Transcatheter Closure of Secundum Atrial Septal Defects in the Elderly

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ABSTRACT

Background and Objectives: With the exception of bicuspid aortic valves, atrial septal defects (ASDs) are the most common congenital heart lesions found in adults. A mortality and morbidity benefit has clearly been demonstrated in the treatment of this lesion in younger patients. However, the benefits of ASD closure are less well defined in the elderly. We report our experience with transcatheter ASD closure and detail its impact on functional status and right ventricular remodeling as indicators of right heart failure in patients greater than 60 years of age.

Subjects and Methods: Fifty-five patients (median age 70 years) underwent ASD closure at a single center during an eight-year period. Data were collected and analyzed retrospectively. Results: Transcatheter closure was successful in all patients. No major complications occurred during the periprocedural or follow-up periods. Complete defect closure was documented in 97% of patients during follow-up. All patients improved by at least one New York Heart Association (NYHA) functional class. Following ASD closure, no patient was in NYHA III or IV. The median right-ventricular end-diastolic diameter decreased from 39 mm to 26.6 mm (p<0.001). Conclusion: Atrial septal defect closure is safe and effective in elderly patients. Our data and prior published data consistently demonstrate that even patients greater than 60 years of age experience improvement in functional status and right ventricular remodeling. Therefore, patient age should not influence the decision of whether an ASD should be closed.

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KEY WORDS: Congenital heart disease; Atrial septal defect; Aged.

Introduction

With the exception of bicuspid aortic valves, atrial septal defects (ASDs) are the most common congenital heart lesions found in adults. Hemodynamically significant secundum type ASDs are now routinely treated with transcatheter closure, while primum and sinus venosus defects still require surgical closure.1-4 Untreated hemodynamically significant ASDs have the potential to reduce life expectancy, decrease exercise capacity, and cause right heart failure, pulmonary arterial hypertension, and atrial tachyarrhythmias. Long-term follow-up data in younger patients below the age of 25 years suggest that surgical ASD repair results in normal life expectancy.5 Furthermore, atrial fibrillation can be prevented if patients undergo ASD closure before the age of 40.6 The benefits of ASD closure in elderly patients (defined as above the age of 60 years) are less well defined.7 Some reports suggest that surgical ASD closure in older patients still prevents volume overload-induced heart failure and leads to reduction in pulmonary arterial pressure and improvement of symptoms.8 Conversely, ASD closure may be detrimental in elderly patients with advanced pulmonary arterial hypertension or left ventricular diastolic or systolic dysfunction who need the ASD as a “pop-off” valve.9,10

With the advent of transcatheter ASD closure and its lower procedural morbidity compared to surgical closure, it may be reasonable to lower the threshold for ASD closure in the elderly, with the hope of improving morbidity. We report our experience with transcatheter ASD closure and detail its impact on functional status and right ventricular remodeling as indicators of right heart failure in patients greater than 60 years of age.

Methods

Study population

All patients above 60 years of age who underwent at-
tempted transcatheter ASD closure at a single tertiary referral center between September 1999 and March 2008 were included in the present study. Data were collected retrospectively. Indications for defect closure were a hemodynamically significant ASD with a diameter less than 40 mm and sufficient rims (≥5 mm, except the anterior margin, which was allowed to be deficient). Patients undergoing patent foramen ovale closure and those with ASDs greater than 40 mm in diameter or partial anomalous pulmonary venous drainage were excluded. Fifty-five patients (35 females; 20 males) with a median age of 70 years (range 61-87 years) underwent attempted device closure of their defects.

Device implantation

The Amplatzer Septal Occluder (ASO) (AGA Medical Corp., Plymouth, Minnesota, USA) was used in all patients except for one. The ASO and the implantation procedure have been described previously. Between September 1999 and August 2000, all procedures were performed under general anesthesia and simultaneous fluoroscopic and transesophageal echocardiographic (TEE) guidance. After August 2000, all procedures were performed with conscious sedation and simultaneous fluoroscopic and intracardiac echocardiography (ICE).

Baseline hemodynamics were evaluated in all patients prior to closure. If the mean left atrial pressure was greater than 18 mmHg, temporary balloon occlusion of the ASD was performed for 15 minutes. During balloon occlusion, the left atrial pressure was recorded using the distal tip of the balloon catheter, after removal of the guide wire. If the mean left atrial pressure increased by more than 5 mmHg from baseline, the procedure was abandoned, and the patient received several days of an afterload-reducing agent and diuretic therapy. The patient was then re-evaluated using the same balloon-occlusion technique. If the mean left atrial pressure did not change by more than 5 mmHg, the ASD was completely closed. However, if the pressure increased by more than 5 mmHg, a fenestration was created in the device, which was then deployed according to a protocol described previously.

