Concomitant Reconstruction of Arch Vessels during Repair of Aortic Dissection

Slobodan Micovic, MD, MsC
Dusko Nezic, MD, PhD
Petar Vukovic, MD, PhD
Marko Jovanovic, MD
Branko Lozuk, MD, PhD
Sinisa Jagodic, MD
Bosko Djukanovic, MD, PhD

Surgery for acute aortic dissection is challenging, especially in cases of cerebral malperfusion. Should we perform only the aortic repair, or should we also reconstruct the arch vessels when they are severely affected by the disease process? Here we present a case of acute aortic dissection with multiple tears that involved the brachiocephalic artery and caused cerebral and right upper-extremity malperfusion. The patient successfully underwent complete replacement of the brachiocephalic artery and the aortic arch during deep hypothermic circulatory arrest, with antegrade cerebral protection. We have found this technique to be safe and reproducible for use in this group of patients. ***(Tex Heart Inst J 2014;41(4):421-4)***

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From: *Departments of Cardiac Surgery (Drs. Djukanovic, Jovanovic, Micovic, Nezic, and Vukovic), Vascular Surgery (Dr. Lozuk), and Anesthesiology (Dr. Jagodic), Cardiovascular Institute Dedinje, 11000 Belgrade, Serbia*

Address for reprints:
Slobodan Micovic, MD, Cardiovascular Institute Dedinje, Milana Tepica 1, 11000 Belgrade, Serbia

E-mail:
micko2006@yahoo.com

In the presence of neurologic symptoms, surgical treatment of acute aortic dissection requires special attention. Whether repair of the ascending aorta needs to be supplemented by reconstruction of the arch vessels is still uncertain. There are few published papers[1,2] concerning the successful concomitant repair of arch vessels. Here we report the successful repair of a brachiocephalic artery, followed by reconstruction of the ascending aorta with the patient in profound hypothermia.

Case Report

In November 2012, a 40-year-old man was admitted to a regional hospital after the sudden onset of severe chest pain. An emergency-unit physician established a preliminary diagnosis of type A acute aortic dissection. Soon thereafter, the patient was transferred to our institution. At the time of admission, he was drowsy and reported right-hand numbness. No pulses were present in the right upper extremity, and the right carotid pulse was diminished. A bedside transthoracic echocardiogram confirmed the presence of an intimal flap in the ascending aorta. There were no signs of cardiac tamponade, and the patient was hemodynamically stable. We proceeded with an emergent 64-slice multidetector computed tomographic (MDCT) scan (Fig. 1), which showed type A acute aortic dissection with 3 intimal tears. One tear was at the left main coronary ostium, and the 2 others were at the level of the aortic arch—the second between the brachiocephalic and left carotid arteries, and the third below the left subclavian artery. The right subclavian artery was proximally occluded, and the flow in the right common carotid artery was diminished by false-lumen compression. The coronary arteries were free of disease.

Our surgical plan was to reconstruct the brachiocephalic artery while the patient was cooling down in preparation for deep hypothermic circulatory arrest (DHCA). We established extracorporeal circulation via transventricular (apical) arterial and standard venous cannulation. We exposed the brachiocephalic artery in a usual manner (by means of a separate incision on the right side of the neck), and, as the patient's core temperature decreased to 22 °C, we constructed end-to-end anastomoses between branches of a bifurcated Y graft (12 × 6 mm) and the carotid and subclavian arteries. We then conducted the remnant of the Y graft into the anterior mediastinum, separately cannulated the arterial branches with intraluminal cannulas, and began antegrade cerebral perfusion (ACP) at a flow rate of 350 mL/min.

During DHCA (54 min at 18 °C), a separate 30-mm Dacron graft was used for hemiarch reconstruction (the distal anastomosis having been secured by suturing the

Fig. 1 *A 64-slice multidetector-row computed tomogram shows type A aortic dissection starting at the level of the aortic annulus and spreading toward the arch. The arrows show that the false lumen compresses and occludes the brachiocephalic artery and its branches.*

graft to the aortic lumen near the left carotid orifice), thus precluding mid-arch intimal tear. Through this "hemiarch graft," another ACP line was inserted into the left common carotid artery, thus increasing the rate of antegrade cerebral perfusion to 700 to 800 mL/min. Next, the Y graft was anastomosed to the hemiarch graft in an end-to-side fashion. Extracorporeal circulation was reestablished with reinsertion of the arterial cannula into the hemiarch graft. We performed a classic Bentall procedure during the rewarming period, using a 28-mm composite valved conduit that was then connected to the hemiarch graft, thus completing the surgical procedure (Fig. 2). Extracorporeal circulation was stopped after the period of reperfusion. The remainder of the operation was performed in the usual manner.

The patient was fully awake 5 hours thereafter and was extubated 20 hours postoperatively. He spent another 6 days in the hospital. His postoperative period was uneventful. Before his discharge from the hospital, we performed a follow-up MDCT scan (Fig. 3), which showed the patent bifurcated graft. One year after the operation, the patient was doing well.

