

# Aortic arch banding procedure for proximal type I endoleak after thoracic endovascular aneurysm repair with the chimney technique

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## ABSTRACT

An aortic arch banding procedure was performed on an 82-year-old man for treatment of proximal type I endoleaks 2 days after he had undergone emergency thoracic endovascular aortic repair with the chimney technique for a ruptured aortic arch aneurysm. Contrast-enhanced computed tomography after the second procedure demonstrated significant shrinkage of the aneurysmal sac as well as a complete disappearance of the endoleaks. The basic concept of this technique is to treat the type IA endoleak, including possible gutter endoleaks, by creating a new proximal seal zone distal to the chimney graft using a banding technique. (*J Vasc Surg Cases and Innovative Techniques* 2017;3:228-31.)

Thoracic endovascular aortic repair (TEVAR) with the chimney technique can be a less invasive alternative to conventional total arch replacement. However, this technique can cause persistent type I endoleaks, which may lead to subsequent aneurysmal enlargement or rupture with poor outcomes.

We successfully performed an aortic arch banding procedure to treat the type I endoleaks after emergency TEVAR with the chimney technique. The patient's consent was obtained for publication of the article.

## CASE REPORT

An 82-year-old man on ventilator support under the diagnosis of ruptured thoracic aortic aneurysm was emergently transferred to our institute. On admission, contrast-enhanced computed tomography (CT) revealed an aortic arch aneurysm measuring a maximum diameter of 80 mm and extravasation of the contrast agent into the left thoracic cavity (Fig 1). Conventional total aortic arch replacement using cardiopulmonary bypass (CPB) under circulatory arrest was at first planned as a primary treatment of choice. However, considering consumption coagulopathy disorders due to hemorrhagic shock and the patient's age being >80 years, conventional total aortic arch replacement was considered high risk. Therefore, TEVAR was alternatively considered. As the aneurysm was located on

