TREATMENT OF POSTINTUBATION AIRWAY STENOSIS

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Various methods have been used for treatment of postintubation airway stenosis (PIAS). Among these methods, resection and anastomosis (RA) is reported to be the most effective. We review our experience with the treatment of a relatively large number of these patients.

Keywords: Endotracheal intubation • laryngotracheal stenosis • treatment

Introduction

Critical care units have been established in most cities in our country and as a result, an increasing number of patients are assisted with mechanical ventilation. Consequently, the prevalence of patients with postintubation airway stenosis (PIAS) has risen dramatically.

The resection and anastomosis (RA) technique for treatment of PIAS has been well described by Grillo and Mathisen.1 Also, Pearson and Grillo have described the resection techniques for the stenosis in the subglottic region.2

Although surgical techniques other than RA are used for treatment of PIAS, (for example, implanting cartilage, bone and muscular flaps in constricted areas), recent researches have shown that the appropriate treatment for PIAS is simply resection of stricture and anastomosis of the two normal ends of the remaining airway.3–7

The main purpose of this study was to present and analyze our experience with the treatment of tracheal and subglottic stenosis.

Materials and Methods

A total of 120 patients with PIAS underwent surgical treatment in Masih Daneshvari and Shaheed Modarres Hospitals, from the Department of Thoracic Surgery, Shaheed Beheshti University of Medical Sciences between 1993 and 1999. On admission, a questionnaire was completed for each patient and details of treatment process and results were recorded. All registrations and statistical analyses were computer based. Surgical operations and other therapeutic measures were either performed by the first author or by other colleagues with the supervision of the first author. Laser therapy was performed in the endoscopy and Laser Section of the Masih Daneshvari Hospital. Patients were followed-up by periodic outpatient visits or telephone calls. General information about the patients is summarized in Table 1.

Rigid bronchoscopy was conducted by a senior surgeon experienced in managing airway stenosis. After passing the bronchoscope through the vocal cords and visualizing the stenosis, the bronchoscope was passed through the stenosis under direct vision. Having passed the stenosis, secretions that were gathered in the trachea and bronchi distal to the stenosis were suctioned. This procedure was repeated using larger tubes. After being assured of the airway patency, the surgeon focused on the anatomy and morphology of the stricture and measured its dimensions. After bronchoscopy, if the patient’s condition and other considerations including surgeon and operating room availability allowed, resection and anastomosis would be performed at the same stage. Otherwise, the patient would be operated at a more suitable time. The same situation existed for
performing laser therapy or dilatation. In some patients lesions were considered unresectable. These patients were either treated by placing new stents or keeping the previous stent in place for an unlimited period of time.

We used Grillo’s technique in tracheal RA. For the resection of subglottic region, initially we used Grillo’s technique but recently we have used Pearson’s technique due to its greater convenience. The main purpose of the operation was the complete resection of the fibrotic and stenotic parts of the trachea and subglottic region and anastomosis of the remaining normal two ends. In the area of anastomosis both mucosal and cartilaginous walls of the airway should be intact and devoid of deformity and stricture.

Results

Ninety-one patients underwent tracheal or subglottic resection. Five of these patients were reoperated due to residual or recurrent of stenosis. A total of 96 operations were performed on 91 patients consisting of 71 tracheal and 20 laryngotracheal stenoses. The mean length of the resected portion was 3.46 cm with a range of 1.5 – 7 cm. This was a little more than what had been anticipated by preoperation bronchoscopy. The reasons for selecting nonsurgical treatment in 29 patients were as follows: dilatation was curative and therefore surgery was unnecessary in 15; granulation tissue was destroyed by laser therapy in 6; and resection was impossible due to extensive laryngeal and tracheal stenosis in 5 patients. Three patients did not consent to surgery.

Nonsurgical techniques consisted of dilatation with bronchoscope, using Nd-Yag laser through fiberoptic bronchoscope for burning and evaporation of granulation tissue and fibrosis, extraction of granulation tissue by rigid bronchoscopy forceps, and permanent or transient placement of stent in some patients.

