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Case Report

Postoperative paraplegia after transapical transcatheter aortic valve implantation

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ABSTRACT

An 84-year-old man with severe aortic valve stenosis underwent transcatheter aortic valve implantation (TAVI). We selected a transapical approach TAVI because he had a 48-mm abdominal aortic aneurysm and his descending aorta was covered with severe atherosclerosis, a so-called “shaggy aorta”. A 26-mm Sapien XT prosthesis (Edwards Lifesciences, Irvine, CA, USA) was successfully implanted, and TAVI was performed using cardiopulmonary bypass. His postoperative clinical course was unremarkable on the first day. On postoperative day 3, however, his systemic circulation suddenly collapsed due to cardiac tamponade. We performed an emergency re-thoracotomy. This operation improved his systemic circulation, but he had no movement in either leg. Magnetic resonance imaging showed spinal cord ischemia around the T10 level and acute multifocal micro cerebral infarctions. The cause of his neurological symptoms was thought to be spinal cord ischemia brought about by the shaggy aorta and low blood pressure due to cardiac tamponade after TAVI.

<**Learning objective:** Postoperative spinal cord injury is caused by hypotension embolisms, and aortic dissection particularly in patients with severe aortic arteriosclerosis. Spinal cord ischemia is a rare complication after transcatheter aortic valve implantation because the descending aorta is not operated upon. However, it is necessary to keep in mind that postoperative hemodynamic instability can cause spinal cord ischemia in patients with a shaggy aorta.>

Introduction

In recent years, transcatheter aortic valve implantation (TAVI) has rapidly spread for high-surgical-risk patients with severe aortic valve stenosis as an alternative to surgical aortic valve replacement. In early cases of transapical TAVI (TA-TAVI), we experienced postoperative paraplegia owing to spinal cord ischemia after postoperative cardiac tamponade. In general, postoperative complications of TAVI include aortic regurgitation, atrioventricular block, and cerebral infarction. Although paraplegia is a common complication of thoracoabdominal aortic surgery, it is rarely associated with TAVI. Here we report the case of a man with paraplegia due to spinal cord ischemia after TA-TAVI.

Case report

An 84-year-old man experienced dyspnea on exertion. He had previously undergone percutaneous coronary intervention for angina pectoris. At that time, aortic stenosis (AS) was detected by echocardiogram. He was admitted to our hospital due to AS progression. His medical history revealed lung lobectomy for lung cancer, and his respiratory function was markedly impaired, causing chronic obstructive pulmonary disease.

Electrocardiogram revealed normal sinus rhythm and no ischemic change but left ventricle hypertrophy pattern. Echocardiogram showed severe and diffuse left ventricular hypertrophy. The aortic valve and posterior leaflet of the mitral valve were

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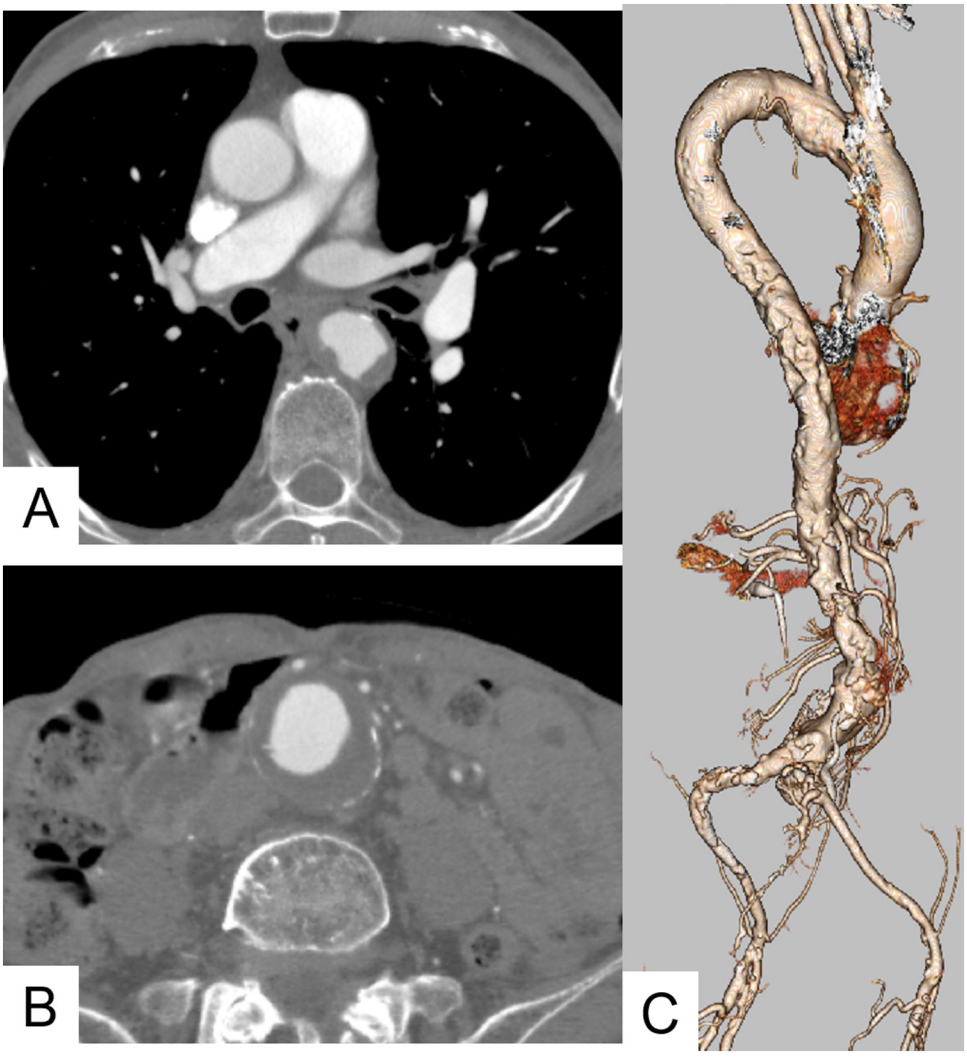

