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Transseptal Puncture and Cryoballoon Ablation of Atrial Fibrillation in Patients with Atrial Septal Occluder or Atrial Septal Defect Surgical Repair: A Single Center Experience

ABSTRACT

Background: Atrial fibrillation (AF) is a common arrhythmia in patients with atrial septal defect (ASD). Cryoballoon ablation (CA) is a safe and efficient method for pulmonary vein (PV) isolation in the treatment of AF. Achieving left atrial access may be difficult in patients with atrial septal occluders (ASO) or surgical repair of ASD. The aim of this study was to present our experience with the efficacy and safety of transseptal puncture and AF ablation in CA in this subset of patients.

Methods: We retrieved our data about patients with ASO or surgical repair of ASD undergoing cryoballoon AF ablation procedures at our center between August 2019 and January 2022.

Results: Nine patients (age 43.88 ± 9.73 years) with AF (5 paroxysmal and 4 persistent) and ASO or surgical repair of ASD were enrolled. All three patients had a 28 mm Amplatzer ASO device which occupied the whole septum, and direct puncture through the ASO was performed. Sequential balloon dilatation was performed in 2 patients with surgical ASD repair and all 3 patients with ASO. Four of 6 patients (66.7%) in the surgical repair group required transesophageal echocardiography during transseptal puncture. The endpoint of the procedure, isolation of all PVs, was achieved in all 9 patients. None of the patients had evidence of an interatrial shunt or pericardial effusion at the end of the procedure. Total procedural time (123 ± 28 minutes vs. 63 ± 21 minutes, $P = .024$) and total fluoroscopy time (41 ± 5 minutes vs. 23 ± 8 minutes, $P = .024$) were significantly higher in the percutaneous closure group.

Conclusions: In patients with ASO or surgical repair of ASD, CA of AF might be feasible, safe, and effective. The balloon dilatation of the interatrial septum (IAS) might assist transseptal access through the ASO or a surgically repaired thickened IAS.

Keywords: Atrial fibrillation, atrial septal defect, cryoballoon ablation

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INTRODUCTION

Atrial fibrillation (AF) is one of the common arrhythmias in congenital atrial septal defect (ASD) patients, and the risk of developing AF is higher than in the general population even after surgical repair or percutaneous closure.[1] Catheter ablation is an effective treatment for AF, and pulmonary vein (PV) isolation is considered the cornerstone of all AF ablation strategies.[2] Cryoballoon ablation (CA) has emerged as an encouraging alternative to radiofrequency (RF) catheter ablation and is equally effective for PV isolation in patients with paroxysmal and persistent AF.[2,3]

In patients with atrial septal occluders (ASO) or surgical repair of ASD, especially in those with drug-refractory and symptomatic AF, catheter ablation is indicated. Access to the left atrium (LA) through the interatrial septum (IAS), namely transseptal puncture (TSP), is a critical step for CA of AF. The obliteration of the fossa ovalis by surgical patches or percutaneous closure devices presents a unique challenge to the operator performing TSP for LA instrumentation.[4] Catheter ablation

