Kardiologia Polska 2017; 75, 9: 868–876; DOI: 10.5603/KP.a2017.0115

ARTYKUŁ ORYGINALNY / *ORIGINAL ARTICLE*

Percutaneous left atrial appendage occlusion procedures in patients with heart failure

Magdalena Szymała, Witold Streb, Katarzyna Mitręga, Tomasz Podolecki, Grzegorz Mencel, Tomasz Kukulski, Zbigniew Kalarus

1st Department of Cardiology, Congenital Heart Diseases, and Electrotherapy, Clinical Unit of Cardiology, Silesian Centre for Heart Diseases, Medical University of Silesia, Zabrze, Poland

Abstract

Background: Atrial fibrillation (AF) is the most common supraventricular tachyarrhythmia. Percutaneous left atrial appendage occlusion (LAAO) may be considered for stroke prophylaxis in patients with nonvalvular AF (NVAF), especially in contraindications for oral anticoagulants (OAC) or high risk of bleeding. The data about implantation, safety, efficacy, and follow-up are limited. Moreover, there are no studies on patients with NVAF and heart failure with severe left ventricular systolic dysfunction (left ventricular ejection fraction [LVEF] ≤ 35%).

Aim: To assess the safety, efficacy, and mid-term outcomes of LAAO procedures with Amplatzer Cardiac Plug (ACP) and Amplatzer Amulet device in patients with NVAF and heart failure with LVEF ≤ 35% (group I) and to perform a comparative analysis of the patients who had LAAO with NVAF and LVEF > 35%.

Methods: The analysis included 80 patients (group I: 19, group II: 61) with NVAF. The patients were enrolled for the study if they had: $CHA_2DS_2VASc \geq 2$ and high risk of bleeding assessed in HAS-BLED (≥ 3) or less points in HAS-BLED but coexisting contraindications for OAC, or thromboembolic complications while using OAC. Time of follow-up was six months.

Results: In the studied population, the median CHA_2DS_2VASc score was 4 and the average HAS-BLED score was 3.2. Device implantation was successful in all patients from group I and in 59/61 patients from group II. The periprocedural clinical efficacy (no thromboembolic complications) was 100% in group I and 98.4% in group II. Serious periprocedural complications (cardiac tamponade: 2.5%, device embolisation: 1.25%, unexplained death: 1.25%) occurred only in patients from group II (p = NS). The mid-term clinical efficacy was 100% in group I and 98.3% in group II (p = NS). During follow-up, one transient ischaemic attack and three deaths not related to the procedure occurred.

Conclusions: Percutaneous LAAO is an effective and safe procedure in patients with NVAF and severe systolic heart failure. No significant periprocedural and mid-term differences, in terms of safety and efficacy, between the group with severe systolic heart failure (LVEF ≤ 35%) and the group without severe left ventricular systolic dysfunction (LVEF > 35%) were found.

Key words: heart failure, atrial fibrillation, stroke, left atrial appendage occlusion

Kardiol Pol 2017; 75, 9: 868–876

INTRODUCTION

Atrial fibrillation (AF) is the most frequent supraventricular tachyarrhythmia, occurring in 1–2% of the general population [1]. In addition, AF leads to many complications including stroke, which is the most dangerous and simultaneously constitutes one of the main causes of death in this group of patients [2]. Presently, the standard method of stroke prophylaxis in patients with AF and the indications for this treatment based on the CHA_2DS_2/CHA_2DS_2VASc score are oral anticoagulants (OAC) — the vitamin K antagonists (VKA) as well as novel oral anticoagulants (NOAC) [3]. Application of oral anticoagulants, both VKA and NOAC, constitutes a risk of many severe complications, including serious bleeding. Thus, in the group of patients with a high risk of bleeding as well as with contraindications for treatment with OAC, the procedure of left atrial appendage occlusion (LAAO) is worth considering because it is the main site of thrombus formation in the course of nonvalvular AF (NVAF) [4]. One of the risk

Address for correspondence:
Magdalena Szymała, MD, PhD, 1st Department of Cardiology, Congenital Heart Diseases, and Electrotherapy, Clinical Unit of Cardiology, Silesian Centre for Heart Diseases, Medical University of Silesia, ul. M.C. Skłodowskiej 9, 41–800 Zabrze, Poland, e-mail: kapmag@poczta.onet.pl
Received: 30.12.2016 **Accepted:** 18.04.2017 **Available as AoP:** 01.06.2017

Table 1. Inclusion criteria

• Non-valvular atrial fibrillation
• Age ≥ 18 years
• CHA_2DS_2VASc scale ≥ 2 points
• High risk of bleeding — HAS-BLED ≥ 3 points
• Less points in HAS-BLED, but coexisting contraindications for oral anticoagulants, thromboembolic complications while using oral anticoagulants
• Written, informed consent

factors of thromboembolic complications in AF is heart failure (HF) and/or impaired left ventricular ejection fraction (LVEF). In the clinical study a fourfold increase in the risk of stroke was observed in patients with AF and systolic HF when compared to the population without the dysfunction [5]. Olesen et al. [6] indicated in their study a varying impact of particular risk factors on the overall risk of thromboembolic complications. The risk of stroke assigned to HF equals 1.5%/100 patient-years in annual observation and 2.35%/100 patient-years in five-year observation [6]. Moreover, HF also increases the risk of severe bleeding events [7]. Therefore, all patients with systolic HF with LVEF ≤ 35% and AF have an indication for stroke prophylaxis. In patients with HF, particularly those with a severe impairment of left ventricular systolic function, due to a significant enlargement of heart chambers, the procedure of LAAO may be more difficult to perform and present a higher risk. So far, there are no data concerning LAAO in patients with AF, systolic HF, and severe impairment of left ventricular systolic function (LVEF ≤ 35%).

