

Case Report

Hybrid Repair of Ductus Arteriosus Aneurysm and Severe Aortic Stenosis in an Adult

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Abstract

Background: Patent ductus arteriosus in adults is rare and often complicated by an aneurysm. Ductus arteriosus aneurysms can be treated by open surgery using hypothermic circulatory arrest, but if the operative risk is too high, endovascular treatment also becomes an option. Therefore, the treatment option should be selected on a case-by-case basis.

Case Presentation: Here we report a successful hybrid repair of ductus arteriosus aneurysm, identified during a preoperative examination for severe aortic stenosis, in an elderly patient.

Conclusions: A hybrid procedure including the closure of the Patent Ductus Arteriosus (PDA), Aortic Valve Replacement (AVR), and reconstruction of the supra-aortic vessels was successfully performed for an adult patient with a ductus arteriosus aneurysm and severe Aortic Stenosis (AS). A hybrid procedure may be useful for adult patients with PDA and other cardiovascular diseases.

Keywords: Aortic Stenosis; Ductus Arteriosus Aneurysm; Patent Ductus Arteriosus; Thoracic Endovascular Aortic Repair

Introduction

PDA is common in childhood. However, adult PDA may also be identified during examinations for heart failure [1-3]. The operative risk associated with adult PDA is often higher than that with pediatric PDA because of coexisting calcified ductal aneurysms [2]. As a result, Thoracic Endovascular Aortic Repair (TEVAR) has become the mainstream treatment of PDA in adults [3]. When an adult patient has PDA along with another cardiovascular disease that require a surgical repair, an open or a hybrid approach can be recommended. Here we report the case of an elderly patient who was successfully treated with a hybrid repair for ductus arteriosus aneurysm and AS.

Case Report

A 78-year-old woman with congestive heart failure caused by severe AS, with a maximum and mean pressure gradient of 94.7 and 57.8 mmHg, respectively, measured by echocardiography, was referred from another hospital for surgical treatment. Echocardiography revealed that left ventricular diastolic and systolic dimensions were 66 and 45 mm. Aortic valve area was 0.20 cm² calculated by the continuity equation, whereas it was 0.60 cm² calculated by planimetry. Systolic pulmonary pressure was estimated as 64.5 mmHg and eccentric left ventricular hypertrophy was observed. Computed tomography angiography revealed a 5.1-mm PDA with an aneurysm (Figure 1).

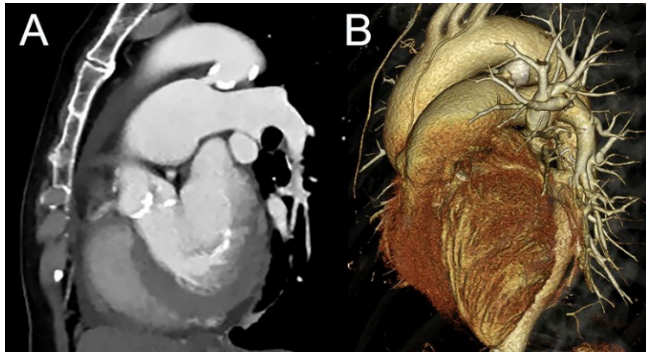


Figure 1: (A) Preoperative and (B) Three-dimensional computed tomography showing a 44-mm calcified ductus arteriosus saccular aneurysm.

Elective surgery was planned but the patient was admitted to our hospital prior to the scheduled date with New York Heart Association (NYHA) functional class IV heart failure (Figure 2). There was no cyanosis and SpO₂ was 95%. Despite anti-failure management with bi-level positive airway pressure ventilation, dobutamine infusion, and pleural drainage, her symptoms did not improve, and the patient developed serious hypotension and oliguria. Therefore, we decided to perform an urgent surgery two days after admission.



Figure 2: Preoperative chest X ray showing pulmonary edema and pleural effusion.

The surgery was performed in a hybrid operation room. After median sternotomy, Cardiopulmonary Bypass (CPB) was established with right atrial drainage and aortic arch cannulation. Mild hypothermia was achieved with a bladder temperature of 32°C, and the aorta was cross-clamped with an antegrade cardioplegia. During 3 minutes of circulatory arrest, the main pulmonary artery was incised, and the ostium of the PDA was closed with a pledgeted mattress suture under direct vision. CPB was restarted, and the severely calcified aortic valve was replaced with a 23-mm bioprosthesis (Crown, LivaNova PLC, London, UK) using a continuous suture technique [4]. Then, the proximal and distal anastomoses between the main body of a 26-mm branched vascular prosthesis (Gelweave Lupiae, Vascutek Ltd, Scotland, UK) and the aorta were performed.

