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Assessment of cardiac arrhythmia in children after percutaneous closure of secundum atrial septal defect with the Amplatzer Septal Occluder

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Abstract

Background: *Transcatheter closure of secundum atrial septal defect (ASD II) with the Amplatzer Septal Occluder (ASO) in children is an alternative method to surgical closure. The aim of this study was to analyse arrhythmia in the early period after percutaneous closure of ASD II in children.*

Methods: *In the group of 60 children aged 4.5–18.5 years (av. 10 years) arrhythmia evaluation was performed prior to the procedure and 24 hours and 1 year afterwards. All patients underwent standard ECG and 29 of them also underwent 24-hour Holter ECG monitoring.*

Results: *Prior to closure 59 children had sinus rhythm and 1 child had a low atrial rhythm. In Holter ECG intermittent junctional rhythm was recorded in 2 children, Wenckebach block in 1 and 400 single supraventricular ectopy (SVE) also in 1 child. Twenty-four hours after the procedure arrhythmia was found in 5 patients. In four children with arrhythmia 100 to 10000 SVE was recorded and non-sustained supraventricular tachycardia (SVT) in 2 of them. In 1 child single ventricular ectopic beats coexisted. One patient developed symptomatic atrial flutter/fibrillation after 3 weeks. After 1 year ECG Holter monitoring showed that 2 patients had non-sustained SVT. None of the 4 girls with SVE immediately after the procedure had arrhythmia 1 year later. There were no changes in baseline rhythm according to the assessment made 1 year following closure.*

Conclusion: *New asymptomatic supraventricular dysrhythmias occurring at 24 hours after percutaneous ASD II closure could result from the ASO device. Serious symptomatic arrhythmia is rare in children after the procedure, but further studies are required.* (Folia Cardiol. 2006; 13: 427–431)

Key words: secundum atrial septal defect, Amplatzer Septal Occluder, arrhythmia, children

Introduction

Secundum atrial septal defect (ASD II) is one of the most common congenital heart pathologies in children. An increased pulmonary (Qp) to systemic (Qs) flow ratio of Qp:Qs ≥ 1.5–2:1 and/or the presence of right ventricle volume overload are the indications for defect closure [1–3]. Symptomatic atrial arrhythmias are well known sequelae of unclosed ASD II, mainly in adults [1, 2, 4–7].

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Open heart surgery was the method of choice for more than 45 years. The outcomes after open heart surgery are very good with a mortality rate of less than 1%, but cardiosurgical intervention could lead to a new arrhythmia, mostly as a result of the scar formation within the atrium. Atrial arrhythmia has been observed late after the operation, even when this was performed at an early age [5–7]. Garson reported sick sinus syndrome and atrial arrhythmia in 23% of children operated on [1].

In the last decade transcatheter closure of ASD II has been an alternative approach to conventional open heart surgery for children as well as for adults. After multi-centre studies, the Amplatzer Septal Occluder (ASO) has come to be considered one of the best devices for this procedure. The ASO is a self-expanding, self-centring device which has been reported as having a high 97% occlusion rate with minimal acute major complications [8–15]. Few published data exist regarding arrhythmia after percutaneous closure of ASD II with ASO in children [16–19].

The aim of this study was to analyze arrhythmia after percutaneous closure of ASD II using ASO in children during the period immediately after the procedure.

Methods

The study group consisted of 60 children aged 4.5–18.5 years (mean age 10 years) with body weights of 16–97.5 kg (mean weight 39.9 kg) in whom percutaneous closure of ASD II had been performed. Amplatzer Septal Occluder devices (AGA Medical Corp., Golden Valley, Minnesota) sizes 11––30 mm (av. 17 mm) were used to close ASD II with a stretched diameter size of 10–26 mm (av. 15 mm). All the procedures were performed under fluoroscopy and transesophageal echocardiography monitoring.

For arrhythmia evaluation all patients underwent standard 12-lead electrocardiography (ECG) (AsCard 3, Aspel) prior to the procedure and 24 hours and 1 year afterwards. In 29 patients 24-hour Holter ECG monitoring (CardioScan8, MTM multitechmed) were also performed prior to the procedure and 24 hours and 1 year afterwards. The additional evaluations were carried out in patients with symptomatic arrhythmia.

Results

Prior to ASD II closure, standard ECG revealed sinus rhythm in 59 children and a low atrial rhythm in one patient. One patient with sinus rhythm had a short episode of junctional rhythm.

In 29 children in whom 24-hour Holter ECG monitoring was performed prior to the procedure, sinus rhythm was dominant in 28 children with intermittent junctional rhythm in 2 children, while 1 child had a dominant low atrial rhythm. In 1 patient second-degree Wenckebach block was detected during hours of sleep with a maximal RR duration of 2226 ms. In one boy 400 single supraventricular ectopic beats (SVE) were recorded.

