Paraplegia after coronary artery bypass surgery: An uncommon complication in a patient with history of thoracic endovascular aortic repair

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ABSTRACT
Neurologic lesions are unusual complications after coronary artery bypass surgery. Among them, paraplegia is one of the rarest, with only a few cases reported in the literature.1-5 In these cases, paraplegia is mainly considered the result of medullary ischemia secondary to systemic hypotension. Other causes include atherosclerotic microembolization as a result of aortic clamping and intra-aortic balloon counterpulsation therapy. To the best of our knowledge, paraplegia after CABG has never been described 2 months after thoracic endovascular aortic repair (TEVAR).

CASE REPORT
A 75-year-old man was referred to our institution for acute aortic syndrome. His past medical history included systemic arterial hypertension and smoking. The enhanced computed tomography (CT) scan revealed an acute intramural hematoma extending from the left subclavian artery to the aortic hiatus, without any organ malperfusion. A penetrating aortic ulcer was also remarkable at the level of the eighth to ninth thoracic vertebrae. The patient remained in pain for 1 week despite optimal medical treatment including blood pressure control and analgesia. TEVAR using two Valiant endografts (Medtronic, Minneapolis, Minn) was decided on. The proximal stent graft (36/36-200 mm) was landed just distal to the origin of the left subclavian artery. The second stent graft (36/36-150 mm) was deployed in the distal thoracic aorta to cover the aortic ulceration 12 mm above the celiac trunk (Fig). Initially, we did not plan to cover more than eight intercostal pairs, and because we did not cover the left subclavian artery, we did not proceed with cerebrospinal fluid (CSF) drainage. The patient was hemodynamically stable, and the findings on neurologic examination during the following 48 hours were unremarkable; therefore, we did not perform CSF drainage after TEVAR. The endografts were well positioned and the left subclavian artery remained patent on the CT angiography scan performed before discharge. The patient had favorable outcomes and was discharged after 5 days.

Two months later, the patient presented with atypical chest pain associated with dyspnea at exertion. The enhanced CT scan showed neither TEVAR-related complications nor acute aortic syndrome on the proximal part of the thoracic aorta (ascending and arch). Despite a normal electrocardiography recording, unstable angina was suspected; emergency coronary angiography was performed, revealing coronary artery disease with significant proximal stenoses on the three main vessels. Despite prior TEVAR, we did not consider the paraplegia risk associated with CABG, and we decided to use both internal thoracic arteries (ITAs) with a Y construct for complete revascularization. The rest of the preoperative evaluation was not remarkable.

The patient underwent quintuple on-pump CABG surgery (cardiopulmonary bypass time, 96 minutes; aortic clamping time, 87 minutes). Both ITA grafts presented with a diameter up to 3 mm. Big intercostal collaterals distributed between the third and eighth ribs were also remarkable. The left ITA graft was used to revascularize the left anterior descending artery and the first diagonal branch, and the right ITA was anastomosed to the first and second marginal branches and the posterior descending artery. The patient had a stable hemodynamic condition during the procedure and was transferred to the intensive care unit without pharmacologic inotropic support. The immediate postoperative course was marked by a hypovolemic condition related to surgical bleeding (900 mL during the first 24 postoperative hours). This postoperative
bleeding was due to coagulation disorders that were corrected without the need for surgical revision. Hypovolemia, acute renal failure, and hypoxic cytolysis were reversed after fluid filling and norepinephrine infusion (0.4-0.6 mg/h). Sedative drugs were stopped, and the patient was extubated at postoperative day 2. The neurologic examination showed a complete impairment in motor and sensory functions of the lower limbs associated with areflexia and sphincter hypotonia. Magnetic resonance imaging of the spine was performed emergently, showing medullary ischemia from the seventh and eighth thoracic vertebrae to the conus terminalis. Because of the late diagnosis of paraplegia, CSF derivation was not considered. The patient was transferred to a rehabilitation center after 9 days. Two years after CABG surgery, the patient did not present with any functional neurologic recovery of the lower extremities. Informed consent was obtained from the patient for publication of this case report.

DISCUSSION

We hypothesize that the mechanism of paraplegia in this case was medullary ischemia due to systemic hypotension associated with the loss of arterial collaterality after sampling of both ITAs during CABG surgery.

The Adamkiewicz artery is known as the largest anterior segmental medullary artery. This main source of spinal cord vascularization is usually perfused by multiple collaterals, including the intercostal arteries, the lumbar arteries, and the ITAs as described by Yoshioka et al.6,7 In some patients, the ITA may be the main or the only functional collateral artery for the Adamkiewicz artery.6,7 Therefore, the loss of this blood supply may result in spinal cord ischemia and finally in postoperative paraplegia in case of ITA harvesting for CABG surgery. After TEVAR of the whole thoracic descending aorta, all intercostal arteries were covered in this case and thus could not participate in medullary perfusion anymore. However, we did not observe any neurologic disorder of the lower limbs initially after endoprosthesis deployment, suggesting efficient blood supply for the spine from other branches like the left subclavian artery, lumbar arteries, or ITA. We hypothesize that double ITA graft harvesting during CABG surgery resulted in an acute dramatic decrease of medullary perfusion and thus spinal cord ischemia. In addition, transient postoperative hypovolemia may have worsened the medullary injury, leading to irreversible paraplegia. Several trials have investigated the risk factors for paraplegia after TEVAR, and no one has found a significant correlation with coronary artery disease.8-10 Nonetheless, CABG surgery has not been investigated separately as a risk factor for paraplegia, especially the bilateral ITA approach for CABG. The marked increased diameter of the ITA at time of CABG surgery in this case is consistent with our hypothesis. The ITAs were bigger than usual and with large collateral intercostal arteries, suggesting the development of circulatory supply for the Adamkiewicz artery after complete coverage of the posterior intercostal arteries as the consequence of TEVAR.

This case highlights the strong but underestimated relationship between ITA and spinal cord vascularization through the intercostal arteries, including the Adamkiewicz artery, especially after TEVAR. In this case, we suggest that TEVAR increased the paraplegia risk. The key message of the case report is to be aware that in patients with prior TEVAR covering intercostal arteries, perfusion of the spine may be dramatically impaired by ITA sampling for CABG. We believe that this an important message for clinicians, and it should be considered in the decision-making process in case of severe coronary artery disease requiring reperfusion. We therefore suggest that CT angiography or magnetic resonance angiography of the spinal cord vascularization be considered in patients referred for CABG who have past history of TEVAR. In case of main collateral supply from the ITA, surgeons may not use both ITAs for CABG and may consider alternative grafts or percutaneous revascularization. Similarly, CSF drainage and pressure monitoring as well as motor evoked potential monitoring should be considered in surgical patients before and during the days after CABG surgery using ITA graft to reduce the risk of spinal cord ischemia. Above all, every effort should be made to avoid hypovolemia during and after surgery.

Fig. Control angiography after thoracic endovascular aortic repair (TEVAR) showing complete exclusion of the descending thoracic aorta. The left subclavian artery remained patent.
Finally, in light of our report, it could also be relevant to systematically screen the medullary vascularization before TEVAR in patients with past history of coronary revascularization with bilateral ITA grafts.

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