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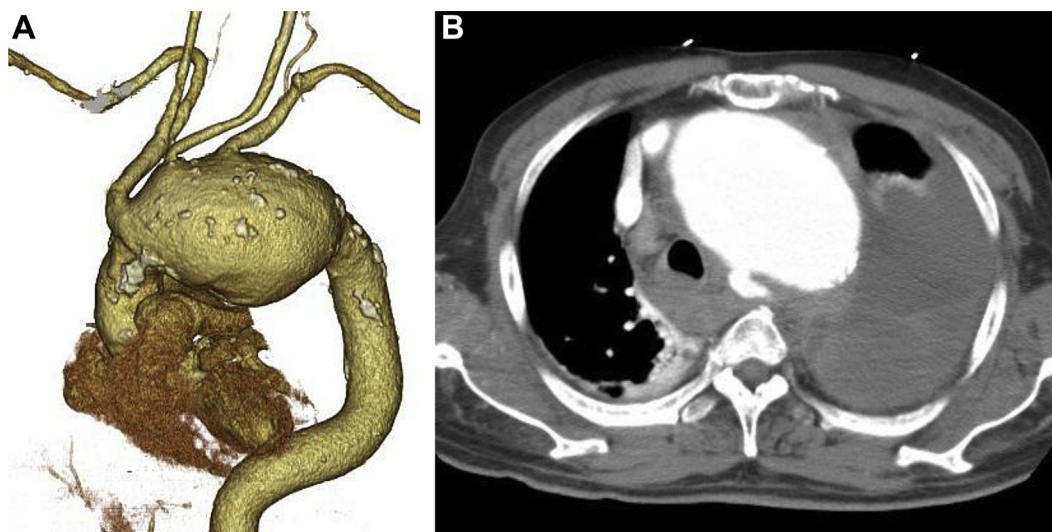
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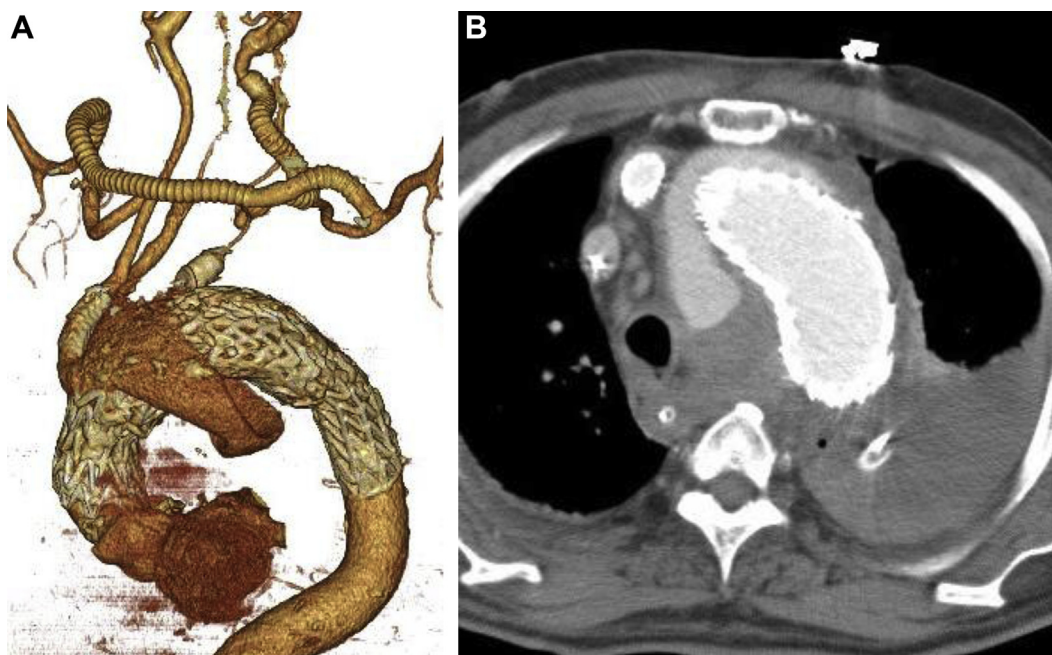
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the aortic arch, zone 0 landing TEVAR with the chimney graft, including debranching of the supra-aortic neck vessels, was chosen. Under general anesthesia in the supine position, bilateral axillary arteries (AxAs) through infraclavicular incisions, left common carotid artery (CCA), and left common femoral artery were exposed. After systemic heparinization, supra-aortic debranching was created among the right AxA, the left CCA, and the left AxA using a T-shaped artificial blood vessel (8 mm, Gore-Tex Stretch Graft; W. L. Gore & Associates, Flagstaff, Ariz), followed by suturing and ligation of the proximal stump of the left CCA. Measurement details from CT were as follows: proximal ascending aorta, neck length of 57 mm and diameter of 34 to 36 mm; brachiocephalic artery (BCA), length of 40 mm and diameter of 11 to 12 mm; and distal descending thoracic aortic, diameter of 31 mm. Two main grafts (Gore C-TAG [W. L. Gore & Associates], 45 × 200 mm and 37 × 200 mm) were delivered through the left common femoral artery and placed from the ascending aorta to the proximal descending aorta. After this, a chimney graft (Gore Excluder leg [W. L. Gore & Associates], 14 × 140 mm) was delivered and placed from the BCA into the ascending aorta through the right AxA. Thereafter, the main grafts and the chimney graft were deployed, followed by the performance of kissing balloons to prevent gutter endoleaks. Finally, the orifice of the left subclavian artery was embolized using a 14-mm Amplatzer vascular plug (St. Jude Medical, St. Paul, Minn) to prevent type II endoleaks. Completion angiography revealed type IA endoleaks without visualization of the aneurysmal body. Follow-up contrast-enhanced CT on the second day after the initial procedure demonstrated a rapid enlargement of the aneurysmal body from 80 to 94 mm in diameter without extravasation as well as persistent type IA endoleaks (Fig 2). Therefore, an emergency aortic arch banding procedure between the BCA and the left CCA was scheduled for the same day. The patient's informed consent was obtained for the performance of the aortic arch banding procedure before the second emergency operation. Under general anesthesia, the ascending and proximal arch aorta was exposed after median sternotomy. A definite diagnosis of gutter endoleaks was obtained from a



**Fig 1.** A and B, Computed tomography (CT) demonstrating an aortic arch aneurysm measuring a maximum diameter of 80 mm with extravasation of the contrast agent into the left thoracic cavity.

