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Severe Tracheal Compression Caused by False Aneurysm Arising from the Ascending Aorta: Successful Airway Management Using Induced Hypotension and Bronchoscopy

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Tracheobronchial compression is a well-recognized complication of thoracic aortic aneurysm.[1–5] However, severe tracheal compression in the upper trachea is uncommon, and there are few reports regarding the airway management of such a case during surgery.

We describe management of a patient in whom severe tracheal compression originating 2.5 cm below the vocal cords was present. The tracheal compression was caused by a false aneurysm arising from the ascending aorta and protruding cephalad beyond the suprasternal notch.

CASE REPORT

A 55-yr-old man (157 cm, 54 kg) was admitted to our hospital with an enlarging, pulsating tumor in the cervical region present for the past 2 months and with dysphagia of 5 months' duration. On physical examination, the arterial blood pressure and pulse rate were normal. The tumor was 7.0×4.0×2.0 cm in size, and the overlying skin was purple (fig. 1).

Pulmonary function tests revealed that vital capacity (VC) was 3.03 l (91% of normal); FEV_1 was not measured. Arterial blood gas analysis showed the following values: P_{CO_2} 43.9 mmHg, Pa_{O_2} 93.2 mmHg, *p*H 7.395, and FI_{O_2} 0.21, and the electrocardiogram (ECG) showed a complete right bundle branch block. All routine laboratory studies were normal, and serologic tests for syphilis were negative.

Digital subtraction angiogram (DSA) confirmed the diagnosis of an aneurysm of the ascending aorta. Nuclear magnetic resonance (NMR; fig. 2) and enhanced computed tomographic (CT) scans showed compression of the anterior tracheal wall from 2.5 cm to the vocal cords 8.5 cm below; it was maximal at the level of the sternoclavicular joint. The narrowest cross-sectional diameter of the trachea was 6.5 mm. The aneurysm contained principally blood. The patient was scheduled for surgical resection of the aneurysm.

Under local anesthesia, the left radial artery and a peripheral vein were cannulated. A flow-directed pulmonary artery catheter was inserted *via* the right basilar vein. Cardiopulmonary bypass (CPB) was available in case of need.

The patient was administered 100% oxygen *via* a face mask. Induction of anesthesia was accomplished with droperidol 7.5 mg and 50% oxygen and nitrous oxide with enflurane 0.5%. Intermittent positive pressure ventilation (IPPV) was given *via* face mask.

To facilitate tracheal intubation, fentanyl 1.0 mg and pancuronium 8 mg were administered intravenously; IPPV was easily performed. When the arterial blood pressure was 100/40 mmHg, a spiral endotracheal tube (6.0 mm ID, 8.2 mm OD) was introduced into the trachea, but it was impossible to advance the tip of the tube beyond the stenosed segment of the trachea and the cuff beyond the vocal cords. In spite of the presence of a small leak even after packing the pharynx around the tube with gauze, IPPV was possible with some difficulty. A fiberoptic bronchoscope inserted through the endotracheal tube revealed anterior tracheal wall compression with an intact tracheal lumen. To facilitate intubation beyond the stenosis, hypotension was induced with Trimethaphan camsylate; when the systolic blood pressure was decreased to 60 mmHg, the endotracheal tube could be passed beyond the stenosis with minimal force under the direct view of a flexible bronchoscope. With the tube in position, IPPV was instituted without any difficulty. Anesthesia was maintained with 50% oxygen and nitrous oxide with enflurane (0–0.5%) and with supplemental doses of fentanyl iv.

The right femoral artery and vein were exposed for CPB cannulation. Induced hypotension was continued to prevent rupture of the aneurysm until CPB was started. During CPB and under deep hypothermia, resection and repair of the aneurysm were performed successfully.

Bronchoscopic inspection of the trachea at the end of the surgery showed no evidence of residual tracheal compression. The patient made an uneventful recovery.