The aim of the study was to assess the efficacy and safety of LAAO procedures using the Amplatzer Cardiac Plug (ACP) and Amplatzer Amulet devices in the periprocedural observation and the mid-term follow-up in a group of patients with NVAF and systolic HF (LVEF ≤ 35%), and to perform a comparative analysis of the patients who had LAAO with NVAF and LVEF > 35%.

METHODS

Study group

The analysis covered 80 consecutive patients with NVAF, who were subjected to the procedure of percutaneous LAAO. The inclusion criteria for the study are presented in Table 1. In order to conduct the comparative analysis of the periprocedural and mid-term efficacy and safety of the procedure, the following two groups were separated from the patients included in the study:

— Group I — patients with AF and systolic HF, with a severe impairment of left ventricular systolic function (LVEF ≤ 35%) — 19 (23.75%) patients;
— Group II — patients with AF with no accompanying severe impairment of left ventricular systolic function (LVEF > 35%) — 61 (76.25%) patients.

LAAO procedures

LAAO procedures were performed with an ACP device (49 patients) and Amplatzer Amulet (31 patients). All patients before the procedure were administered anticoagulants at a loading dose (if they had not taken these drugs earlier): acetylsalicylic acid (ASA, 300 mg) and clopidogrel (300–600 mg, depending on the risk of bleeding). After the procedure they took clopidogrel (75 mg/day) for three months — until the follow-up transoesophageal echocardiography (TEE) and ASA (75 mg/day) for at least six months.

The implantation procedures were performed under general anaesthesia with TEE and fluoroscopic guidance.

A transseptal puncture was guided by TEE and left atrial pressures and performed in the middle lower part of the septum. After the transseptal puncture and introduction of the system to the left atrium, unfractionated heparin was administered at an initial dose of 1000 U/10 kg b.w. to increase the activated clotting time to at least 250 s. Following transseptal puncture, the sheath was introduced into the left atrial appendage (LAA) using a guide wire. Angiography was performed in at least two perpendicular planes. Based on angiography and TEE visualisation, the LAA anatomy was determined and the largest dimension of the LAA neck (landing zone — the place where the device is going to be implanted) was measured. The size of the device was chosen depending on the maximum measured width of the LAA neck. After preparing an ACP introduction system, the occluder at the proper size was introduced under the TEE and fluoroscopic guidance into the LAA using the sheath to enable the expansion of the device lobe perpendicularly to the LAA long axis.

The procedural success was defined as a successful implantation of the occluder in the LAA with no significant leaks around the device, assessed periprocedurally using angiography and a TEE examination.

The peridevice leaks (after the procedure and in the mid-term observation) were assessed in accordance with the classification by Ostermayer et al. [8] where a significant leak (in TEE with the colour-coded Doppler) is > 3 mm wide. The other leaks (1–3 mm — mild, < 1 mm — trace) were considered as insignificant from the perspective of potential thromboembolic complications [8].

Study plan

The clinical efficacy was defined on the basis of occurrence of thromboembolic incidents including strokes/transient ischaemic attack (TIA) in the periprocedural and mid-term follow-up.

Safety was defined on the basis of the adverse events analysis linked to the procedures assessed in the preoperative period — until the discharge from the hospital. Serious adverse events were defined as the occurrence of thromboembolic incidents including stroke/TIA, device embolisation, air embolism, major bleeding, significant pericardial effusion or cardiac tamponade, procedure-related death, and other clinically significant complications.

In the mid-term follow-up serious adverse events were defined on the basis of the following: thromboembolic incidents including stroke/TIA, major bleeding, or device embolisation. The overall mortality was also assessed in the general study population.

Mid-term follow-up time was six months. The mid-term follow-up covered 77/80 patients (96.25%). The end point of the assessment was efficacy, safety, including occurrence of thromboembolic incidents in the observation period, as well as mortality, in the study population. All patients included in the study, as well as assessing their clinical condition, had basic laboratory tests, transthoracic echocardiography, and TEE performed before the LAAO procedure. During follow-up two visits or phone calls were performed after three and six months. TEE was performed after three months of follow-up.

Statistical analysis

The continuous parameters with a normal distribution were presented as mean ± standard deviation (SD). The continuous parameters, which did not have normal distribution, were presented as median ± interquartile range (IR). The qualitative parameters were presented as the number and percentage. The t-Student test was used for the comparative analysis of the continuous variables of the obtained results with a normal distribution. The U Mann-Whitney test was applied when the distribution of the continuous variable deviated from the normal. In the case of discrete variables, the obtained results were compared with the χ^2 independent test and the exact Fisher's test if the number of the groups was small. The level of statistical significance, at which the difference was statistically significant, was accepted for $p < 0.05$.