After declamping the aorta, the carotid and subclavian arteries were divided, cannulated for selective cerebral perfusion with monitoring via cerebral oxymetry, and reconstructed. The brachiocephalic artery was similarly reconstructed. After thorough deairing, CPB was discontinued and hemostasis was obtained. Subsequently, a Zone-0 TEVAR (Zenith Alpha, Cook Medical, Inc., Bloomington, IN, USA; Conformable Gore Tag, W. L. Gore & Associates, Inc., Newark, DE, USA) was performed and an additional stent graft (Zenith Alpha Extension, Cook Medical, Inc., Bloomington, IN, USA) was left indwelling for type IV endoleak (Video 1). The patient was extubated on the following day, released from the intensive care unit on the postoperative day 3, and subsequently discharged home as NYHA functional class II (Figures 3 and 4).

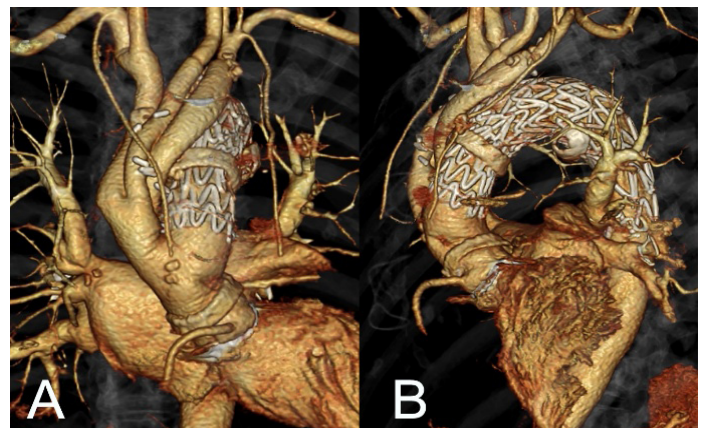


Figure 3: (A, B) Postoperative three-dimensional computed tomography showing reconstruction of the supra-aortic vessels with a Lupiae vascular prosthesis and aortic stent grafts.



Figure 4: Postoperative chest X ray showing improvement of heart failure.

Discussion

PDA in the elderly often poses significant therapeutic challenges because of coexisting calcified ductal aneurysm and frailty of the patient [2]. A simple closure of the PDA may stress the aneurysm; therefore, it carries a risk of rupture. In the present case, there were several treatment options; (A) AVR with concomitant total arch replacement, in which the ductal aneurysm is resected under hypothermic circulatory arrest; (B) a hybrid repair including AVR, closure of PDA, rerouting of the supra-aortic vessels and TEVAR or (C) transcatheter AVR and endovascular occlusion of the PDA with or without TEVAR. Although the patient was in cardiogenic shock, the average life expectancy for 78-year-old females in Japan was 13.37 years in 2017 [5]. An urgent operation with hypothermic circulatory arrest for an elderly patient with severe heart failure would be accompanied by significant perioperative risks, whereas long-term results with transcatheter and endovascular procedures are unknown [6].

In addition, there was only a 10-mm landing zone for a Zone-2 TEVAR in this case. Thus, a hybrid repair was selected,

in which reconstruction of the supra-aortic vessels was safely performed with selective cerebral perfusion. The bovine-like trunk of the Lupiae prosthesis was useful in obtaining a sufficient proximal landing zone during TEVAR. To our knowledge, this is the first report of hybrid repair of ductus arteriosus aneurysm and aortic stenosis in which aortic valve replacement, total arch rerouting without circulatory arrest and zone-0 TEVAR were concomitantly performed. Point to note about the assessment of AS severity is that the pressure difference around the aortic valve might be overestimated because of the blood flow through the PDA. However, in this case, severe AS was shown by planimetry with the measured area of 0.60 cm², and severe stenosis was confirmed at surgery. Thus, it is important to evaluate AS severity using different methods when PDA coexists.

In summary, a hybrid procedure including the closure of the PDA, AVR, reconstruction of the supra-aortic vessels using a Lupiae graft and TEVAR was successfully performed for an adult patient with a ductus arteriosus aneurysm and severe AS. A hybrid procedure may be useful for adult patients with PDA and other cardiovascular diseases.

Conflict of Interest

The authors have no conflicts of interest to declare.

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