Use of an Amplatzer Vascular Plug type II to occlude elongated patent ductus arteriosus in adult patient

Przezcewnikowe zamknięcie przetrwałego przewodu tętniczego typu wydłużonego za pomocą implantu Amplatzer Vascular Plug typu II u dorosłego pacjenta

Jeronimo Daniel Heredia, Małgorzata Szkutnik, Roland Fiszer, Bogusława Serzysko, Jacek Białkowski

Congenital Heart Diseases and Pediatric Cardiology Department, Silesian Medical University, Silesian Center for Heart Diseases, Zabrze, Poland

Postep Kardiol Inter 2012; 8, 3 (28): 246–249
DOI: 10.5114/pwki.2012.30405

Abstract

Patent ductus arteriosus (PDA) is one of the most prevalent congenital heart diseases. Transcatheter closure of PDA is the treatment method of choice. In spite of recent advances in transcatheter management, the occlusion of certain anatomical types of PDA remains a challenge. The aim of the study was to report novel use of the Amplatzer Vascular Plug type II (AVPII) for closure of large elongated type of PDA (type E according to Krichenko classification) in a 19-year-old man. In clinical examination a soft continuous murmur was heard in the 2-3 left intercostal space. Echocardiography confirmed left to right shunt through the PDA. Left ventricle and left atrium were at the upper limit for body weight. In angiography the duct was 20 mm long, 7 mm wide with 3 mm narrowing at the pulmonary end. For the procedure we applied a 12 mm AVPII. The AVPII is a self-expanding, nitinol wire mesh occluder dedicated for arterial and venous occlusion in the peripheral circulation. It was delivered through a 6 F catheter retrogradely. The distal disc and medial part of the AVPII were opened inside the duct, and the proximal disc in the pulmonary artery. Complete closure of the PDA was confirmed in angiography. No complications during the procedure or 3-month follow-up were observed. Application of the AVPII is a safe and effective method of treatment for adult patients with elongated type of PDA.

Key words: device closure, patent ductus arteriosus

Streszczenie

Przetrwały przewód tętniczy (*patent ductus arteriosus* – PDA) jest częstą wrodzoną wadą serca, a przezcewnikowe zamykanie tej struktury – leczniczym postępowaniem z wyboru. Pomimo niewątpliwego postępu obserwowanego w kardiologii interwencyjnej, zamykanie niektórych anatomicznych postaci PDA pozostaje wyzwaniem. Celem pracy jest przedstawienie przypadku mężczyzny w wieku 19 lat, u którego PDA typu wydłużonego (według kwalifikacji Kirchenko – typ E) zamknięto przy zastosowaniu nowatorskiej metody, używając do tego celu Amplatzer Vascular Plug typ II (AVPII). W badaniu klinicznym stwierdzano u pacjenta ciągły szmer w 2–3 przestrzeni międzyżebrowej. Echokardiografia potwierdziła lewo-prawy przeciek na poziomie PDA. Wymiary lewej komory i lewego przedsionka były w górnych granicach normy dla masy ciała. W angiografii przewód tętniczy miał następujące wymiary: 20 mm długości, 7 mm średnicy i 3-milimetrowe zwężenie przy końcu płucnym. Do przezcewnikowego zamknięcia zastosowano AVPII 12 mm. AVPII jest samorozprężającym się implantem, wykonanym z siatki z nitynolowego drutu, stosowanym zwykle do zamykania nieprawidłowych połączeń w obwodowym układzie krążenia. Był on dostarczony odżylnie za pomocą cewnika 6 F. Dystalny dysk i środkową część AVPII otworzono w PDA, a proksymalny dysk w tętnicy płucnej. W kontrolnej angiografii stwierdzono całkowite zamknięcie PDA. Nie obserwowano żadnych powikłań okołozabiegowych oraz w 3-miesięcznej obserwacji. Zastosowanie AVPII u dorosłego pacjenta z PDA typu wydłużonego jest bezpieczną i skuteczną metodą leczenia.

Słowa kluczowe: przezcewnikowe zamknięcie, przetrwały przewód tętniczy

Introduction

Patent ductus arteriosus (PDA) is one of the most prevalent congenital heart diseases (CHD). The patency of this communication between the aorta and the pulmonary artery (PA) may be the cause of heart failure, left heart dilatation or pulmonary artery hypertension. Proba-

Corresponding autor/*Adres do korepondencji:*
Prof. Jacek Białkowski MD, PhD, Congenital Heart Diseases and Pediatric Cardiology Department, Silesian Medical University, Silesian Center for Heart Diseases, 9 M. Curie Skłodowskiej, 41-800 Zabrze, Poland, tel./fax: +48 32 271 34 01, e-mail: jabi_med@poczta.onet.pl
Praca wpłynęła: 6.07.2012, **przyjęta do druku:** 6.08.2012.

bly it is also responsible for increased risk of infectious endarteritis. Nowadays the method of choice is transcatheter closure of this communication.