By bronchoscopic evaluation, the measured length of the tracheal or subglottic stenosis was in the range of 1 – 7 cm with a mean of 3.22 cm. The site of stenosis started from the vocal cords to 9 cm beneath them (mean 2.9 cm). The part of the tube causing stenosis in the majority of patients was the cuff (Table 1).

Table 2 presents the results of treatment. Two patients were reoperated by resection and anastomosis due to residual stenosis in trachea (one patient) or subglottic region (one patient). One patient with subglottic and tracheal stenosis after first operation experienced a recurrence of stenosis in the subglottic region and was reoperated on by resection of the region and transient stent placement in glottis. The final results in these 3 patients were satisfactory in 2 and good in 1.

In two other patients stenosis was considered to be too long during the primary evaluation. The length of trachea and subglottis to be resected was extensive, therefore a portion of the stenotic segment was resected and anastomosis was performed in stenotic area. Both of these patients were reoperated on successfully after one year, where in the second operation, it was possible to resection the remaining stenotic area and conduct a new anastomosis. In addition, there were 14 patients who had been operated on previously in other centers and were referred to us due to recurrence of stenosis. We performed the resection and anastomosis successfully.

Five patients in the resected group died. In one patient, tracheo-innominate artery fistula occurred 5 days after the operation and the patient died before receiving any possible management. Another patient became severely hypoxemic during preoperative trial of bronchoscopy, which was conducted for dilatation of tracheal stenosis. Immediately the patient underwent the tracheotomy procedure. Resection and anastomosis of trachea was performed in the same session. Postoperatively the patients was found to be brain dead, and although there was no problem with operation technique and airway patency, the patient died a few weeks later. The main reason for primary respiratory failure and subsequent respiratory failure in this patient was myasthenia gravis.

Table 1. General information on 120 patients with airway stenosis due to endotracheal intubation.

<table>
<thead>
<tr>
<th>Individual information</th>
<th>Reason for intubation</th>
<th>Mean duration of intubation (day)</th>
<th>Part of tube causing stenosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female: 36</td>
<td>Head trauma: 78</td>
<td>In all patients: 14.9</td>
<td>Cuff: 92 patients</td>
</tr>
<tr>
<td>Male: 84</td>
<td>Suicide by toxin ingestion: 12</td>
<td>In surgically resected patients: 16.2</td>
<td>Tip of tube: 15</td>
</tr>
<tr>
<td>Mean age (year): 25.9</td>
<td>Noncerebral trauma: 10</td>
<td>In non-surgically treated patients: 10.7</td>
<td>Stoma: 10</td>
</tr>
<tr>
<td>Range: 1 – 83 years</td>
<td></td>
<td>Range: 1 – 90 days</td>
<td>Undetermined: 3</td>
</tr>
<tr>
<td>Tracheal stenosis: 88</td>
<td>Postcardiac surgery: 9</td>
<td>Statistical significance: positive</td>
<td>Total: 120</td>
</tr>
<tr>
<td>Subglottic stenosis: 32</td>
<td>Others: 11</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Treatment of postintubation airway stenosis

Table 2. Treatment results in 120 patients with airway stenosis due to intubation.

<table>
<thead>
<tr>
<th>Patients /Results</th>
<th>91 patients with resection and anastomosis</th>
<th>29 patients with nonsurgical treatment</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent *</td>
<td>67 (13.6%)</td>
<td>10 (34.5%)</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Good **</td>
<td>13 (14.3%)</td>
<td>1 (3.4%)</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Satisfactory †</td>
<td>6 (6.6%)</td>
<td>10 (34.5%)</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>Death</td>
<td>5 (5.5%)</td>
<td>2 (5%)</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Permanent need for stent</td>
<td>–</td>
<td>6 (20.5%)</td>
<td>–</td>
</tr>
</tbody>
</table>

*Excellent = patient returned to normal airway position after surgery; ** Good = patient has normal physical activity but prolonged postoperative period, and needs stenting and dilatation; †Satisfactory = patient has normal respiratory status but becomes dyspnoeic with severe exercise.

