Management of Pulmonary Artery Sling Associated With Tracheal Stenosis

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Background. Pulmonary artery sling is often associated with congenital tracheal stenosis and intracardiac anomalies. This study examines the influence of concomitant anomalies and individual surgical procedures.

Methods. Between 1984 and 2006, 31 patients underwent surgical repair of pulmonary artery sling (median, 6 months; range, 29 days to 9 years). Twenty-eight of them underwent left pulmonary artery reimplantation and tracheoplasty, whereas the remaining 3 received only left pulmonary reimplantation. The first 4 patients with long segment tracheal stenosis were treated with a costal cartilage graft and the next 19 with slide tracheoplasty. Five patients underwent tracheal resection with end-to-end anastomosis. Associated cardiac anomalies in 10 patients were repaired concomitantly with left pulmonary artery reimplantation and tracheoplasty.

Results. Two patients died early of low-output syndrome (n = 1) and ventricular arrhythmia (n = 1). Follow-up was complete in all patients (median, 4.6 years) with 3 late deaths arising from residual tracheal stenosis or pulmonary hypertension. Two survivors with a costal cartilage graft remain free of respiratory problems. Of 16 survivors who underwent slide tracheoplasty, 9 who did not have tracheostomy are fully active and 7 had tracheostomy to treat tracheomalacia and granulation. Among 5 survivors of tracheal resection, 4 are doing well without tracheostomy. Echocardiography showed that the left pulmonary artery was patent in all assessed patients, but 1 required balloon arterioplasty.

Conclusions. Left pulmonary reimplantation with simultaneous repair of tracheal stenosis and intracardiac anomalies results in low operative mortality and satisfactory left pulmonary artery patency. However, the management of younger infants with tracheoplasty for long segment stenosis involving carina or complex cardiac anomalies remains challenging.

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Pulmonary artery sling is a vascular anomaly wherein the left pulmonary artery arises from the right pulmonary artery and continues toward the left between the lower trachea and esophagus. Pulmonary artery sling is often associated with congenital tracheal stenosis. Patients with pulmonary artery sling comprise those whose respiratory symptoms are due to external tracheal compression that can be corrected by relief of the sling mechanism, and those who have severe diffuse tracheal stenosis with complete rings (ring-sling complex) [1]. In particular, long segment or distal tracheal stenosis involving carina is life threatening and difficult to treat. The ideal treatment for long segment tracheal stenosis and the management of younger infants with complex cardiac anomalies remains controversial. In addition, pulmonary artery sling is often associated with intracardiac anomalies. Here we review the short- and long-term results of our strategy for treating pulmonary artery sling.

Patients and Methods

This study was approved by the Ethics Committee of Children’s Hospital as a retrospective chart analysis. The Committee waived the need for patient consent.

We reviewed 31 patients (15 boys and 16 girls; age range, 29 days to 9 years; median, 6 months) with pulmonary artery sling, among whom 29 underwent surgical repair of this anomaly at Kobe Children’s Hospital, and 2 underwent tracheoplasty at Kobe Children’s Hospital after left pulmonary artery reimplantation at another institute between 1984 and 2006 (Table 1). At the time of surgery, 22 of the patients were less than 1 year old, and 12 were less than 6 months old. All patients presented with respiratory symptoms varying from mild or occasional stridor to severe distress and choking. Seventeen patients were on preoperative ventilatory support. Nine patients with severe tracheal stenosis were in critical respiratory distress despite being managed on mechanical ventilation. Pulmonary artery sling was diagnosed by echocardiography in most patients. Earlier in this series, pulmonary artery sling in 3 patients was revealed during tracheoplasty and in another 3 who underwent angiography to identify the anomalous course of the left pulmonary artery. The remaining 3 patients had intracardiac anomalies.
Twenty-five patients (81%) were preoperatively diagnosed by echocardiography. Tracheal lesions were diagnosed in almost all patients by rigid bronchoscopy. Diagnosis by three-dimensional spiral computed tomographic imaging has recently become popular. The stenotic lesion encompassed between 50% and 100% (median, 78%) of the total tracheal length in 22 patients (71%) with long segment tracheal stenosis, and in 16 of them, the carina was involved in the stenotic lesion. Tracheobronchus (right upper bronchus arising from the trachea) was evident in 6 patients, and cardiac anomalies were associated in 11. Twenty-eight patients underwent left pulmonary artery reimplantation and tracheoplasty, whereas the other 3 patients with occasional stridor, mild tracheal narrowing, or short segment complete rings underwent only left pulmonary artery reimplantation without tracheoplasty. We defined mild stenosis as occasional symptoms and more than 50% diameter of a normal segment or more than a diameter of 4 mm in small infants, moderate stenosis as symptomatic but no respiratory embarrassment, and severe stenosis as respiratory embarrassment that needs mechanical ventilation. Endoscopic techniques with dilatation and laser resection were preoperatively applied to 3 patients (patients 21, 22, and 29), and postoperatively in 10 to address complications. Stenting trachea was preoperatively performed in 2 patients (patients 18 and 22).

