laser surgery caused the framework to collapse, and thus the treatment plan had to be switched to a resection procedure. The amount of raw surface area after laser surgery needs to be considered since a large area may heal with restenosis. An intralesional corticosteroid and topical application of mitomicin C have been reported to have beneficial effects in the treatment and prevention of laryngotracheal stenosis[4-16]. In the present series, the patients who were properly treated with endoscopic treatment could achieve decannulation within 2-4 procedures. Repeated laser surgery without any improvement of the lesion indicates failure of the procedure, and reevaluation of the lesion and selection of other treatment modalities are required.

Thanks to the original work by Fearon and Cotton in 1972 and 1974, expansion and augmentation with a cartilaginous graft has become the standard laryngotracheal reconstructive technique with a high success rate of decannulation[17-23]. However, not all LTS can be treated with this procedure. Proper evaluation and selection of the patient is essential. A successful operation requires a substantial lumen and availability of the rigid framework. A stent helps to support and stabilize the reconstructed framework during the healing process. A complete healing period takes about 1-6 weeks, depending on the severity of the lesion. If there is only a small lumen and little amount of reconstructable framework, the proper treatment is to use a resection procedure. Although the single-stage approach has been proven to be an effective treatment [1,24-27], the authors prefer the two-stage approach with retaining of the tracheotomy tube. This technique allows the physician to observe the patient in an ordinary ward; the patient does not need care in the intensive care unit (ICU), and sedation or use of neuromuscular blocking agents is not necessary. In the present series, the patients could usually be decannulated within a few weeks after the operation. Decannulation may have a few weeks delay compared to the single-stage approach, but the advantage is that the surgeon can wait safely while patients have a tracheotomy tube until the reconstructive site is optimal for decannulation. Most of the patients have had a tracheotomy for months or years; waiting an additional few weeks will not make any difference and can save an ICU bed for patients who really need it. Otolaryngologists should be able to perform this two-stage operation in a secondary care hospital

without referring the patient to a university hospital. The perichondrium of the cartilaginous graft acts like a bridge for respiratory mucosa to grow on. From the authors' observation, complete healing takes 2-4 weeks, depending on the size of the bare area. The bare area of cartilaginous graft which involves less than one-third of the luminal circumference needs about 2 weeks; an area involving one-third to two-thirds needs 2-4 weeks, and an area involving more than two-thirds needs more than 4 weeks to obtain complete healing. Mucosal or skin grafts may hasten the healing period and decannulation[28-30] ; however, it is technically difficult to perform especially in a small larynx.

Patients who have severe stenosis and/or lose the rigid framework are candidates for the resection procedure. Isolated tracheal stenosis can be treated with tracheal resection and primary anastomosis. If the stenosis extends to the subglottic level, some part of the cricoid has to be resected. Partial cricotracheal resection with primary anastomosis has been proven to be a safe and effective procedure for pediatric patients with severe subglottic stenosis[31-35]. The highest margin for partial cricotracheal resection reported was for the level of the undersurface of the true vocal cords. However, the smaller the area of mucosa left below the true vocal cords, the higher the risk of restenosis and glottic edema [31,32]. The authors' suggestion is that a few millimeters of mucosal strips should be left below the true vocal cords. If the stenosis extends to the level of the upper border of the cricoid, anterior laryngotracheal spilt above and below anastomosis level and/or posterior cricoid split with cartilage augmentation will help to enlarge the anastomotic lumen. It also helps to approximate both resected ends. Resected cricoid can be transformed in to a diamond shape for the augmentation (Fig. 2). Again, the two-stage approach is certainly safe for partial cricotracheal resection, especially when the anastomotic level is high in the subglottic lumen.