RESULTS

In the analysed population for group I, 19 patients were included, while for group II — 61 patients. A statistically significant difference between the groups was found in the range of age, gender, echocardiographic parameters, concentration of N-terminal pro B-type natriuretic peptide, New York Heart Association class, and for some comorbidities. Moreover, the groups differed in implanted devices and the form of AF. The general characteristics of the study groups is shown in Table 2. The procedure with the use of the primarily selected size of the device was performed in 89.5% of successful cases in group I and in 90.2% in group II. In eight (10%) patients it was necessary to change the primary selected size of the device. The procedure was not remarkably different between the groups (Table 3). Successful LAA closure was obtained in all patients from group I and 96.7% of patients from group II. In one patient from group II the device could not be implanted due to anatomical conditions (additional LAA lobe precluding LAAO), and one patient required surgical intervention because a device embolism occurred. Clinical efficacy in the periprocedural observation (no thromboembolic complications) amounted to 100% in group I and 98.4% in group II (Fig. 1). Severe complications in the periprocedural period occurred in 5% of the study population and were observed only in group II. These were cardiac tamponade requiring pericardiocentesis, and device embolisation; one patient (belonging to group II) died 12 h after the procedure. The post-mortem examination did not reveal the reason for her death, but the device was not dislocated nor was there any thrombus on its surface. Moreover, less significant complications were also observed (Table 4). The six-month observation covered 96.25% of patients (77/80) — 19 from group I and 58 patients from group II. Clinical efficacy in the mid-term follow-up equalled 100% in group I and 98.3% in group II (Fig. 2). During the follow-up one thromboembolic incident occurred in a patient from group II two months after the procedure. It was TIA without permanent neurological sequelae. Follow-up TEE in this patient did not demonstrate any significant leaks, thrombus, or device dislocation. In the mid-term follow-up, three patients (two belonging to group I and one patient belonging to group II) died. Those were deaths resulting from comorbidities unrelated to the procedure. In the period of the mid-term follow-up in the study population there were no strokes, major bleedings, or device dislocations.

TEE follow-up

TEE examination in the mid-term follow-up was performed in 73/80 patients (17 patients from group I and 56 patients from group II) included in the study. No significant perideVice leak was found in the mid-term TEE. A device-related thrombus was observed in 5/73 (6.8%) patients (one patient from group I and four patients from group II; p = NS). All cases concerned the ACP device. One patient (group II) did not comply with the indications and did not use antiplatelet therapy. The rest of them were on double antiplatelet therapy. Device-related thrombus did not correlate with any adverse event at follow-up (i.e. no strokes or TIAs occurred in patients with thrombus at follow-up). The thrombus was treated with clopidogrel and OAC (three patients) or with clopidogrel and low molecular weight heparin (two patients) until control TEE (1–3 months).

DISCUSSION

Oral anticoagulants, both VKA and NOAC, as well as reducing the risk of ischaemic stroke, are also linked to the risk of major bleeding. So far, no study has been conducted on the LAAO procedures in patients with HF and LVEF ≤ 35%. Moreover, in most studies concerning the Watchman devices as well as ACP, HF with a severe left ventricular systolic dysfunction was a criterion for exclusion [9–13]. Only a few studies included information about LVEF in the study group, while in some of them a severe left ventricular systolic dysfunction was a criterion for exclusion [11, 13–15]. It seems that the procedures in this group of patients may be technically more difficult and bear more risk; however, the benefits of this type of procedure

Table 2. Baseline patient characteristics

	Study population (n = 80)	Group I (LVEF ≤ 35%) (n = 19)	Group II (LVEF > 35%) (n = 61)	p
Age, mean ± SD (range)	71.1 ± 8.9 (46–87)	67.3 ± 9.2 (46–82)	72.2 ± 8.6 (49–87)	< 0.05
Gender:				< 0.05
Male	52 (65%)	17 (89,5%)	35 (57.4%)	
Female	28 (35%)	2 (10,5 %)	26 (42.6%)	
HAS-BLED, mean ± SD (range)	3.2 ± 0.8 (2–5)	3.4 ± 0.96 (2–5)	3.2 ± 0.8 (2–5)	NS
CHA_2DS_2VASc, median ± IR (range)	4 ± 2 (2–8)	4 ± 3 (2–8)	4 ± 2 (2–6)	NS
NYHA class:				< 0.05
I	42 (52.5%)	0 (0%)	42 (68.9%)	
II	32 (40%)	13 (68.4%)	19 (31.1%)	
III	6 (7.5%)	6 (31.6%)	0 (0%)	
Echocardiographic parameters, mean ± SD (range):				
End diastolic diameter [mm]	52.9 ± 10.7 (35–87)	67.3 ± 9.2 (54–87)	48.2 ± 5.6 (35–65)	< 0.01
End systolic diameter [mm]	37.9 ± 11.9 (19–67)	55.3 ± 8.1 (40–67)	32.3 ± 6.1(19–49)	< 0.01
Left atrium diameter [mm]	46.3 ± 6.9 (33–69)	50.4 ± 7.4 (44–69)	45±6.2 (33–62)	< 0.01
LVEF [%]	46.9 ± 13.75 (13–70)	25.9 ± 6.5 (13–35)	53.4±7.3 (40–70)	< 0.01
NT-proBNP level [pg/mL], median ± IR (range)	865.2 ± 1564.2 (5–7863)	2048 ± 3312 (548.8–7863)	580 ± 1210.6 (5–3062)	< 0.01
AF paroxysmal/persistent	47 (58.75%)	7 (36.8%)	40 (65.6%)	< 0.05
AF permanent	33 (41.25%)	12 (63.2%)	21 (34.4%)	< 0.05
Implanted device:	43 (53.75%)	18 (94.7%)	25 (41%)	< 0.01
Pacemaker	24 (30%)	2 (10.5%)	22 (36.1%)	< 0.05
CRT-D	12 (15%)	10 (52.7%)	2 (3.3%)	< 0.01
ICD	7 (8.75%)	6 (31.6%)	1 (1.64%)	< 0.01
Chronic obstructive pulmonary disease	6 (7.5%)	2 (10.5%)	4 (6.5%)	NS
History of stroke/TIA	19 (23.75%)	8 (42.1%)	11 (26.5%)	< 0.05
History of bleeding	52 (65%)	11 (57.9%)	41 (67.2%)	NS
Liver dysfunction	3 (3.75%)	3 (15.8%)	0 (0%)	< 0.05
History of MI	27 (33.75%)	14 (73.6%)	13 (21.3%)	< 0.01
Coronary artery disease	57 (71.25%)	15 (78.9%)	42 (68.8%)	NS
Diabetes	30 (37.5%)	7 (36.8%)	23 (37.7%)	NS
Arterial hypertension	19 (23.75%)	8 (63.1%)	11 (85.2%)	NS

