» **Case Report** «

Delayed Visceral and Spinal Cord Malperfusion after Axillo-Bifemoral Bypass for Complicated Acute Type B Aortic Dissection

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We describe a successfully treated case of acute type B aortic dissection complicated with lower extremity, visceral, and spinal cord malperfusion. To restore perfusion to both lower extremities, we performed an emergency right axillo-bifemoral bypass. Furthermore, we performed total arch replacement, including primary entry closure, because of delayed visceral organ ischemia. Unexpectedly, delayed paraplegia occurred after hospital discharge; however, the patient recovered without any neurologic sequelae after early introduction of hyperbaric oxygen therapy. Because another episode of organ malperfusion in the long term cannot be anticipated, and even though the previous organ malperfusion episode was treated successfully, close observation is mandatory for detecting clinical manifestations in combination with the availability of imaging modalities.

Keywords: acute type B aortic dissection, visceral malperfusion, paraplegia

Introduction

Acute type B aortic dissection complicated with rupture and organ malperfusion is a life-threatening condition. The standard treatment involves immediate surgery. Organ malperfusion involving all of the lower extremity, viscera, and spinal cord due to acute type B aortic dissection rarely occurs in individuals. We report the case of a patient who underwent right axillo-bifemoral bypass for lower extremity malperfusion;

subsequently, total arch replacement for visceral malperfusion was performed, and the patient was administered hyperbaric oxygen therapy for the treatment of an episode of paraplegia.

Case Report

A 44-year-old man was admitted to our hospital complaining of persistent back pain and uncontrolled leg pain. He had not been treated for hypertension. His bilateral femoral pulses were absent, and cyanosis was observed on his lower extremities. Upper extremity blood pressure was 190/106 mmHg without a significant difference between the right and left sides. Emergent contrast-enhanced computed tomography demonstrated acute type B aortic dissection, which extended from the distal arch to the bilateral common iliac arteries. At the level of the abdominal terminal aorta, the true lumen was compressed by the thrombosed false lumen, and the blood flow was absent at both common iliac arteries (Fig. 1A and 1B).

Under the diagnosis of acute type B aortic dissection with bilateral lower extremity malperfusion, we performed emergency right axillo-bifemoral bypass with an 8 mm ringed polytetrafluoroethylene graft

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Fig. 1 Contrast-enhanced computed tomography on first admission showed the enhanced false lumen of the descending aorta (white arrow) (A) and the severely calcified non-enhanced abdominal terminal aorta (white arrow) (B).

tracked subcutaneously. The condition of both lower extremities dramatically improved, although the acute renal failure due to reperfusion injury required hemodialysis filtration. The postoperative peak serum creatine phosphokinase level and serum creatinine level was 28604 U/L and 1.4 mg/dL, respectively. Initially, the postoperative course was uneventful; however, the patient gradually started having stomachaches after meals. His abdomen was soft and flat, and laboratory data for internal organ function were within normal limits. Urgent enhanced computed tomography revealed narrowing of the true lumen of the thoracoabdominal aorta, which was markedly compressed by the false lumen at the level of the celiac and superior mesenteric arteries (Fig. 2). We decided to perform total arch replacement, including primary entry closure, under the diagnosis of delayed visceral malperfusion on postoperative day 33 after performing right axillo-bifemoral bypass.

Under median sternotomy, cardio-pulmonary bypass was instituted in the standard fashion with ascending aortic and bicaval cannulation. Under deep hypothermic circulatory arrest, the neck vessels were reconstructed using the arch-first technique with retrograde cerebral perfusion. Then, we found the intimal tear approximately 3 cm distal from the left subclavian artery with antegrade cerebral perfusion through a 4-branch Dacron graft. The transected aorta was reinforced by two Teflon felt strips both inside and outside the distal aorta, after excluding the entry site. Because the distal aortic wall was thick and hard, a smaller tube graft was used as an elephant trunk. After distal anastomosis, rewarming of the whole body was performed. Finally, total arch replacement was completed.

Postoperatively, contrast-enhanced computed tomography revealed expansion of the true aortic lumen and

Fig. 2 Contrast-enhanced computed tomography after the appearance of stomachaches showed patent graft (white arrowheads), narrowing of the true lumen of the thoracoabdominal aorta (black arrow), and the markedly decreased blood flow of the celiac and superior mesenteric arteries (white arrow) (A–C).

partial thrombosis of the false lumen (Fig. 3A–3C). Abdomen symptoms were markedly improving. However, a bleeding tendency caused by disseminated intravascular coagulation continued, and a prolonged rehabilitation was required because of disuse syndrome. He was discharged on postoperative day 35 after performing total arch replacement without any complications.

The patient was readmitted to our hospital with paraplegia that occurred unexpectedly on day 15 after the previous hospital discharge. Magnetic resonance imaging showed a hyperintense lesion on the spinal cord at T12 (Fig. 3D). Hyperbaric oxygen therapy was started immediately, and systemic heparinization

Fig. 3 Contrast-enhanced computed tomography after total arch replacement showed expansion of the true aortic lumen, partial thrombosis of the false lumen (white arrowhead), and increased blood flow of the celiac and superior mesenteric arteries (white arrow) (A–C). Magnetic resonance imaging on second admission showed a hyperintense lesion on the spinal cord at T12 (D).

was started continuously. After 24 h, the neurological deficiency was completely resolved, and the patient was discharged on the day 10 after his second admission. Since then, he is being followed up once a month for medical treatment.