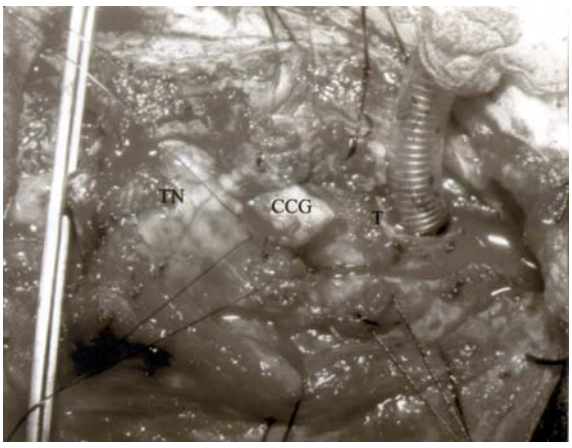

Fig. 2 Cricoid cartilage was sculptured into a diamond shape (CCG) for anterior augmention in partial cricotracheal resection (T = trachea, TN = thyroid notch)

Treatment of complete all-level laryngeal stenosis is time consuming and not straightforward. Although many options of treatment including open laryngeal surgery have been performed, the final result is usually disappointing. Usually, full function of the larynx can not be restored. LTR with cartilaginous augmentation, lysis of fibrotic scar, and placement of a stent are the mainstays of the treatment. A static lesion of the subglottic area responds well to expansion and augmentation procedures along with a period of stenting. A stent can be placed as high as the level of the false vocal cords; however, this will not totally prevent supraglottic fibrotic adhesion and posterior glottic stenosis. The framework of the larynx is usually distorted. Supraglottic and glottic stenoses are always the barrier to decannulation. Since structures in this area are not static, but dynamic during deglutition and phonation, they tend to collapse together, resulting in fibrotic adhesion in spite of previous lysis procedures. Supraglottic scaring causes adhesion of the aryepiglottic (A-E) folds, false vocal cords, and laryngeal surface of the epiglottis. A retronagtic position of the epiglottis caused from fibrosis, which cannot be totally prevented by any stent, shortens the true vocal cords' length. Fibrotic scar at the glottic level creates bulginess of arytenoids and interarytenoid fibrosis. All of these conditions are refractory to many treatment options.

Endoscopic laser excision of supraglottic scar needs to be done repeatedly in order to create a substantial lumen above the true vocal cords. Posterior glottic stenosis fixes the vocal cords in a paramedian position; this is the most difficult part of treatment. Posterior augmentation with cartilaginous graft has been proven to be effective in pediatric patients[36-38]. In the present series, such an operation in an adult failed to create an adequate posterior glottic lumen. This could be due to a higher rate of cartilaginous resorption, more severe degree of fibrosis, and more compromised blood supply. Microtrapdoor flap with microexcision of the scar using either an endoscopic or an external approach

has been reported to be successful[38-41]. However, this is technically difficult, especially in such conditions. In spite of performing arytenoidectomy and cordectomy, two of the presented cases of complete all-level laryngeal stenosis could not be decannulated. While the patients used stomal buttons, they had acceptable voice quality without aspiration. Their stomal buttons could be temporary plugged, with mild dyspnea and noisy breathing on exertion. Aggressive surgical procedures may lead to untreatable complications such as aspiration and aphonia.

Stents are often required in laryngotracheal surgery in order to provide stability for the newly reconstructed airway, to minimize the shearing forces between opposing laryngeal structures, to force distraction of cartilaginous segments, and to maintain mucosal grafts. Although cartilage generally requires 4 to 8 weeks of healing time in order to allow enough intrinsic structural support to develop between the graft and the native laryngeal cartilage, stable cartilaginous grafts in a good native laryngeal framework may not need stenting[42]. One to two weeks of endotracheal tube stenting have proven to be sufficient for single-stage laryngotracheal reconstruction (SSLTR)[1,24-27,43,44]. This will provide good mucosal healing on the graft, a decrease in swelling, and a healing of the framework between graft and native structure. In the present series, 1-2 weeks of stenting for two-stage laryngotracheal reconstruction (TSLTR) in a good reconstructed framework was sufficient before decannulation. In case of an unstable reconstructed framework, the duration of stenting should be prolonged for an additional 2-4 weeks. However, if three to six months of stenting are required to distract and fix the segment with fibrosis, that means the framework is not good enough for reconstruction then the plan of treatment should be switched to a resection procedure, which has a better outcome and shorter cannulation time. There are many types of stents, for example the Cotton-Lorenz rigid Teflon stent, the Alboulker stent, Silastic roll, Montgomery T-tubes, and the nasotracheal tube. Commercial stents are too expensive for Thai patients. They cost 200 $US (8400 baht) each. The use of medical-grade silicone tube in the present series yielded an acceptable outcome. It costs 4000 baht for 20 feet, which is not as expensive as the commercial ones and can be used for many patients.