In 5 patients, primarily in 4 of them arrhythmia was found 24 hours after the procedure on standard ECG or/and 24-hour Holter ECG monitoring. On standard ECG, all 60 children had sinus rhythm and in 4 patients primarily SVE were detected. Of the 29 children in whom the Holter ECG was performed the day after ASD II closure arrhythmia was found in 4 patients. In 3 children with primarily arrhythmia 100 to 10000 SVE were recorded with non-sustained supraventricular tachycardia (SVT) in 2 of them. In 1 child with SVE 269 single ventricular ectopic beats (VE) were also detected.

In a patient with 400 SVE and episodes of junctional rhythm on Holter ECG prior to procedure the arrhythmia was aggravated 24 hours following closure and he had 630 single SVE beats and short non-sustained supraventricular tachycardia. This patient developed symptomatic atrial flutter (AFl) lasting over 24 hours and atrial fibrillation (AF) 3 weeks after the procedure. The patient was admitted to the nearest hospital, the Department of Children and Adolescents at the Non-invasive Unit of Cardiac Disease of the Śniadecki Hospital, Bialystok (Head: K. Siwicka-Szmitkowska, MD, PhD), where arrhythmia resolved spontaneously while the patient was heparinized in preparation for cardioversion. Afterwards anti-arrhythmic prophylaxis with a β-blocking agent was introduced and aspirin was replaced by acenocumarol to prevent thromboembolic complications. When subsequently evaluated up to 3000 single SVE beats were detected. At 6-month follow-up of this patient no episodes of AFl/AF had taken place.

Of 5 patients with arrhythmia observed 24 hours after the procedure there was only 1 with SVE and SVT in whom a large (28 mm) ASO had been used.

As in the pre-closure results, 3 patients displayed a para-sinus rhythm with 1 child having a dominant low atrial rhythm and the other 2 episodes of intermittent junctional rhythm. None of the patients had the second-degree Wenckebach block reported prior to the procedure.

One year after the intervention, standard ECG showed sinus rhythm in 58 patients and low atrial

rhythm in 1 child. There were no changes in baseline rhythm on Holter ECG performed 1 year after the procedure when compared to the results obtained before ASD II closure.

Analysis of the 24-hour Holter ECG monitoring performed after 1 year revealed single episodes of non-sustained SVT at a rate of about 150 beats per minute in 2 boys. One of these patients, aged 13, had a prominent Eustachian valve which was entrapped in the delivery system during procedure and a small piece was extracted without any haemodynamic consequences. However, none of the 4 patients in whom arrhythmia had been detected on standard ECG/Holter ECG the day after the procedure had SVE/VE a year later.

Atrioventricular second-degree Wenckebach block was found in 2 children during hours of sleep, with the maximal RR duration of 2335 ms and 2140 ms, in one of them for the first time.

Table 1 contains the standard ECG and 24-hour Holter ECG data of the patients discussed.

Discussion

There's a paucity of data on rhythm disturbance observations following percutaneous closure of ASD II, but according to some published reports even after a successful procedure cardiac dysrhythmias (SVE, SVT, AF) and atrioventricular heart block have been observed [16–19]. In our study group, there were no significant changes in baseline rhythm on 24-hour Holter ECG monitoring when compared with the results obtained prior to the procedure.

Analysis of standard ECG or/and Holter ECG results, performed 24 hours after the procedure, revealed the presence of supraventricular arrhythmia in 5 children. In 1 of these patients arrhythmia was detected by standard ECG, in 1 by Holter ECG monitoring and in the other 2 by both methods. These 4 patients had single SVE beats, coexisting in 2 cases with non-sustained SVT. In 1 patient with single SVE on Holter ECG monitoring prior to closure the arrhythmia had been aggravated 24 hours later with the occurrence of symptomatic AFl/AF 3 weeks after the procedure.

Hill et al. [16] found new arrhythmia and atrioventricular conduction disturbances 24 hours after procedure in 10 patients out of 41 children (24%) and adults with ASD II treated with the ASO. Six patients from their study group developed non-sustained SVT, as we observed in 2 patients. The authors also reported a wandering atrial pacemaker primarily in 3 other patients, whereas in our group no increased incidence of this arrhythmia was observed. Moreover, the authors found asymptomatic complete heart block in a 6-year-old child in whom a 24 mm ASO had been used and who subsequently underwent pacemaker implantation. The authors indicated that the large size of the device and the ASD anatomy could provoke conduction disturbances. They pointed out the lack of a sufficient posterior-inferior rim in patient with complete atrioventricular block. In our group of 60 patients no significant atrioventricular conduction disturbances were observed. Only in 1 patient was a large ASO used which might have participated in the post-closure occurrence of supraventricular arrhythmia.

