Ann Vasc Dis Vol. 12, No. 3; 2019; pp 385–387

Online June 3, 2019
doi: 10.3400/avd.cr.19-00004

Case Report

Left Subclavian-Bilateral External Carotid Artery Bypass for Symptomatic Carotid Artery Dissection Secondary to Open Repair of Type A Aortic Dissection

Wakiko Hiranuma, MD,[1] Takuya Shimizu, MD, PhD,[1] Miki Takeda, MD,[1] Takayuki Matsuoka, MD, PhD,[1] Tadanori Minakawa, MD, PhD,[1] Makoto Miura, MD, PhD,[1] Toshiaki Hayashi, MD, PhD,[2] Tatsuya Sasaki, MD, PhD,[2] and Shunsuke Kawamoto, MD, PhD[1]

Symptomatic carotid dissection, secondary to surgical repair of Stanford type A acute aortic dissection (AAD), requires prompt intervention. A 56-year-old man who underwent total arch replacement with frozen elephant trunk for AAD presented with left hemiplegia and unilateral spatial neglect 16 h after the surgery. Cerebral computed tomography (CT) revealed no fresh lesions, and CT angiography showed severe bilateral carotid dissection. The patient's neurological symptoms improved soon after left subclavian-bilateral external carotid artery bypass to correct symptomatic severe right cerebral ischemia. Therefore, this technique can be a good option for symptomatic carotid dissection in selected patients.

Keywords: carotid artery dissection, bypass, type A aortic dissection

Introduction

Symptomatic carotid dissection, secondary to surgical repair of type A acute aortic dissection (AAD), requires prompt intervention, but there is no standard treatment. Here we report the case of a patient who presented with cerebral ischemia symptoms after undergoing total arch replacement for AAD and was successfully treated with left subclavian-bilateral external carotid artery bypass.

Case Report

A 56-year-old man with Stanford type A AAD was transferred to our hospital (**Fig. 1A**). He had a history of bacterial meningitis and cerebral hemorrhage (evacuation was performed, and he survived without sequelae) six years before this admission. An emergent total arch replacement with a frozen elephant trunk (**Fig. 1B**) was performed on the day of admission. Sixteen hours after the surgery, the patient presented with left hemiplegia and left unilateral spatial neglect. Cerebral computed tomography (CT) revealed no fresh lesions (**Fig. 2A**). Carotid ultrasonography revealed that the right common carotid artery's true lumen was extremely narrow due to dissection (**Fig. 2B**). CT angiography revealed severe bilateral carotid artery dissection and a right vertebral artery that was dominant to left (**Fig. 2C**). Given the patient's symptoms were caused by ischemia of the right cerebral hemisphere, and the left carotid artery showed severe stenosis, we decided to perform an emergent revascularization by left subclavian-bilateral external carotid artery bypass. After intravenous administration of heparin (2,000 U), a 7-mm artificial graft (PROPATEN, Gore-Tex, Flagstaff, Arizona, USA) was anastomosed to the left subclavian artery. The distal graft anastomosis created a bifurcation, and one branch of the graft was passed under the left sternocleidomastoid muscle to make an end-to-side anastomoses with the left external carotid artery. Next, the left cerebral regional oxygen saturation (rSO2) rose by >10% (i.e., to >60%). The right external carotid artery was revascularized by

[1] *Department of Cardiovascular Surgery, Tohoku Medical and Pharmaceutical University Hospital, Sendai, Miyagi, Japan*
[2] *Department of Neurosurgery, Tohoku Medical and Pharmaceutical University Hospital, Sendai, Miyagi, Japan*

Received: February 3, 2019; Accepted: April 2, 2019
Corresponding author: Wakiko Hiranuma, MD. Department of Cardiovascular Surgery, Tohoku Medical and Pharmaceutical University Hospital, 1-12-1 Fukumuro, Miyaginoku, Sendai, Miyagi 983-8512, Japan
Tel: +81-22-259-1221, Fax: +81-22-259-1232
E-mail: wakiko.h@hosp.tohoku-mpu.ac.jp

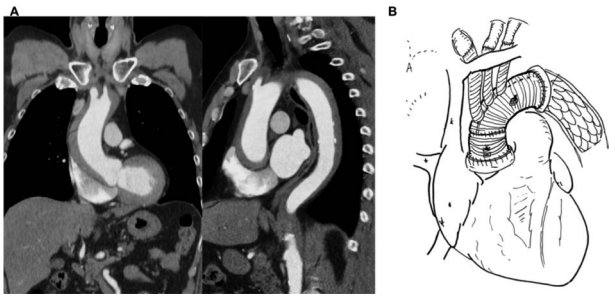

Fig. 1 (**A**) Preoperative computed tomography shows Stanford type A dissection from the bilateral common carotid arteries to the superior mesenteric artery. (**B**) Total arch replacement with frozen elephant trunk was performed.