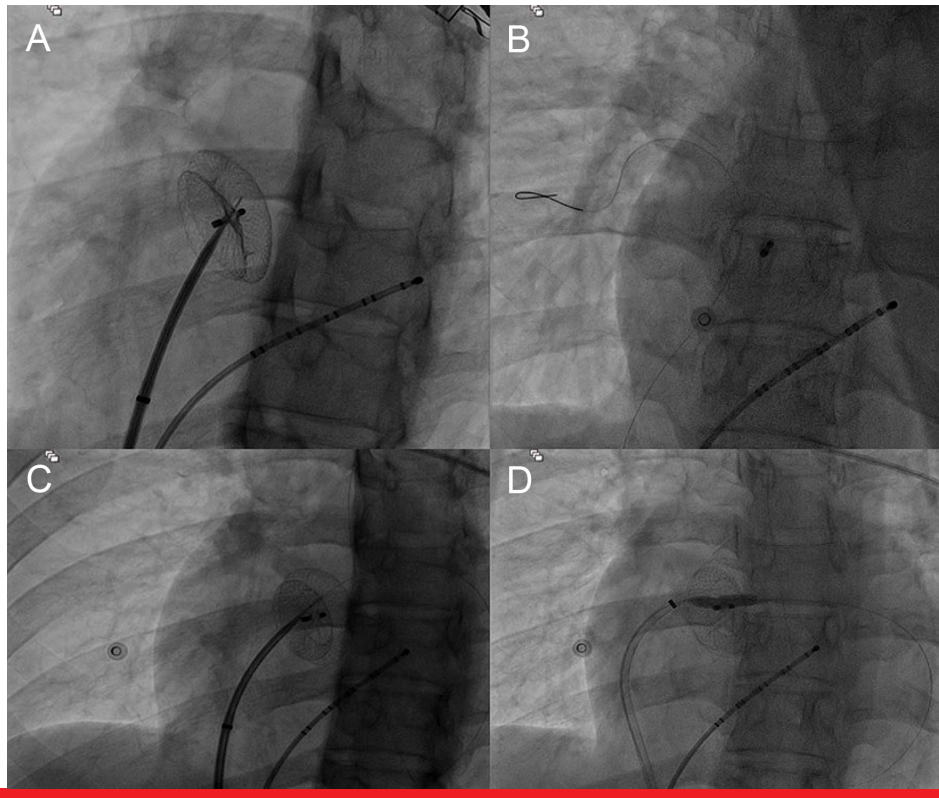

Figure 1. (A) Puncture of the Amplatzer Septal Occluder through Brockenbrough needle (Medtronic, Minneapolis, Minnesota) in a left anterior oblique (LAO) projection. (B) Passage of the coronary 0.014-inch guidewire to the right superior pulmonary vein in a right anterior oblique (RAO) projection. (C) ASO balloon dilatation with 1.5*15 mm coronary CTO balloon in a left anterior oblique (LAO) projection. (D) ASO balloon dilatation with a 5*20 mm coronary balloon in a left anterior oblique (LAO) projection.

is usually is avoided or delayed in patients with ASD closure devices due to the higher perceived risks and difficulty of performing TSP.[5]

In this study, we reported our experience with CA of symptomatic AF in patients with ASO or surgical repair of ASD. To our knowledge, this is the first study to perform CA on this subset of patients.

METHODS

Study Population

This is a single-center, retrospective, and observational study. We retrieved our data on drug-refractory AF patients with ASO or surgical repair of ASD undergoing cryoballoon AF ablation procedure at our center between August 2019 and January 2022. Patients who underwent transcatheter implantation of ASO constituted the percutaneous occluder group. Patients who underwent surgical repair of ASD constituted the surgical repair group. Exclusion criteria included: (1) percutaneous ASD closure or surgical repair of ASD performed within 6 months; (2) LA anterior-posterior diameter >55 mm; (3) New York Heart Association cardiac function III or IV; (4) serum creatinine level of >1,5 mg/dL; (5) presence of any atrial tachycardia or atrial flutter on electrocardiogram (ECG); (6) left atrial thrombus. Transesophageal echocardiography (TEE) examination was performed the same day as the ablation procedure in order to exclude the presence of left atrial or appendage thrombus and define the IAS anatomy. All interventions were performed with uninterrupted oral anticoagulation. Vitamin K antagonist was continued with a target international normalized ratio (INR) between 2.0 and 2.5 without bridging therapy. The study protocol was approved by the local Ethics Committee. Written informed consent was obtained from all patients. Artificial intelligence and assisted technologies were not used in our study.

Transseptal Puncture Through the Surgically Repaired Septum

All ablation procedures were done under conscious sedation. Intravenous midazolam up to 5 mg and pethidine HCL up to 100 mg were used for sedation. A steerable decapolar catheter was positioned within the coronary sinus (CS) through the right femoral vein. A bolus of unfractionated

HIGHLIGHTS

- Achieving left atrial access may be difficult in patients with ASO or surgical repair of ASD.
- The balloon dilatation of the IAS is usually needed for transseptal access through the ASO or a surgically repaired thickened septum.
- This is the first study to perform CA in patients with ASO or surgical repair of ASD.