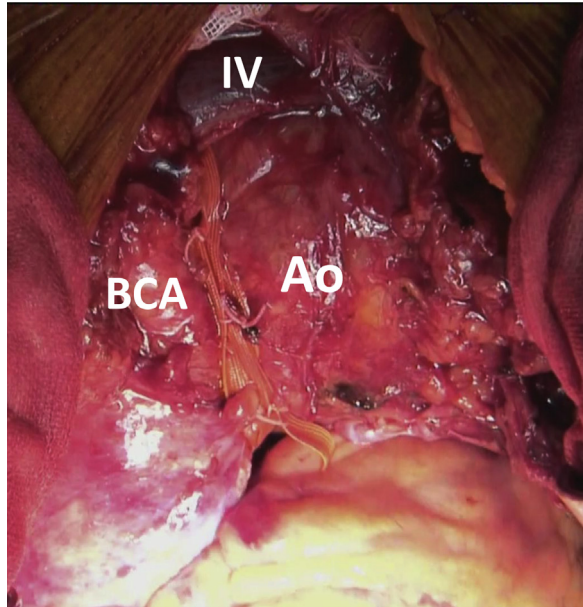


**Fig 2.** A and B, Computed tomography (CT) on the second day after the initial procedure revealing a rapid re-enlargement of the aneurysmal body from 80 to 94 mm in diameter caused by persistent type I endoleak.

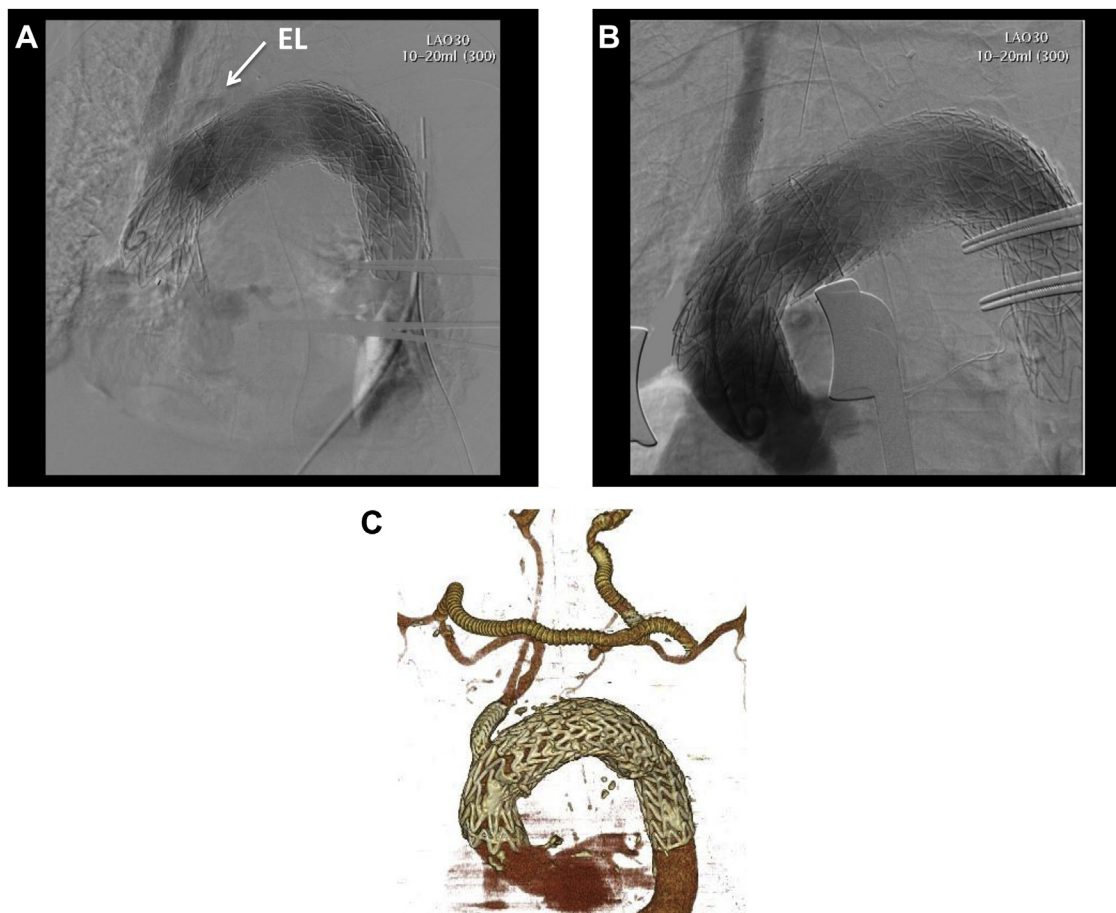
color duplex ultrasound probe placed on the aortic arch. The proximal aortic arch lesion between the BCA and the left CCA was dissected and doubly encircled with umbilical tape. Next, the umbilical tape was tightened at the level of complete disappearance of gutter endoleaks on aortography and sutured on the aortic adventitia (Fig 3). The patient's postoperative course was generally uneventful, and a postoperative CT scan 2 days after the second procedure showed no endoleaks, with significant shrinkage of the aneurysmal sac from 94 to 88 mm (Fig 4).