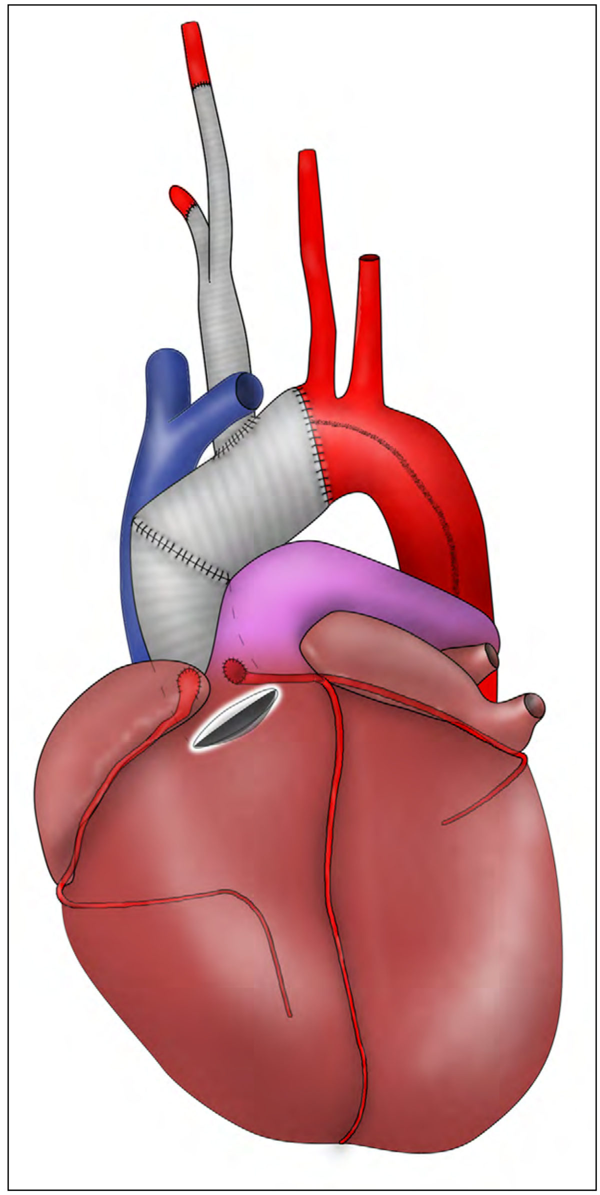

Fig. 2 *This drawing illustrates our surgical approach to brachiocephalic artery reconstruction during the classic Bentall procedure, including hemiarch replacement for type A acute aortic dissection. Branches of bifurcated 12 × 6-mm Dacron graft (shown in gray) were connected to the carotid and subclavian arteries in an end-to-end fashion and then anchored (end-to-side) to a separate 30-mm Dacron graft (also in gray), which was used for hemiarch reconstruction. Extracorporeal circulation was then reestablished. After completion of the Bentall procedure, a mechanical valve composite conduit was connected to the hemiarch graft. The sketched line shows residual dissection in the descending aorta.*

Fig. 3 *A 64-slice multidetector-row computed tomogram on the 7th postoperative day shows the widely patent bifurcated graft that replaced the diseased brachiocephalic artery.*

Discussion

There is no doubt that the treatment of patients with type A acute aortic dissection remains challenging.[3] In a case that involves an intimal tear in the aortic arch, it is even more complex. Questions remain: Do we need to reconstruct the arch vessels when they are acutely occluded or when flow is severely impaired by false-lumen compression? If we decide to proceed, should we reconstruct those vessels with the patient under deep hypothermia? In contrast with the treatment of malperfusion syndrome involving the coronary arteries or iliofemoral vessels, vascular reconstruction has almost never been performed on the carotid arteries.[4] There are 2 main reasons. First, the occlusion usually resolves after ascending aortic repair; and second, revascularization is sometimes harmful, especially if the patient presents with signs of ischemic stroke. It is now clear that carotid arteries sometimes remain occluded after aortic repair and that patients in that circumstance have poor postoperative outcomes.

Our patient was thought to have a high probability of malperfusion because of the long occlusive lesion of the right subclavian artery and the nearly occluded right common carotid artery. In addition, the patient appeared to be a good candidate for revascularization, because he presented very early after the onset of mild neurologic symptoms.[5] The carotid artery reconstruction was safely performed with the patient under profound hypothermia (22 °C), without increasing the time of DHCA. In this case, transventricular cannulation was used. We generally avoid cannulating the femoral arterial site for risk of additional malperfusion, and in this particular patient the left axillary artery was occluded. Because we believe it is very important to establish antegrade flow in patients with acute aortic dissection, we have routinely used that approach for the last decade.[6] The cannulation site can be chosen in accordance with the specific needs of the patient. Although it is not clear which patients will benefit from the addition of this specific surgical procedure, we believe that separate revascularization needs to be performed in cases similar to ours, regardless of the presence or absence of neurologic symptoms. Recently, Urbanski and Wagner[1] published a paper describing their reconstruction, with great success, of the brachiocephalic artery in 3 patients. Shortly before that, Abe and colleagues[2] reported a case of successful carotid–aorta bypass in a similar situation. The reconstruction can be performed safely during a period of deep hypothermia, because lowering the temperature helps to protect the central nervous system. The other option would be to perform urgent stenting of the carotid and brachiocephalic arteries; however, those procedures are time consuming and require additional diagnostic imaging. There are several reports[7] of this additional endovascular approach, but all of those procedures were performed after surgical repair of the aortic dissection. We strongly believe that reconstruction of the arch vessels needs to performed before or during ascending aortic reconstruction.

Given the poor natural course of type A acute aortic dissection when complicated by cerebral malperfusion,[8] the decision to plan the reconstruction of the arch vessels is justified.[9]

In conclusion, we believe that brachiocephalic artery reconstruction can be safely performed in a patient who presents with type A acute aortic dissection. This operative tactic is a good solution in cases of severe impairment of blood flow in the vessels of the neck.

Such reconstruction can be safely performed with use of DHCA and, when combined with left ventricular apical cannulation, can be the treatment of choice for this group of patients.

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