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Persistent upper airway obstruction after aneurysmectomy of brachiocephalic trunk

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Introduction

Tracheal compression is a well-recognized complication of aneurysm of the aortic arch and its main branches. In many cases, surgical resection of the aneurysm relieves the respiratory insufficiency and residual tracheomalacia in adults is rare.

We present a case in which progressive tracheal compression caused by an aneurysm resulted in tracheomalacia and residual severe airway obstruction even after surgical repair of the aneurysm. The patient was subsequently treated with plastic repair of the trachea with a favorable result.

Case report

A 76-year-old woman, weighing 48kg, first became aware of a palpable cervical mass in 1980, at which time an aneurysm of the brachiocephalic trunk was detected. Although she was informed of the necessity for resection of the aneurysm in 1984, she repeatedly refused to undergo surgical intervention. In 1992, exertional dyspnea developed due to airway compression by the aneurysm. Six months thereafter, with increasing difficulty in breathing, she was scheduled for resection of the aneurysm and prosthetic replacement.

On admission to the thoracic surgical unit, the patient showed stridor with poor air entry on auscultation, but was able to lie in the supine position. The chest roentgenogram demonstrated a large superior mediastinal mass with tracheal deviation to the left side and extreme narrowing. Aortography confirmed the presence of a large (4cm × 6cm) aneurysm which arose just distal to the brachiocephalic trunk and terminated below the right common carotid artery. Magnetic resonance imaging (MRI, Fig. 1) revealed that the aneurysm consisted of a thickening wall and a solid organized clot, which was closely attached to the trachea and pressed on it. The tracheal caliber was deformed to a saber sheath shape. A pulmonary function test revealed the following values: forced vital capacity (FVC), 1.581 (predicted 2.051); forced expiratory volume in 1s (FEV1), 1.021; FEV/FVC ratio, 67.5%; peak expiratory flow rate (PEFR), 1.391·s^{-1}. Blood gas analyses (FIO_2) were pH 7.36, PaO_2 97.5mmHg, and $PaCO_2$ 43.3mmHg.

Prior to the induction of anesthesia, cannulation for femoro-femoral bypass was instituted to ensure extracorporeal oxygenation of blood because it was not known whether the airway would be controllable. After the induction of anesthesia, a 6.0-mm endotracheal tube was inserted proximal to the narrowed portion of the trachea, and intermittent positive pressure ventilation of the lung (IPPV) was instituted without difficulty. The tracheal wall was then examined through the tube using a 4.0-mm fiberscope. About 8cm below the glottis, the inner wall was narrowing and pulsatile anterolaterally, but the lumen was round in cross section under positive airway pressure. At the more distal portion, the carina and the bronchial tree presented a normal appearance. Use of the fiberscope facilitated guidance of the endotracheal tube. After the tube was inserted beyond the narrowing portion, mechanical ventilation was performed uneventfully. The aneurysm was located at the brachiocephalic trunk and adhesion to the tracheal wall was not severe. Following resection of the aneurysm from the aortic arch, the neck vessels (the right common carotid and subclavian arteries) were reimplanted into the ascending aorta using a forked Dacron graft.