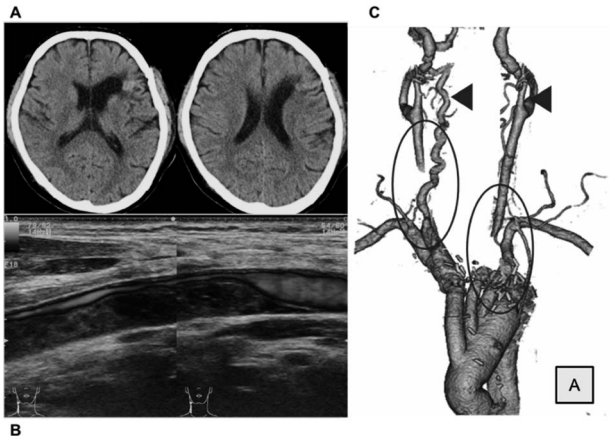

Fig. 2 (**A**) No new visible changes observed in the cranial plain computed tomography (CT). (**B**) Carotid ultrasonography shows severe stenosis of the right common carotid artery. (**C**) CT angiography shows severe stenosis of the bilateral common carotid arteries (circles). The right vertebral artery is greater than the left (arrow heads).

the other branch of the graft over the dorsal aspect of the anterior cervical muscles, and we performed an end-to-side anastomosis with the artery. The right cerebral rSO2 then rose from approximately 40% to >60%. Edaravone and aspirin were started in the perioperative period. The postoperative course was uneventful. The left hemiplegia and unilateral left spatial neglect resolved soon after the surgery. CT angiography on postoperative day 7 showed graft patency and improved enhancement of the bilateral carotid arteries' true lumen (**Fig. 3A**). A magnetic resonance imaging performed on postoperative day 20 showed a small, anterior cerebral artery territory infarction that caused no apparent neurological symptoms (**Fig. 3B**). One month after revascularization, the patient was transferred to a rehabilitation hospital. He was discharged home after two months of rehabilitation and returned to work four months after the surgery. CT angiography three months after surgery showed occlusion of the left subclavian-right external carotid artery bypass. Since the right common carotid artery's true lumen was already

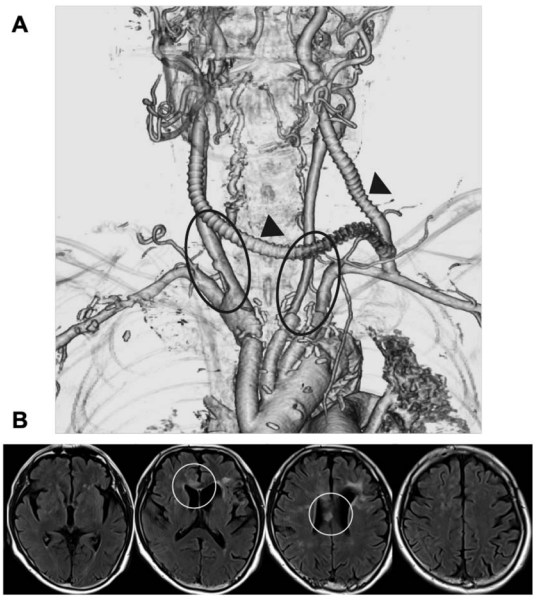

Fig. 3 (**A**) Left subclavian-bilateral external carotid artery bypass was performed with an expanded polytetrafluoroethylene graft. Computed tomography angiography seven days after the surgery shows the patent graft (arrow heads) and an extended true lumen of the bilateral common arteries (circles). (**B**) Axial Fluid Attenuated inversion recovery images of magnetic resonance imaging, performed 20 days after the surgery, showed a small left anterior cerebral artery territory infarction (circles) causing no apparent neurological symptoms.

extended, he presented no symptoms due to occlusion of the bypass.

Discussion

Common carotid artery dissection has been reported in 15%–41% of patients with surgery for Stanford type A AAD.[1] Most patients experience asymptomatic dynamic stenosis or occlusion and do not require invasive intervention.[2] If symptomatic common carotid artery dissection occurs, then immediate revascularization, endovascular, or direct surgery is required. Endovascular treatment (EVT) is minimally invasive, and it has become mainstream. Most case reports of common carotid artery dissection include EVT.[3–5] However, it is associated with risks of embolic complications and vascular injuries when the fresh dissection is treated. The covered stent might prevent these problems[6,7]; however, it is not always easy to find a safe route of access in aortic dissection cases where the long-term patency of stents is not known.[8] Some cases, such as that of our patient, are difficult to treat by EVT because of the dissection. CT angiography showed a dominant right vertebral artery in our patient; dissection of the brachiocephalic artery extended to the right subclavian artery and included fresh thrombi in the false lumen. The bilateral