Three doses of cephalaxin were administered in the periprocedural period. Acetylsalicylic acid (81 mg daily) was started 48 hours prior to the procedure and continued for six months. Furthermore, during the last three years of our practice, clopidogrel 75 mg per day was given for the first two months following closure. Prophylaxis for bacterial endocarditis was recommended for six months after the procedure, and yearly thereafter to assess symptoms and to evaluate for the possibility of complications or residual shunt. Symptom status was classified according to the New York Heart Association (NYHA) system. Right ventricular end-diastolic diameter (RVEDD), defined as the largest diameter of the mid-right ventricular cavity during diastole in the short axis view, was evaluated using TTE. Residual shunt was defined as a leak traversing the occluder or passing between the two discs of the ASO detected by two-dimensional color-flow Doppler. Residual shunting was classified according to the color-jet width described by Boutin et al., trace <1 mm, small >1 mm and <2 mm, moderate >2 mm and <4 mm, and large >4 mm.

Statistics

Data are presented as medians and ranges. Differences in RVEDD were compared using the Student’s t-test. The alpha level was set at 0.05. In patients with multiple ASDs, the largest defect size was used for analysis.

Results

Patient characteristics

Transcatheter closure was successful in all patients. Procedural and hemodynamic data are summarized in Table 1. Three of the 55 patients had multiple ASDs requiring two devices for complete closure. An ASO was used for closure in all but one patient, who was closed with a Helex occluder (W. L. Gore & Associates, Flagstaff, Arizona, USA). A fenestrated ASO was placed in two patients who had a fixed increased left atrial pressure. The 6 mm diameter fenestration served as a protective interatrial communication, reducing left ventricular preload by allowing left-to-right shunting and preventing the development of pulmonary edema. Pulmonary arterial hypertension (defined as a mean pressure greater than 20 mmHg) was present in 23 patients (42%).

Six patients had significant pulmonary hypertension (defined as a mean pressure greater than 40 mmHg); of these, five had complete ASD closure without any events. In one patient, a small defect was left open due to concurrent evidence of left ventricular diastolic dysfunction.

<table>
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<tr>
<th>Table 1. Procedural characteristics</th>
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<tr>
<td><strong>Median</strong></td>
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<td>Qp/Qs ratio</td>
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<tr>
<td>Fluoroscopy time (minutes)</td>
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<td>Procedure time (minutes)</td>
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<tr>
<td>Defect diameter* (TEE/ICE) (mm)</td>
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<tr>
<td>Defect diameter† (Stretched) (mm)</td>
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<td>Device size (mm)</td>
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* Diameter as measured by color Doppler with TEE or ICE. † Diameter as measured by balloon sizing with “stop-flow” technique.

Follow-up

Clinical and echocardiographic follow-up information were available in 31 patients. The median follow-up duration was 28 months (range 6-79 months). Device closure was associated with a significant decrease in the RVEDD. The median RVEDD decreased from 39 mm (range 20-55 mm) before ASD closure to 26.6 mm (range 14-38 mm) at a median interval of 6 months (p<0.001) (Fig. 1).

The majority of patients showed improvement in symptoms during follow-up (Table 2). One NYHA class III patient with a moderately large ASD and reduced left ventricular diastolic elasticity underwent successful ASD closure with a fenestrated ASO and subsequently improved by one functional class during follow-up. However, he was admitted with acute decompensated heart failure six years after his ASD closure, secondary to severe diastolic dysfunction from his chronic hypertension.

Thirteen patients (24%) had atrial fibrillation or flutter prior to ASD closure. Three patients underwent radiofrequency ablation prior to ASD closure, and the other ten remained in atrial fibrillation. Only one patient had new onset persistent atrial fibrillation 4 years after ASD closure.

Immediate closure was accomplished in 87% of patients (46 of 53 patients). Trivial shunts were seen in three patients, and small shunts were seen in three patients. A moderate shunt was seen in one patient. The two patients who received a fenestrated ASO were excluded. During follow-up, complete closure was documented in 97% of patients (32 of 33 patients). One patient had a persistent small residual shunt.