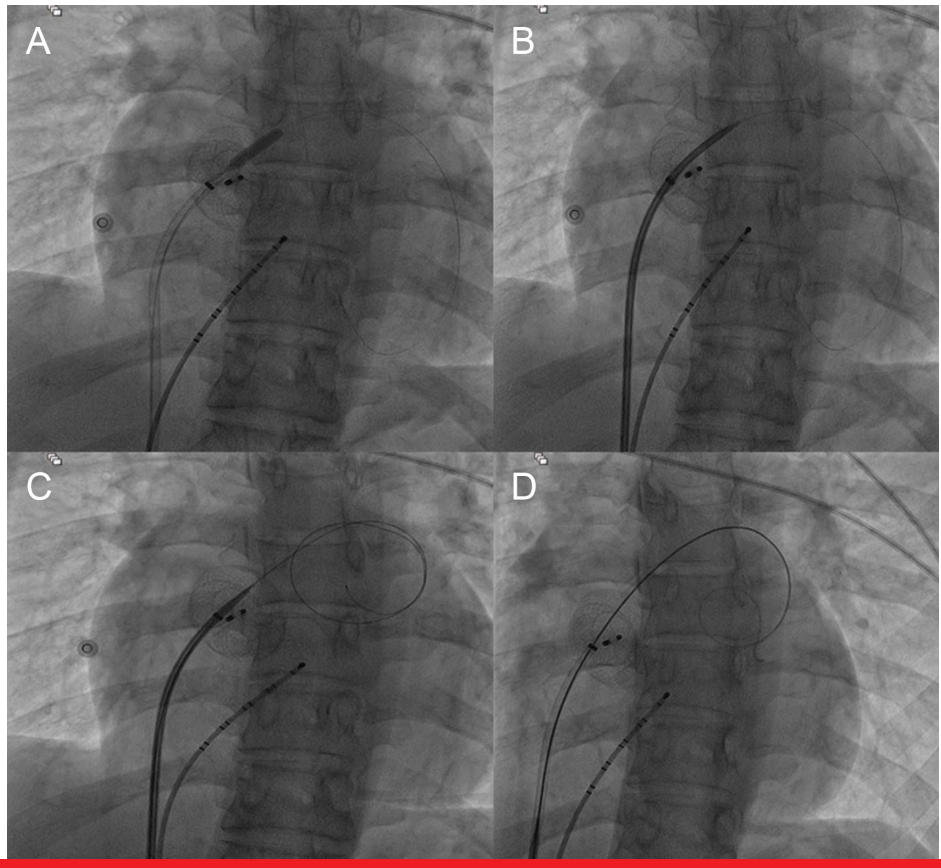

Figure 2. (E) ASO balloon dilatation with a 5*20 mm coronary balloon in a left anterior oblique (LAO) projection. (F) Advancement of the dilator of transeptal sheath (HeartSpan, Merit Medical Systems Inc.) to the left atrium through the ASO device in a left anterior oblique (LAO) projection. (G) Exchange of the 0.014-inch guidewire with a manually shaped Amplatz Super Stiff (Boston Scientific Corporation, Boston, MA) 0.035-inch 260 cm guide wire (H) Retrieval of the dilator of transeptal sheath.

heparin (5.000 U) was administered prior to TSP. Intermittent heparin boluses were given to maintain an activated clotting time >300 after the transseptal access. Left atrium access was obtained with a single TSP guided by fluoroscopy and TEE if needed. An 8.5 Fr transseptal sheath and a dilator (HeartSpan, Merit Medical Systems Inc.) were advanced over a 0.032-inch guidewire to the superior vena cava (SVC). Then the guidewire was removed, and a Brockenbrough transseptal needle (Medtronic, Minneapolis, Minnesota) was introduced into the dilator and advanced to just proximal to the sheath tip. On the fluoroscopic left anterior oblique (LAO) view, the entire apparatus comprised of the sheath, dilator, and transseptal needle was oriented towards the IAS and withdrawn down the SVC and IAS smoothly until the dilator tip "jump" was observed. Then, the position and orientation of the Brockenbrough transseptal needle tip was checked on the right anterior oblique (RAO) view. When needed, on the RAO 45° view, the transseptal assembly was slightly rotated clockwise to the posterior of the device or counterclockwise to the anterior. Then the needle was gently advanced to the septum. When the needle tip crossed the IAS, a small amount of contrast material was injected to confirm that the needle was in the LA. The dilator was advanced over the needle into the LA. In some patients, due to the surgical repair of ASD, engagement of the fossa ovalis could not be assessed by the fluoroscopic visualization of a "jump" to the septum, and TEE monitoring was needed to assess the optimal site of the TSP. The dilator was advanced over the needle into the LA after injecting a small amount of contrast material. If the dilator could not be advanced to the LA, sequential balloon dilation was applied. A 0.014-inch coronary guidewire was advanced through the needle into the LA and placed in the left superior PV. The needle was then withdrawn, and sequential balloon dilatations were performed using 1.5-10.0-mm non-compliant balloons to ease sheath manipulation. Finally, the transseptal sheath was advanced into the LA.

Transeptal Puncture Through the Occluder Device

Left atrium access through the device was performed with balloon dilatation technique. Transseptal puncture was performed under fluoroscopy guidance after the whole system was gradually withdrawn to the lower part of the left disc of the ASO from the SVC on LAO view. Then a 0.014-inch coronary guidewire was advanced through the needle into the LA and placed in the left superior PV, and sequential balloon dilation technique was applied as described. Figures 1,2 and 3 summarize the sequential balloon dilatation of TSP in patients with ASO during CA of AF.