### Table 1. Patient Characteristics

<table>
<thead>
<tr>
<th>Pt. No.</th>
<th>Age</th>
<th>Type of Tracheal Stenosis</th>
<th>Length of Stenosis mm (%)</th>
<th>Preop. Ventilation</th>
<th>Carinal Involvement</th>
<th>Tracheoplasty</th>
<th>Complications &amp; Reoperation</th>
<th>Duration of Postoperative Intubation (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8 mo</td>
<td>Short</td>
<td>26 (47)</td>
<td>+</td>
<td>+</td>
<td>Costal</td>
<td>G, M</td>
<td>170</td>
</tr>
<tr>
<td>2</td>
<td>5 mo</td>
<td>Long</td>
<td>45 (78)</td>
<td>+</td>
<td>+</td>
<td>Costal</td>
<td>+</td>
<td>74</td>
</tr>
<tr>
<td>3</td>
<td>6 mo</td>
<td>Long</td>
<td>45 (81)</td>
<td>+</td>
<td>+</td>
<td>Costal</td>
<td>Reop. for obstruction</td>
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<tr>
<td>4</td>
<td>2 mo</td>
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<td>50 (88)</td>
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<td>+</td>
<td>Costal</td>
<td>G</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>11 mo</td>
<td>Short</td>
<td>18 (30)</td>
<td>+</td>
<td>+</td>
<td>E-E</td>
<td>+</td>
<td>28</td>
</tr>
<tr>
<td>6</td>
<td>9 mo</td>
<td>Long</td>
<td>30 (66)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>29 d</td>
<td>Long</td>
<td>25 (50)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>LOS, pulmonary bleeding</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>12 mo</td>
<td>Short</td>
<td>25 (50)</td>
<td>+</td>
<td>+</td>
<td>E-E</td>
<td>G</td>
<td>59</td>
</tr>
<tr>
<td>9</td>
<td>1 mo</td>
<td>Short</td>
<td>12 (16)</td>
<td>+</td>
<td>+</td>
<td>E-E</td>
<td>G, M</td>
<td>+</td>
</tr>
<tr>
<td>10</td>
<td>4 mo</td>
<td>Long</td>
<td>30 (80)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>G, GER</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>32 mo</td>
<td>Short</td>
<td>30 (40)</td>
<td>+</td>
<td>+</td>
<td>None</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>7 mo</td>
<td>Long</td>
<td>30 (75)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>32</td>
</tr>
<tr>
<td>13</td>
<td>4 mo</td>
<td>Long</td>
<td>27 (50)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>G, M</td>
<td>+</td>
</tr>
<tr>
<td>14</td>
<td>108 mo</td>
<td>Long</td>
<td>65 (86)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>12</td>
</tr>
<tr>
<td>15</td>
<td>1 mo</td>
<td>Long</td>
<td>45 (100)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>LOS</td>
<td>+</td>
</tr>
<tr>
<td>16</td>
<td>1 mo</td>
<td>Long</td>
<td>45 (90)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>32</td>
</tr>
<tr>
<td>17</td>
<td>4 mo</td>
<td>Short</td>
<td>14 (38)</td>
<td>E-E</td>
<td>+</td>
<td>PH crisis</td>
<td>+</td>
<td>33</td>
</tr>
<tr>
<td>18</td>
<td>10 mo</td>
<td>Long</td>
<td>35 (70)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>G, M</td>
<td>+</td>
</tr>
<tr>
<td>19</td>
<td>24 mo</td>
<td>Long</td>
<td>45 (70)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>12</td>
</tr>
<tr>
<td>20</td>
<td>23 mo</td>
<td>Long</td>
<td>60 (80)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>Cerebral infarction</td>
<td>+</td>
</tr>
<tr>
<td>21</td>
<td>12 mo</td>
<td>Long</td>
<td>38 (70)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>Reop. for leakage</td>
<td>52</td>
</tr>
<tr>
<td>22</td>
<td>4 mo</td>
<td>Long</td>
<td>50 (80)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>G</td>
<td>+</td>
</tr>
<tr>
<td>23</td>
<td>19 mo</td>
<td>Long</td>
<td>75 (88)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>LOS, GER</td>
<td>+</td>
</tr>
<tr>
<td>24</td>
<td>4 mo</td>
<td>Long</td>
<td>55 (85)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>G, M, PH</td>
<td>+</td>
</tr>
<tr>
<td>25</td>
<td>4 mo</td>
<td>Long</td>
<td>44 (70)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>G</td>
<td>+</td>
</tr>
<tr>
<td>26</td>
<td>28 mo</td>
<td>Short</td>
<td>30 (50)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>27</td>
<td>2 mo</td>
<td>Long</td>
<td>35 (78)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>22</td>
</tr>
<tr>
<td>28</td>
<td>9 mo</td>
<td>Short</td>
<td>18 (30)</td>
<td>+</td>
<td>+</td>
<td>None</td>
<td>+</td>
<td>0</td>
</tr>
<tr>
<td>29</td>
<td>6 mo</td>
<td>Long</td>
<td>32 (70)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>Reop. for leakage</td>
<td>+</td>
</tr>
<tr>
<td>30</td>
<td>75 mo</td>
<td>Long</td>
<td>55 (50)</td>
<td>+</td>
<td>+</td>
<td>Slide</td>
<td>+</td>
<td>6</td>
</tr>
<tr>
<td>31</td>
<td>4 mo</td>
<td>Short</td>
<td>20 (40)</td>
<td>+</td>
<td>+</td>
<td>E-E</td>
<td>G</td>
<td>33</td>
</tr>
</tbody>
</table>