When the diameter of the PDA is 1.5 mm or less, coils are a very good therapeutic option [1]. When the diameter of the PDA is larger, with typical conical aortic ampulla, closure with the Amplatzer Duct Occluder (ADO) [2] or the very similar but cheaper Cardio-O-Fix Occluder [3] has proved to be a safe and feasible method with excellent results in short and long term follow-up.

The Amplatzer Vascular Plug type II (AVPII) was originally conceived for the closure of peripheral vascular malformations. It is a redesigned version of the Amplatzer Vascular Plug type I (AVPI), which was a woven nitinol wire cylinder, but had a long total time of occlusion. The AVPII has finer, more densely woven nitinol wire and a three-segment design to facilitate rapid, complete occlusion (Figure 1). This relatively new device has been used successfully for closure of collateral vessels associated with single ventricle repair, transhepatic fistula and surgical Ao-PA shunts [4, 5]. It has also been used for percutaneous PDA closure [6-9], but the number of such reports is limited and the results contradictory [5, 10].

According to the Krichenko alphanumeric morphological classification, there exist 5 types of PDA: type A – conical ductus with ampulla at the aortic end; type B – window type (short PDA with no constriction), type C – tubular (without necking); type D – complex (with constrictions at both ends); type E – elongated PDA with constriction at the pulmonary end [11]. The type of the duct is important for selection of the device for transcatheter closure.

We present a case of a 19-year-old male patient with large elongated type of PDA successfully closed with the AVPII device.

Case report

A 19-year-old male patient was transferred to our institution for transcatheter treatment. He was diagnosed in another centre because of worse exercise tolerance, where the diagnosis of PDA was established. In clinical examination a soft continuous murmur (2/6) was heard in the 2-3 left intercostal space. Echocardiography confirmed left to right shunt through the PDA. Left ventricle and left atrium were at the upper limit for body weight. Chest X-ray showed mild cardiomegaly and increased pulmonary vascularity. Angiography performed with a 6 F pigtail catheter in 90-degree lateral projection visualized a long PDA of elongated anatomy (Krichenko classification type E) with narrowing in the pulmonary connection. The diameter of the tubular part of the PDA was 7 mm, that of the narrowing at the pulmonary end was 3 mm, and the length of the PDA was 20 mm (Figure 2). The calculated QP/QS ratio was 1.5 and the mean pulmonary arterial pressure 18 mm Hg. We decided to use the 12 mm Amplatzer Vascular Plug type II (AGA Medical Corp part of St Jude Medical) because of such PDA morphology. The chosen device has 9 mm length and the medial part 12 mm in diameter. We decided to use an oversized plug (5 mm larger than the PDA itself) in order to fill the whole ductal length and achieve a longer device due to compression in the PDA lumen. The PDA was crossed from the venous side with a multipurpose catheter, and then over an Amplatzer 0.035 inch × 260 cm extra-stiff wire, exchanged on a Judkins Right 6 F guiding catheter (0.071 inch internal lumen). Through this catheter the AVPII was implanted: the distal disc and medial part of the plug were opened inside the PDA lumen and the proximal disc in the pulmonary artery. After detachment, angiography showed no flow through the occlusive device (Figure 3). Echocardiography performed on the following day (before discharge home) and 3 months later confirmed complete closure of the PDA without residual shunt. There were no periprocedural complications or during 3 months of follow-up.

Discussion

The ADO is a device that has shown in many publications encouraging results and safety in PDA transcatheter closure [2, 12, 13]. Several investigations have shown the capability of this device to close the most frequent form of PDA – the conical one. In tubular types of PDA (C,D,E according to Krichenko [11]), as in our case, there is an important risk of protrusion of this device because of the relatively small aortic ampulla of the PDA. According to our previously published data, elongated type of PDA in our material was present in 11/75 (15%) adult patients [12] and 104/393 (26%) children [13]. In case of small diameter of the PDA, detachable coil application was an effective method of treatment [12, 13]. In the case of "window" type PDA (type B of PDA according of Krichenko) where the aortic ampulla is absent we have proved efficacy

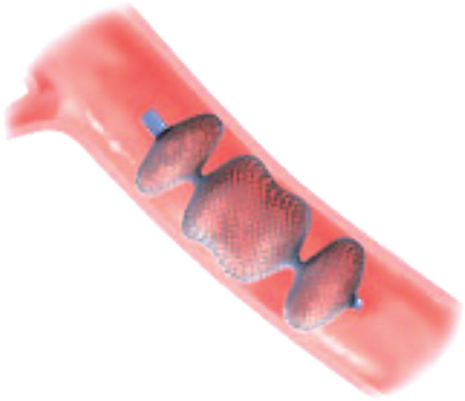

Fig. 1. Schema of Amplatzer Vascular Plug II – two discs connected with cylindrical part (with permission of AGA Medical Comp)
Ryc. 1. *Schemat implantu Ampaltzer Vascular plug typu II – 2 dyski połączone z centralną częścią cylindryczną (za zgodą AGA Medical Comp)*