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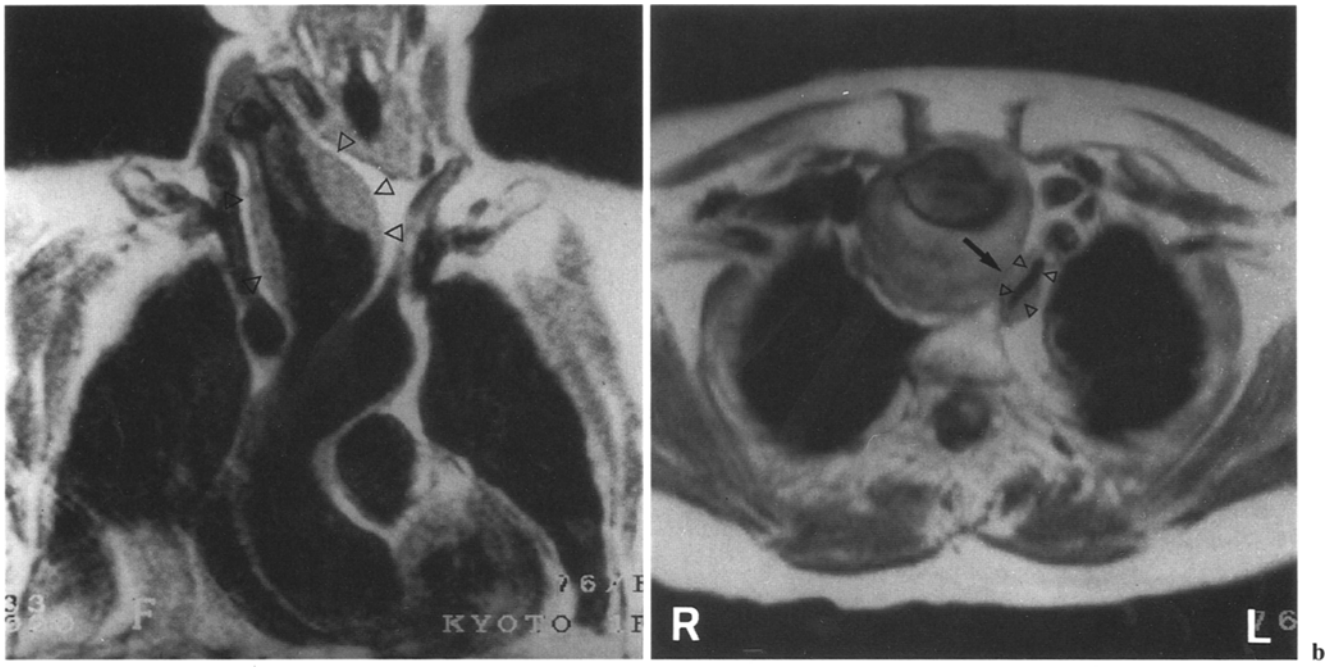

a b

Fig. 1. Magnetic resonance imaging scan. **a** Frontal view confirming the aneurysm (*open triangles*), which consists of a solid organized clot and thickening of the wall of the brachiocephalic trunk. **b** Horizontal view showing that the aneurysm is closely attached to and compressing the trachea anterolaterally (*arrow*). The tracheal caliber was deformed to a saber sheath shape (*open triangles*)

The day after the operation, the patient was hemodynamically stable and regained consciousness without neurological defect, but respiratory assistance was needed owing to atelectasis and pleural effusion. One week after surgery, her pulmonary condition had improved, and she was extubated. However, dyspnea soon developed without audible signs of bronchial constriction. Fiberscopic examination revealed that the tracheal wall was keeping the lumen under mandatory ventilation, but these was intermittent obstruction in the expiratory phase under spontaneous breaths. The vulnerable structure seemed to be confined to the anterolateral cartilaginous area (Fig. 2), and the site of the obstruction coincided with the portion that had been pressed by the aneurysm. A nasotracheal tube was reinserted and placed beyond the collapsed segment of trachea. Several attempts to remove the tube during the following week were unsuccessful owing to the recurrence of severe respiratory embarrassment, and no more improvement of the tracheomalacia could be seen by the scope.

Three weeks after the aneurysmal resection, surgical repair of the tracheal wall was carried out. About 6 cm of the autologos rib was applied to the anterior trachea as a splint. The following day the patient was extubated. No further airway obstruction has been noted during a 2-month follow-up period.