AF — atrial fibrillation; IR — interquartile range; LVEF — left ventricular ejection fraction; CRT-D — cardiac resynchronisation therapy; ICD — implantable cardioverter-defibrillator; MI — myocardial infarction; NT-proBNP — N-terminal pro B-type natriuretic peptide; NYHA — New York Heart Association; SD — standard deviation; TIA — transient ischaemic attack

Table 3. Procedure characteristics

	Study population (n = 80)	Group I (LVEF ≤ 35%) (n = 19)	Group II (LVEF > 35%) (n = 61)	p
Total procedural time [min], mean ± SD (range)	92.5 ± 24.7 (40–180)	89.5 ± 22.7 (40–135)	93.5 ± 25.4 (45–180)	NS
Fluoroscopy time [min], median ± IR (range)	10 ± 8 (3.5–73.9)	8 ± 8.4 (4–57)	10 ± 7 (3.5–73.9)	NS
Amount of contrast agent [mL], median ± IR (range)	100 ± 100 (15–300)	99.2 ± 100 (15–220)	80 ± 110 (20–300)	NS
Diameter of implanted device [mm], mean ± SD (range)	24.3 ± 3.8 (16–34)	25.2 ± 4.4 (16–34)	24 ± 3.5 (18–34)	NS

IR — interquartile range; SD — standard deviation

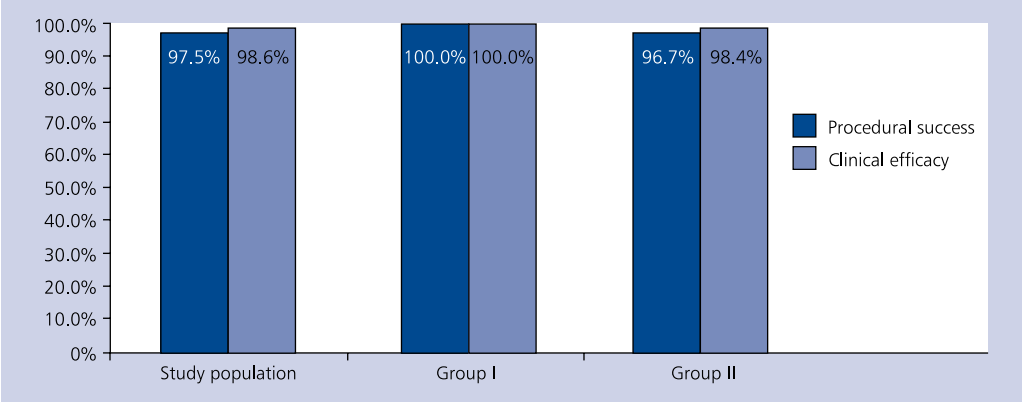

Figure 1. Procedural success and periprocedural clinical efficacy (p = NS)

Table 4. Periprocedural adverse events

	Study population (n = 80)	Group I (LVEF ≤ 35%) (n = 19)	Group II (LVEF > 35%) (n = 61)	p
Major adverse events	4 (5%)	0 (0%)	4 (6.5%)	NS
Cardiac tamponade	2 (2.5%)	0 (0%)	2 (3.3%)	NS
Device embolisation	1 (1.25%)	0 (0%)	1 (1.6%)	NS
Unexplained death	1 (1.25%)	0 (0%)	1 (1.6%)	NS
Air embolism	0 (0%)	0 (0%)	0 (0%)	–
Major bleeding	0 (0%)	0 (0%)	0 (0%)	–
Other adverse events	9 (11.25%)	3 (15.8%)	6 (9.8%)	NS
Vascular complications	1 (1.25%)	0 (0%)	1 (1.6%)	NS
Non-significant pericardial effusion	8 (10%)	3 (15.8%)	5 (8.2%)	NS
Adverse events total	13 (16.25%)	3 (15.8%)	10 (16.4%)	NS

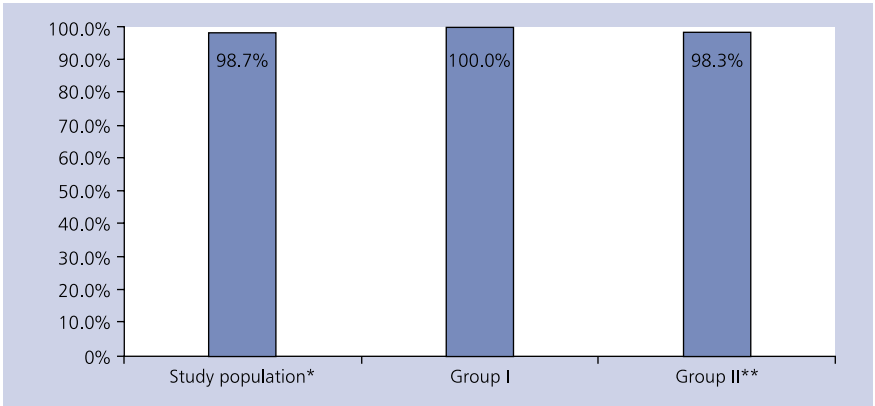

Figure 2. Clinical efficacy in mid-term follow-up (p = NS); *N = 77; **One transient ischaemic attack in group II