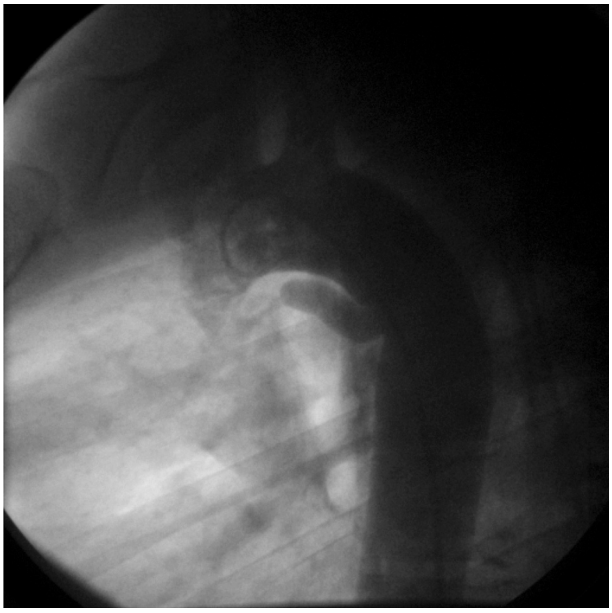

Fig. 2. Aortography – lateral projection. Patent ductus arteriosus – elongated type – before closure
Ryc. 2. *Aortografia – projekcja boczna. Przetrwały przewód tętniczy typu wydłużonego – przed zamknięciem*

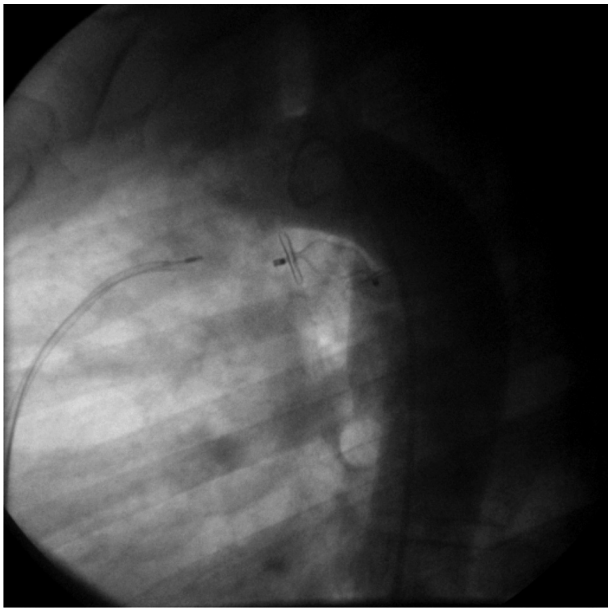

Fig. 3. After closure with 12 mm Amplatzer Vascular Plug II. The device is well seated within the ducts; one disc is opened in the pulmonary artery. No residual flow
Ryc. 3. *Po przezcewnikowym zamknięciu za pomocą implantu Amplatzer Vascular Plug typu II 12 mm. Implant dobrze umiejscowiony w świetle przewodu, jeden dysk otwarty w tętnicy płucnej. Szczelne zamknięcie*

of double umbrella devices such as CardioSeal or Rashkind umbrella [12-14].

In the literature we have found that transcatheter closure of PDA with AVPII was described only in children (the oldest one was 4 years old) [8, 9]. We have confirmed that the Amplatzer plug II is also useful for closure of a relatively large elongated type of PDA in an adult patient. Such type of PDA is not well suited to closure with coils or ADO. Coil embolization of high flow tubular PDA often requires multiple coils, and malposition, embolization and recanalization can occur. The ADO aortic retention disc makes centring the device in tubular PDA difficult. If the aortic ampulla (as in our case) is inadequate, the device may be at risk for embolization to the descending aorta. Using the AVPII we found that the device was easily delivered through a small catheter (6 F) into the centre of the duct, leading to complete occlusion without obstruction of the aorta or the left pulmonary artery. The approach to AVPII delivery was to have all discs contained within the ductus when possible or (as in our case) to have two discs within the duct and one disc opened in the pulmonary artery [9]. Such a strategy was due to the presence of the relatively long PDA (20 mm). In case of application of AVPI there have been reported complications such as surgery requirement because of persistent flow in high-speed systems or need of second closure with coils for a similar reason [4, 15]. One disadvantage of this device is the lack of thrombogenic material inside that may result in persistent shunt. A good option for solving this could be loading the device with coils [9, 15]. Another solution (indicated also by others and implemented by us) is use of an oversize device in order to pack the PDA completely and avoid residual flow. A big advantage of this device is the necessity of a relatively low profile delivery system and the possibility of anterograde or retrograde implantation.

Application of the AVPII is a safe and effective method of treatment for adult patients with elongated type of PDA.

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