Discussion

Medical treatment has been the first choice of therapy in patients with uncomplicated acute type B aortic dissection. Patients with acute type B aortic dissection who present organ malperfusion require emergent surgical treatment since ischemia-related organ damage could become irreversible. Despite improvements in surgical techniques, perioperative care, and endovascular techniques, in-hospital mortality in complicated acute type B aortic dissection remains as high as 23.5% and 29.3% as reported by Murashita, et al. and Trimarchi, et al., respectively.^{1,2)} Usually, high dosages of pain medication and sedatives are administered; however, it is crucial to determine the best time for surgery based on the evaluation of subjective symptoms, physical findings such as pulseless femoral artery and cyanosis of extremities, laboratory data, and imaging findings.

Open surgical aortic replacement, open abdominal fenestration, extra-anatomical bypass, and bypass to

visceral organs have been used to restore organ perfusion.³⁾ Recent advances in interventional technology include thoracic endovascular aortic repair (TEVAR), interventional abdominal fenestration, and bare-stenting to dissected visceral arteries.^{4,5)} Because it could be difficult to perform abdominal fenestration and endovascular therapy in the presence of a severely calcified infrarenal abdominal aorta and an occlusive thrombosed abdominal terminal aorta, we decided to perform axillo-bifemoral bypass to ensure prompt revascularization to the lower extremities.

Stomachache after a meal can be recognized as an early sign of relatively mild visceral ischemia. Kuo, et al. and Kim, et al. reported that axillo-femoral bypass relieves visceral malperfusion in type B aortic dissection.^{6,7)} We agree that axillo-femoral bypass plays an important role in maintaining visceral perfusion by redirecting blood flow into the true lumen; however, may not always relieve visceral malperfusion in type B aortic dissection. In the present case, because the extension of the dissection into the visceral arteries was not recognized and the true lumen was collapsed by a false lumen within the aorta, additional central aortic repair including closure of the large aortic intimal tear was needed. Excellent early and midterm results of TEVAR for complicated acute type B aortic dissection have been reported recently.⁸⁾ However, TEVAR was considered an inappropriate option because the patient was young and had the anatomical characteristic of short distance between the arch vessels and large intimal tear. Our only alternative was to use a tube graft that was smaller than a 4-branch Dacron graft as an elephant trunk, because both intima and adventitia of the dissected aorta distal to the subclavian artery was fibrosed and thickened. It was very difficult to control the greater propensity for bleeding caused by disseminated intravascular coagulation syndrome associated with platelet decrease after total arch replacement. However, partial thrombosis of the false lumen in the thoraco-abdominal aorta was finally obtained.

Paraplegia occurred because the intercostal and lumbar arteries or the Adamkiewicz artery may have been compromised. Furthermore, an additional abundant network that includes the radicular artery, vertebral artery, and internal mammary artery is essential for preserving the blood supply to the anterior spinal arteries. On the other hand, delayed paraplegia is rare, and may occur because of the disappearance of

blood flow in the false lumen. Paraplegia resolved rapidly in the present case. The compromise of branch vessels is less likely to occur with open surgical techniques such as axillo-femoral bypass and total arch replacement, as compared with endovascular intervention. Therefore, open surgery may have the advantage of increasing the blood supply from the collateral circulation in a critical situation. In the present case, the paraplegia was treated by hyperbaric oxygen therapy and the maintenance of systemic heparinization and appropriate blood pressure. Takahashi, et al. reported cerebrospinal fluid drainage as a useful treatment to resolve paraplegia after acute type A aortic dissection.⁹⁾ In addition, cerebrospinal fluid drainage may be useful to reduce spinal cord ischemia.

Conclusion

This experience suggests the importance of early treatment for complicated acute type B aortic dissection and early diagnosis of organ ischemia on a case-by-case basis. Since new episodes of organ malperfusion could occur in the long term, even though a previous organ malperfusion episode was successfully treated, close observation is mandatory for detecting clinical manifestations, in combination with the availability of imaging modalities.

Disclosure Statement

The authors have no conflict of interest.

References

- 1) Murashita T, Ogino H, Matsuda H, et al. Clinical outcome of emergency surgery for complicated acute type B aortic dissection. *Circ J* 2012; 76: 650-4.
- 2) Trimarchi S, Nienaber CA, Rampoldi V, et al. Role and results of surgery in acute type B aortic dissection: insights from the International Registry of Acute Aortic Dissection (IRAD). *Circulation* 2006; 114: I-357-64.
- 3) Uchida N, Shibamura H, Katayama A, et al. Surgical strategies for organ malperfusions in acute type B aortic dissection. *Interact Cardiovasc Thorac Surg* 2009; 8: 75-8.
- 4) Maeda T, Kurimoto Y, Osawa H, et al. A case of emergency stent grafting for Stanford type B dissection with limb ischemia and renal dysfunction. *Jpn J Vasc Surg* 2008; 17: 463-6.
- 5) Shiiya N, Sawada A, Tanaka E, et al. Percutaneous mesenteric stenting followed by laparoscopic exploration for visceral malperfusion in acute type B aortic dissection. *Ann Vasc Surg* 2006; 20: 521-4.
- 6) Kuo HN, Lai HC, Chang YW, et al. Axillofemoral bypass relieves visceral malperfusion in type B aortic dissection. *Ann Thorac Surg* 2013; 95: 703-5.
- 7) Kim KH, Choi JB, Kuh JH. Simultaneous relief of acute visceral and limb ischemia in complicated type B aortic dissection by axillobifemoral bypass. *J Thorac Cardiovasc Surg* 2014; 147: 524-5.
- 8) Khoynzhad A, Donayre CE, Omari BO, et al. Midterm results of endovascular treatment of complicated acute type B aortic dissection. *J Thorac Cardiovasc Surg* 2009; 138: 625-31.
- 9) Takahashi K, Satokawa S, Takahashi S, et al. Cerebrospinal fluid drainage as a useful treatment to relieve paraplegia caused by acute type A aortic dissection. *Jpn J Cardiovasc Surg* 2006; 35: 173-6.