may be greater than in the population of patients without HF. The lack of data concerning LAAO procedures in the population of patients with HF precludes a direct comparison between the results of this study and other studies. Nowadays, there are many devices used for LAAO (Wavecrest, Occlutech, Gore, Lifetech), which are either in the clinical phase or are

being introduced to clinical practice, while such occluders as ACP, Watchman, and recently Amplatzer Amulet are used in clinical practice. The only randomised studies concerning the efficacy and safety of the LAAO compared to warfarin therapy were conducted with the use of the Watchman system [9, 11]. The data concerning the application of ACP are more limited and derive from non-randomised studies, among which the largest is the multicentre study by Tzikas et al. [16], which included 1047 patients. In those studies, high efficacy and safety of LAAO procedures were revealed. Procedural efficacy in the studies concerning the Watchman system amounted to 91–95.1% [9–12]. Procedural efficacy in the studies with ACP device was 97.3% in the multicentre study and 91.9–100% in the other smaller studies [13–22]. In turn, clinical efficacy has been comparable for Watchman and ACP devices — 95.8–100% [9–22]. In the study by Urena et al. [14], in which 15.3% of the study group was constituted by patients with LVEF ≤ 40% (the average LVEF in the study population was 60%) the clinical efficacy was 98.1%, while in the study by Plicht et al. [15], in which the average LVEF was 48.7%, no thromboembolic incidents were observed in the periprocedural period. The first reports of using Amplatzer Amulet occluders indicate a comparable clinical and procedural efficacy with ACP devices [23, 24]. In our study, procedural success was achieved in all patients in group I and in 96.7% patients in group II. The clinical efficacy in group I was higher than in group II (100% vs. 98.4%) but the differences were not significant.

In the assessment of LAAO procedures a factor as important as efficacy is procedural safety. The data concerning the type and number of periprocedural complications play a key role in the appropriate selection of patients for LAAO. So far in clinical studies relating to Watchman and ACP it has been indicated that the procedures are a safe method of stroke prevention in patients with NVAF, while the experience of the centre and increasing overall knowledge on implantation of the occluders have an impact on the number of complications. The PROTECT AF study revealed that the efficacy of the LAAO procedures was non-inferior to that of warfarin therapy (severe periprocedural complications occurred in 7.4% of patients) [9]. In subsequent studies relating to the Watchman system: Continued Access Registry (CAP) and PREVAIL, the number of serious adverse events was lower and equalled 3.7% and 2.2%, respectively [10, 11]. A similar tendency could be observed in the studies with the ACP, in which the incidence of severe periprocedural complications was 0–11.5% [13–22], while in Danna et al.'s study [13] (the average LVEF 57%) it amounted to 10.8% and in Urena et al.'s study [14] — 11.5%. In the European register — which is one of the first studies — the percentage of periprocedural complications (7.4%) was higher than in the multicentre study or other larger studies [16, 17, 19, 20]. The most common periprocedural complication relating to LAAO procedure was cardiac tamponade (1–4%), while other described complications were: device embolisation (0.6–5.4%), periprocedural stroke (0.86–2%), major bleeding (0.6–5.8%), periprocedural myocardial infarction (0.1%), and procedure-related death (0.76–0.8%) [9–22]. Furthermore, the incidence of periprocedural complications was comparable to studies with Amplatzer Amulet devices [23, 24]. In our study, in the periprocedural period, no severe complications were observed in group I. The most common complication in group II was cardiac tamponade, which occurred with a similar incidence as in the PREVAIL or a multicentre study. In one patient, the device slipped from the sheath during implantation, which required immediate surgical intervention. Comparing to Urena et al.'s study [14], which is similar to our study in terms of the risk of stroke and bleeding, in which the patients with HF participated, the incidence of severe periprocedural complications was 11.5%, and additionally a high percentage of bleeding was observed (5.8%). In Danna et al.'s study [13], in turn, the most common adverse event was device embolisation (5.4%). It should be emphasised that in our study we did not observe any major bleedings or air embolisms, described in most of the available studies concerning both Watchman and ACP devices. A significant element of the LAAO procedure analysis is also the course of the procedure itself. In most literature data, a detailed analysis of particular parameters describing the course of the procedure is missing. In the studies with the Watchman device only the mean procedural time, which amounted to 50–62 min, was given [9, 10, 12]. Among the studies with ACP, the mean procedural time in the available literature equalled in Plicht et al.'s study [15], at 68 min, while in other studies it was comparable with our results and equalled to 90–103 min [15, 20–22]. The average fluoroscopic time in our study was lower compared to the literature data, in which it equalled to 14.7-28.2 min [13, 19, 21, 22]. Comparing to the literature data [9–20], our population is a group with very high risk of thromboembolic and bleeding complications. Moreover, the patients from both groups (group I and group II) were burdened with numerous comorbidities, also with those not included in the CHA_2DS_2VASc and HAS-BLED scores. The patients with HF constituted almost 1/4 of the study population. The clinical inhomogeneity of the population participating in other studies in terms of the risk of thromboembolic and bleeding events as well as comorbidities together with the lack of literature data concerning the assessment of procedures in patients with HF forbids a direct comparison of long-term results with the results in our study. The results of the five-year follow-up in the PROTECT AF study revealed that LAAO is more effective in stroke prevention and mortality reduction than optimal therapy with warfarin [25]. The data obtained in the PROTECT AF and PREVAIL studies also indicated that most complications, including stroke in patients with AF subject to the LAAO procedure, occur in the periprocedural period [10, 11]. The