gravis. This could have been due to the same reason that our method of inducing anesthesia by inhaling halothane was not successful in maintaining spontaneous respiration during bronchoscopy. The third patient was an 83-year-old female with COPD who had experienced acute respiratory failure and underwent mechanical ventilation for 3 weeks, which resulted in a tracheoesophageal fistula. She was urgently operated on with a fistula repair and tracheal resection and anastomosis. Unfortunately respiratory failure persisted after surgery and the patient was maintained under mechanical ventilation. Eight days after surgery disruption of anastomosis occurred and the patient died. Two other patients died due to obstruction of T-tube with mucus plugs. In spite of training the families in the care of T-tubes, they could not save their patients. There were 2 deaths in patients with nonsurgical treatments; in one of them, death occurred due to inadvertent tracheostomy tube extraction and the inability of the patient and family to reinsert the tube into the tracheotomy stoma. The other death occurred due to severe hypoxemia while performing bronchoscopy.

Postoperative complications occurred in 23 patients after RA operation including: need for reoperation in 5 patients, need for dilatation in 9 patients, recurrent nerve paralysis in 2 patients, wound infection in 4 patients, and other complications in 3 patients. Most of these complications were relieved after appropriate treatment except in 2 cases who displayed recurrent nerve paralysis. These two patients continued to present with hoarseness in spite of a normally patent airway.

Discussion

Although postintubation tracheal and subglottic stenosis causes a serious and precarious clinical situation for the patient, most patients are effectively treated by appropriate therapeutic procedures and return to their ordinary lives without any residual complication. Appropriate treatment for most patients is complete resection of the stenotic airway and anastomosis of the normal airway (trachea to trachea or trachea to thyroid and cricoid cartilage). Only in a minority of patients, who have short-segment stenosis and intact cartilage rings, nonsurgical procedures such as dilatation, laser therapy, or granulation tissue extraction via bronchoscopy can be curative. In 29 patients who underwent nonsurgical treatment, outcome was good in only 10 cases. These cases mainly consisted of patients with such minor lesions that we doubt whether resolution of their stenosis is the direct consequence of our treatment. In the remaining 19 patients with more serious lesions, outcome was not satisfactory.

In our opinion satisfactory results will not be obtained by using surgical techniques other than resection and anastomosis. Cartilage graft implantation in stenotic areas of airway and other tracheoplastic procedures are of little benefit. Among 14 patients with recurrent stenosis who were previously operated on in other centers, 8 had undergone cartilage implantation in the larynx (6 patients) or trachea (2 patients). While performing the surgical exploration, we found a very dense fibrous tissue in the cartilage graft location. While the degree of fibrous reaction was so extensive in those patients who had undergone cartilage or bone grafting, in patients for whom resection and anastomosis had been performed, the most prevalent reasons for restenosis were incomplete resection of the stenotic area or ischemia in the anastomosis site. Both of these problems are preventable and are considered to be technical issues. In the 91 patients, whom we surgically treated, 5 were reoperated on. Among these patients only one had a true recurrence of stenosis in subglottic region in the previous anastomosis location. In fact the true recurrence rate of stenosis after resection and anastomosis was 1 in 91 (1%). Among the 5 patients who died after resection and anastomosis, death was preventable in at least 4 cases. For example, in the case with myasthenia...
gravis, anesthesia induction by inhalation technique should not have been used and the patient should have undergone tracheotomy from the beginning. In the patient with COPD who was under mechanical ventilation, we possibly could have prevented anastomosis failure if we had limited the operation to an end tracheostomy and repair of the fistula. In two patients who died of T-tube obstruction, this accident was avoidable by standard T-tube care including humidifying the lumen, using proper suctioning technique, and further education of the patient’s family regarding appropriate responses when airway obstruction occurs. Other complications were minimal in our patients and most of them were easily managed.

Moreover, instructing residents for the employment of surgical technique of RA is simple and effective. Although the majority of patients were operated on by our surgical team and mainly by the first author, none of our surgeons experienced difficulty during the learning courses in order to perform this operation.

References