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Case Report

Use of Embolic Protection Devices during Hybrid Thoracic Endovascular Aortic Repair for a Shaggy Aorta: A Case Report

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An 87-year-old man presented with a saccular aneurysm at the proximal descending thoracic aorta. As computed tomography revealed a shaggy aorta, we planned hybrid thoracic endovascular aortic repair (TEVAR) with embolic protection devices (EPDs) in both internal carotid arteries to prevent a cerebrovascular accident. We inserted an Emboshield NAV^6 Embolic Protection System (Abbott Vascular, Abbott Park, IL, USA) into both internal carotid arteries before performing the TEVAR procedure. The patient was discharged from the hospital on postoperative day 4 without any neurological complications.

Keywords: Aneurysm, Aorta, Arch, Endovascular procedures, Cerebral protection, Case report

Case report

An 87-year-old man presented to the emergency room complaining of dysarthria and transient right hemiplegia with onset upon waking. The initial laboratory results showed a high creatinine level (1.65 mg/dL) and hemoglobin A1c (6.8%). Brain magnetic resonance imaging revealed acute infarction along the left central sulcus without hemorrhagic transformation; thus, the patient was hospitalized in the stroke unit. In the diagnostic work-up, computed tomographic angiography (CTA) was performed, demonstrating a saccular aneurysm at the proximal descending thoracic aorta (DTA) and underlying severe atherosclerosis, with a protruding atheroma and irregular mural thrombus (maximal thickness, over 10 mm) running from the ascending aorta to the thoracoabdominal aorta without any other symptoms (Fig. 1). The only other notable finding was mild stenosis (<20%) in the proximal internal carotid arteries (ICAs), and no calcified plaques were observed either on Doppler ultrasonography or magnetic resonance angiography. We were consulted regarding this patient for the surgical treatment of a saccular aneurysm at the proximal DTA.

The patient had several preoperative comorbidities other than the recent stroke. He had underlying diseases of hypertension, diabetes mellitus, dyslipidemia, and chronic kidney disease. He had undergone percutaneous coronary intervention due to 2-vessel disease in the 1990s. Accordingly, we regarded him as a high-risk patient for postoperative stroke and decided to use embolic protection devices (EPDs) prior to thoracic endovascular aortic repair (TEVAR).

Approximately 3 months after the onset of stroke, we planned hybrid zone 2 TEVAR. Through a left supraclavicular incision, a left common carotid artery (LCCA)-to-left subclavian artery (LSCA) bypass was made using an 8-mm Dacron graft. A small incision was made on the right neck, and we exposed the right common carotid artery (CCA). After performing purse-string sutures with 6-0 Prolene in both CCAs, we inserted 6F sheaths and placed Emboshield NAV^6 Embolic Protection Systems (Abbott Vascular, Abbott Park, IL, USA) into both ICAs (Fig. 2). During EPD placement, which lasted for about 1 hour, cerebral oximetry did not change significantly (right/left: initial 73%/68%, at the end of the operation 70%/65%, highest 71%/72%, and lowest 64%/63% before heparinization). We then embolized the proximal LSCA using a 10-mm Amplatzer Vascular Plug II (AGA Medical Corp., Plymouth, MN, USA). As intraoperative angiography showed significant stenosis at the proximal LCCA, we performed stenting using a 12×40 mm

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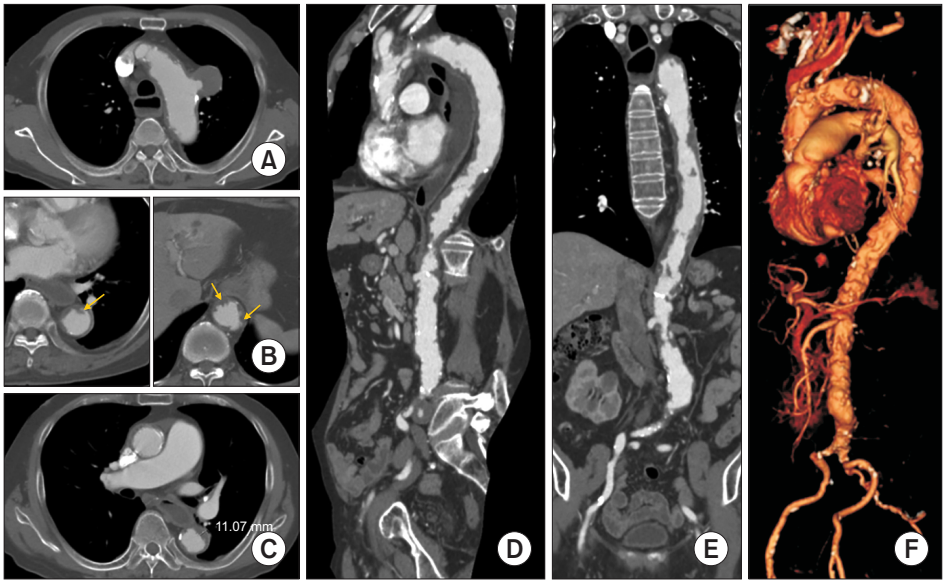