## DISCUSSION

TEVAR with the chimney technique can be a feasible treatment option for thoracic aortic disease affecting the aortic arch, and this technique has been reported to have satisfactory outcomes ranging from 89% to 98% as well as 100% patency of the chimney graft.<sup>1,2</sup> Considering the limited uses of off-the-shelf options for branched and fenestrated grafts, chimney grafts remain a useful intervention option, especially in emergency operations, as demonstrated in this case. On the other



**Fig 3.** Doubly encircled umbilical tape tightened at the level of complete disappearance of gutter endoleaks on aortography and sutured on the aortic adventitia. Ao, Aorta; BCA, brachiocephalic artery; IV, innominate vein.



**Fig 4.** **A,** Significant gutter type I endoleak (EL) identified on aortography before the banding procedure. **B,** Complete disappearance of endoleak demonstrated on aortography after the banding procedure. **C,** Computed tomography (CT) 2 days after the second procedure showing no endoleaks along with significant shrinkage of the aneurysmal sac from 94 to 88 mm.

hand, the Achilles heel of the chimney technique is considered to be an increased risk for type I endoleaks associated with the placement of the chimney graft along the thoracic endograft, which has accounted for an 11% to 18% incidence rate.<sup>3-5</sup> Regarding the number of chimney grafts, a double or triple chimney technique should be avoided if possible because of the increased incidence rate of gutter type I endoleaks.

In this case, although the hemodynamic situation was stable with no significant blood loss after the initial operation, contrast-enhanced CT on the second day after surgery revealed rapid aneurysm re-enlargement due to type IA endoleak. An effective treatment to surgically manage aneurysmal sac enlargement after endovascular aneurysm repair due to type IA endoleak is aortic neck banding.<sup>6-9</sup> In our case, we modified this technique for thoracic aortic lesions and performed, under median sternotomy, the aortic arch banding procedure at the lesion between the BCA and the left CCA using the umbilical tape to control proximal type I endoleaks. We considered using a wide Teflon band as a banding material at first. Although there was about 3 cm in length between the BCA and the left CCA on the greater curvature of the aortic arch, there was not enough space to safely encircle a wide Teflon band. We were concerned about aneurysmal aorta tearing with the presence of type I endoleak, which could eventually cause rerupture of the aneurysmal sac. Thus, we used the umbilical tape compensated by doubly encircling the tape around the aortic arch. The basic concept of this technique is to treat the type IA endoleak, including possible gutter endoleaks, by creating a new proximal seal zone distal to the chimney graft using a banding technique. Also, the benefit of this technique is that it can be performed not only without the use of CPB but also without systemic heparinization. In terms of avoidance of CPB, we consider the most appropriate procedure is zone 0 landing TEVAR with total debranching of the aortic arch

vessels. In our case, however, in addition to hypovolemic shock, we were concerned about uncontrolled bleeding from the rupture site at the time of chest entry or opening of the pericardium as massive pericardial effusion was identified on the enhanced CT scan before the initial emergency procedure. Apart from elective settings, the choice of zone 0 TEVAR requiring median sternotomy without the support of CPB should be carefully determined in emergency cases.

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