

Difficult Placement of Univent Tube[®] Blocker Due to Aberrant Right Subclavian Artery Aneurysm

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There have been few reports on aneurysms of the anomalous branch of the aortic arch. We present a rare case in which correct placement of the movable blocker of a Univent tube[®] was difficult due to an aberrant right subclavian artery aneurysm. A 72-year-old man with a history of hypertension had manifested coughing and wheezing for four months prior to admission to our hospital. A chest computed tomogram revealed that his aortic arch had four branches and that the right subclavian artery did not originate from the first branch, but was the fourth branch. The angiogram disclosed that an aneurysm had developed in the anomalous artery close to the aorta, and behind the other three branches, trachea, and esophagus. The aneurysm not only had pushed the trachea out of place but was also pressing against it. After anesthetic induction, his trachea was intubated using an endotracheal tube with a movable blocker, the Univent tube[®], for single-lung ventilation. The blocker could not be advanced into the left main bronchus due to the tracheal deviation caused by the aneurysm. Several methods of blocker placement, including those recommended in the manual attached to the product, were attempted without success. Finally, the trachea was intubated again using a Univent tube[®] with the blocker tip bent manually, which permitted entrance of the blocker into the bronchus. Blocker placement should be modified to suit patients with a problem in the trachea or bronchi.

Key words : Aberrant right subclavian artery aneurysm, Univent tube[®], One-lung ventilation

INTRODUCTION

Aberrant right subclavian artery (ARSA) is an anomaly characterized by the right subclavian artery branching off from the aortic arch as its fourth furcation distal to both the right and left common carotid arteries and left subclavian artery. This report presents a rare case in which correct placement of the movable blocker of an endotracheal tube (Univent Tube[®]) was difficult due to aneurysmal impingement on the trachea, prior to surgery to treat an ARSA aneurysm (true aneurysm with anomaly of the origin of the right subclavian artery).

CASE

A 72-year-old man had been followed at a

local clinic for management of hypertension and diabetes mellitus for the past 7 years. The patient had manifested coughing and wheezing for 4 months prior to being seen at this hospital, and mediastinal expansion was noted on a standard x-ray film of the chest taken at the local clinic. Chest computed tomograms revealed findings suggestive of an aneurysm of the thoracic aorta and the patient was admitted to this hospital for general examination and surgical treatment.

PRESENT STATUS AND FINDINGS

Height, 163.6 cm; weight, 63.5 kg. His blood pressure was within the normal range and did not differ between the right and left upper limbs. On auscultation, tracheo-stenotic sounds were heard over the right

sternal margin at the level of the second intercostal space. No abnormalities were noted in the hematologic, blood chemistry or urine examinations. Serologic tests were negative for syphilis. Scout films of the chest revealed no abnormalities in the lung fields, but the posteroanterior view disclosed an expanded superior mediastinal shadow. Esophagography revealed that the esophagus had been pushed markedly to the right and the trachea displaced dextroanteriorly, to a position slightly cephalad above the tracheal bifurcation. Aortograms demonstrated a cystiform, dilated aneurysm coinciding with the segment extending from the aortic arch to its transition to the descending aorta and, concomitantly, the right subclavian artery was visualized. Three-dimensional CT scans showed four arterial branches arising from the aortic arch, with the right subclavian artery originating directly from the aortic arch as the fourth branch, next to the origin of the left subclavian artery. The right subclavian artery was coursing behind the right and left common carotid arteries, left subclavian artery, trachea and esophagus, leading to a diagnosis of ARSA (Fig. 1).

The anomalous artery developed a knob, measuring approximately 65 mm in diameter and 110 mm in total length, immediately distal to its branching from the aortic arch. The knob was pushing the trachea and esophagus upwards and to the right (Fig. 2).

There were no other branches arising from the ARSA. On bronchofiberscopic examination, the normal bronchial mucosa was noted to be maintained but there was a strong extramural impingement, from the lower leftward (6-10 o'clock) direction, on the membranous region of the middle and lower segments of the trachea; hence, an overall marked upper rightward deviation of the trachea. The trachea was noticeably narrowed in its mid-portion but permitted passage of a fiberscope with an external diameter of 6 mm (Fig. 3). A diagnosis of ARSA aneurysm was made on the basis of these findings, and the patient was placed on a schedule for an elective operation on account of the potential risks of dyspnea due to the marked pressure upon the trachea and of aneurysmal rupture. However, as thoracodorsal pain abruptly developed he was examined by chest CT scans, which disclosed right pleural effusions; thoracocentesis revealed a sanguineous pleural effusion. Emergency surgery was performed because of the risk of impending aneurysmal rupture.