**Legend:**
- Pt. No.: Patient number
- Age: Age in months
- Type of Tracheal Stenosis: Short or Long
- Length of Stenosis mm (%): Length of stenosis in millimeters as a percentage of the total tracheal length
- Preop. Ventilation: Presence of preoperative ventilation
- Carinal Involvement: Presence of carinal involvement
- Tracheoplasty: Length of tracheoplasty
- Complications: Description of complications
- Duration of Postoperative Intubation (days): Duration of postoperative intubation

*Note:* d = days; E-E = end to end; G = granulation; GER = gastro-esophageal reflux; LOS = low cardiac output syndrome; M = malacia; mo = months; No. = number; PH = pulmonary hypertension; Preop = preoperative; Pt. = Patient; reop = reoperation.
Surgical Treatment

The staff of the divisions of pediatric surgery and cardiovascular surgery cooperated in the surgical procedures including the three types of tracheoplasty that were applied to treat tracheal stenosis: costal cartilage tracheoplasty, slide tracheoplasty, and resection with end-to-end anastomosis.

Of the 23 patients with long segment tracheal stenosis, 4 were treated with a costal cartilage graft between 1984 and 1992 (early patients) and 19 were treated with slide tracheoplasty between 1997 and 2006. Five patients with short segment stenosis (less than 50% total tracheal stenosis) underwent tracheal resection with end-to-end anastomosis.

The first patient was diagnosed with pulmonary artery sling during tracheoplasty through a right thoracotomy. He underwent left pulmonary artery reimplantation without cardiopulmonary bypass through the same approach. All other patients were treated by cardiopulmonary bypass including extracorporeal membrane oxygenation through a median sternotomy. In the absence of additional intracardiac anomalies, cardiopulmonary bypass was achieved using aortic and a single atrial cannulation with the heart beating throughout the procedure. If additional intracardiac anomalies required repair, the aorta was cross-clamped by bicaval cannulation, and the heart was arrested with blood cardioplegia after left pulmonary artery reimplantation. Associated cardiac anomalies in 10 patients were repaired concomitantly with left pulmonary artery reimplantation and tracheoplasty. One patient with pulmonary atresia and an intact ventricular septum had a systemic to pulmonary artery shunt.