Infection and gastroesophageal reflux (GER) have been demonstrated to be major aggravating factors for laryngotracheal stenosis and failure of laryngotracheal surgery[45,46]. The authors do not routinely screen for GER. Although the incidence of GER in Asia and Thailand is not as high as in Western countries[47, 48] , there is still a significant association between GER and upper airway problems[45]. Since infection and GER can interfere with the success of laryngotracheal surgery, it is worth prescribing a prophylactic antibiotic and H2-blocker.

Most of the presented patients were referred from other hospitals and proper treatment was delayed. This prolonged the overall cannulation time. After proper treatment was initiated at our institute, the cannulation time of each treatment group is comparable. Except for complicated cases, most of the patients had a cannulation time from weeks to months. The major reasons for prolonged cannulation time in the present series were having a large bare area of cartilaginous grafts and restenosis with granulation tissue formation.

Complications including atelectasis, pneumonia, cortical blindness from accidental extubation, opioid withdrawal symptom, and neuromucular fatigue due to usage of a neuromucular blocking agent and sedation during the intensive postoperative period of SSLTR have been reported [20,23,44,49]. Other complications such as granulation tissue at the graft site, cervical emphysema, wound infection, graft loss and tracheomalacia have also been reported in other studies[50]. Only minor complications were noted in the present series. Granulation tissue, which occurs at the reconstruction area, may be due to a large raw surface area, irritation from the stent and tracheotomy tube, aggressive scar dissection, and the individual response of the patient. Despite prophylactic treatment with an antimicrobial agent and H2 blocker, infection and GER could still be the major contributing factors to the occurence of these complications, which require reevaluation and intensive treatment. Follow up endoscopy with sequential removal of granulation tissue and topical application of mitomicin C is beneficial to resolve this condition. Recurrent laryngeal nerve injury from PCTR can be prevented by meticulous surgery. Dissection is limited to the subperichondrial plane, and resections of the cricoid must be performed anterior to the cricothyroid joints. Tracheomalacia at the stomal level is the result of tracheal framework collapse from previous

tracheotomy or irritation from the lower end of the stent. Preoperative endoscopy is essential for detecting any existing stomal collapse and this area should be included in the reconstructive plan. The stent should be removed as early as possible to reduce the irritation. From the authors' experience, placing a stent in for 1-2 weeks should not cause resorption of cartilage.

Conclusions

Prevention is absolutely the best method to overcome LTS. Good endotracheal intubation care and conversion to tracheotomy at the proper time need to be encouraged. Furthermore, when LTS occurs, selection of the proper treatment is the key to success. Endoscopic treatment is suitable for a thin web and/or soft and short-segment stenosis that has a good framework. Patients who fail from repeated endoscopic procedures should be reevaluated and considered for other treatment options. LTR by expansion and augmentation yields a high success rate in moderate to severe stenosis that has a good framework. Poor cartilaginous framework and/or severe stenosis are indications for a resection procedure. The result of the treatment for complete all-level laryngeal stenosis is usually disappointing. All functions of the larynx may not be restored. Appropriate treatment will not only lead to early decannulation but will also reduce costs, number of operations and prevent complications.