ANESTHETIC COURSE

As the surgery was planned to consist of elective aneurysmectomy, patch closure at the origin, and revascularization of the ARSA, anesthesia with unilateral right pulmonary ventilation was scheduled. Intramuscular scopolamine was administered

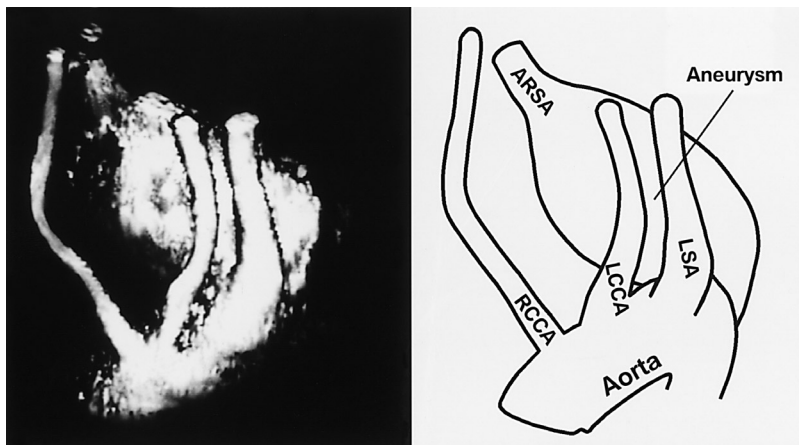


Fig. 1 Three-dimensional CT scan (right anterior oblique view). An aneurysm is seen on the ARSA branching off from the dorsal aspect of the distal aortic arch. ARSA = Aberrant right subclavian artery, LSA = Left subclavian artery, LCCA = Left common carotid artery, RCCA = Right common carotid artery.

as preanesthetic medication, and anesthesia was induced using midazolam and fentanyl. After muscle relaxation with vecuronium, the trachea was intubated using an endotracheal tube with a movable blocker (Univent Tube®) with an internal diameter of 8.0 mm. While the tracheal intubation was uneventful, it was extremely difficult to advance the blocker into the left main bronchus due to the tracheal deviation caused by the aneurysm, and the blocker slipped into the right main bronchus despite using maneuvers

such as blocker rotation, tube revolution, and pushing the larynx aside to the right (see below). A subsequent attempt to advance the Univent Tube® to a depth beyond the narrowed portion of the lumen and ensuing revolution of the tube also failed in that the tube lost movement in the stenosed lumen, causing the tube to turn completely to the upper right and thus rendering passage into the left main bronchus impossible. Further, another attempt at left unilateral intubation, guided by a bronchoscope, was by inser-

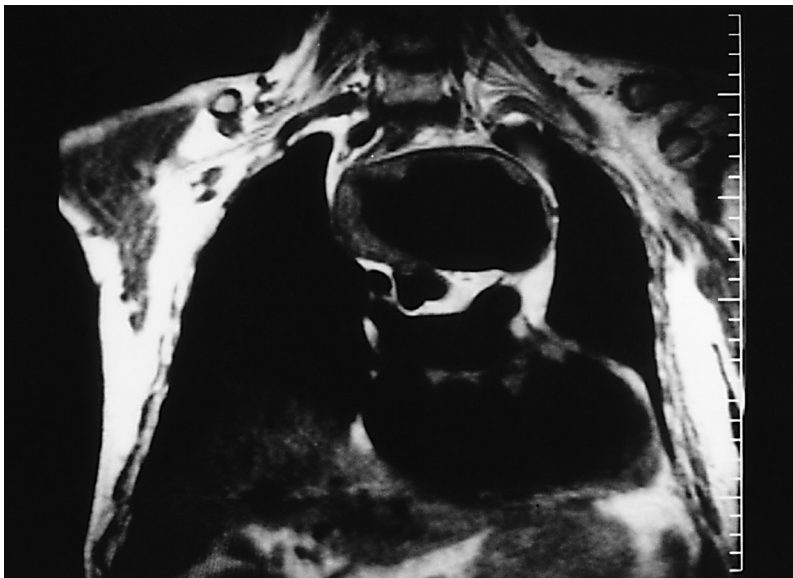


Fig. 2 MRI (chest coronal section view). Marked deviation of the trachea and esophagus to the right due to pressure from the aneurysm.

