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Transcatheter Closure of Atrial Septal Defect: One Center Experience and Mid-Term Follow-Up

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ABSTRACT

Objectives: The aim of this study is to present our center's experience with device closure of atrial septal defects.
Introduction: Atrial septal defects (ASD) constitute the most frequent congenital heart disease in adults and ostium secundum (OS) is the most common type. Device closure of ASD is currently accepted as the treatment of choice.
Methods: Retrospective study, over a five-year period from 2016 to 2021. All patients who benefited from OS-ASD closure were included.
Results: Twenty-three patients were recruited. All patients had a significant shunt. The majority were female (69,9%) and the average age was 30,39 years; age range 6 – 70. The average hospital admission time was 3 ± 1 days. Dyspnea (≥ NYHA II) was noted in 62%. Closure success rate was 95,7%. During Follow up, an improvement in functional status was observed in all cases. A significant decrease in right cavities dilatation as well as pulmonary arterial pressure has been reported.
Conclusion: Device closure of secundum atrial septal defects demonstrates a high procedural success rate with a low incidence of complications in the follow up period.

INTRODUCTION

Atrial septal defect (ASD) is defined as a persistent communication between the right and left atrium. ASD is one of the most common adult congenital defects comprising 7%–10% of all congenital heart defects in adults. (1)

There has been a shift of paradigm for therapeutic strategy of ASD over the last decades. Techniques and devices for transcatheter treatment have been evolved and refined; as a result, device closure of ASD is currently accepted as the treatment of choice in most patients with secundum ASD, showing excellent efficacy as well as lower complication rate comparing to surgery. (2,3)

Extensive experiences have verified safety and usefulness of the procedure, and established general principle for device closure of ASD including patient selection, peri-procedural assessment as well as procedural technique with various measures to prevent potential complications.

Therefore, in this study, we report our experience in using the percutaneous device to repair ASD.

MATERIAL AND METHODS

Between January 2016 and December 2021, 23 patients underwent percutaneous device closures of isolated secundum ASDs at our institution. Each routine examination included a physical examination, an electrocardiogram, a chest X-ray and at least two instances of transthoracic echocardiography. Blood tests were done to exclude contraindications to antiplatelet therapy.

The following including criteria were applied: 1) all patients regardless of age, 2) has a confirmed diagnosis of single ASD by transthoracic echocardiography with a significant left to right shunt, 3) Rims than 5 mm except the retro-aortic rim, 4) Low pulmonary resistance (< 5UW) , 5) streched balloon diameter less than 36 mm, and 6) no intra cardiac thrombus or contra indication to anti-platelet therapy.

Exclusion criteria were: 1) an ostium primum defect or venous sinus ASD, 2) severe pulmonary hypertension that can lead to a right to left shunting, 3) a puncture site with infective or venous thrombus, and 4) coexisting cardiac anomalies that need to be corrected under open repair.

- Echocardiography

ASD was detected using pre-operation transthoracic echocardiography (TTE) (with Doppler interrogation and color from the parasternal, subxiphoid, and apical views. Transesophageal echocardiography (TEE) was used to accurately determine ASD size (the largest diameter),

circumferential structures, morphologic features, and rims of the defect during the procedure.

- Technique

The procedure was performed under local anesthesia and light sedation or under general anesthesia whenever transesophageal echocardiography (TEE) was planned with continuous monitoring of hemodynamic, respiratory and electrocardiogram parameters.

First of all, basal hemodynamic parameters were carried out.

Intravenous heparin therapy was administrated at a dose of 100 UI/Kg in all patients as soon as femoral access was obtained.

A multipurpose catheter was advanced into the Inferior vena cava (IVC) then into the right atrium and across the interatrial septum to be placed in one of the pulmonary veins, usually the superior left one which allows a rigid 0,035 inch guide wire to be positioned.

Under fluoroscopic guidance with transthoracic or transesophageal echocardiography control, the ASD was measured with an equalizer balloon ™ inflated in the left atrium and withdrawn to the right atrium.

The balloon and guidewire were removed and a calibration plate was used to define the size of the occlusion device.

In the pediatric population, the assessment by transthoracic echocardiography was used exclusively.

In keeping with these measurements and after deciding that closure would be attempted, an Amplatzer occluder device was chosen that was slightly larger in diameter (around 2 mm) than the ASD in the adult population and 1 mm larger than the maximum diameter measured on transthoracic echocardiography in pediatric population.

