Long-Term T-tube Stenting as Definitive Treatment for Severe Acquired Subglottic Stenosis in Children

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Long-Term T-tube stenting as definitive treatment for severe acquired subglottic stenosis in children

小児の重度後天性声門下腔狭窄症に対する根治術としての長期 T-tube ステント療法

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The management of severe acquired subglottic stenosis (SGS) secondary to prolonged endotracheal intubation in the neonatal period remains a difficult challenge. Children with severe acquired SGS often require multiple procedures to achieve a satisfactory outcome [1-2]. There is also the risk of fatal respiratory obstruction during these procedures. As these severe SGS cases often need long-term stenting to ensure a safe airway during treatment, we used a silicon T-tube following an anterior cricoid split (ACS). We analyzed our results of long-term T-tube stenting for severe acquired subglottic stenosis.

1. Materials and methods

A retrospective chart review was conducted of all neonates with severe acquired SGS after prolonged intubation treated with a T-tube between September 1999 and July 2009 at Takatsuki General Hospital, Osaka, Japan. Severe SGS was either Cotton grade 3 or 4 stenosis, which was defined as an obstruction greater than 90% [3]. The chart review identified 20 such neonates.

A tracheostomy had been performed in all of the neonates after the diagnosis of acquired SGS by bronchoscopy. Thereafter, children underwent a bronchoscopic examination annually or semiannually to assess the extent of subglottic inflammation indicated by redness or edema of the subglottic mucosa. After the subglottic inflammation had resolved, the definitive operation was performed. The operative procedure consisted of an ACS and placement of a silicon T-tube (Koken, Inc., Tokyo, Japan) as a stent for the expanded subglottic lumen. The ACS was performed as described by Cotton [4]. The proximal tip of the T-tube was placed in the supraglottic space. If necessary, a posterior or lateral cricoid split was also performed. After the operation, patients no longer required ICU care, and were discharged home within a week. Thereafter, semi-annual bronchoscopic examinations were performed to evaluate the subglottic area and to exchange the T-tube. The criteria for T-tube decannulation, as determined by bronchoscopic examination, were the absence of subglottic inflammation bleeding, edema or re-stenosis after the removal of T-tube..

We analyzed various factors related to these patients, such as gestational age, weight at birth, duration of intubation before tracheostomy, degree of stenosis, age at definitive operation, duration of T-tube stenting, and complications. These patients were then divided into two groups according to the timing of the T-tube stent placement: an initial operation group and an additional operation group.

Neonates complicated with other congenital life-threatening anomalies such as congenital laryngotracheal disease were excluded from this study.

2. Results

We identified 20 children who were treated with long-term T-tube stenting. Of the 20, 12 (60%) were successful decannulated, while 4 continued to require T-tube stenting. In the remaining 4 children, T-tubes were switched to ordinary tracheostomy tubes because of progressive development of tube-tip granulation (2 children) or failure of decannulation (2 children) after 14.5 months (range, 5 - 33 months). The cause of failure were ongoing stenosis at the surgical site within a few weeks

after decannulation. The mean postoperative follow-up period of the 16 children who had been successfully decannulated or who required continuation of T-tube stenting was 74 months (range, 22 - 115 months). We experienced no other complication except tube-tip granulation or early re-stenosis. There were neither early nor late deaths. Voice quality improved gradually after decannulation.

The initial operation group was comprised of 14 patients and the additional operation group was comprised of 6 patients. Among these 6 patients, other procedures, including resection of granulation tissue, endoscopic dilatation, ACS and costal cartilage grafting, had failed. Table 1 shows demographic data and outcome in the initial operation group. Decannulation was achieved in 8 of the 14 children in the initial operation group (57.1%). Figure 1 shows the endoscopic view of case 4 prior to and after T-tube stenting. Three patients continued to require T-tube stenting, and in the remaining three the T-tubes were switched to tracheostomy tubes. The average duration of stenting in the initial operation group was 16.1 months. Demographic data and outcome in the additional operated group are shown in Table 2. Decannulation was achieved in 4 of the 6 children (66.7%) in that group. The average duration of T-tube stenting was 65.8 months. The decannulation rate did not differ between the initial operation group and the additional operation group. On the other hand, the duration of postoperative stenting was significantly different. There were no significant differences in demographic factors between the initial operation and the additional operation groups.

3. Discussion

We demonstrated a 60% decannulation rate with T-tube stenting in children with severe subglottic stenosis. For both preoperative and postoperative, a T-tube is safe and easy to manage for the medical team, the patients, and their families. The technique for T-tube placement is simple and requires no special devices or special techniques. For cricotracheal reconstruction, the postoperative use of heavy sedation or respiratory care is sometimes needed, and errors in their management could be fatal [5, 6]. Patients managed with T-tube stenting do not require intensive care and sedation is unnecessary. Furthermore, the T-tube is versatile in its ability to cope with different airway demands due to the presence of three lumens. It can assist child's breathing and is easy to care for [7]. Patients can leave the hospital within a week after the procedure and can live normally at home.

Experience in the management of pediatric laryngotracheal stenosis has been frequently reported. Although various decannulation rates (35 to 100 %) have been shown, some patients who were successfully treated in previous studies required multiple operations [1-2, 5-6, 8-9]. The overall decannulation rate in our series was 60%. Considering that the technique is easy and the airway with a T-tube in place is safe, our rate of successful outcome was sufficiently acceptable.

