A Modiﬁed Technique of Direct Aortic Arch Debranching Using a Shunt for Cerebral Perfusion Protection During Hybrid Repair of an Aortic Arch Aneurysm

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Introduction: We report a 74-year-old man with highly advanced arteriosclerosis and aortic arch aneurysm and who had a past medical history of cerebral infarction.

Case report: Recurrence of cerebral infarction during operation if cerebral blood ﬂow decreased during debranching of the cerebral arteries was a concern. A direct reconstruction to the arch vessels was carried out with a temporary shunt blood circuit using a 12-Fr balloon perfusion catheter to prevent cerebral ischaemia, and thoracic endovascular aneurysm repair was performed.

Discussion: This method is safe and useful for elderly persons with advanced arteriosclerosis.

INTRODUCTION
Thoracic endovascular aneurysm repair (TEVAR) creates new options for patients having a very high risk for morbidity and mortality during conventional operations. Although this is a less invasive procedure to treat patients with thoracic aortic aneurysm, TEVAR for aortic arch aneurysm presents technical and anatomical difﬁculties, because cervical branches are obstacles to obtaining a sufﬁcient landing zone. Thus, there have been many reports describing aortic arch reconstruction using an extra-anatomical bypass. Almost all of these reports applied single clamping of cervical vessels, when the cervical vessels were reconstructed. In these methods, cerebral ischaemia was considered a risk during cross-clamping time in particular, as in this patient with a past history of cerebral infarction. We report a patient with an aortic arch aneurysm with highly advanced arteriosclerosis and who had a past medical history of cerebral infarction. We outline the management strategy during the debranching of cervical branches.

CASE REPORT
Aortic arch aneurysm was diagnosed in a 74-year-old man by a computed tomography (CT) scan (Fig. 2 (A)). He was a very high-risk patient with a history of bronchial asthma, cerebral infarction and percutaneous coronary intervention for ischaemic heart disease. Hybrid therapy with TEVAR, after direct reconstruction for cervical branches of the aorta, was performed.

A hand-made trifurcated outﬂow tract graft was prepared using a 10-mm-diameter collagen-impregnated woven Hemashield Platinum® Dacron graft (Maquet, Hirrlingen, Germany) anastomosed to the side of a 14 × 8-mm Hemashield Platinum® graft. After median sternotomy was performed, the proximal end of the trifurcated graft was anastomosed to the ascending aorta. A 12-Fr balloon perfusion catheter (Sumitomo Bakelite Co., Ltd. Tokyo, Japan), which was connected to one of the branches of the trifurcated graft, was inserted into the brachiocephalic artery as a temporary shunt. The blood pressure of the brachiocephalic artery was maintained at more than 50 mmHg and rSO² was unchanged during the operation. The brachiocephalic artery was reconstructed with a 10-mm branch of the trifurcated graft. The left common carotid artery was reconstructed in the same fashion. Next, a 6-mm-diameter gelatin-coated Dacron graft (Gelsoft® Plus, Vascutek, Glasgow, Scotland, UK), which was anastomosed to the left subclavian artery, was guided to the mediastinum via the left thoracic space; this was anastomosed with another branch of the trifurcated graft, which had been...
used for the temporary shunt. The left subclavian artery was ligated just distal to the branching point (Fig. 1). Because this patient had a past history of cerebral infarction and heart ischaemia, and because arteriosclerosis had progressed, we worried about recurrence of cerebral infarction during the operation if cerebral blood flow decreased during debranching of the cerebral arteries. CT examination revealed no complications at the anastomotic sites of the direct reconstruction (Fig. 2 (B)).

Two weeks after the first operation, TEVAR was performed with three Gore TAG® stent grafts (W. L. Gore & Associates, Newark, DE, USA). Postoperative CT which was performed 1 week after the second operation revealed no endoleak (Fig. 2 (C)). We waited until the patient had completely recovered from the operative damage. The patient was discharged from our hospital without complications 2 weeks after the TEVAR, which is usual in Japan.
DISCUSSION

Endovascular repair of aortic arch aneurysms is still a very challenging procedure. At least 2 cm of proximal neck is required for sufficient fixation of the stent graft. Direct reconstruction or extra-anatomical bypass of the branching vessels is frequently needed. We previously reported an aortic arch aneurysm treated with the Matsui-Kitamura stent graft, a flexible and curved stent graft, which was placed following extra-anatomical arch vessel bypass by antegrade selective cerebral perfusion under left heart bypass.\(^1\)\(^2\) Cerebral perfusion using left heart bypass is useful for cerebral protection, although it is more invasive than our method. Moreover, the amount of heparin is decreased in our method, which decreases the risk of bleeding. Although the single clump method was used for a short duration during reconstruction of the cervical branches,\(^3\) neurologic complication was a major concern. The indications for this method are elderly persons who need a less invasive operation and patients with advanced atherosclerosis, especially those with a past history of cerebral infarction. We believe that the method is strongly indicated for patients with stenosis of the carotid artery, vertebral artery and basilar artery on preoperative magnetic resonance imaging. In the present case, a temporary shunt was used for preventing cerebral ischaemia. The temporary shunt supplied effective blood flow, as measured by \(rSO_2\) and perfusion pressure. We planned to increase the size of the temporary shunt cannula if \(rSO_2\) had decreased. This procedure requires a lower level of heparin compared with left heart bypass, which is advantageous in that it lowers the risk of bleeding.

Hybrid repair of an aortic arch aneurysm, including the use of a temporary shunt circuit to lower the risk of cerebral ischaemia, was notably beneficial for our high-risk patient.

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CONFLICTS OF INTEREST

None declared.

REFERENCES