Table 1. Patients' ECG/ Holter results before and after transcatheter ASD II closure using the Amplatzer septal occluder.

Patient and age (years)	Pre-closure		Post-closure — 24 h		Post-closure — 1 year	
	ECG	Holter	ECG	Holter	ECG	Holter
MA; 17.5	SR	SR, WAV	SR	SR	SR	SR/JR, WAV
MP; 18	SR	SR	SR/SVE	100 SVE, SVT	SR	SR
AK; 12	AR	AR/SR	SR	AR/SR	AR	AR/SR
KP; 15	SR	SR	SR	SR	SR	WAV
JM; 17.5	SR	SR	SR/SVE	SR	SR	SR
MK; 13	SR	SR	SR	SR	SR	SVT
MS; 10	SR	SR	SR	264 SVE, SVT	SR	SR
MŁ; 18	SR/JR	SR/JR	SR/JR	SR	SR	SR/JR, SVT
KS; 16	SR	SR	SR/SVE	10000 SVE, 269 VE	SR	SR
MS; 17	SR	SR/JR, 400 SVE	SR/SVE	630 SVE, SVT	Afl/AF*	3000 SVE**

SR — sinus rhythm, AR — atrial rhythm; JR — junctional rhythm; WAV — Wenckebach atrioventricular block; SVE — supraventricular ectopic beats; SVT — supraventricular tachycardia; VE — ventricular ectopic beats; AFl — atrial flutter; AF — atrial fibrillation; *ECG performed 3 weeks after procedure; **Holter performed 6 months after procedure

Karwot et al. [18] reported SVT a day after procedure in 1 female patient who was successfully treated with verapamil. The overall incidence of arrhythmia in their report was 2.1% and was significantly lower when compared with surgically treated patients. In our study group, the supraventricular arrhythmia was observed primarily on Holter ECG monitoring in 4 (13.7%) patients after 24 hours and in 2 (6.8%) after 1 year.

One year following ASD II closure in our study group, non-sustained SVT was detected primarily in 2 patients. In one of them, technical problems had occurred during the procedure. None of the 4 girls with supraventricular arrhythmia after closure had arrhythmia one year later.

Hessling et al. [17] evaluated 23 children at one year after percutaneous closure of ASD II with the same device and found primarily intermittent atrial rhythm in 5 patients, whereas 3 patients with intermittent atrial rhythm prior to closure had sinus rhythm one year later. The incidence of parasinus rhythm in their group was, however, comparable to findings in healthy children [20, 21].

The results of our study showed changes in the number of patients with Wenckebach block detected during the night hours. Prior to the procedure this had been detected in one child, whereas 24 hours after closure none of the patients had Wenckebach block; after 1 year it occurred in 2 patients. As the Wenckebach block was recorded only during hours of sleep it could result from increased activity of the parasympathetic system. Scott et al. [20] and Southall et al. [21] observed atrioventricular second-degree Wenckebach block in healthy children.

The data reported by us corresponds to the findings of Hill et al. [16], indicating that supraventricular arrhythmia detected at 24 hours after percutaneous closure of ASD II with the ASO could result from device implantation, since the arrhythmia disappeared during the follow-up period in the four of our patients concerned. It is not clear whether the non-sustained SVT observed after 1 year in 2 boys aged 13 and 18.5 years is also due to the ASO. It seems that this transient arrhythmia could be present in the healthy population, but further evaluation of these patients is needed. Kostis et al. [22] detected episodes of SVT in a healthy population aged from 16 to 65, but Scott et al. [20] did not find any SVT in a group of 131 boys aged from 10 to 13 years.

According to the literature and our study, serious arrhythmia is rare in children after percutaneous closure of ASD II. In our group of 60 children it was only in one male aged 16.5 years that symptomatic arrhythmia occurred in the form of AFl/AF at 3 weeks after the procedure. Kumor at al. [19] reported AF in three adults within 3 days of closure of ASD II with an ASO.

In conclusion, new asymptomatic supraventricular dysrhythmias occurring 24 hours after percutaneous ASD II closure could result from the ASO device used. Serious symptomatic arrhythmia is rare in children after the procedure, but further studies are required.