Afterwards, the delivery sheath and the dilator were advanced along the guide wire into the left atrium through the septal defect. The Amplatzer atrial septal defect occluder is then advanced through the delivery sheath into the left atrium. Under TEE monitoring, the left disc was deployed, and the delivery sheath was pulled until the disc paralleled the atrial septum. The right disc is deployed while keeping traction on the delivery cable, and the disk was tugged to check for the positioning and hold. The occluder was released by rotating the delivery cable after no severe residual shunting was found by TTE. The sheath and the delivery cable were extracted from the right atrium, and the pressure dressing on the puncture point was made.

At the end of the procedure, prophylactic antibiotic therapy with second generation cephalosporin was administrated.

- Statistical analysis :

Quantitative variables were presented as means with standard deviations or medians with interquartile intervals. Statistical analysis were performed using SPSS software (Version 22.0; SPSS Inc., Chicago, III).

RESULTS

Between January 2016 and December 2021, successful transcatheter ASD occlusion was done in 23 consecutive patients who presented at our institution.

The mean age of patients was 30,39 years with extremes ranging from 6 to 70 years.

The adult and pediatric population represented 73,9% and 26,1 % of the population respectively.

Our study included 30,4 % of male and 69,9 % of female patients.

The notion of parental consanguinity was noted in 21,7% of cases.

At the time of presentation, Dyspnea on exertion was the main symptom in 62% of cases.

Only one adult patient in our series had clinical signs of right heart failure.

The electrocardiography (ECG) showed regular sinus rhythm in 95,7 % of cases.

Cardiomegaly depending on the right cavities was found in 18 patients.

All these patients showed a simple, single centrally located fossa ovalis ASD on echocardiographic examination.

On TOE, the maximum defect diameter varied between 16–31 mm while the balloon stretched diameter varied between 17–34 mm.

All patients had dilated right cavities with preserved right ventricular systolic function.

Twenty-three ASDs were closed with devices of 16 –36 mm; 13 patients were treated successfully with the Amplatzer septal occluder , 8 patients with the Figulla Flex II ASD occluder and 2 patients with the Ceraflex ASD occlude device.

The procedure was performed under fluoroscopic guidance combined with transthoracic echocardiography in 10 cases and transesophageal echocardiography in 13 cases.

3 patients in our series underwent a combined gesture: Two dilatations of the pulmonary valve stenosis and a percutaneous closure in an adult of a patent foramen oval associated with an 18 mm ASD with a single 21 mm device.

The procedure time varied between 17–56 minutes (median 23 minutes) and the fluoroscopy time between 4,6 – 18,3 minutes (median 7 minutes), with a tendency to shorter procedural and screening times after the learning curve. The average hospital admission time was 3 ± 1 days.

Technical success was achieved in 95,7 % of the patients. The only case of failure was due to an early post procedural migration of the device requiring urgent surgery.

There were no cases of arrythmia or conductance disorder, cardiac erosion, device embolization, pericardial effusion, endocarditisis or death related to the procedure.

- Follow up:

All patients reported a clear clinical improvement.

At transthoracic echocardiography, no residual shunt was detected during the entire follow up in all cases. There was a decrease in right chamber dilatation in all patients.

The evolution was marked by a significant improvement in systolic pulmonary artery pressure and the grade of the tricuspid regurgitation in the majority of cases.

No cases of secondary device migration, device thrombosis, further surgery, endocarditisis, complication of antiplatelet therapy, thromboembolic complications or death occurred during the entire follow up period.