Fig. 1. (A) Saccular aneurysm in the proximal descending thoracic aorta. (B) Mural thrombus surrounding over three-fourths of the circumference of aorta (arrows). (C) The maximal thickness of the mural thrombus measured over 10 mm. (D) Sagittal view of the diffusely atherosclerotic aorta. (E) Coronal view of the aorta. (F) Three-dimensional visualization of the aorta.

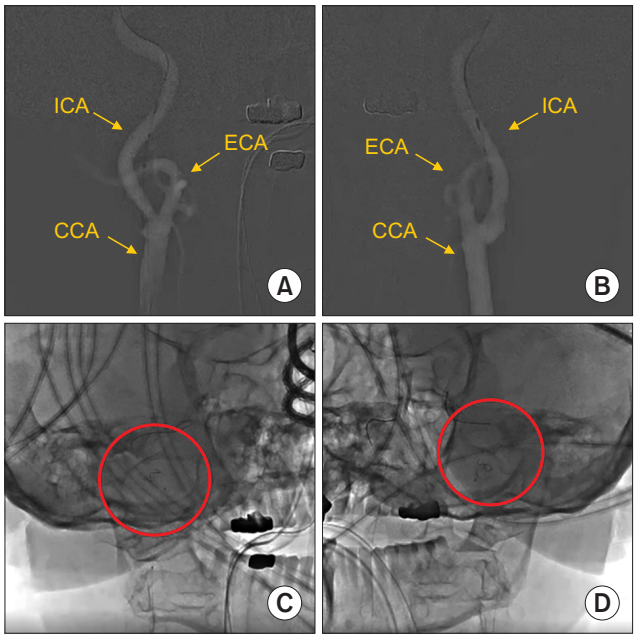

Fig. 2. Placement of embolic protection devices in the right (A, C) and left (B, D) internal carotid arteries. ICA, internal carotid artery; ECA, external carotid artery; CCA, common carotid artery.

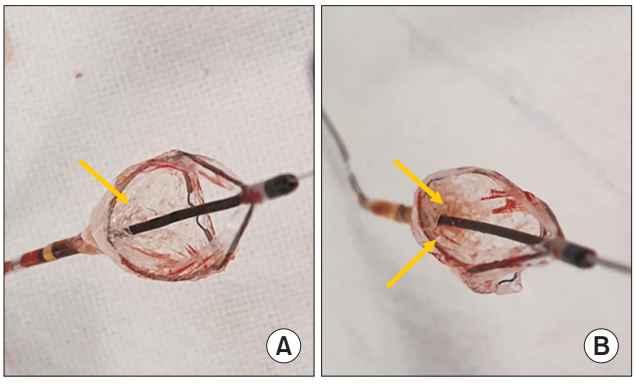

Fig. 3. Filters retrieved from both internal carotid arteries. The filter retrieved from the left side (A) was clearer than that on the right side (B), where some fine yellowish particles were captured (arrows).

Epic stent (Boston Scientific Corp., Natick, MA, USA).

We cut down the left femoral artery and performed a complete zone 2 hybrid TEVAR. We inserted 42×42×200 mm Valiant Captivia stent-grafts (Medtronic Vascular, Santa Rosa, CA, USA) after snaring down the femoral artery to prevent distal embolism. We ended the intervention after the retrieval of both EPDs from the bilateral ICAs. At the final angiography, we could see the patent LCCA stent and the LCCA-to-LSCA bypass graft, as well as the intact vertebral artery, and could not find any endoleaks. An examination of the filters retrieved from both ICAs showed yellowish, fine particles captured by the filter material, especially in the filter that had been placed on the right side (Fig. 3).