Fig. 1. Preoperative contrast computed tomography. (A) Preoperative computed tomography angiogram revealed diffuse severe arteriosclerosis of the thoracic aorta including penetrating atherosclerotic ulcer. (B) Note the infra-renal abdominal aortic aneurysm with a 48 mm diameter and thick mural thrombus. (C) Mural thrombus and calcification due to arteriosclerosis from thoracic aorta to abdominal aorta.

remarkably thickened and calcified. Aortic valve area was 0.88 m^2 and the peak gradient was 108 mmHg on Doppler imaging, indicating severe AS. Coronary angiography revealed no significant stenosis. Computed tomography showed a 48-mm abdominal aortic aneurysm and "shaggy aorta" from the descending thoracic to the thoracoabdominal (Fig. 1). The Iliac arteries were 4.2 mm on the left side and 5.6 mm on the right side. Additionally, his logistic EuroSCORE was 19.3% and STS score was 10.4%. Therefore, we planned TAVI, owing to the high risk in surgical aortic valve replacement (SAVR), and chose transapical access.

We performed TA-TAVI with a 26-mm Sapien XT (Edwards Lifesciences, Irvine, CA, USA). Cardiopulmonary bypass (CPB) established from the right femoral vein to the left subclavian artery was used during the surgery because of circulation support. TAVI was performed using a standard technique from the 5th intercostal space and completed uneventfully.

He left the intensive care unit on the day after operation. On postoperative day 2, atrial fibrillation developed, necessitating treatment with verapamil, bisoprolol, and apixaban. On postoperative day 3, he exhibited shock, and echocardiography showed cardiac tamponade. Hence, pericardial drainage under re-thoracotomy was immediately performed. In the operating room, his systolic blood pressure dropped to around 50 mmHg after anesthesia induction. His systemic circulation improved due to the pericardial drainage. After waking up, his legs were immobile. Postoperative computed tomography showed that his aorta and its arteriosclerosis were unchanged. Magnetic resonance imaging showed spinal cord ischemia around T10 and multiple acute cerebral infarctions (Fig. 2). He was diagnosed with paraplegia caused by spinal cord ischemia and was administered steroids and edaravone. Paraplegia persisted despite medication; hence, he was transferred to another rehabilitation hospital. After that, his paraplegia continued without improvement.

Discussion

TAVI is used as an alternative method in some high-risk severe AS patients, who cannot be treated with traditional SAVR. Because TAVI does not usually require cardiopulmonary bypass and cardiac arrest, surgical complications are lesser than conventional SAVR [1]. In general, coronary artery occlusion, atrioventricular block requiring permanent pacemaker implant, aortic valve regurgitation, and stroke are major complications in patients who undergo