Complications

Minor periprocedural complications occurred in ten patients. Four patients developed hematomas at their venous puncture sites. A small pericardial effusion was noted in five patients. All patients were followed clinically without any need for drainage. During the implantation procedure, a pacemaker lead dislodged in one patient and required re-implantation. All periprocedural complications resolved without long-term sequelae. During follow-up, one patient was noted to have a femoral pseudoaneurysm one year after her procedure, which required surgical repair. However, this patient underwent another cardiac catheterization two weeks prior to the closure procedure. Four patients died during follow-up, and all expired for reasons unrelated to ASD closure (one due to chronic liver disease, one due to ischemic heart disease, and two due to other severe cardiovascular comorbidities).

Discussion

Our data support prior published data suggesting that ASD closure is safe and effective, even in patients over 60 years of age. This finding is consistent with the recently published recommendations issued by the American College of Cardiology and the American Heart Association addressing the care of adults with congenital heart disease. These guidelines state that any hemodynamically significant ASD should be considered for closure, irrespective of age.

There are, however, several differences in the treatment strategies and potential benefits of ASD closure in adult and pediatric patients.

First, although the indications for transcatheter closure are the same as for surgical closure, the former modality has lower periprocedural morbidity in all age groups. Presumably due to the higher incidence of comorbidities in elderly patients, age may have a significant impact on periprocedural mortality in surgically treated adult patients. Ghosh et al., demonstrated that patients below 51 years of age carried a periprocedural surgical mortality of 0%, while patients above 51 years of age carried a periprocedural surgical mortality of 3.3%. This makes transcatheter ASD closure even more appealing in the elderly.

Second, except for some extraordinary circumstances, it is unlikely that ASD closure will provide a mortality benefit in the elderly age group. Nevertheless, our data, as well as data from other investigators, demonstrate that symptomatic patients improve following ASD closure, resulting in an improved quality of life.

But, even in asymptomatic patients, ASD closure can provide benefits such as favorable cardiac remodeling of
a dilated right ventricle. This may prevent development of frank right heart failure. Further, the functional capacity of patients with ASDs is substantially impaired. The subjective impression of functional capacity may be overestimated by patients with congenital heart disease, and it has been documented that functional capacity improves even in patients who consider themselves asymptomatic.

Another important difference between pediatric and elderly patients is coexisting pulmonary arterial hypertension or left ventricular diastolic dysfunction caused by long standing hypertension in the latter group. Thus, it is important to carefully assess the feasibility of completely closing the defect. As shown in the present study, the right ventricular size decreases soon after ASD closure in elderly patients. The loss of a decompressive ASD can result in serious acute effects on left heart hemodynamics, which have been reported after surgical repair of ASDs. A possible explanation for this pathophysiological mechanism in elderly patients is restrictive left ventricular diastolic dysfunction leading to left atrial hypertension and subsequent pulmonary edema. The ASD serves as a protective interatrial communication, reducing the left ventricular preload through left-to-right shunting. Therefore, we placed a fenestrated ASO in two patients and left a small defect open in two other patients who had multiple ASDs. This outlines the importance of careful hemodynamic assessment of potential left ventricular dysfunction in elderly patients with moderate-to-large ASDs. We recommend evaluation of this hemodynamic phenomenon by temporary balloon occlusion of the defect in any patient with a baseline left atrial pressure of ≥ 18 mmHg for 15-20 minutes, as described in the methods section of this paper and detailed in a more extensive manner in an earlier publication.

Finally, atrial fibrillation is part of the natural course of an untreated ASD. It is more likely for an adult patient presenting with an ASD to be in atrial fibrillation at the time of diagnosis than it is for a child or adolescent. This is simply due to the hemodynamic effects of the ASD on right and left atrial size, which lead to myocardial stretch and atrial fibrillation over time. A landmark study evaluating the effect of surgical ASD closure has documented that ASD closure beyond the age of 40 has no effect on the future development of atrial fibrillation. In our study, patients in atrial fibrillation at baseline remained in this rhythm, except for those undergoing radiofrequency ablation. A temporary increase in atrial fibrillation was documented following occluder placement in a different patient population in a previous study. We were not able to reproduce this finding in the present study.

Our study has several limitations, including a retrospective design, incomplete follow-up data, and a lack of a control group. Nevertheless, the present study confirms the positive impact of ASD closure on right ventricular remodeling and functional status.

In conclusion, ASD closure is safe and effective in elderly patients. Our data and prior published data consistently demonstrate that even patients above 60 years of age experience improvement in functional status and right ventricular remodeling. Patient age should not influence the decision of whether an ASD should be closed. However, careful assessment of hemodynamic status is warranted prior to complete closure of the defect.

REFERENCES