References

1. Cotton RT, Myer CM 3rd, O'Connor DM, et al. Pediatric laryngotracheal reconstruction with cartilage grafts and endotracheal tube stenting: the single-stage approach. Laryngoscope 1995; 105(8 Pt 1): 818-21.
2. Cotton RT, Gray SD, Miller RP. Update of the Cincinnati experience in pediatric laryngotracheal reconstruction. Laryngoscope 1989; 99: 1111-6.
3. Myer CM, 3rd, O'Connor DM, Cotton RT. Proposed grading system for subglottic stenosis based on endotracheal tube sizes. Ann Otol Rhinol Laryngol 1994; 103(4 Pt 1): 319-23.
4. Rosen G, Vered IY. Triamcinolone acetonide injection for laryngeal stenosis. Laryngol Otol 1975; 89: 1043-6.
5. Othersen HB Jr. Intubation injuries of the trachea in children. Management and prevention. Ann Surg 1979; 189: 601-6.
6. Maniglia AJ. Tracheal stenosis: conservative surgery as a primary mode of management. Otolaryngol Clin North Am 1979; 12: 877-92.
7. Jazbi B, Goodwin C, Tackett D, et al. Idiopathic subglottic stenosis. Ann Otol Rhinol Laryngol 1977; 86(5 Pt 1): 644-8.
8. Ingrams DR, Ashton P, Dhingra J, et al. Slow-release 5-fluorouracil and triamcinolone reduces subglottic stenosis in a rabbit model. Ann Otol Rhinol Laryngol 2000; 109: 422-4.
9. Ward RF, April MM. Mitomycin-C in the treatment of tracheal cicatrix after tracheal reconstruction. Int Pediatr Otorhinolaryngol 1998; 44: 221-6.
10. Valdez TA, Shapshay SM. Idiopathic subglottic stenosis revisited. Ann Otol Rhinol Laryngol 2002; 111: 690-5.
11. Spector JE, Werkhaven JA, Spector NC, et al. Prevention of anterior glottic restenosis in a canine model with topical mitomycin-C. Ann Otol Rhinol Laryngol 2001; 110: 1007-10.
12. Rahbar R, Shapshay SM, Healy GB. Mitomycin: effects on laryngeal and tracheal stenosis, benefits, and complications. Ann Otol Rhinol Laryngol 2001; 110: 1-6.
13. Rahbar R, Jones DT, Nuss RC, et al. The role of mitomycin in the prevention and treatment of scar formation in the pediatric aerodigestive tract: friend or foe? Arch Otolaryngol Head Neck Surg 2002; 128: 401-6.
14. Eliashar R, Eliachar I, Esclamado R, et al. Can topical mitomycin prevent laryngotracheal stenosis? Laryngoscope 1999; 109: 1594-600.
15. Correa AJ, Reinisch L, Sanders DL, Huang S,et al. Inhibition of subglottic stenosis with mitomycin-C in the canine model. Ann Otol Rhinol Laryngol 1999; 108(11 Pt 1): 1053-60.
16. Coppit G, Perkins J, Munaretto J, et al. The effects of mitomycin-C and stenting on airway wound healing after laryngotracheal reconstruction in a pig model. Int Pediatr Otorhinolaryngol 2000; 53: 125-35.
17. Cotton RT. Management of subglottic stenosis. Otolaryngol Clin North Am 2000; 33: 111-30.
18. Cotton RT, McMurray JS. Laryngotracheal stenosis. New perspectives. Pediatr Pulmonol - Suppl 1999; 18: 64-6.
19. Cotton RT, O'Connor DM. Paediatric laryngotracheal reconstruction: 20 years' experience. Acta Otorhinolaryngol Belg 1995; 49: 367-72.
20. Yellon RF, Parameswaran M, Brandom BW. Decreasing morbidity following laryngotracheal reconstruction in children. Int Anesthesiol Clin 1997; 35: 145-57.
21. Fearon B, Cotton R. Surgical correction of subglottic stenosis of the larynx in infants and children. Progress report. Ann of Otol Rhinol Laryngol 1974; 83: 428-31.
22. Fearon B, Cotton R. Surgical correction of subglottic stenosis of the larynx. Prelimenary report of an experimental surgical technique. Ann Otol Rhinol Laryngol 1972; 81: 508-13.

