The importance of Amplatzer devices in the percutaneous treatment of congenital heart defects in children and adults based on own experience. 35 years of Congenital Heart Defects and Paediatric Cardiology Department at Silesian Centre for Heart Diseases, Zabrze, Poland

Authors: Jacek Białkowski, Małgorzata Szkutnik

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The importance of Amplatzer devices in the percutaneous treatment of congenital heart defects in children and adults based on own experience. 35 years of Congenital Heart Defects and Paediatric Cardiology Department at Silesian Centre for Heart Diseases, Zabrze, Poland

Jacek Bialkowski, Małgorzata Szkutnik
Congenital Heart Defects and Paediatric Cardiology Department, Medical University of Silesia in Katowice, Silesian Centre for Heart Diseases, Zabrze, Poland

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Correspondence to:
Prof. Jacek Bialkowski, MD, PhD,
Congenital Heart Defects and Paediatric Cardiology Department,
Medical University of Silesia in Katowice,
Silesian Centre for Heart Diseases,
M Curie-Sklodowskiej 9, 41–800 Zabrze, Poland,
phone: +48 606 488 475,
e-mail: jabi_med@poczta.onet.pl

INTRODUCTION
Amplatzer devices (AD) were a major breakthrough in congenital heart defects transcatheter treatment (TT). Our Department celebrate the 35th anniversary this year. The first author (JB) managed the Clinic in the years from 1998 till now and prof. M Szkutnik was the head of our cathlab until 2017 (now is conducted by doc. R. Fiszer).

METHODS
We would like to present our most important scientific papers on AD application in the percutaneous closure of: 1) atrial septal defect (ASD); 2) patent ductus arteriosus (PDA), 3) postinfarction ventricular septal defect (PIVSD) and 4) vascular malformation. We took into account the number of citations according to Web of Science (c).
RESULTS AND DISCUSSION

Atrial septal defect

We performed 1847 procedures of ASD transcatheter closure at our Institute in years 1997–2021 according to guidances of PTK and AISN [1] (Figure 1). We published our preliminary data on efficacy of TT of ASD in 2004 [2]. The manuscript was recognized by the Spanish Society of Cardiology as the best publication of the year on paediatric cardiology. We proved that ASD closure with Amplatzer atrial septal occluders (ASO) is safer than surgical treatment and with fewer complications [3]. Also data on better outcome of transcatheter vs. surgical ASD closure in regards to heart rate variability (HRV) parameters were documented (Am J Cardiol 2003). The experience in closure of double ASDs with single ASO was presented, too [4]. We concluded that double ASDs which are considerably close to each other can be occluded with one device. If the distance between both defects exceeds 7 mm (the difference in radius of the device and its waist is 7 mm) the device should be slightly oversized. Small residual shunt is observed in those patients after the procedure, however, it usually disappears up to a year. This phenomenon is the result of a slow and constant expansion of the device to its primary shape or endothelialisation process (which takes approximately 6 months), or both.

Publication related to adult patients underlined very good results of ASD closure also among 150 patients >60 years old (yo) and was most frequently cited [5]. Small children is the second interesting group of patients. According to many textbooks ASD should be closed at the age of 5–6 years. In 2018 we presented our experience in successful ASD closure in 156 children < 3 yo [6].

The issue of occurrence of arrhythmias and conduction abnormalities after ASD closure was published in 2008 [7]. Tachyarrhythmia was found in 1.3% of patients up to 3 months after ASD closure (n = 9/738): 8 atrial fibrillation and 1 supraventricular tachycardia. All were successfully treated with use of antiarrhythmic drugs or cardioversion. Endothelialisation process was suspected to be the major reason of this tachyarrhythmias. Moreover, complete atrioventricular block in two children (at the age of 15 and 16 years) with considerably small defects occurred after 4.3 and 1.5 years, respectively, and both needed pacemaker implantation. This strongly underlines the necessity of constant follow-up of those patients. The delayed/incomplete process of endothelialisation (or even lack of endothelialisation) is a rare finding after ASD closure with ASO, which was documented in our 20 yo patient with meningitis and infective endocarditis which occurred two years after ASD closure [8].

Patent ductus arteriosus
We have performed over 1000 procedures of PDA transcatheter closure since 1993 till 2021, with different devices [9]. Amplatzer Duct Occluder (ADO) type II Additional Sizes (ADOIIAS) (which was designed for small children) in adult patients introduced in our team by prof. M. Szkutnik is especially noteworthy. ADOIIAS replaced coils to close small to medium PDAs in daily practice in our Clinic, because of its high effectiveness and lack of complications [10]. Our triple training travels to La Paz in Bolivia, which is situated at the level of 3600 meter over the sea level, resulted in an interesting finding that PDAs at such high altitudes are considerably large, and that the ADOI is especially useful in those patients. The next step was to compare PDAs’ characteristics between inhabitants of high-altitude (Mexico City, Guatemala City, La Paz, Bolivia) and low-altitude cities (Madrid, Spain; Zabrze, Poland). Patients from the latter two cities had lower pulmonary artery pressures and smaller PDAs diameter vs. high-altitude inhabitants, which may result from higher partial pressure of oxygen [11]. This work was completed under the patronage of Latin Pediatric Cardiology Society and carried out within this Society by the Interventional Cardiology Working Group (of which JB was the chairman in the years 2008–2012).

**Postinfarction ventricular septal defect**

PIVSD closure is a challenging problem for both percutaneous and surgical approach. In publication from 2003 we highlighted low success rate of transcatheter PVSD closure in the acute phase after infarct (up to 3 weeks) due to friability of necrotic tissues [12]. Moreover, we found ASO especially useful in such defects as it’s short waist suits well in a thin scar tissue. We are currently collecting the long-term follow-up of 23 patients survivors of this intervention. The general recommendation is to close the PIVSD in the acute phase with surgical approach (patients in the worst clinical condition), and with TT in both subacute and chronic phases. Likewise, PIVSDs after surgery and with recanalization (not so rare) are also suitable for device closure.

**Vascular malformations**

In cooperation with colleagues from National Institute of Cardiology in Mexico City we published series of 5 patients with severe cyanosis, in whom we closed large pulmonary arterio-venous fistulas with use of ADOI, with very good results [13]. In a 5- yo child after Kawashima surgery (modified Fontan palliation) and with severe desaturation we used the ASO to close a major intrahepatic venovenous malformation shunting to the atrium (over 2 cm in diameter). Both discs of the ASO device ‘stented’ the fistula and
closed it completely [14]. Our experiences in percutaneous closure of ruptured sinuses of Valsalva aneurysm (RSVA) with various devices like ADOI and ASO were described in several papers according to the extension of observation of the patients as well as to the growth of experience. The last paper (published together with colleagues from Amosov Institute in Kiev, Ukraine) summarized results of RSVA closure in 23 patients, which is one of the largest reported cohort [15]. We concluded that percutaneous closure of RSVA is safe and effective, however, recanalizations are possible (in different location), and also suitable for second percutaneous attempt.

References


Figure 1. The number of procedures of transcatheter closure of atrial septal defect per year in Silesian Center for Heart Diseases in Zabrze (Poland) in the years 1997–2021