ASAP study also confirmed the long-term efficacy of Watchman device implantation in patients with contraindications for OAC (clinical efficacy — 98%) [12]. Similar are the results from ACP studies, in which the clinical efficacy was 95.4–100% [13–22]. The thromboembolic events during follow-up in ACP studies occurred in the following frequency: ischaemic stroke — 0.9–2.9%, TIA — 0.9–3%, and systemic embolisms — 0.7%. The incidence of major bleeding in turn amounted to 1.5–2.6% [13–22]. In Urena et al.'s study [14], strokes and TIA occurred in 3.8% of the patients, while in Plicht et al.'s study [15] there were no thromboembolic incidents observed in the time of follow-up. In the all studies so far a significant reduction of stroke risk has been revealed in relation to the assessed risk based on $CHADS_2$/CHA_2DS_2VASc score. In our study, in the time of the follow-up, there were no thromboembolic incidents, bleeding, device embolisation, or other adverse events in group I. The clinical efficacy in the mid-term follow-up was 100% in group I, while in group II — 98.3%. Both groups were not significantly different in terms of efficacy and number of adverse events during observation. The accepted observation period covered the period in which the risk of thromboembolic events is the highest in patients subject to the procedure. As can be concluded from previous studies, after a few months, when the device is covered with endothelium, the risk of thromboembolic complications significantly decreases. The high clinical mid-term efficacy, obtained in the study population, proves that the six-month observation already indicates the benefits of LAAO procedures in stroke prevention also in the group of patients with severe HF.

Follow-up TEE plays an important role in the assessment of LAAO procedures. The meaning of the device-related thrombus and peridevice leaks in term of potential thromboembolic complications is still being discussed. In the studies concerning the Watchman device, the incidence of device-related thrombus was similar regardless of the warfarin therapy after LAAO procedure (4.2% in the PROTECT AF study and 4% in the ASAP study) [9, 12]. The frequency of thrombus-related stroke was also similar in those studies (0.6%) [9, 12]. In the studies concerning ACP device, the frequency of thrombus (1.4–17.6%) as well as significant peridevice leak (1.49–17%) was differentiated [15, 16, 18, 20, 22]. Thromboembolic complications related to the thrombus were observed in two cases (one TIA and one peripheral embolism) [18, 22]. In the present study there was no significant peridevice leak in control TEE. The incidence of device-related thrombus was similar to the data from the studies concerning ACP device and did not correlate with any adverse event at follow-up.

The results of the present analysis, particularly concerning the patients with severe systolic HF, are comparable to the results of previous studies concerning LAAO, which mostly included patients without a significant dysfunction of LVEF. Thus, it should be concluded that it is an effective and safe method of stroke prevention also in patients with AF and severe systolic heart failure.

CONCLUSIONS

The conducted analysis indicates that the LAAO procedure in patients with NVAF, HF, and LVEF ≤ 35% is relatively safe and equally effective in stroke prevention as in patients less burdened with LVEF > 35%. The course of LAAO procedures in both groups is not significantly different. The patients with severe systolic HF benefit from LAAO in a similar way as patients without heart failure.

Conflict of interest: *Zbigniew Kalarus — participation in a company sponsored speaker's bureau: Pfizer, Boehringer-Ingelheim, Amgen, MSD, Berlin-Chemie, Abbott, travel expenses to cardiology congresses: Abbott, advisory committee: Boehringer-Ingelheim, Amgen, Astra Zeneca.*

References

1. Go AS, Hylek EM, Phillips KA, et al. Prevalence of diagnosed atrial fibrillation in adults: national implications for rhythm management and stroke prevention: the AnTicoagulation and Risk Factors in Atrial Fibrillation (ATRIA) Study. JAMA. 2001; 285(18): 2370–2375, indexed in Pubmed: 11343485.
2. Benjamin EJ, Wolf PA, D'Agostino RB, et al. Impact of atrial fibrillation on the risk of death: the Framingham Heart Study. Circulation. 1998; 98(10): 946–952, indexed in Pubmed: 9737513.
3. Kirchhof P, Benussi S, Kotecha D, et al. 2016 ESC Guidelines for the management of atrial fibrillation developed in collaboration with EACTS. Eur Heart J. 2016; 37(38): 2893–2962, doi: 10.1093/eurheartj/ehw210, indexed in Pubmed: 27567408.
4. Al-Saady NM, Obel OA, Camm AJ. Left atrial appendage: structure, function, and role in thromboembolism. Heart. 1999; 82(5): 547–554, doi: 10.1136/hrt.82.5.547, indexed in Pubmed: 10525506.
5. Wolf PA, Abbott RD, Kannel WB. Atrial fibrillation as an independent risk factor for stroke: the Framingham Study. Stroke. 1991; 22(8): 983–988, doi: 10.1161/01.STR.22.8.983, indexed in Pubmed: 1866765.
6. Olesen JB, Lip GYH, Hansen ML, et al. Validation of risk stratification schemes for predicting stroke and thromboembolism in patients with atrial fibrillation: nationwide cohort study. BMJ. 2011; 342: d124, doi: 10.1136/bmj.d124, indexed in Pubmed: 21282258.
7. Friberg L, Rosenqvist M, Lip GYH. Evaluation of risk stratification schemes for ischaemic stroke and bleeding in 182 678 patients with atrial fibrillation: the Swedish Atrial Fibrillation cohort study. Eur Heart J. 2012; 33(12): 1500–1510, doi: 10.1093/eurheartj/ehr488, indexed in Pubmed: 22246443.
8. Ostermayer SH, Reisman M, Kramer PH, et al. Percutaneous left atrial appendage transcatheter occlusion (PLAATO system) to prevent stroke in high-risk patients with non-rheumatic atrial fibrillation: results from the international multi-center feasibility trials. J Am Coll Cardiol. 2005; 46(1): 9–14, doi: 10.1016/j.jacc.2005.03.042, indexed in Pubmed: 15992628.
9. Holmes DR, Reddy VY, Turi ZG, et al. Percutaneous closure of the left atrial appendage versus warfarin therapy for prevention of stroke in patients with atrial fibrillation: a randomised non-inferiority trial. Lancet. 2009; 374(9689): 534–542, doi: 10.1016/S0140-6736(09)61343-X, indexed in Pubmed: 19683639.
10. Reddy VY, Holmes D, Doshi SK, et al. Safety of percutaneous left atrial appendage closure: results from the Watchman Left Atrial