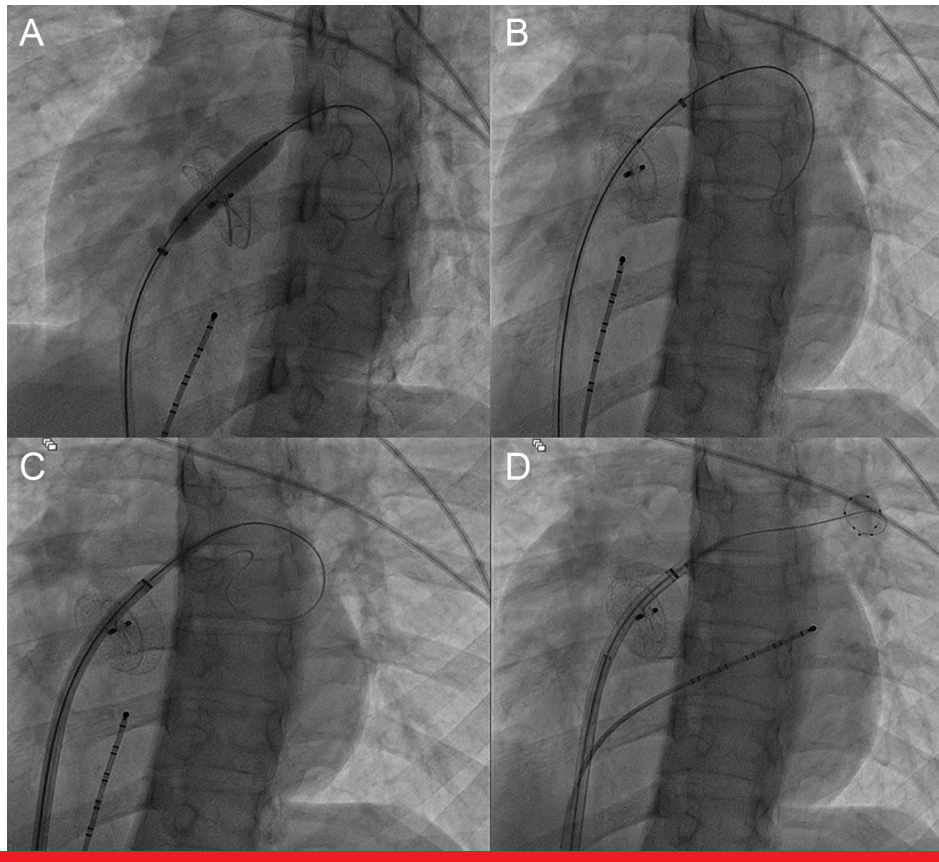

Figure 3. (I) Dilatation of the ASO device with a 10*40 mm PTA balloon (Admiral Xtreme, Medtronic Inc.). (J) Advancement of the transeptal sheath to the left atrium over the PTA balloon in a left anterior oblique (LAO) projection. (K) Advancement of the 12-F steerable sheath (FlexCath Advance, Medtronic Inc.) to the left atrium in a left anterior oblique (LAO) projection. (L) Lumen mapping catheter (Achieve, Medtronic Inc.) is in the left superior pulmonary vein, and second-generation 28-mm cryoballoon (Arctic Front Advance; Medtronic Inc.) is in the left atrium in a left anterior oblique (LAO) projection.

Cryoballoon Ablation

After the TSP, the transeptal sheath in the LA was replaced with a steerable 15F sheath (FlexCath Advance, Medtronic Inc., Minneapolis, MN, USA). All patients underwent PV isolation using a 28-mm cryoballoon (Arctic Front Advance; Medtronic Inc.). The balloon was introduced into the PV ostium over the Achieve catheter (Medtronic Inc.). The balloon was inflated and positioned at the PV ostium. A contrast agent was injected to the distal site of the balloon in order to visualize PV occlusion. A single freezing period of 180 seconds was applied for each PV isolated in less than 60 seconds. Extra cryoballoon applications were applied when PV was not isolated. If the balloon nadir temperature exceeded –55°C, CA would be terminated. During CA of the right-sided PVs, high-output right phrenic nerve stimulation was performed using a decapolar CS catheter within the SVC. When loss of pacing capture occurred, the cryoapplication was immediately terminated. After the procedure, exit and entrance block of all PVs were confirmed by pacing maneuvers. If the patients were not in sinus rhythm after CA, cardioversion was performed.