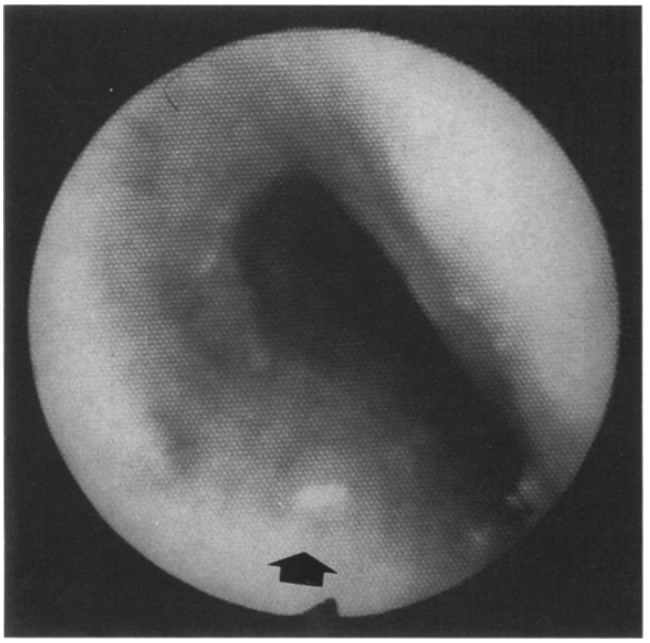

Fig. 2. Fiberscopic image 15 days after aneurysmal resection; deformity of the tracheal wall had persisted (*Arrow*, membranous portion of the trachea)

Discussion

Aneurysms involving the aortic arch and its main branches are usually well localized and amenable to reconstructive operation. In recent years, the results of this form of therapy and associated cerebral protection techniques have improved. However, the management of airway obstruction complicated by tracheobronchial compression still poses many problems. As many authors have pointed out, the respiratory state is precarious by induction and during anesthesia [1–6], but in adults it is rare that airway obstruction markedly increases because of tracheomalacia after surgical repair [7,8].

Secondary tracheomalacia in adults may be the consequence of chronic compression which results in tracheal wall weakness with disintegration of some of the tracheal rings [9,10]. In these cases, degeneration of the cartilaginous elements of the trachea and aneurysmal abruption might lead to structural dissolution in intrinsic tracheal support and to more serious respiratory failure after aneurysmectomy. At present it is difficult to predict the reversibility of the tracheal wall and the possibility of postoperative airway obstruction in patients scheduled for aneurysmectomy. MacGillivray [11] reported two cases where the different content of the aneurysm resulted in different respiratory management. In one case the sac contained a solid organized clot. This fixed obstruction resulted in difficult intubation beyond the tracheal narrowing, and extensive tracheobronchomalacia was found at autopsy. In the second case, the aneurysm was filled with blood and was sufficiently compliant to enable distal passage of a tracheal tube; the tracheal wall compression was reversible after extubation. A 70-year-old woman described by Charette et al. [12] had a heavily calcified aneurysm for 9 years before it ultimately caused acute respiratory insufficiency, but postoperative fiberscopy confirmed restoration of the tracheobronchial anatomy.

Information such as the duration of external compression, the contents of the aneurysm, and the extent of airway narrowing should help us to predict the probability of postoperative residual tracheomalacia. Magnetic resonance imaging (MRI) provides excellent anatomical details, and may be of considerable value not only in confirming the diagnosis, but also in predicting the reversibility of the tracheal obstruction after surgery and in planning the surgical approach [13].

Tracheomalacia poses a difficult problem, especially after removal of a large mass. Because the incidence of tracheomalacia is quite low, it remains a major clinical challenge. A variety of reconstructive methods have been utilized, including implantation of Silastic and Marlex mesh prostheses. Other techniques include internal stenting or placement of external support prostheses. We cannot make any assessment of these because there are so few reports on experimental methods for the management of tracheomalacia [14], but we think it better not to do such stressful surgery as tracheal reconstruction at the same time as aneurysmectomy. If temporary internal support with an endotracheal tube does not provide adequate structural rigidity for the softened trachea for a sufficient period of time, a second-stage procedure should be carried out.

Thus, it is necessary to keep in mind the possibility of residual airway obstruction during the preoperative evaluation. Examination of the tracheobronchial tree by fiberscope during the perioperative and the postoperative phases is essential, and deciding on a second-stage operation to prevent tracheomalacia is the best management option in such a case.

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