Appendage System for Embolic Protection in Patients with AF (PROTECT AF) clinical trial and the Continued Access Registry. Circulation. 2011; 123(4): 417–424, doi: 10.1161/CIRCULATIONAHA.110.976449, indexed in Pubmed: 21242484.
11. Holmes DR, Kar S, Price MJ, et al. Prospective randomized evaluation of the Watchman Left Atrial Appendage Closure device in patients with atrial fibrillation versus long-term warfarin therapy: the PREVAIL trial. J Am Coll Cardiol. 2014; 64(1): 1–12, doi: 10.1016/j.jacc.2014.04.029, indexed in Pubmed: 24998121.
12. Reddy VY, Möbius-Winkler S, Miller MA, et al. Left atrial appendage closure with the Watchman device in patients with a contraindication for oral anticoagulation: the ASAP study (ASA Plavix Feasibility Study With Watchman Left Atrial Appendage Closure Technology). J Am Coll Cardiol. 2013; 61(25): 2551–2556, doi: 10.1016/j.jacc.2013.03.035, indexed in Pubmed: 23583249.
13. Danna P, Proietti R, Sagone A, et al. Does left atrial appendage closure with a cardiac plug system reduce the stroke risk in nonvalvular atrial fibrillation patients? A single-center case series. Pacing Clin Electrophysiol. 2013; 36(3): 347–353, doi: 10.1111/pace.12058, indexed in Pubmed: 23252940.
14. Urena M, Rodés-Cabau J, Freixa X, et al. Percutaneous left atrial appendage closure with the AMPLATZER cardiac plug device in patients with nonvalvular atrial fibrillation and contraindications to anticoagulation therapy. J Am Coll Cardiol. 2013; 62(2): 96–102, doi: 10.1016/j.jacc.2013.02.089, indexed in Pubmed: 23665098.
15. Plicht B, Konorza TFM, Kahlert P, et al. Risk factors for thrombus formation on the Amplatzer Cardiac Plug after left atrial appendage occlusion. JACC Cardiovasc Interv. 2013; 6(6): 606–613, doi: 10.1016/j.jcin.2013.02.014, indexed in Pubmed: 23787233.
16. Tzikas A, Shakir S, Gafoor S, et al. Left atrial appendage occlusion for stroke prevention in atrial fibrillation: multicentre experience with the AMPLATZER Cardiac Plug. EuroIntervention. 2016; 11(10): 1170–1179, doi: 10.4244/EIJY15M01_06, indexed in Pubmed: 25604089.
17. Park JW, Bethencourt A, Sievert H, et al. Left atrial appendage closure with Amplatzer cardiac plug in atrial fibrillation: initial European experience. Catheter Cardiovasc Interv. 2011; 77(5): 700–706, doi: 10.1002/ccd.22764, indexed in Pubmed: 20824765.
18. Nietlispach F, Gloekler S, Krause R, et al. Amplatzer left atrial appendage occlusion: single center 10-year experience. Catheter Cardiovasc Interv. 2013; 82(2): 283–289, doi: 10.1002/ccd.24872, indexed in Pubmed: 23412815.
19. Meerkin D, Butnaru A, Dratva D, et al. Early safety of the Amplatzer Cardiac Plug™ for left atrial appendage occlusion. Int J Cardiol. 2013; 168(4): 3920–3925, doi: 10.1016/j.ijcard.2013.06.062, indexed in Pubmed: 23890886.
20. Santoro G, Meucci F, Stolcova M, et al. Percutaneous left atrial appendage occlusion in patients with non-valvular atrial fibrillation: implantation and up to four years follow-up of the AMPLATZER Cardiac Plug. EuroIntervention. 2016; 11(10): 1188–1194, doi: 10.4244/EIJY14M10_13, indexed in Pubmed: 25354761.
21. Lam YY, Yip GWK, Yu CM, et al. Left atrial appendage closure with AMPLATZER cardiac plug for stroke prevention in atrial fibrillation: initial Asia-Pacific experience. Catheter Cardiovasc Interv. 2012; 79(5): 794–800, doi: 10.1002/ccd.23136, indexed in Pubmed: 21542102.
22. López-Mínguez JR, Eldoayen-Gragera J, González-Fernández R, et al. Immediate and one-year results in 35 consecutive patients after closure of left atrial appendage with the Amplatzer cardiac plug. Rev Esp Cardiol (Engl Ed). 2013; 66(2): 90–97, doi: 10.1016/j.rec.2012.04.017, indexed in Pubmed: 24775381.
23. Lam SC, Bertog S, Gafoor S, et al. Left atrial appendage closure using the Amulet device: an initial experience with the second generation amplatzer cardiac plug. Catheter Cardiovasc Interv. 2015; 85(2): 297–303, doi: 10.1002/ccd.25644, indexed in Pubmed: 25158644.
24. Gloekler S, Shakir S, Doblies J, et al. Early results of first versus second generation Amplatzer occluders for left atrial appendage closure in patients with atrial fibrillation. Clin Res Cardiol. 2015; 104(8): 656–665, doi: 10.1007/s00392-015-0828-1, indexed in Pubmed: 25736061.
25. Reddy VY, Sievert H, Halperin J, et al. Percutaneous left atrial appendage closure vs warfarin for atrial fibrillation: a randomized clinical trial. JAMA. 2014; 312(19): 1988–1998, doi: 10.1001/jama.2014.15192, indexed in Pubmed: 25399274.