Follow Up

After CA, patients were monitored in the hospital for at least 1 day and assessed for procedural complications. The first 2 months were set as the blanking period. Anticoagulation and antiarrhythmic drug therapy (ADT) were continued for at least two months. After 2 months, anticoagulation was continued according to the stroke risk determined by CHA_2DS_2 -VASc (Congestive heart failure, Hypertension, Age ≥75 years, Diabetes mellitus, prior Stroke or transient ischemic attack, Vascular disease, Age 65-74 years, Sex category) score and the presence of a prosthetic valve, while ADT was continued in patients who developed atrial arrhythmia. Recurrence was defined as any episode of AF or atrial tachycardia lasting for at least 30 seconds after the blanking period. Transthoracic echocardiography (TTE) was performed on the day after the ablation procedure and 2 months after the procedure to detect residual interatrial shunt, device deformation, or pericardial effusion.

Patients were recalled for outpatient clinical visits including physical examination, 12-lead ECG, TTE, and 24-hours ECG monitoring at 1, 2, 6, and 12 months following the procedure and every year thereafter.

Statistical Analysis

All statistical analyses were performed with SPSS 22 (SPSS, Chicago, IL, USA) for Windows Evaluation Version statistical package. The normality distribution was evaluated using

the Kolmogorov-Smirnov test. Continuous variables are presented as the mean ± standard deviation. Categorical variables were summarized as frequencies. Continuous data were compared using the Mann–Whitney U-test. Categorical variables were compared by the chi-square or Fisher's exact test. The Kaplan–Meier analysis was conducted to assess freedom from AF during follow-up. A *P* level of <.05 was accepted as statistically significant with a 95% confidence interval and 5% margin of error.

RESULTS

Clinical Characteristics

Nine patients (age 43.88 ± 9.73 years, 5 female) with drug refractory symptomatic AF and ASO or surgical repair of ASD with pericardium were enrolled. Patients with ASO were defined as percutaneous closure group (3 patients, age 42.67 ± 14.84), and patients who underwent surgical repair of ASD were defined as surgical repair group (6 patients, age 44.50 ± 9.0). Ostium secundum ASD was the indication for percutaneous device closure in patients with ASO. Only one of the 6 patients in the surgical repair group had a prosthetic mitral valve implantation in addition to the IAS repair. The mean LA diameter was 42.89 ± 4.68 mm, the left ventricular ejection fraction (LVEF) was 57% ± 11%, and the mean body mass index was 26.17 ± 4.37 kg/m^2. Atrial septal defect repair or device implantation was performed an average of 5.8 years ago (range 2-10 years). Eight patients were on novel oral anticoagulant therapy, while one patient with a prosthetic mitral valve was on warfarin therapy. Cryoballoon ablation was performed in 5 patients with paroxysmal AF and 4 patients with persistent AF. The baseline clinical characteristics of the study population are summarized in Table 1.

Transseptal Access and Procedural Data

The success rate of TSP was 100%. Three patients had a 28 mm Amplatzer (Abbott, Plymouth, Minnesota) ASO device, which occupied the whole septum, and direct puncture through the ASO was performed with sequential balloon dilatation. Sequential balloon dilatation was performed in 2 patients (33.3%) in the surgical repair group and all of 3 patients in percutaneous closure group. Four of 6 patients (66.7%) in the surgical repair group required TEE during TSP. Transesophageal echocardiography was not required for any of the percutaneous closure group because the IAS anatomy and closure device were clearly seen on fluoroscopy. All patients underwent PV isolation using a 28-mm cryoballoon. The endpoint of the procedure, isolation of all PVs, was achieved in all 9 patients. None of the patients had evidence of an interatrial shunt or pericardial effusion at the end of the procedure with TTE. Total procedural time (123 ± 28 minutes vs. 63 ± 21 minutes, *P* = .024) and total fluoroscopy time