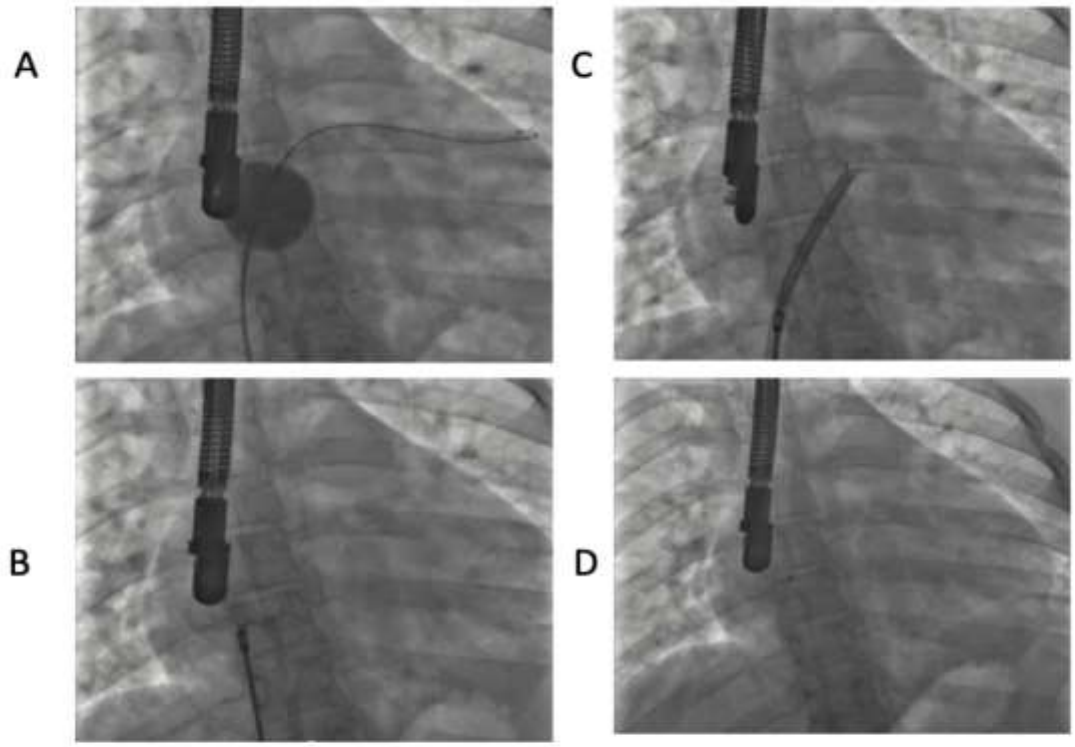

Figure 1: Endovascular closure of an ostium secondum atrial septal defect. (A) The stiff guide wire is placed in the superior left pulmonary vein. The ASD is measured with an equalizer balloon ™ inflated in the left atrium and withdrawn to the right atrium. (B) Release of the left disk of the device. (C) Release of the right disk of the device. (D) Final position.

DISCUSSION

An ASD is a common congenital heart disease. The advantages of percutaneous shunt closure over surgical closure have been discussed in previous literature. (4) There is a significant cost reduction when open heart surgery is avoided and the length of hospital stay is also reduced. The shorter procedure time without the use of general anesthesia also reduces the risk of complications and is favorable to patients with significant comorbidities. (5).

As for baselines characteristics and similarly to our study population, Atashband el al. found in a comprehensive analysis of 23 studies including 1958 patients, with OS- ASD closed percutaneously, a 68% female predominance, a 49% prevalence of dyspnea (≥ NYHA II) and 16% of atrial arrhythmias (6).

However, atrial Fibrillation was found in only one case in our series and was present before the device implantation. Arrhythmia was the most common complication occurring during the peri-implantation and subsequent follow-up period and has been noted in different case series. The higher incidence of arrhythmia events around the peri-implantation period is generally transient and likely relates to the procedure while the true incidence of arrhythmia over time is probably much lower (1% in our series) and has been attributed to longstanding chamber enlargement. (7)

Procedural success was noted 95,7% of cases. The only case of failure was due to an early post procedural migration of the device. This was a 45 years old patient. We occluded the defect with 34 mm stretched balloon. Then, we chose a 36 mm device that appeared stable at the time of implantation. The device had migrated and was blocked in the pulmonary artery trunk. The device was surgically removed in emergency and the ASD was closed in the same time.

Patients with an ASD had a significant reduction in the right ventricular size following shunt closure. This is consistent with other studies which demonstrated significant RV improvement following percutaneous ASD closure, with further improvement in RV dilatation noted on subsequent imaging studies. (8)

Our follow-up revealed significant functional gain in terms of dyspnea despite late ASD closure in adulthood. This substantial improvement was demonstrated even in patients who considered themselves initially asymptomatic (9) and was reported by several studies regardless of age of intervention. (10)

CONCLUSION

This series is consistent with experiences from other centers showing a high success rate of device implantation and low rates of complications during the procedure and at mid-term follow-up.

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