Cite this article as: Szymała M, Streb W, Mitręga K, et al. Percutaneous left atrial appendage occlusion procedures in patients with heart failure. Kardiol Pol. 2017; 75(9): 868–876, doi: 10.5603/KP.a2017.0115.

Zabiegi przezskórnego zamknięcia uszka lewego przedsionka u pacjentów z niewydolnością serca

Magdalena Szymała, Witold Streb, Katarzyna Mitręga, Tomasz Podolecki, Grzegorz Mencel, Tomasz Kukulski, Zbigniew Kalarus

I Klinika Kardiologii, Wrodzonych Wad Serca i Elektroterapii, Oddział Kliniczny Kardiologii, Śląski Uniwersytet Medyczny, Śląskie Centrum Chorób Serca, Zabrze

Streszczenie

Wstęp: Migotanie przedsionków (AF) jest najczęstszą tachyarytmią nadkomorową. Standardową metodą profilaktyki powikłań zakrzepowo-zatorowych, w tym udaru mózgu u tych chorych, są doustne antykoagulanty (OAC). Alternatywną metodą profilaktyki udaru mózgu u pacjentów z niezastawkowym migotaniem przedsionków (NVAF), w szczególności u osób z przeciwwskazaniami do OAC lub wysokim ryzykiem powikłań krwotocznych, są zabiegi przezskórnego zamknięcia uszka lewego przedsionka (LAAO). Dane dotyczące skuteczności i bezpieczeństwa zabiegów LAAO oraz obserwacji długoterminowej są wciąż ograniczone. Ponadto aktualnie nie ma badań dotyczących zabiegów LAAO u osób z NVAF oraz z niewydolnością serca z ciężkim upośledzeniem funkcji skurczowej lewej komory (frakcja wyrzutowa lewej komory [LVEF] ≤ 35%).

Cel: Celem pracy była ocena skuteczności i bezpieczeństwa zabiegów LAAO z zastosowaniem okluderów Amplatzer Cardiac Plug i Amplatzer Amulet w obserwacji wczesnej oraz średnioterminowej u chorych z NVAF i towarzyszącą skurczową niewydolnością serca z LVEF ≤ 35% (grupa I) i u pacjentów z NVAF oraz LVEF > 35% (grupa II).

Metody: Do badania włączono 80 kolejnych chorych z NVAF (grupa I: 19 pacjentów; grupa II: 61 pacjentów). Kryteria włączenia do badania stanowiły: $CHA_2DS_2VASc \geq 2$ punkty oraz wysokie ryzyko powikłań krwotocznych oceniane w skali HAS-BLED (≥ 3 punkty) lub niższe ryzyko powikłań krwotocznych, ale współistniejące przeciwwskazania do OAC lub powikłania zakrzepowo-zatorowe mimo stosowania OAC. Okres obserwacji wynosił 6 miesięcy.

Wyniki: W analizowanej populacji mediana punktów w skali CHA_2DS_2VASc wynosiła 4, natomiast średnia liczba punktów w skali HAS-BLED — 3,2. Skuteczną implantację urządzenia uzyskano u wszystkich chorych z grupy I oraz u 59/61 pacjentów z grupy II. Skuteczność kliniczna w okresie okołozabiegowym (definiowana na podstawie występowania incydentów zakrzepowo-zatorowych) wynosiła 100% w grupie I oraz 98,4% w grupie II. Istotne powikłania okołozabiegowe (tamponada serca: 2,5%, embolizacja okluderem: 1,25%, zgon z niewyjaśnionej przyczyny: 1,25%) obserwowano tylko w grupie II (p = NS). Skuteczność kliniczna średnioterminowa wynosiła 100% w grupie I oraz 98,3% w grupie II (p = NS). W okresie obserwacji zanotowano 1 przejściowy incydent niedokrwienny oraz 3 zgony niezwiązane z zabiegiem.

Wnioski: Zabiegi LAAO stanowią skuteczną i bezpieczną metodę prewencji udaru mózgu u chorych z NVAF oraz ciężką skurczową niewydolnością serca. Nie zaobserwowano istotnej statystycznie różnicy pod względem skuteczności i bezpieczeństwa zabiegów LAAO w obserwacji wczesnej oraz średnioterminowej między grupą z AF i towarzyszącą niewydolnością serca z ciężkim upośledzeniem funkcji skurczowej lewej komory (LVEF ≤ 35%) a grupą z AF bez ciężkiego upośledzenia funkcji skurczowej lewej komory (LVEF > 35%).

Słowa kluczowe: niewydolność serca, migotanie przedsionków, udar mózgu, zamknięcie uszka lewego przedsionka

Kardiol Pol 2017; 75, 9: 868–876

Adres do korespondencji:
dr n. med. Magdalena Szymała, I Klinika Kardiologii, Wrodzonych Wad Serca i Elektroterapii, Oddział Kliniczny Kardiologii, Śląski Uniwersytet Medyczny, Śląskie Centrum Chorób Serca, ul. M.C. Skłodowskiej 9, 41–800 Zabrze, e-mail: kapmag@poczta.onet.pl
Praca wpłynęła: 30.12.2016 r. **Zaakceptowana do druku:** 18.04.2017 r. **Data publikacji AoP:** 01.06.2017 r.