23. Cotton RT. Management of subglottic stenosis in infancy and childhood. Review of consecutive series of cases managed by surgical reconstruction. Ann Otol Rhinol Laryngol 1978; 87(5 pt 1): 649-57.
24. Cotton RT. Management of laryngotracheal stenosis and tracheal lesions including single stage laryngotracheoplasty. Int Pediatr Otorhinolaryngol 1995; 32 Suppl: S89-91.
25. McQueen CT, Shapiro NL, Leighton S, et al. Single-stage laryngotracheal reconstruction: the Great Ormond Street experience and guidelines for patient selection. Arch Otolaryngol Head Neck Surg 1999; 125: 320-2.
26. Prescott CA. Protocol for management of the interposition cartilage graft laryngotracheoplasty. Ann Otol Rhinol Laryngol 1988; 97(3 Pt 1): 239-42.
27. Lusk RP, Gray S, Muntz HR. Single-stage laryngotracheal reconstruction. Arch Otolaryngol Head Neck Surg 1991; 117: 171-3.
28. Hoasjoe DK, Franklin SW, Aarstad RF, et al. Posterior glottic stenosis mechanism and surgical management. Laryngoscope 1997; 107: 675-9.
29. Valdez TA, Wang Z, Schumann R, et al. Anterior window laryngoplasty: a new anatomic approach for posterior glottic and subglottic stenosis. Ann Otol Rhinol Laryngol 2001; 110: 519-23.
30. Thome R, Thome DC, Behlau M. The use of buccal mucosa graft at posterior cricoid splitting for subglottic stenosis repair. Laryngoscope 2001; 111: 2191-4.
31. Walner DL, Stern Y, Cotton RT. Margins of partial cricotracheal resection in children. Laryngoscope 1999; 109: 1607-10.
32. Stern Y, Gerber ME, Walner DL, et al. Partial cricotracheal resection with primary anastomosis in the pediatric age group. Ann Otol Rhinol Laryngol 1997; 106: 891-6.
33. Monnier P, Lang F, Savary M. Partial cricotracheal resection for severe pediatric subglottic stenosis: update of the Lausanne experience. Ann Otol Rhinol Laryngol 1998; 107(11 Pt 1): 961-8.
34. Triglia JM, Nicollas R, Roman S. Primary cricotracheal resection in children: indications, technique and outcome. Int Pediatr Otorhinolaryngol. 2001; 58: 17-25.
35. Monnier P, Lang F, Savary M. Cricotracheal resection for pediatric subglottic stenosis. Int Pediatric Otorhinolaryngol 1999; 49 Suppl 1: S283-6.
36. Berkowitz RG. The management of posterior glottic stenosis following endotracheal intubation. Aust N Z Surg 1994; 64: 621-5.
37. Zalzal GH. Posterior glottic fixation in children. Ann Otol Rhinol Laryngol 1993; 102: 680-6.
38. Bogdasarian RS, Olson NR, Arbor N. Posterior glottic laryngeal stenosis. Otolaryngol Head Neck Surg 1980; 88: 765-72.
39. Dedo HH, Sooy CD. Endoscopic laser repair of posterior glottic, subglottic and tracheal stenosis by division or micro-trapdoor flap. Laryngoscope 1984; 94: 445-50.
40. Montgomery WW. Posterior and complete laryngeal (glottic) stenosis. Arch Otolaryngol 1973; 98: 170-5.
41. Glodberg AN. Endoscopic postcricoid advancement flap for posterior glottic stenosis. Laryngoscope 2000; 110: 482-5.
42. Younis RT, Lazar RH. Laryngotracheal reconstruction without stenting. Otolaryngol Head Neck Surg 1997; 116: 358-62.
43. Rothschild MA, Cotcamp D, Cotton RT. Postoperative medical management in single-stage laryngotracheoplasty. Arch Otolaryngol Head Neck Surg 1995; 121: 1175-9.
44. Bauman NM, Oyos TL, Murray DJ, et al. Postoperative care following single-stage laryngotracheoplasty. Ann Otol Rhinol Laryngol 1996; 105: 317-22.
45. Yellon RF, Goldberg H. Update on gastroesophageal reflux disease in pediatric airway disorders. Am J Med 2001; 111 Suppl 8A: S78-84.
46. Toohill RJ, Ulualp SO, Shaker R. Evaluation of gastroesophageal reflux in patients with laryngotracheal stenosis. Ann Otol Rhinol Laryngol 1998; 107: 1010-4.
47. Osatakul S, Sriplung H, Puetpaiboon A, et al. Prevalence and natural course of gastroesophageal reflux symptoms: a 1-year cohort study in Thai infants. J Pediatr Gastroenterol Nutr 2002; 34: 63-7.
48. Ho KY, Kang JY, Seow A. Prevalence of gastrointestinal symptoms in a multiracial Asian population, with particular reference to reflux-type symptoms. Am J Gastroenterol 1998; 93: 1816-22.
49. Zeitouno AG, Manoukian J. Severe complications of anterior cricoid split operation and siggle-stage laryngotracheoplasty. Ann Otol Rhinol Laryngol 1994; 103: 723-5.
50. Silva AB, Lusk RP, Muntz HR. Update on the use of auricular cartilage in laryngotracheal reconstruction. Ann Otol Rhinol Laryngol 2000; 109: 343-7.