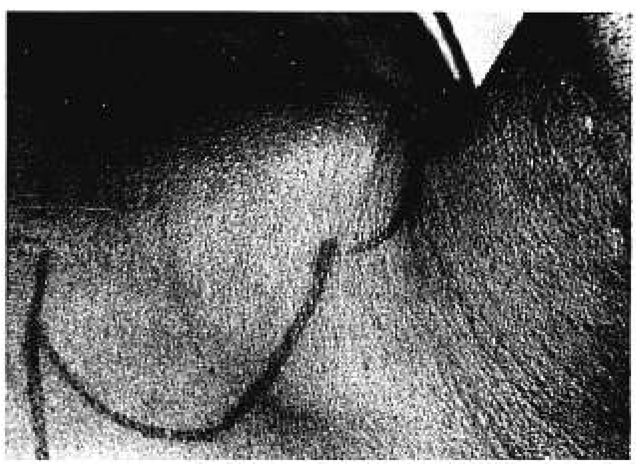

FIG. 1. Cervical region, left anterolateral view; size of the tumor was 7.0 × 4.0 × 2.0 cm in size, and the overlying skin color was purple.

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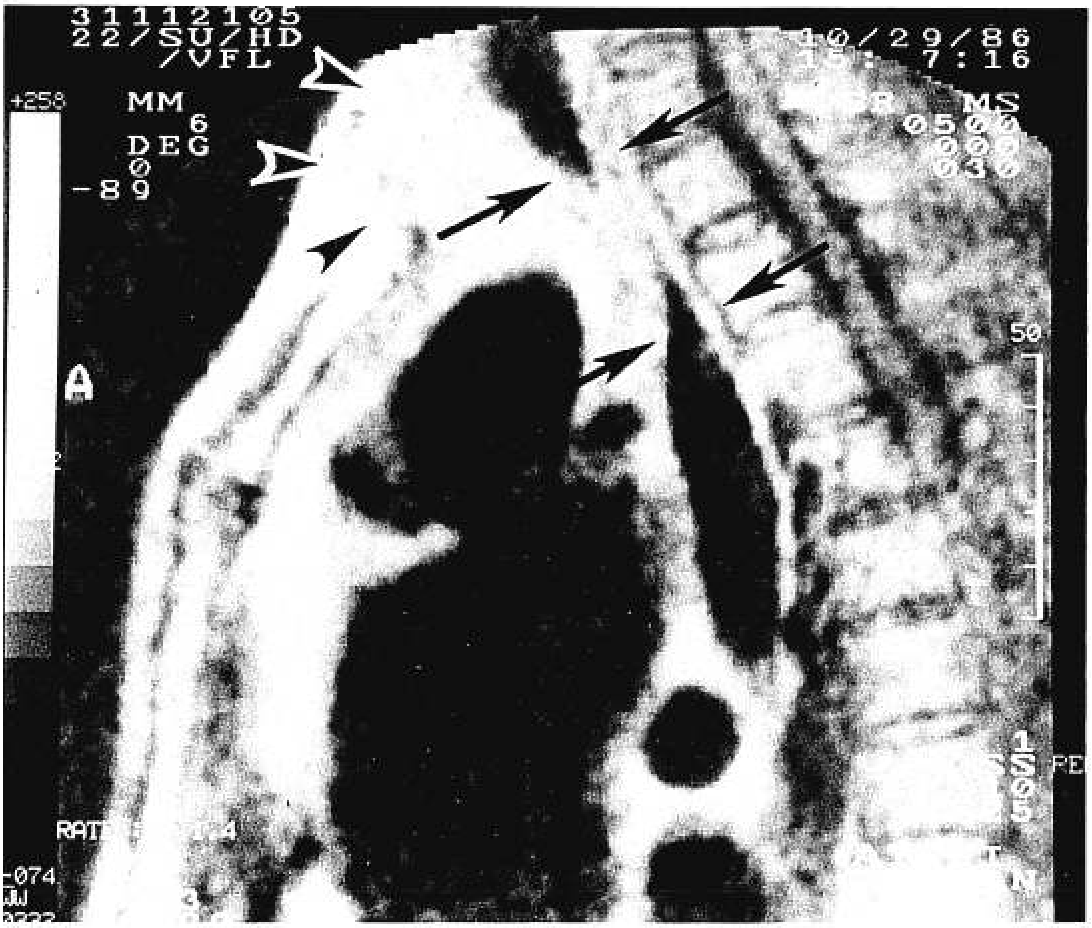

FIG. 2. Sagittal section of the thorax on NMR shows compression of the anterior tracheal wall from 2.5 cm to the vocal cords 8.5 cm below; compression is maximal at the level of the sternoclavicular joint (arrows). The compressing portion of the aneurysm contained principally liquid blood. The portion of the aneurysm protruding above the suprasternal notch contained clots (arrowheads).