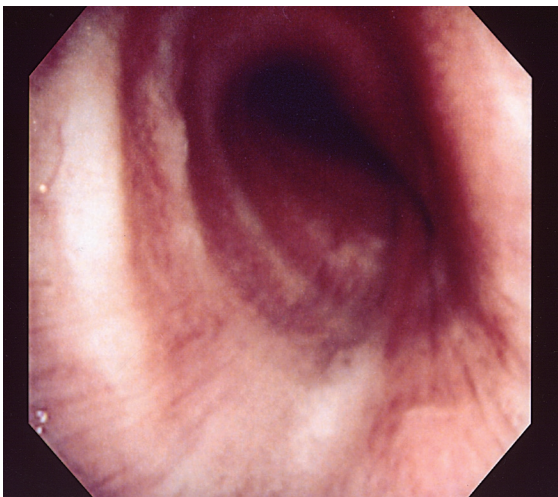


Fig. 3 Bronchoscopic photograph. Marked narrowing of the trachea and right upward deviation due to intense extramural impingement on middle and lower tracheal segments from the left lower membranous region.

tion of the blocker and then removal of the tube. This attempt also failed because even the insertion of the bronchofiberscope was impractical due to the short distance between the narrowed portion and the tracheal bifurcation. The final attempt to intubate the trachea using a Univent Tube[®], with the blocker tip bent manually and placing of the rotated blocker into the correct bronchus, was successful. Anesthesia was maintained with fentanyl, nitrous oxide, oxygen and low-concentration isoflurane, and controlled via monitoring of pressure in the left radial artery and central venous blood pressure.

SURGICAL COURSE

Surgery was performed using an anterior approach to median sternotomy, with a left lateral incision. As the entrance to the knob was considered to be relatively wide from intraoperative findings, a synthetic fabric graft substitution for the thoracic descending aorta, including knob entrance, aneurysmectomy, and right subclavian artery revascularization, was performed under partial extracorporeal circulation with an artificial heart-lung machine (Fig. 4).

During surgery the patient suddenly developed ST depression and ventricular fibrillation possibly due to decreased coronary blood flow caused by excessive pressure on

the heart. After defibrillation, extracorporeal circulation was switched to complete extracorporeal circulation with brain perfusion. Postoperatively, the patient was uneventfully weaned from the artificial heart-lung machine. The total blood loss was approximately 6,000 mL, surgical duration was 11 hours and 35 minutes, and the duration of anesthesia 12 hours and 40 minutes. After the operation, the patient's consciousness remained cloudy following admission to the CCU and neurological findings indicated a cerebral complication. The patient died on the third postoperative day.

DISCUSSION

Most of the case reports published on ARSA aneurysms deal with autopsy findings or surgical procedures [4, 5, 16], while articles pertaining to management of general anesthesia are comparatively few in number. ARSA is relatively common as a congenital anomaly of the aortic arch, and it is classified as a form of vascular ring. It is characterized by the right subclavian artery arising as a fourth branch from the distal portion of the aortic arch following both right and left common carotid arteries and the left subclavian artery, consequent on the persistent embryonal right dorsal aortic arch [4]. Its incidence has been reported to be

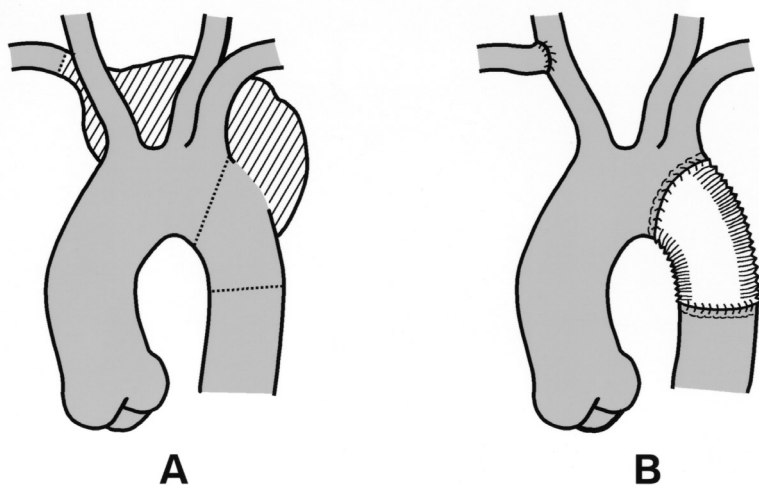


Fig. 4 Schematic illustration of surgical procedures. Synthetic fabric graft substitution for the thoracic descending aorta including the knob entrance; aneurysmectomy; and right subclavian artery revascularization were performed. A = Preoperative, B = Postoperative.