Table 1. Baseline Clinical Characteristics and Laboratory Findings

Variables	All Patients (n = 9)	Percutaneous Closure Group (n = 3)	Surgical Repair Group (n = 6)	*P* Value
Baseline characteristics				
Age (years), mean (SD)	43.88 ± 9.73	42.67 ± 14.84	44.50 ± 9.00	.714
Gender (female), n (%)	5 (55.6%)	2 (66.7%)	3 (50%)	.714
Diabetes mellitus, n (%)	3 (33.3%)	1 (33.3%)	2 (33.3%)	1.0
Hypertension, n (%)	4 (44.4%)	1 (33.3%)	3 (50%)	.714
Body mass index (kg/m^2)	26.17 ± 4.37	22.12 ± 2.73	28.20 ± 4.09	.095
AF type (paroxysmal), n (%)	5 (55.6%)	1 (33.3%)	4 (66.7%)	.548
Left ventricular ejection fraction (%)	56.67 ± 10.54	51.67 ± 18.92	59.17 ± 5.84	.905
Left atrial diameter (mm), mean (SD)	42.89 ± 4.68	42.67 ± 7.57	43.0 ± 4.04	.905
CHADVASC Score, mean (SD)	1.56 ± 1.50	1.67 ± 2.08	1.50 ± 1.51	1.0
HASBLED score, mean (SD)	0.44 ± 0.50	0.33 ± 0.57	0.50 ± 0.54	.714
Laboratory findings				
Creatinine (mg/dL; SD)	0.86 ± 0.12	0.81 ± 0.15	0.89 ± 0.12	.381
WBC (×10^3/μL; SD)	7.67 ± 1.33	8.19 ± 0.27	7.40 ± 1.55	.548
Neutrophil (×10^3/μL; SD)	4.41 ± 1.02	4.30 ± 0.34	4.46 ± 1.35	.714
Lymphocyte (×10^3/μL; SD)	2.39 ± 0.61	2.93 ± 0.66	2.12 ± 0.48	.167
Hemoglobin (g/dL; SD)	14.38 ± 1.32	14.43 ± 0.94	14.35 ± 1.66	.905
Platelets (×10^3/μL; SD)	257.11 ± 44.54	287.67 ± 44.45	241.83 ± 40.05	.262
ALT(U/L)	22.37 ± 6.83	20.0 ± 2.64	23.55 ± 8.72	.548
AST (U/L)	19.11 ± 5.97	18.67 ± 10.01	19.33 ± 4.88	.714
Medications				
NOAC, n (%)	8 (88.9%)	3 (100%)	5 (83.3%)	.714
Warfarin, n (%)	1 (11.1%)	0 (0%)	1 (16.7%)	1.0

*Mann–Whitney U-test, Chi-square Test, Fisher's Exact Test. *P* < .05 statistically significant. Continuous variables are reported (mean ± SD). Categorical variables are reported n (%).
AF, Atrial fibrillation; ALT, alanine transaminase; AST, aspartate transaminase; NOAC, novel oral anticoagulants; WBC, white blood cell.

Table 2. Procedural Data Comparison of the Groups

Variables	Percutaneous Closure Group (n = 3)	Surgical Repair Group (n = 6)	*P* Value
TEE during TP, n (%)	0 (0%)	4 (66.7%)	.167
Balloon dilatation during TP, n (%)	3 (100%)	2 (33.3%)	.167
Time since ASD intervention (years), mean (SD)	5.0 ± 2.00	6.16 ± 3.18	.548
Total procedural time (minutes), mean (SD)	123.33 ± 27.53	63.0 ± 20.65	**.024**
Total fluoroscopy time (minutes), mean (SD)	40.67 ± 5.13	23.33 ± 7.52	**.024**

*Mann–Whitney U-test, Chi-square test, Fisher's Exact test. *P* < .05 statistically significant. Continuous variables are reported (mean ± SD). Categorical variables are reported as n (%).
ASD, Atrial septal defect; TEE, Transesophageal echocardiography; TP, Transseptal punction.

(41 ± 5 minutes vs. 23 ± 8 minutes, *P* = .024) were significantly higher in the percutaneous closure group. Comparison of the procedural data is summarized in Table 2.

Follow Up

After a mean follow-up of 29 ± 14 months, sinus rhythm was maintained in 6 patients (66.7%). During the blanking period, two patients presented with AF and sinus rhythm was restored with DC cardioversion. Anti-arrhythmic drugs (AAD) was restarted in 3 patients with recurrence of AF/atrial tachycardia after the blanking period. Improvement in LVEF was seen in 2 patients with persistent AF. During follow-up, no procedure-related complications were observed and no residual interatrial shunt, device deformation or pericardial effusion was detected on TTE. Procedural data and clinical outcomes are summarized in Tables 3A and B.

DISCUSSION

Main Findings

To our knowledge, this is the first study to report on CA in patients with ASO or surgical repair of ASD. The major findings of the present study are as follows: (1) CA of AF in patients with ASO or surgical repair of ASD is feasible, safe, and effective. (2) For AF patients with ASO, TSP can be achieved through the occluder if the disc diameter is prohibitive for transseptal passage through the native IAS. (3) The manipulation of the sheath and cryoballoon is challenging.