external carotid arteries were not involved in the dissection. Therefore, we thought EVT was associated with a high risk of complications, such as brainstem infarction, following an injury to the brachiocephalic artery. Direct surgery of the external carotid artery might be safer. Although direct surgery is invasive, extrathoracic reconstruction of the supraaortic trunks, including carotid-subclavian artery bypass, is well tolerated.[9] In our case, left subclavian-bilateral external carotid artery bypass successfully improved stenosis or the occlusive lesions of true vascular lumens, and achieved physiological hemodynamics without directly affecting cerebral hemodynamics since we did not directly manipulate the native common carotid artery in this way. Successful performance of direct revascularization depends on maintaining inflow and outflow. Because clamping dissected arteries makes the dissection worse, the surgery should not approach the dissected arteries. In our patient, the left subclavian artery was chosen for the inflow because dissection of the brachiocephalic artery continued to the right subclavian artery. Regarding the outflow, we chose the external carotid arteries so we would not need to clamp the common and internal carotid arteries. Clamping might make the dissection worse, and reduce brain perfusion significantly during anastomosis, because the contra-lateral carotid artery was also dissected with narrowed true lumen. Considering the graft patency, the carotid bifurcated area could be an option for distal anastomosis; however, in this case, the main purpose of the surgery was to improve the perfusion pressure in the internal carotid arteries' true lumen without even transient discontinuation of blood flow during the procedure. Furthermore, since we expected to remodel the common carotid arteries, as we observed three months after the surgery, the bypass grafts' patency was only critical in the acute phase. Direct revascularization should be considered in cases where a safe access route is not ensured. Available reports of direct revascularization include carotid–carotid bypass and endarterectomy of dissected regions.[10] Also, Shimura et al. reports the safety of external carotid to left subclavian artery bypass in patients who underwent thoracic endovascular aortic repair.[11] To the best of our knowledge, this is the first report for common carotid artery dissection secondary to surgical repair of Stanford type A AAD. The optimal intervention to achieve revascularization should be chosen on a case-by-case basis, and this surgical strategy could be an option.

Conclusion

We performed left subclavian-bilateral external carotid artery bypass for symptomatic common carotid artery dissection secondary to surgical repair of type A AAD. Symptomatic carotid dissection requires prompt intervention, and either EVT or direct revascularization should be chosen on an individual basis.

Disclosure Statement

The authors have no conflicts of interest to declare.

Author Contributions

Writing: WH
Critical review and revision: all authors
Final approval of the article: all authors
Accountability for all aspects of the work: all authors

References

1) Zieliński T, Wolkanin-Bartnik J, Janaszek-Sitkowska H, et al. Persistent dissection of carotid artery in patients operated on for type A acute aortic dissection—carotid ultrasound follow-up. Int J Cardiol 1999; **70**: 133-9.
2) Charlton-Ouw KM, Azizzadeh A, Sandhu HK, et al. Management of common carotid artery dissection due to extension from acute type A (DeBakey I) aortic dissection. J Vasc Surg 2013; **58**: 910-6.
3) Gao P, Wang Y, Chen Y, et al. Open retrograde endovascular stenting for left common carotid artery dissection secondary to surgical repair of acute aortic dissection: a case report and review of the literature. Ann Vasc Surg 2015; **29**: 1019.e11-5.
4) Furuta T, Wajima D, Aketa S, et al. Carotid arterial stent for symptomatic carotid dissection of post-operative aortic replacement for Stanford type A aortic dissection: case report and review of literature. Currently Practical Neurosurgery 2017; **27**: 409-15. (in Japanese)
5) Hayase M, Yang T, Oda M, et al. Carotid artery stenting for bilateral cerebral malperfusion due to carotid dissection after open surgical repair of type A aortic dissection in Marfan syndrome: a case report. Japanese Journal of Neurosurgery 2015; **24**: 41-7. (in Japanese)
6) Assadian A, Senekowitsch C, Rotter R, et al. Long-term results of covered stent repair of internal carotid artery dissections. J Vasc Surg 2004; **40**: 484-7.
7) Ferrer C, Grande R, Venturini L, et al. Spot stenting of supra-aortic branch vessels for residual type A dissection. Ann Vasc Surg 2017; **45**: 268.e1-7.
8) Donas KP, Mayer D, Guber I, et al. Endovascular repair of extracranial carotid artery dissection: current status and level of evidence. J Vasc Interv Radiol 2008; **19**: 1693-8.
9) Owens LV, Tinsley EA Jr, Criado E, et al. Extrathoracic reconstruction of arterial occlusive disease involving the supraaortic trunks. J Vasc Surg 1995; **22**: 217-21; discussion, 221-2.
10) Droeser RA, Wolff T, Mujagic E, et al. Two different cases of postoperative symptomatic common carotid artery involvement in type A aortic dissection. BMJ Case Rep 2012; **2012**: bcr2012006902.
11) Shimura S, Yamaguchi M, Cho Y, et al. External carotid-to-subclavian artery bypass in stent grafting of thoracic aorta. Asian Cardiovasc Thorac Ann 2013; **21**: 546-50.