about 0.5% [3, 7, 9, 13, 18]. Most individuals with this anomaly remain symptom-free [7], and symptomatic ARSA is rare [8]. In symptomatic cases, clinical manifestations develop in the fourth to fifth decades of life and include dysphagia, chest pain and thromboembolism (involving cerebral and lower limb ischemia). The condition is classified into four types: Group 1, ARSA oppressing the esophagus leading to dysphagia; Group 2, ARSA complicated by occlusive arterial lesions; Group 3, ARSA developing an aneurysm; and Group 4, ARSA associated with aneurysm of the thoracic aorta. The case reported herein falls into group 3. Anatomically, the ARSA courses posteriorly to the trachea and esophagus to the right upper limb in 80% of cases, between the esophagus and trachea in 15% , and anteriorly to the esophagus in 5% [1, 14, 15]. It presses against the esophagus from the rear, thereby giving rise to what is known as “dysphagia lusoria” [8, 13]. Aneurysmal transformation of ARSA rarely occurs [4, 7] and has been attributed to cystiform bulging of the vessel at its origin into a diverticular dilatation (Kommerell’s aortic diverticulum) [4, 10]. However, there have been no reports referring to this condition and further study is necessary. Whatever the cause, rupture of the aneurysm is fatal and surgery for a permanent cure should be undertaken, with consideration of the risk of embolism.

In general, aneurysmectomy is performed via a left thoracotomy approach, followed by right subclavian arterial revascularization to prevent right upper limb necrosis and subclavian steal syndrome [15]. Intraoperative emboli and cerebral complications have been pointed out as potential risks associated with the procedure [9]. The rationale for employing the usual operative procedure in the present case was based on: (1) the aneurysmal lesion was situated distally from the origin of the ARSA, (2) the knob entrance was fairly wide, and (3) there were symptoms of impending rupture, so that it was possible to ensure that the knob entrance was closed within a satisfactory visual field. A key to the management of general anesthesia lies in exercising caution against excessive pressure upon the surrounding viscera to avoid intraoperative complications such as ventricular fibrillation. Lack of sufficient preoperative information on the right vertebral and

basilar arteries probably accounted, at least in part, for the cerebral complication in this case, although it remains unclear whether the flaw was brain ischemia associated with ventricular fibrillation or blood flow failure in the regions of the brain supplied by the right vertebral artery. It might have been possible to avoid the latter if the operation had been performed using a two-stage approach [5, 7], involving a right subclavian artery-right common carotid artery end-to-side anastomosis by a right cervical incision, followed, with subsequent posture change, by aneurysmectomy via a left thoracotomy. As variants in the region of the aortic arch are not uncommon, the present case of brain perfusion described herein stresses the importance of preoperative delineation of brain hemodynamics and intraoperative monitoring of cerebral blood flow. The fact that abrupt switching to complete extracorporeal circulation was undertaken due to the sudden onset of ventricular fibrillation during surgery indicates the brain perfusion was performed without sufficient relevant monitoring.

In the practice of right single-lung ventilation, it has been recognized that use of a double lumen tube may cause injury to the compressed trachea or aneurysmal based on of its shape and size, including the external diameter. In the present case, we selected the Univent Tube[®], the external diameter of which does not notably differ from the regular endotracheal tube, and does not necessitate insertion into the main bronchus. We are also quite familiar with the device since it is used almost routinely for one-lung ventilation at our institution. In the case of a Univent Tube[®] blocker, its insertion into the left main bronchus requires procedural maneuvers because of anatomical variations in the angle of tracheal bifurcation and diameter of the bronchial lumen [11]. Customary methods include endotracheal tube rotation, blocker revolution, and use of a bronchoscopic stylet. At our institution we make it a rule to employ the “laryngotracheal rightward compression” as the procedure of first choice, in which the blocker is blindly introduced into the left main bronchus, with the patient’s head turned to the left, by manually pushing the larynx (thyroid and cricoid cartilages) and the upper trachea aside to the right (contralateral), and by tak-

ing advantage of the resultant endotracheal tube rotation and linear arrangement of the tracheal and left main-bronchial pivots.

Our past success in achieving insertion of the blocker into the left main bronchus using the method described above was one of the reasons for the selection of the Univent Tube[®]. In the case reported herein, however, it was difficult to introduce the blocker into the left main bronchus despite attempts with several methods of blocker placement, due to a marked tracheal deviation caused by aneurysmal impingement. Thus, the situation was dealt with by using a Univent Tube[®] whose blocker tip had been bent considerably. The possibility of blocker and/or pilot tube breakage is inherent in this measure, however. Insertion of the movable blocker into the left main bronchus might have been achieved by attempting the various procedures documented in the literature [2, 12, 17]. Recently, a torque control blocker (TCB) type Univent Tube[®] has been devised, in which the degree of revolution can be controlled by rotating the proximal end of the blocker so that the torque generated is transmitted to the blocker tip [6]. The difficulty of insertion might have been circumvented if we had used this type of device.