Sequential balloon dilation may help facilitate TSP and manipulation of the sheath and cryoballoon, especially in ASO patients. (4) The total procedure and fluoroscopy times might be longer in such patients.

Atrial Fibrillation in Patients with Atrial Septal Occluder or Atrial Septal Defect Surgical Repair

Atrial septal defect is one of the common forms of congenital heart disease. Atrial fibrillation risk is significantly increased in patients with ASD. In unoperated adults, the estimated incidence of AF is approximately 10% under the age of 40 years, rising to at least 20% with increased age, pulmonary arterial pressure, and systemic hypertension.[6] Atrial fibrillation risk is higher than that in the normal population even after surgical repair or percutaneous closure.[1] Catheter ablation has been recommended for drug-refractory AF patients. Some studies on AF treatment in patients with ASD focused mainly on surgical treatment with the maze procedure at the time of ASD closure.[7,8] Evertz et al[9] reported a concomitant PV isolation and percutaneous closure of ASD with 5 patients. Matsutani et al[10] reported a thoracoscopic ablation of PVs after percutaneous ASD closure. Garg et al[11] reported in a recent meta-analysis that catheter ablation for AF is feasible and safe with favorable long-term outcomes in patients who have previously undergone a percutaneous ASD closure. Our data shows that CA is feasible in patients with ASO or surgical repair of ASD.

Transesophageal Echocardiography During the Transseptal Puncture

In patients with ASO or surgical repair of ASD, the decision regarding where to puncture can be made based on the TEE performed prior to the procedure. If there is adequate space around the device, TSP on the IAS could be possible; otherwise, direct access through the device is necessary. It is not difficult to locate the TSP site on the ASO device using fluoroscopy. However, in patients with surgical repair of ASD, it could be challenging due to displacement of normal anatomical landmarks. The usual fluoroscopic "jump" may not be observed.

The TEE monitoring might be crucial to assess the optimal site for the TSP and to monitor the advancement of the dilator and sheath in the LA. Additionally, TEE would help to prevent potential complications in these patients, including perforation of the RA posterior wall and aortic root. In our

Table 3A. Procedural Data and Clinical Outcomes of Patients with Atrial Septal Occluder

No	Sex	Age	AF Type	Occluder Type	LAD (mm)	Preoperative LVEF (%)	AF Recurrence in 2 Months	AF Recurrence in 6 Months	AF Recurrence in 1 Year	LVEF at 1st Year (%)
1	M	30	PERS	Amplatzer 28 mm	34	65	+	-	-	65
2	F	59	PERS	Amplatzer 28 mm	48	30	-	-	+	**50**
3	F	39	PAF	Amplatzer 28 mm	46	60	-	-	-	60

AF, Atrial fibrillation; M, Male; F, Female; LAD, Left atrial diameter; LVEF, Left ventricular ejection fraction; PAF, Paroxysmal atrial fibrillation; PERS, Persistent atrial fibrillation.

Table 3B. Procedural Data and Clinical Outcomes of Patients with Surgical Repair of Atrial Septal Defect

No	Sex	Age	AF Type	TEE During TSP	Baloon Dilatation During TSP	LAD (mm)	Preoperative LVEF (%)	AF Recurrence in 2 Months	AF Recurrence in 6 Months	AF Recurrence in 1 Year	LVEF at 1st Year (%)
1	F	48	PAF	-	-	40	65	-	-	-	65
2	M	42	PAF	+	+	39	65	-	-	-	65
3	M	31	PERS	+	-	50	50	-	**+**	-	**60**
4	F	51	PERS	+	+	43	60	**+**	-	**+**	60
5	F	39	PAF	-	-	41	55	-	-	-	55
6	M	56	PAF	+	-	45	60	-	-	-	60

AF, Atrial fibrillation; M, Male; F, Female; LAD, Left atrial diameter; LVEF, Left ventricular ejection fraction; PAF, Paroxysmal atrial fibrillation; PERS, Persistent atrial fibrillation; TEE, Transesophageal echocardiography; TSP, Transseptal puncture.

study, TEE was necessary for TSP in 66.7% of patients with surgical repair of ASD. Transesophageal echocardiography was not required for TSP in all 3 patients with ASO.