References

1. Garson A. Jr. The science and practice of pediatric cardiology. Garson A Jr, Bricker JT, Fisher DJ, Neish SR ed. Williamas & Wilkins, Baltimore 1998: 713–788; 1024–1036.
2. Hoffman P, Konka M. Implikacje kliniczne różnej lokalizacji ubytków przegrody międzyprzedsionkowej. Przegl Lek, 2002; 59: 713–718.
3. Shaheen J, Alper L, Rosenmann D et al. Effect of surgical repair of secundum type atrial septal defect on right atrial, right ventricular and left ventricular volumes in adults. Am J Cardiol, 2000; 86: 1395–1397.
4. Bink-Boelkens MThE, Bergstra A, Landsman MLJ. Functional abnormalities of conduction system in children with an atrial septal defect. Interv J Cardiol, 1988; 20: 263–272.
5. Berger F, Vogel M, Kramer A et al. Incidence of atrial flutter/fibrillation in adults with atrial septal defect before and after surgery. Ann Thorac Surg, 1999; 68: 75–78.
6. Majewska B, Różański J, Baranowski R et al. Tachyarytmie nadkomorowe u dorosłych pacjentów z ubytkiem przegrody międzyprzedsionkowej typu II przed operacją i w obserwacjach odległych. Pol Arch Med Wewn, 1999; 6: 1077–1081.
7. Karpawich PP, Antillon JR, Cappola PR et al. Pre- and postoperative electrophysiologic assessment of children with secundum atrial septal defect. Am J Cardiol, 1985; 55: 519–521.
8. Szkutnik M, Białkowski J, Gavora P et al. Przezskórne zamykanie ubytków w przegrodzie międzyprzedsionkowej metodą implantacji Amplatzer Septal Occluder — doświadczenia wstępne. Kardiol Pol, 1998; 49: 216.
9. Fischer G, Stieh J, Uebing A et al. Experience with transcatheter closure of secundum atrial septal defects using the Amplatzer septal occluder: a single center study in 236 consecutive patients. Heart, 2003; 89: 199–204.
10. Walsh KP, Maadi IM. The Amplatzer Septal Occluder. Cardiol Young, 2000; 10: 493–501.
11. Du Zhong-Dong Du, Hijazi ZM, Kleinman CS et al. Comparison between transcatheter and surgical clo-

sure of secundum atrial septal defect in children and adults, results of a multicenter nonrandomized trial. J Am Coll Cardiol, 2002; 39: 1836–1844.
12. Hijazi ZM, Cao QL, Patel HT et al. Transesophageal echocardiographic results of catheter closure of atrial septal defects in children and adults using the amplatzer device. Am J Cardiol, 2000; 1387–1390.
13. Omeish A, Hijazi ZH. Transcatheter closure of atrial septal defects in children and adults using the Amplatzer Septal Occluder. J Interven Cardiol, 2001; 14: 37–44.
14. Oho S, Ishizawa A, Akagi T et al. Transcatheter closure of atrial septal defects with the Amplatzer Septal Occluder — A Japanese Clinical Trial. Circ J, 2002; 66: 791–794.
15. Chan KC, Godman MJ, Walsh K et al. Transcatheter closure of atrial septal defect and interatrial communications with a new self expanding nitinol double disc device (Amplatzer Septal Occluder): multicenter UK experience. Heart, 1999; 82: 300–306.
16. Hill SL, Berul ChI, Patel HT et al. Early ECG Abnormalities associated with transcatheter closure of atrial septal defects using the Amplatzer Septal Occluder. J Interven Cardiac Electrophysiol, 2000; 4: 469–474.
17. Hessling G, Hyca S, Brockmeier K et al. Cardiac dysrhythmias in pediatric patients before and 1 year after transcatheter closure of atrial septal defects using the Amplatzer Septal Occluder. Pediatr Cardiol, 2003; 24: 259–262.
18. Karwot B, Białkowski J, Szkutnik M et al. Jatrogenne zaburzenia rytmu serca u dzieci po zamknięciu ubytku przegrody międzyprzedsionkowej. Metoda kardiochirurgiczna lub przezcewnikowa (korek Amplatzer). Kardiol Pol, 2005; 62: 35–43.
19. Kumor M, Baranowski R, Jakubowska E et al. Ocena zaburzeń rytmu serca i przewodzenia przedsionkowo-komorowego u pacjentów po roku od zamknięcia ubytku przegrody międzyprzedsionkowej lub drożnego otworu owalnego metodą przezskórną. Folia Cardiol, 2002; 9: 553–558.
20. Scott O, Williams GJ, Fiddler GI. Results of 24 hour ambulatory monitoring of electrocardiogram in 131 healthy boys aged 10 to 13 years. Br Heart J, 1980; 44: 304–308.
21. Southall DP, Johnston F, Shinebourne EA et al. 24-hour electrocardiographic study of heart rate and rhythm patterns in population of healthy children. Br Heart J, 1981; 45: 281–291.
22. Kostis JB, Moreyra AE, Natarajan N et al. Ambulatory electrocardiography: what is normal? Am J Cardiol, 1979; 43: 420.