Left pulmonary artery reimplantation proceeded according to the classic repair method [2]. If required for tracheoplasty, complete resection of the thymus was useful to expose the superior mediastinum. The brachiocephalic artery, innominate vein, the aorta, the ligamentum (or duct), the right pulmonary artery, trachea, and the left pulmonary artery from the superior aspect of the right pulmonary artery were dissected. The ligamentum was divided, and the peripheral left pulmonary artery was dissected circumferentially to the left hilar branches taking care to avoid the phrenic and recurrent laryngeal nerves. The left pulmonary artery was detached from the right pulmonary artery and translocated to the left of the trachea. The orifice of the left pulmonary artery was enlarged as far as the posterior aspect by an incision. The left pulmonary artery was implanted into the left side of the main pulmonary artery with continuous 6-0 polydioxanone or 7-0 polypropylene sutures.

Tracheoplasty was performed with the heart beating or while rewarming the patient after aortic declamping on cardiopulmonary bypass.

COSTAL CARTILAGE TRACHEOPLASTY. The precise details of tracheoplasty with a costal cartilage graft have been described [3, 4]. The entire stenotic segment was incised and opened in the anterior midline. A cartilage graft was harvested from the seventh rib, trimmed into an ellipse, and sutured to the tracheal edges with interrupted 5-0 monofilament absorbable sutures. An endotracheal stent tube was replaced with the tip beyond the reconstruction.

SLIDE TRACHEOPLASTY. This surgery proceeded as described [5]. The stenotic segment was circumferentially dissected and divided transversely at the midpoint. The proximal and distal segments were incised in the posterior and anterior midlines, respectively. Both ends were trimmed to face each other and slid together to provide a large caliber lumen. The end-to-end anastomosis around the entire oblique circumference was achieved using interrupted 5-0 absorbable sutures. The vertical incision was extended into the carina of patients with carinal involvement in stenosis, and a stent was inserted to reach the tip of the superior flap to prevent restenosis.

Intracardiac anomalies and pulmonary artery sling were concomitantly repaired with tracheoplasty in 10 patients: ventricular septal defect in 4, atrial septal defect in 2, Cor triatriatum in 1 (patient 24), partial anomalous pulmonary venous return in 1 (patient 3), double-outlet right ventricle with subaortic ventricular septal defect in 1 (patient 5), and tetralogy of Fallot with absent pulmonary valve in 1 (patient 15). Patient 10, who had long segment tracheal stenosis, underwent primary repair of coarctation, ventricular septal defect, and pulmonary artery sling at another institution.

Results

These procedures resulted in 2 early deaths. One male infant (patient 7) with pulmonary atresia, intact ventricular septum, and long segment tracheal stenosis underwent systemic to pulmonary artery shunt, left pulmonary artery reimplantation, and slide tracheoplasty at the age of 23 days. He died of pulmonary bleeding, hypoxia, and low-output syndrome. A 1-month-old boy (patient 15) who had tetralogy of Fallot without a pulmonary valve underwent intracardiac repair, pulmonary artery plication, left pulmonary artery reimplantation, and slide tracheoplasty. However, he died of low-output syndrome and ventricular arrhythmia after long cardiopulmonary bypass.

Follow-up was completed for all patients, including 3 late deaths, and ranged from 5 months to 19 years (median, 4.6 years). Two late deaths occurred (patient 1 at 11 months and patient 4 at 12 years) after tracheoplasty with a costal cartilage graft owing to residual tracheal stenosis; and 1 late death (patient 24) at 7 months after slide tracheoplasty, pulmonary artery sling, and Cor triatriatum repair was due to residual tracheal stenosis and pulmonary hypertension.

Of 4 patients who underwent costal cartilage graft repair, 2 survived and were followed up for 3 and 19 years. One of the survivors required a second tracheoplasty for residual stenosis. The time to extubation after surgery was 42 and 74 days for patients 2 and 3. However, both currently remain free of respiratory problems.