การดูแลรักษาภาวะกล่องเสียง และหลอดลมตีบตัน

วีระชัย ตันตินิกร, ชลธิศ สินรัชตานันท์, ปารยะ อาศนะเสน

จุดประสงค์ *: เพื่อรวบรวมและประเมินผลการรักษาภาวะกล่องเสียงและหลอดลมตีบตัน (LTS)*
รูปแบบการศึกษา*: การศึกษาย้อนหลังจากแฟ้มรายงานผู้ป่วย*
สถานที่ *: โรงพยาบาลมหาวิทยาลัยระดับทุติยภูมิ*
กลุ่มผู้ป่วย *: ผู้ป่วย LTS ที่ได้รับการรักษาโดยผู้รายงานชื่อแรกตั้งแต่ มกราคม 2543 ถึง มกราคม 2546*
ข้อมูลวัดผล *: สาเหตุนำของ LTS รายละเอียดของพยาธิสภาพ หัตถการที่ใช้รักษา ผลแทรกซ้อนจากการรักษา ระยะเวลาและจำนวนผู้ป่วยที่ประสบความสำเร็จจากการรักษาจนสามารถถอดท่อหลอดลมได้*
ผลลัพธ์ *: ผู้ป่วย 21 รายเป็น ชาย 9 ราย หญิง 12 ราย อายุตั้งแต่ 1-32 ปี ครึ่งหนึ่งของผู้ป่วยมีอายุน้อยกว่า 10 ปี subglottic lumen เป็นตำแหน่งการตีบตันที่พบบ่อยที่สุดมีจำนวน 14 ราย ตามด้วย cervical trachea จำนวน 5 ราย ผู้ป่วย 9 ราย รับการรักษาผ่านการส่องกล้อง 9รายรับการรักษาด้วยวิธีการผ่าตัด laryngotracheal reconstruction (LTR) 3 รายรักษาด้วยวิธี tracheal resection และ 3รายรักษาด้วยวิธี partial cricotracheal resection ผู้ป่วย 19 ราย (90.5%) สามารถถอดท่อหลอดลมออกได้การรักษาผ่านการส่องกล้องให้ผลสำเร็จสามารถถอดท่อหลอดลมออกได้ภายหลังการรักษา 2-4 ครั้ง ผู้ป่วย 2 รายที่มีปัญหา all-level laryngeal stenosis ไม่สามารถถอดท่อหลอดลมออกได้ถึงแม้ว่าจะได้รับการรักษาอย่างเต็มที่ด้วยการผ่าตัด LTR การใช้เลเซอร์ผ่านการส่องกล้อง และ arytenoidectomy การรักษาจนสามารถถอดท่อหลอดลมได้โดยรวมใช้เวลา 2-210 วัน ขนาดผิวเปลือยของ costal cartilagenous graft และการตีบซ้ำจาก granulation tissue เป็นสาเหตุสำคัญของการรักษาที่ใช้เวลานาน*
สรุป *: การรักษา LTS ที่เหมาะสมโดยประเมินตามลักษณะตรวจพบทางพยาธิสภาพจะให้ผลการรักษาที่ดีภายในระยะเวลาที่พอเหมาะ การตีบตับของกล่องเสียงและหลอดลมที่เกิดขึ้นหลายระดับโดยเฉพาะที่ตำแหน่ง supraglottic และ glottic area มักตอบสนองต่อการรักษาไม่ดีนักทำให้ไม่สามารถฟื้นสภาพหน้าที่ของกล่องเสียงได้อย่างสมบูรณ์*