DISCUSSION

An aneurysm arising from the thoracic aorta and protruding cephalad beyond the upper sternal notch is rare, and severe tracheal compression of the upper trachea is an uncommon complication. There are only a few reports that address the airway management of such cases.

MacGillivray described two patients with severe tracheal compression.[5] In the first case, after induction of general anesthesia, it was impossible to introduce even a 5.0-mm tracheal tube beyond the tracheal stenosis. A 9.0-mm tube therefore was positioned proximal to the obstruction, and institution of IPPV was difficult. In another case, the femoral artery and vein were cannulated under local anesthesia, and it was possible to establish CPB rapidly before induction of general anesthesia. After induction, intubation with a 7.0-mm tracheal tube beyond the tracheal stenosis was possible with minimal force; after intubation, IPPV was instituted.

A variety of methods for providing adequate oxygenation and carbon dioxide elimination have been recommended to manage tracheal stenosis. There can be divided into five approaches: 1) orotracheal intubation with a slender tube beyond the tracheal stenosis; 2) orotracheal intubation with a standard tube proximal to the obstruction; 3) high-frequency jet ventilation (HFJV) through the stenotic area; 4) high-frequency positive-pressure ventilation (HFPPV); and 5) CPB.

By using the first of these approaches, the patient's upper airway can be maintained securely. The ID of the endotracheal tube should be larger than 5.5–6.0 mm for adults to permit proper gas exchange by IPPV.[6–8] This technique should be the first choice whenever it is possible to introduce a endotracheal tube of ID greater than 5.5–6.0 mm.

It is hazardous to blindly advance the endotracheal tube against resistance. Cohen *et al.* point out that forcing the endobronchial tube into position could rupture the aneurysm as well as the trachea, when the trachea or bronchus are obstructed or deviated by the aneurysm.[9] They recommend the use of a fiberoptic bronchoscope to manipulate the tube under direct visualization. We selected a spiral endotracheal tube with a soft tip to reduce the possibility of aneurysm or tracheal rupture and advanced the tube under the direct view of a bronchoscope and after induction of hypotension.

Tracheal stenosis due to aneurysm is influenced by the type of contents present in the aneurysm. If the contents of the compressing part of the aneurysm are not solid clots but rather liquid blood, tracheal compression is reversible dynamically.

Some degree of tracheal compression can be reduced by decreasing the blood pressure. In a patient with a thoracic aortic aneurysm described by Matsushita *et al.*, ventilation that was impossible after angiography-associated hypertension became feasible after successful reduction of the systemic blood pressure.[10] We therefore recommend prior assessment of the contents of the aneurysm with NMR and CT scans as a guide to anesthetic management. If the contents of the aneurysm are liquid blood, the volume of the aneurysm can be changed dynamically by decreasing blood pressure.

Initiation of femoro-femoral CPB prior to the induction of anesthesia is an effective means of managing patients with major airway obstruction.[5,11,12] However, drawbacks of CPB include increase in blood loss due to anticoagulation, difficulties associated with CPB techniques, and a decrease in coagulation factors.

In conclusion, we present a case of severe tracheal compression 2.5 cm below the vocal cords caused by a false aneurysm arising from the ascending aorta and protruding cephalad beyond the supra sternal notch. We successfully inserted a 6.0 mm ID spiral endotracheal tube beyond the tracheal compression with the use of bronchoscopy and induced hypotension. We suggest that our technique is a useful method in the management of a compromised upper airway due to an aneurysm.

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