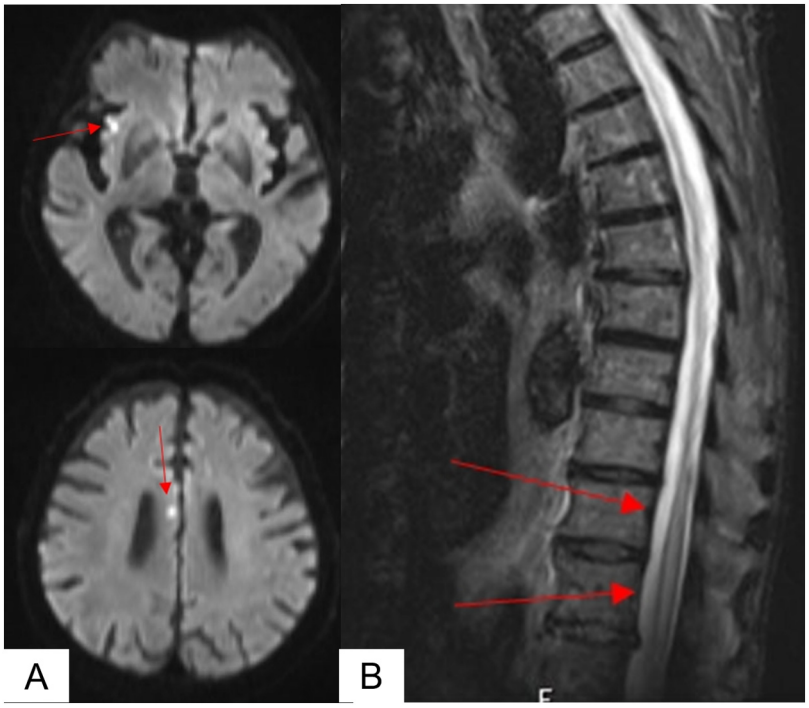

Fig. 2. Postoperative magnetic resonance imaging. (A) Postoperative cerebral diffusion-weighted magnetic resonance imaging showed several small acute cerebral infarctions of the right cerebrum. (B) Spinal cord magnetic resonance imaging suggested spinal cord ischemia and edema (arrows) below the T10 spinal cord level but no hematoma.

TAVI. Common neurological complications include cerebral infarction, and paraplegia due to spinal cord ischemia is a rare complication.

Spinal cord ischemia is caused by circulatory insufficiency of the spinal arteries, mainly the Adamkiewicz artery. Spinal circulatory insufficiency can be caused by multiple factors such as hypotension, thoracic aortic dissection, and lumbar arterial embolization. Spinal cord ischemia is commonly experienced after thoracoabdominal aortic operations [2] and is not a life-threatening complication; however, it significantly reduces quality of life. Furthermore, it is related to mortality in the long-term.

TA-TAVI does not require surgical manipulation or catheterization of the descending aorta. Therefore, spinal cord ischemia usually does not occur. To the best of our knowledge, spinal cord ischemia has not been reported for TAVI. However, our patient exhibited diffuse arteriosclerosis of the thoracic and abdominal arteries, known as “shaggy aorta.” Some reports have shown paraplegia due to spinal cord ischemia in patients with shaggy aorta and/or abdominal aorta and peripheral artery disease who undergo aortic non-touch surgeries such as coronary artery bypass grafting [3–6]. Regardless of the type of operation, the rate of aorta-related complications, including spinal cord ischemia, is increased in patients with a shaggy aorta [7]. Because the risk of aortic-related complications such as embolization and aortic dissection was high, we selected TA-TAVI so as not to perform an intra-aortic technique.

In this case, paraplegia did not develop immediately after TAVI. And postoperative magnetic resonance image that showed spinal cord central edema did not reveal spinal cord infarction but revealed spinal cord ischemia. Therefore, we considered that spinal cord ischemia occurred due to circulatory instability caused by cardiac tamponade. However, we have never experienced a case of spinal cord ischemia after cardiac tamponade. For patients with a shaggy aorta, since some intercostal arteries may be occluded, the risk of spinal cord ischemia caused by severe hypotension is higher than in those with a healthy aorta. Hypotension due to cardiac tamponade continued for a short time on postoperative day 3, but hypotension worsened after the introduction of anesthesia and continued for about 30 min. We considered this event to be most harmful because paraplegia does not occur after TA-TAVI and before pericardial drainage. Perioperative hypotension is unlikely to occur during TAVI procedure, except in cases of valve deployment. However, we used CPB to stabilize intraoperative hemodynamics because intraoperative circulation failure may occur due to severe left ventricular hypertrophy when inserting the delivery system. If TA-TAVI was performed without using CBP and circulatory failure occurred, spinal cord ischemia may have developed similarly after TAVI. We believe that TAVI procedure could be performed safely because of circulation support.

General strategies for preventing spinal cord ischemia include maintaining consistent postoperative blood pressure, cerebrospinal fluid drainage, medical therapies (steroid, naloxone, edaravone), and hyperbaric oxygen therapy [8]. We believe that maintaining sufficient blood pressure to prevent collapse of spinal perfusion is particularly important. For 2–3 days after thoracic abdominal aortic surgery, postoperative systolic blood pressure should be kept above 140 mmHg and mean blood pressure should be kept above 80 mmHg [8–10]. In this case, however, cardiac tamponade was particularly harmful. The patient’s blood pressure immediately improved after pericardial drainage; however, by that time, spinal cord ischemia had developed. Cerebrospinal fluid drainage could not be performed because of antiplatelet therapy for angina pectoris and anticoagulant therapy for atrial fibrillation.

It is necessary to consider that cardiac surgery can cause spinal cord ischemia in patients with a shaggy aorta. Postoperative bleeding and cardiac tamponade should be dealt with as soon as possible, and postoperative blood pressure management should be carefully executed. We need to be more careful especially in cases

wherein transfemoral approach TAVI is not suitable due to shaggy aorta.

Conflict of interest

The authors declare that there is no conflict of interest.

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