**Case
Report**

Use of a Stent Graft for Patent Ductus Arteriosus in an Octogenarian Eliminates Ductus Flow

Wataru Tatsuishi, MD, Go Kataoka, MD, Ryota Asano, MD, Atsuhiko Sato, MD,
and Kiyoharu Nakano, MD

Closure of a patent ductus arteriosus (PDA) in the elderly is a high-risk procedure because of tissue fragility and many possible complications. The patient in our case was an 81-year-old woman with a window-type PDA caused by cardiac failure. Based on the anatomy of the PDA and aorta and to minimize invasion, we used a stent graft to close the PDA. This approach was successful; hemodynamics improved and ductus flow was eliminated during the follow-up period without intervention from the pulmonary artery side.

Keywords: endovascular procedures, stent, geriatric, patent ductus arteriosus

Introduction

Open surgical repair of patent ductus arteriosus (PDA) is very invasive and challenging in elderly patients because of the use of cardiopulmonary bypass, the calcification of the duct, and the possibility of rupture. Endovascular repair using a coil or an occluding device can also be problematic because of migration, rupture, residual shunt, and other complications. Stent-graft treatment is a relatively less invasive procedure for PDA repair, resulting in fewer complications. However, PDA sometimes persists after stent-graft treatment, and residual ductus flow and pressure on the wall of the PDA is worrisome. We present here a case of adult PDA treated using a stent graft and show follow-up computed tomography (CT) images.

Department of Cardiovascular Surgery, Tokyo Women's Medical University, Medical Center East, Tokyo, Japan

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Corresponding author: Wataru Tatsuishi, MD. Department of Cardiovascular Surgery, Tokyo Women's Medical University, Medical Center East, Nishiogu 2-1-10, Arakawa-Ku, Tokyo 116-8567, Japan
Email: wataru0812_drt@ybb.ne.jp

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Case Report

PDA caused cardiac failure in an 81-year-old woman. A chest film showed lung congestion and bilateral pleural effusion. The concentration of serum brain natriuretic peptide (BNP) was 1180 pg/mL. Transthoracic echocardiography (TTE) revealed a PDA jet in the main pulmonary artery and mild tricuspid valve regurgitation. The pressure gradient of the tricuspid valve was 35 mmHg. CT showed pulmonary artery dilatation (50 mm) and a 9-mm PDA duct with a diameter of 17 mm at the pulmonary artery end and 14 mm at the thoracic artery end (**Fig. 1**). Aortography also showed shunt flow through the PDA. The pulmonary artery systolic pressure was 42 mmHg, with a substantial left-to-right shunt (shunt ratio, 63%; pulmonary-to-systemic flow ratio, 2.8; arterial oxygen saturation, 95%; and pulmonary artery saturation, 84.5%).

We initially considered using an occluding device because the PDA diameter was 9 mm. However, the slight dilation of the PDA at the end of the pulmonary artery and thoracic aorta (17 mm and 14 mm, respectively) had the potential to cause device migration, dissection, or rupture. Moreover, the anatomical and structural features suggested open surgery should be performed rather than endovascular occlusion using coil or occluding devices. Although direct or patch closure in open surgery without circulation

Fig. 1 Preoperative images. (A) Chest film showing a congestive lung. (B) Transthoracic echocardiography showing a patent ductus arteriosus (PDA) jet in the pulmonary artery. (C) Constriction around the PDA.

Fig. 2 Intraoperative images. (A) Angiography showing patent ductus arteriosus flow and the origin of the subclavian artery. (B) Angiography performed for final confirmation shows minimal shunt flow. The left subclavian artery was patent.

arrest was considered,¹⁾ a less invasive procedure was preferred because of the patient's age. The PDA arose from the descending thoracic aorta 27 mm distal to the origin of the left subclavian artery, and the distance was sufficient, if barely, for a proximal landing zone for a stent graft. Therefore, we ultimately decided to occlude the PDA entry using a stent graft (Zenith TX2 TAA Endovascular Graft; Cook Endovascular, Bloomington, IN). This procedure is the least invasive and most safe for PDA closure.

After treating cardiac failure and obtaining informed consent for PDA closure using a stent graft, the operation was performed under general anesthesia on August 15,

Fig. 3 Postoperative image (A) and follow-up image (B). The ductus was detected in the postoperative image, but was diminished in the follow-up image.

2012. Angiography was conducted to detect the origin of the left subclavian artery and the PDA entry. Following identification of the release position, the stent delivery system (ZTEG-2P-34-127-JP) was inserted into the right femoral artery after exposure. We introduced and released the stent graft in the thoracic aorta in front of the PDA entry. Angiography performed for final confirmation showed only minimal shunt flow, and the left subclavian artery remained unobstructed (**Fig. 2**). The postoperative BNP concentration was 108 pg/mL. Postoperative TTE showed that the PDA shunt had disappeared and that the tricuspid valve pressure gradient had dropped (20 mmHg). Postoperative CT showed closure of the PDA entry on the aorta side but not the pulmonary artery side (**Fig. 3A**). However, the entry on the pulmonary artery side was no longer detected in a follow-up CT scan on May 22, 2015. Moreover, the diameter of the pulmonary artery was reduced (38 mm) (**Fig. 3B**).

During the follow-up period, the patient had no symptoms and required no further medical treatment.

Discussion

PDA is usually diagnosed and treated during childhood. However, we occasionally encounter an undetected

PDA in an adult at our institute. The characteristics of PDA in adults are different from those in children. In particular, ligation of the PDA in adults can be potentially quite dangerous because of pulmonary hypertension, calcification of the duct or around the aorta, and complications such as a thoracic aneurysm.²⁾ Thus, the treatment of choice for PDA in adults has usually been direct closure or patch closure in open surgery with cardiopulmonary bypass or endovascular treatment with coil occlusion or a closure device.

In the guidelines for Japan after 2008, coil occlusion is indicated for PDAs <2 mm in diameter, whereas the Amplatzer duct occluder (AGA Medical, Golden Valley, MN) is used for PDAs >2 mm in diameter. The Amplatzer duct occluder is the first choice for PDAs with a moderate diameter because of its safety, complete closure rates (98%–100%), and fairly wide treatment range (2 mm <PDA diameter <12 mm).^{3,4)} In the present case, it was not suitable for PDA repair owing to dilation of the end of the pulmonary artery and thoracic aorta.

The use of a stent graft for closure of a PDA entry has been reported in several cases involving elderly and high-risk patients.^{5,6)} Given the possibility of morbidity (e.g., residual shunt or a ductal aneurysm) from other procedures, the usefulness of a stent graft for closure has been studied.^{7,8)} With a stent graft, sufficient proximal and distal landing zones are required to avoid endoleaks or migration of the device. However, the size of the proximal landing zone is often too small for a stent graft, because PDA usually occurs close to the left subclavian artery. In such cases, stent grafts cannot inadequately close the PDA entry.

After stent-graft treatment, ductus flow from the pulmonary artery sometimes persists, and consequent pressure on the wall of the PDA is worrisome. In our case, ductus flow was diminished 3 years after treatment. We believe that the stent graft closed off one end of the ductus and thrombosed the ductus, perhaps by affecting the pressure gradient of the pulmonary artery and thoracic artery.

Conclusion

In conclusion, using a stent graft without any other device to treat PDA in elderly patients can improve hemodynamics and eliminate ductus flow during the follow-up period.

Disclosure Statement

None.

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