The decannulation rate did not differ between the initial operation group and the additional operation group. On the other hand, the duration of postoperative stenting was significantly different. The difficulty with treatment of acquired SGS is management of the scar tissue. An additional trauma to the scarred lesion through surgery will again bring about a severe inflammatory response

each time. Rotenberg et al reported that prolonged preoperative intubation decreased the decannulation rate in cricotracheal resection [10]. Jaquet et al reported that patients treated with a single-stage partial cricotracheal resection (PCTR) were decannulated earlier than patients undergoing a double-stage PCTR [5].

Cotton has described that the surgical approach to pediatric laryngotracheal reconstruction consists of stabilization of the enlarged lumen framework and healing of the surgical site [6]. The principles of treatment for SGS are to avoid trauma to the subglottic space as soon as possible and to stabilize the tracheal lumen sufficiently. A T-tube is soft and seems to cause less granulation than the Aboulker stent [7, 11], and is thus a good option for long-term stenting. Indeed, the placement of a T-tube would be a good option for an additional treatment after failure of previous procedures, but in cases of severe SGS, use of the T-tube as an initial option would be desirable. In our series, four children still required T-tube stenting. However their quality of life was better than that with an ordinary tracheostomy with improved vocalization and a reduction in suctioning.

In four patients, T-tubes were replaced with ordinary tracheostomy tubes because of progressive tube-tip granulation or re-stenosis after decannulation. Tube-tip granulation is a considerable disadvantage of T-tube treatment. At best, we planned to place the proximal tip at the supraglottic space to prevent the formation of granulation at the vocal cord. Two children had re-stenosis in the subglottis 3 weeks after decannulation. After experiencing these cases, we have paid careful attention to the symptoms of re-stenosis after decannulation. If such symptoms were observed, a T-tube should be re-inserted immediately. However, we had no re-stenosis among our cases in the long-term follow-up.

4. Conclusion

The treatment of severe acquired SGS in children remains a difficult challenge. Children who were treated with T-tube stenting could carry out the activities of daily living without limitations. T-tube stenting for severe acquired SGS is safe and should be recognized as an alternative treatment in terms of postoperative quality of life. Long-term T-tube stenting as an initial operation should be recommended, since the rate of successful decannulation was acceptable and the time to decannulation was shorter compared with the cases in the additional operation group.

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Case	Gestational age (wk)	Birth weight (g)	Duration of intubation before tracheostomy (mo)	Stenosis grade	Age at definitive operation	Duration of T-tube stenting (mo)	Result
1	28	980	3	3	2y11m	6	decannulated
2	27	586	4	3	5y2m	12	decannulated
3	26	766	13	3	7y0m	13	decannulated
4	25	705	6	3	5y2m	16	decannulated
5	25	830	4	3	5y2m	17	decannulated
6	27	896	7	3	4y0m	20	decannulated
7	29	450	18	3	6y11m	22	decannulated
8	35	2240	2	4	2y3m	23	decannulated
9	34	1816	3	3	4y5m	62	T-tube*
10	28	1115	2	3	5y7m	75	T-tube*
11	28	643	9	3	6y2m	79	T-tube*
12	29	1368	20	3	6y0m	5	reversion**
13	24	570	6	3	5y10m	7	reversion**
14	38	3055	2	3	5y4m	13	reversion**

* T-tube stenting continues to be necessary

** T-tube replaced with ordinary tracheostomy tube

Table 1. Demographics and results in initial operation group

Case	Gestational age (wk)	Birth weight (g)	Duration of intubation before tracheostomy (mo)	Stenosis grade	Age at definitive operation	Duration of T-tube stenting (mo)	Result
15	27	1132	3	4	4y10m	26	decannulated
16	37	2790	3	3	4y11m	58	decannulated
17	26	1015	4	3	10y5m	90	decannulated
18	24	640	5	3	3y11m	95	decannulated
19	33	1682	5	4	4y5m	43	T-tube*
20	27	917	9	3	3y0m	33	reversion**

* T-tube stenting continues to be necessary

** T-tube replaced with ordinary tracheostomy tube

Table 2. Demographics and results in additional operation group

(a)

(b)

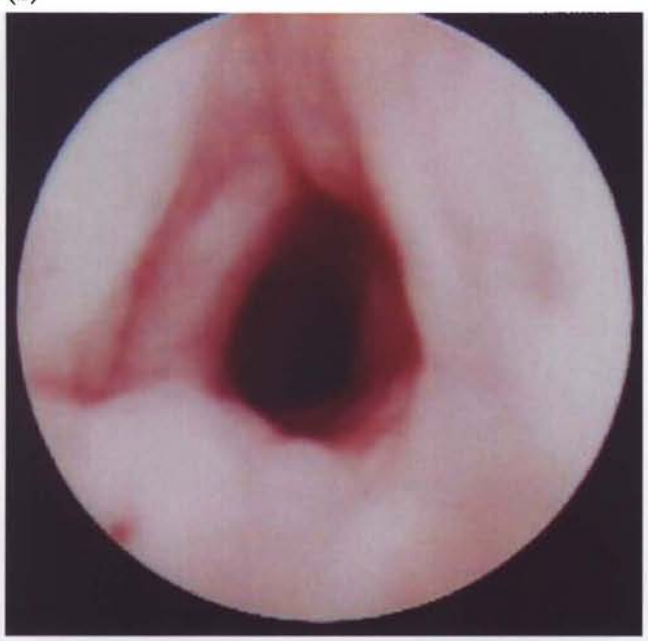

Fig 1.Endoscopic view of case 4 prior to and after T-tube stenting

(a) Preoperatove view showing subtotal obstruction of the subglottis

(b) Postoperative view showing a patent subglottic lumen 2 years after decanulation