Of the 19 patients who underwent slide tracheoplasty, 16 survived and were followed up from 6 months to 9
years (median, 4.4 years). Two patients (patients 21 and 29) required a second tracheoplasty for anastomotic leakage, and endotracheal tubes were removed from 9 patients without incident. The time to extubation was 6 to 52 days (median, 21). Thereafter, they remained free of respiratory problems. Among the other 7 survivors, tracheostomy was required for distal tracheomalacia and granulation that developed around the distal anastomosis in the carina.

Of 5 patients who underwent tracheal resection and end-to-end anastomosis, all survived and were followed up from 4 months to 10 years (median, 6.9 years). Four patients were extubated on postoperative days 28 to 59 (median, 33). The remaining patient underwent tracheostomy to treat tracheomalacia and granulation.

Left pulmonary artery patency was assessed in 12 survivors by echocardiography. The left pulmonary artery was patent in all, but 1 patient required balloon arterioplasty for moderate stenosis. Postoperative left pulmonary artery patency and tracheal lesions were documented using three-dimensional computed tomography in 4 patients.

Comment
The fate of patients with pulmonary artery sling depends on associated tracheal lesions and complex cardiac anomalies. The severity of tracheal stenosis is evaluated based on clinical status or endoscopic findings. Anton-Pacheco and coworkers [6] classified patients into three groups depending on the severity of clinical symptoms and endoscopic findings. Clinical status extends from mild or occasional stridor without respiratory distress to severe respiratory discomfort. Endoscopic findings of mild stenosis comprised a narrow posterior membranous trachea or complete tracheal rings with an adequate diameter (4 to 6 mm in a small infant), and moderate to severe stenosis with complete rings that are characterized by an absent membranous portion with fused tracheal cartilage. Rigid bronchoscopy also revealed anatomic findings of stenosis including length, diameter, with or without carina involvement, or tracheobronchial anomalies (tracheobronchus).

Anton-Pacheco and coworkers [6] observed patients with mild stenosis without surgical intervention, and van Son and associates [7] stated that conservative treatment was preferable for mild or moderate tracheal stenosis. However, the criteria for judging the severity of tracheal stenosis were unclear, and they considered that the presence of complete tracheal rings per se was not an indication for tracheoplasty and that only severe obstruction should be treated surgically. Three patients in our series with mild and segmental complete rings and occasional preoperative symptoms were simply observed without tracheoplasty. We also support the notion that clinically mild tracheal stenosis requires only observation because our patients with this condition have remained free of respiratory problems over the long term after pulmonary artery sling repair.

We previously advocated concomitant repair of both lesions with cardiopulmonary bypass for the surgical management of infants and small children with a difficult and otherwise fatal combination of complex congenital cardiac anomalies and severe tracheal stenosis [8–11]. Fiore and colleagues [12] noted from their series that the mortality and morbidity rates were highest for patients aged less than 1 year. Because concomitant repair for complex cardiac anomalies was also associated with a high mortality rate, palliation for cardiac anomalies has been recommended for these patients. Younger infants with complex cardiac anomalies such as tetralogy of Fallot with an absent pulmonary valve or pulmonary atresia with an intact ventricular septum need early corrective surgery or palliation (systemic to pulmonary artery shunt).

The cardiovascular status of the neonate and young infant with these complex anomalies in our series after long-term cardiopulmonary bypass was unstable. Even during palliation, perioperative care involved serious problems including unstable pulmonary blood flow after cardiopulmonary bypass or hypoventilation from residual tracheal stenosis. Therefore, we advocate a strategy of preventing tracheoplasty for neonates or infants less than 2 to 3 months old owing to high mortality rates. If necessary, recurrent balloon dilation for severe tracheal stenosis should be preoperatively applied. On the one hand, surgery should be postponed as long as possible with the expectation of further tracheal growth and development subject to the patient’s condition [4], but on the other, recurrent dilatation could result in perforation or restenosis of the trachea, and increase the risk of tissue necrosis or leakage after tracheoplasty. Two of 3 patients with preoperative balloon dilation required a second tracheoplasty to treat leakage. Although conservative therapy including balloon dilation or stenting needs special care for delayed complications after tracheoplasty, the only alternative is to delay tracheoplasty for severe tracheal stenosis associated with complex cardiac anomalies.