Transseptal Puncture and Sequential Balloon Dilatation

The major obstacle of AF catheter ablation in patients with ASO or surgical repair of ASD is the technical difficulty in TSP and catheter manipulations. Different transseptal access techniques have been reported in these patients.[1,4,5,12,13] In patients with large-sized devices, TSP could be safely performed directly via the ASO because of the insufficient rims of the native septum for safe transseptal access.[12] In the present study, TSP was performed directly through the device since the device diameter was 28 mm in all patients with ASO. Balloon dilatation was necessary in all of these patients. As a result, the total procedure and total fluoroscopy times were longer. Previous studies have shown that the procedure and fluoroscopy times are similarly prolonged.[1,12] Saluveer et al[14] reported that in a case of AF ablation in which TSP was performed through the ASO without sequential balloon dilatation, the patient was taken to emergency open-heart surgery due to the mapping catheter getting stuck in the device. The sequential balloon dilatation, which has been shown in the literature to avoid such complications and facilitate catheter and sheath manipulations, should be used in TSP to be performed through the ASO device or the thickened septum after surgical repair.[12,13]

Cryoballoon Ablation in Patients with Atrial Septal Occluder or Atrial Septal Defect Surgical Repair

To our knowledge, this is the first published data on the feasibility and safety of AF CA in patients with ASO or surgical repair of ASD. In previous studies, Santangeli et al reported on the technical feasibility of direct access through the ASO device using an upsized dilator for AF RF catheter ablation under intracardiac echocardiography (ICE) guidance.[5] In another study, LA access was achieved by dilating the puncture site on the ASO device using a dilation balloon. Guo et al[12] reported on the feasibility and safety of TSP with a sequential technique during AF RF ablation procedures in patients with ASO.[12] Lakkireddy et al[4] reported that ICE-guided RF catheter ablation of AF using double transseptal access is feasible, safe, and efficacious in patients with an ASO device or surgical ASD repair.[4] In two different studies, if the septum was suitable for passage, TSP was performed outside the device, while in cases where the ASO was wider, TSP was performed through the device and RF catheter AF ablation was performed.[1,15]

Current AF guidelines state that PV isolation is the cornerstone of AF ablation, while non-PV ablations are not routinely recommended.[16-18] Similar efficacy of ablation with RF energy or CA in both paroxysmal and persistent AF has been demonstrated in many clinical studies and meta-analyses.[19-24] Since no arrhythmias other than AF (such as atrial tachycardia and atrial flutter) were detected in the preprocedural ECG and rhythm Holter results of the patients, CA was preferred for PV isolation.

In our clinical practice, we performed PV isolation with cryoballoons as the first procedure in patients with AF, as recommended by Andrade et al[25] in a recent review. As mentioned in a recent review by Nesapiragasan et al,[26] we performed RF AF ablation in recurrent cases, and if PVs were isolated, we performed patient-specific ablation of non-PV foci.

The main difference that distinguishes our study from the RF catheter ablation studies mentioned above is that CA was performed. In the RF catheter ablation of AF, LA access is commonly achieved with a double TSP to insert both an ablation and a circular mapping catheter. Only a single TSP is required in the CA procedure. It should be beneficial to use a single catheter because it involves less risk compared with double puncture, less squeezing of the device, and lower radiation exposure. On the other hand, the diameter of the steerable sheath used for CA (FlexCath Advance) is larger. Additionally, since the sheath diameter is larger in the CA procedures, sequential balloon dilation may facilitate manipulation of the sheath and cryoballoon in patients with ASO or surgical repair of ASD.

Study Limitations

First, this is a retrospective observational study with a small sample in a single center, and no direct comparison was made to a control group with native IAS. However, larger CA series might be difficult for ASO and surgically repaired patients. Second, while acknowledging that ICE is useful in AF ablation for assessment of the optimal puncture site and rapid detection of potential complications, we did not use it in this study. Third, follow-up of the patients was carried out with symptom and rhythm Holter monitoring instead of a loop recorder which may account for underdiagnosis of atrial arrhythmias. Finally, TTE was used instead of TEE to exclude residual shunt after CA, which may lead to an underdiagnosis

of the residual shunt. However, as no deterioration in right ventricular function and/or symptoms of right heart failure were observed during the clinical follow-up, further investigations were not required.

CONCLUSION

In patients with ASO or surgical repair of ASD, CA of AF might be feasible, safe, and effective. The balloon dilatation of the interatrial septum (IAS) might assist transseptal access through the ASO or a surgically repaired thickened IAS. To our knowledge, this is the first study to perform CA in patients with ASO or surgical repair of ASD.

Ethics Committee Approval: The study protocol was approved by the İstanbul Medipol University Ethics Committee (no: E-1084009-772.02-4568, date: 12/08/2022).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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