The postoperative CTA also showed no definite endoleaks. The patient was discharged from the hospital on postoperative day 4 without any neurological complications.

The study was approved by the Institutional Review Board of Seoul National University Hospital (IRB approval no., B-2101/663-701). The patient provided written in-

formed consent for the publication of his clinical details and images.

Discussion

According to a systematic review and meta-analysis specifically investigating the stroke risk of patients undergoing TEVAR procedures for a thoracic aortic aneurysm, the pooled prevalence of perioperative stroke was 4.1% [1]. It is widely known that the stroke risk increases in patients with severe atheromatous disease involving the aortic arch, especially in zone 0 TEVAR or in patients undergoing coverage of the LSCA without revascularization or undergoing occlusion of the LSCA after aortic stent-graft deployment. Another independent risk factor of perioperative stroke is a shaggy aorta [1-4].

Regarding the condition of shaggy aorta, previous studies have revealed correlations between atheromatous aortic disease and the incidence of postoperative stroke. Gutsche et al. [2] classified atheromatous aortic disease as follows: grade I (normal), smooth and continuous aortic intimal surface; grade II, intimal thickening of 3–5 mm; grade III, atheroma protruding <5 mm into the aortic lumen; and grade IV, atheroma protruding >5 mm into the aortic lumen or ulcerated or pedunculated. They demonstrated that severe atheromatous disease (grade IV) involving the aortic arch on computed tomography was strongly associated with postoperative stroke (odds ratio [OR], 14.8; p=0.0016) [2]. Kanaoka et al. [4] defined shaggy aorta as the presence of a mural thrombus in a normal non-aneurysmal aorta with more than three-fourths the circumference of a normal aorta, a thickness of ≥5 mm, and a length of ≥2.5 cm on preoperative computed tomography, and proved that shaggy aorta was an independent risk factor for postoperative cerebral infarction in a univariable analysis (OR, 20.89; p=0.000).

To avoid neurological adverse events, many experts have devoted themselves to developing EPDs, and approximately 10 EPD products have been approved by the United States Food and Drug Administration. The EPD used in this case was the Emboshield NAV^{6} Embolic Protection System from Abbott. This EPD consists of a filter delivery wire that enables the guidewire to rotate or advance freely and a filter composed of 120-μm micro-pores. The distal tip was a 1-mm pore-free zone to prevent embolic materials from extruding into the blood flow. The diameter of the artery at the site of filter placement was limited from 2.5 to 7.0 mm, and we used a 7.0-mm filter.

There are 2 routes for positioning EPDs in both ICAs: brachial artery puncture and CCA puncture via a small neck incision. We recommend the latter because the LCCA is already exposed for the LCCA-LSCA bypass, and the right CCA may also be exposed through a small incision. It is not technically difficult to position the EPDs in both ICAs through the bilateral brachial arteries. However, on the left side, the guidewire can touch the shaggy aortic arch. In contrast, on the right side, retrieval of the EPD can be difficult because the angle of the subclavian and carotid arteries is acute, and the retrieval catheter is relatively rigid. Thus, while the retrieval catheter can touch and damage the intima while passing through the acute-angled innominate artery, possibly causing distal embolization, we can gently retrieve the devices through the exposed CCA. However, if severe atherosclerotic changes or especially an unstable plaque is present in the CCAs, the usage of EPDs should be considered more cautiously.

This patient had signs of a shaggy aorta from the ascending aorta to the thoracoabdominal aorta. In this case, not only the cerebral embolism, but also visceral or lower limb embolism should be noted. The unilateral limb entered by the stent-graft can be protected by distal common femoral clamping, but a visceral embolism cannot be protected. We think that the only way to prevent a visceral embolism is to be especially careful when manipulating the guidewires, catheters, and stent-grafts. In general, we prefer the percutaneous approach using the pre-closing technique instead of femoral exposure. In this case, moderate stenosis (>50%) was observed in the right iliac artery, we cut down and clamped only the left femoral artery.

In summary, we suggest that before performing a hybrid TEVAR procedure in a high-risk patient with a shaggy aorta, placement of an EPD is a reasonable and effective strategy to protect the patient from postoperative neurological complications. Suitable patients should be selected with care and the indications for EPD use should be determined in further studies.

Conflict of interest

No potential conflict of interest relevant to this article was reported.

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