CONCLUSION

This paper describes our experience in applying anesthesia prior to surgery for an ARSA aneurysm, with a review of the literature. In patients with an abnormal trachea/bronchus, including the present case, correct placement of the movable blocker may not be accomplished by the method recommended in the manual attached to the product and other methods of blocker placement would need to be considered.

REFERENCES

- 1) Arkin A: Double aortic arch with total persistence of the right and isthmus stenosis of the left arch. A new clinical and X-ray picture: Report of six cases in adults. *Am Heart J.* 1936; 11: 444-474.
- 2) Asakura N, Okada M, Kihara S, *et al.*: A method of introducing bronchial blocker of Univent Tube to intended bronchus using an angulated-soft-tip guide wire. *J Clin Anesth (Jpn.)* 1997; 21: 971-973.
- 3) Beabout JW, Stewart JR, Kincaid OW: Aberrant right subclavian artery. Dispute of commonly accepted concepts. *Am J Roentgenol Radium Ther Nucl Med.* 1964; 92: 855-864.
- 4) Brown DL, Chapman WC, Edwards WH, *et al.*: Dysphagia lusoria: aberrant right subclavian artery with a Kommerell's Diverticulum. *Am Surg.* 1993; 59: 582-586.
- 5) Esposito RA, Khalil L, Galloway AC, *et al.*: Surgical treatment for aneurysm of aberrant subclavian artery based on a case report and a review of the literature. *J Thorac Cardiovasc Surg.* 1988; 95: 888-891.
- 6) Hasegawa J, Toshiyasu S, Haruo F, *et al.*: Utility of a torque control type Univent tracheal tube. *J Jpn. Society for Clin Anesth (Jpn.)*. 2000; 20: Supplement 344.
- 7) Kieffer E, Bahini A, Koskas F, *et al.*: Aberrant subclavian artery: surgical treatment in thirty-three adult patients. *J Vasc Surg.* 1994; 19: 100-111.
- 8) Klinkhamer AC: Aberrant right subclavian artery. Clinical and roentgenologic aspects. *Am J Roentgenol Radium Ther Nucl Med.* 1966; 97: 438-446.
- 9) Knight G, Codd J: Anomalous right subclavian artery aneurysms: Report of 3 cases, with a review of the literature. *Tex Heart Inst J.* 1991; 18: 209-218.
- 10) Kommerell B: Verlagerung des oesophagus durch eine abnorm verlaufende arteria subclavia dextra (Arteria lusoria). *Fortschr Geb Rontgenstr Nuklearmed Erg-anlyungsband.* 1936; 54: 590-595.
- 11) Kubota H, Kubota Y, Toyoda Y, *et al.*: Selective blind endbronchial intubation in children and adults. *Anesthesiology.* 1987; 67: 587-589.
- 12) Masuda K, Itoh S, Ban M, *et al.*: A new tracheal tube with a bronchial blocker (a new UNIVENT). *J Clin Anesth (Jpn.)*. 1996; 20: 1669-1672.
- 13) Mok CK, Cheung KL, Kong SM, *et al.*: Translocating the aberrant right subclavian artery in dysphagia lusoria. *Br J Surg.* 1979; 66: 113-116.
- 14) Shumacker HB Jr, Isch JH, Finneran JC: Unusual case of dysphagia due to anomalous right subclavian artery. A approach for operative treatment. *J Thorac Cardiovasc Surg.* 1971; 61: 304-308.
- 15) Stone WM, Brewster DC, Moncure AC, *et al.*: Aberrant right subclavian artery. Varied presentations and management options. *J Vasc Surg.* 1990; 11: 812-817.
- 16) Stony WS, Alford WC Jr, Burrus GR, *et al.*: Aberrant right subclavian artery aneurysm. *Ann Thorac Surg.* 1975; 19: 460-467.
- 17) Takakura K, Niie S, Hasegawa K, *et al.*: A new technique to insert blocker in the left bronchus using Univent tracheal tube. *J Clin Anesth (Jpn.)*. 1992; 16: 1446-1447.
- 18) Turkenburg JL, Versteegh MIM, Chandie S: Case report; Aneurysm of an aberrant right subclavian artery diagnosed with MR imaging. *Clin Radiology.* 1994; 49: 837-839.