The ideal treatment for long segment tracheal stenosis remains controversial. Our pediatric surgical team has performed tracheoplasty using a costal cartilage graft in the early 12 consecutive patients (1981 through 1992) with long segment tracheal stenosis. Six of them remain asymptomatic, but 8 had residual stenosis involving granulation or malacia. Three patients required further surgery for residual stenosis. Therefore, since slide tracheoplasty was introduced in 1997 at our institution, Tsugawa and coworkers [4] have shown that the results of slide tracheoplasty in 17 patients (76% survived and 58% are asymptomatic) are superior to those of costal cartilage grafting in 12 patients (66% survived and 50% are asymptomatic). Several surgeons [1, 14, 15] have supported the superiority of slide tracheoplasty for long segment stenosis. The advantages of this technique are the avoidance of graft materials, tension-free sutures, sufficiently enlarged trachea, anatomic and functional trachea, and shorter intensive care unit or hospital stay [15].

We similarly found that complications arise less frequently after slide tracheoplasty than after cartilage grafting [4]. However, if the lesions involve carina, then
tracheomalacia and restenosis due to granulation will complicate any procedure. In our series, 7 of 11 survivors with severe extensive tracheal stenosis involving carina required tracheostomy to treat distal tracheomalacia and granulation that developed after slide tracheoplasty. Furthermore, 7 of 17 patients with preoperative ventilatory support required tracheostomy, and 1 died after surgery. Only 2 of 14 patients without preoperative ventilatory support required tracheostomy. The operative outcome differed between the two groups. Severe extensive tracheal stenosis involving carina and preoperative ventilatory support are likely to lead to tracheostomy after tracheoplasty.

Of the 26 patients described by Beierlein and colleagues [14] who underwent slide tracheoplasty, 3 of 5 patients with extensive plasty for right main bronchus stenosis required subsequent endobronchial stenting. For the patients with carinal involvement in stenosis, we extended the vertical incision into the carina, and advanced a stent tube to reach the tip of the superior flap. Although a stent tube is required to prevent restenosis, it often results in granulation and tracheomalacia. Although we have performed balloon dilations for such lesions, the optimal approach to the problems associated with carina remains to be determined, especially for young infants.

Tracheal resection with end-to-end anastomosis is generally applied when a short segment stenosis involves less than 30% to 40% of the total tracheal length [6, 13]. The risk of leaking and restenosis increases in longer stenosis owing to excessive tension of the anastomosis [16]. In our series, 3 of 5 patients with resection and end-to-end anastomosis had stenotic lesions involving more than 40% of the total tracheal length. In addition, a short and narrow bridge bronchus between the right tracheobronchus and carina in 1 of them was not suitable for slide tracheoplasty [13]. Therefore, the intubation time and hospital stay were lengthened because of residual stenosis. The extended indication of slide tracheoplasty for short segment stenosis should be considered, except for bridging bronchus.

Another controversy in the management of pulmonary artery sling is translocation of the left pulmonary artery with distal tracheal resection [17] versus reimplantation. Backer and colleagues [18] had some concerns about translocation such as the possibility of left pulmonary artery kinking and anterior compression of the trachea by the left pulmonary artery. In addition, van Son and associates [7] also noted that the translocated left pulmonary artery could cause anterior compression of the trachea or left main bronchus. In addition, translocation could result in compression of the left pulmonary artery against the trachea with a risk of left pulmonary artery occlusion. The main concern about implantation is obstruction of the left pulmonary artery. Several reports [2, 7, 18] have described excellent long-term patency of implanted left pulmonary arteries. We also found that reimplantation of the left pulmonary artery yielded satisfactory results.

In conclusion, left pulmonary reimplantation with simultaneous repair of tracheal stenosis and intracardiac anomalies results in low operative mortality and a satisfactorily patent left pulmonary artery. However, the management of younger infants with tracheoplasty for long segment stenosis involving carina or complex cardiac anomalies remains challenging.

References