Original Article

Transesophageal Echocardiographic Characteristics of Secundum-Type Atrial-Septal Defect in Adult Patients

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Abstract

Background: *Given the dearth of data in the existing literature on the size and morphologic variability of secundum-type atrial-septal defect (ASD-II) in adult patients, we aimed to address this issue in a series of consecutive adult patients evaluated by transesophageal echocardiography (TEE).*

Methods: *A total of 50 patients (68.0% female) with isolated ASD-II underwent TEE for the evaluation of the defect. The morphological characteristics of the defect were evaluated, and the largest defect size was measured. The ASD rim was divided into 6 sectors: the superior-anterior, superior-posterior, superior, inferior-anterior, inferior-posterior, and inferior. The minimal length of the defect rims was determined.*

Results: *Mean age at the time of evaluation was 33.62±14.48 years. Mean defect diameter in the all the study patients was 20.80±8.17 mm. Thirteen morphological variations were detected. Deficiency of one rim was detected in 14 (28%) patients, two in 16 (32%), three in 2 (4%), and four in 2 (4%). Deficiency of the superior anterior rim was found in 24% of the patients as the most frequent morphology. There was a significant correlation between the defect size and number of deficient rims (γ=0.558, P value<0.001). Forty-eight (96%) patients emerged for defect closure: 22 (46.2%) suitable for percutaneous closure and 26 (53.8%) for surgical closure. Two patients with small defects were recommended for medical treatment and follow-up.*

Conclusion: *ASD-II is larger and more morphologically variable in adults than in children. Based on the findings of the present and previous studies and given the advantages of percutaneous treatment, it is advisable to make a decision on ASD-II closure as soon as possible before it outgrows the transcatheter closure suitability criteria.*

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Introduction

Percutaneous closure of the secundum type atrial-septal defect (ASD-II) is an acceptable alternative to surgical closure, and the characteristics of the defect are crucial for a successful device closure. Although detailed descriptions of the size and morphology of ASD-II have been reported in children,[1-5] few studies have thus far paid heed to the characteristics of ASD-II in the adult population.[6-7] On the other hand, morphological variations of ASD-II are common and their recognition is crucial for the selection of patients suitable for percutaneous closure. We, therefore, sought to determine the size and morphological variability of ASD-II in a series of consecutive adult patients evaluated by transesophageal echocardiography (TEE).

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Methods

Between March 2007 and November 2008, 50 patients with isolated ASD-II who were referred to our institution (Tehran Heart Center) for an evaluation of the defect were included in this study. Transthoracic echocardiography (TTE) was performed in all the patients. Patients with associated congenital heart defects as well as patent foramen ovale were excluded. The principal parameters assessed by echocardiography consisted of right ventricular (RV) dimension, left ventricular and RV functions, pulmonary artery wedge pressure (or RV systolic pressure), and presence or absence of mitral and tricuspid valve regurgitation. A qualitative assessment of the global systemic RV function was carried out with the visual grading system (1=normal, 2=mild, 3=moderate, and 4=severe impairment).[8] The severity of mitral and tricuspid valve regurgitation was graded qualitatively in accordance with the American Society of Echocardiography guidelines for native valve regurgitation[9] and reported as follows: 1=mild, 2=moderate, 3=moderate to severe, and 4=severe.

The patients were divided into two groups according to the echocardiographer's comment after TEE. The device group comprised 22 (45%) patients whose defect size and morphology were appropriate for percutaneous closure, and the surgery group was comprised of 26 (55%) patients whose defect size and morphology were not suitable for percutaneous closure and were recommended for surgical closure.

TEE was performed using an echocardiographic machine interfaced with a 6T omniplane transesophageal probe (Vivid 7) upon the standard method. The maximum defect size (diameter) was measured. The atrial septal rim was divided into 6 sectors: 1) the superior-anterior, 2) superior-posterior, 3) superior, 4) inferior-anterior, 5) inferior-posterior, and 6) inferior rims.[7, 10] The minimal length of the defect rims was determined. In the patients with multiple defects, the sum of the defect sizes was considered the maximal diameter and the rims were measured from the outer point except for very small fenestrations. Rim deficiency was defined as <5 mm minimal diameter of the rim.[11] A maximal defect diameter ≥30 mm and/or deficiency of any defect rim except for the superior anterior rim was regarded as the criteria for excluding patients from suitability for percutaneous closure.[7]

The categorical data were presented as frequencies and percentages, and the continuous variables were expressed as mean±SD. The continuous variables were compared using the Student t-test, and the categorical variables were compared using the chi-square or Fisher exact test. The association between the ASD size and number of deficient rims was tested using the Pearson correlation coefficients. A P-value less than 0.05 was considered significant level.

Results

A total of 50 patients (68.0% female) with isolated ASD-II were evaluated. Mean age at the time of evaluation was 33.62±14.48 years (range: 14-81 years). The size and morphology of the defects were evaluated by TEE in all the patients.

Comparisons between the two groups with the two recommended types of treatment procedures in terms of patient characteristics and echocardiography findings are illustrated in Table 1. RV size was significantly smaller in the device group (P value=0.004), and the frequency of RV dysfunction was remarkably greater in the surgery group (P value=0.005). Mean pulmonary artery blood pressure was higher in the surgery group, but this difference did not reach a significant level.

Table 1. Patient's characteristics

Parameter	Device closure group (n=22)	Open surgery group (n=26)	P value
Age at evaluation (y)	32.95±10.09	31.85±15.00	NS
Female	15 (68.2)	18 (69.2)	NS
RV function			
Normal	18 (81.8)	11 (42.3)	0.008
Mild	4 (18.2)	15 (57.7)	0.008
LV function			
Normal	19 (86.4)	24 (92.3)	NS
Mild	3 (13.6)	2 (7.7)	NS
RV dimension	36.10±9.16	42.92±6.39	0.004
PA pressure	40.69±7.70	48.59±17.00	NS
MR			
Mild	8 (36.4)	7 (26.9)	NS
Moderate	1 (4.5)	3 (11.5)	NS
TR			
Mild	9 (40.9)	12 (46.2)	NS
Moderate	9 (40.9)	13 (50.0)	NS
Aneurysmal IAS	3 (13.6)	4 (15.4)	NS
Another fenestration	3 (13.6)	2 (7.7)	NS

Numbers are presented as mean±SD or n (%)
NS, Non-significant; RV, Right ventricular; LV, Left ventricular; PA, Pulmonary artery; MR, Mitral regurgitation; TR, Tricuspid regurgitation; IAS, Interatrial septum

According to TEE, the mean defect diameter in all the study patients was 20.80±8.17 mm. Overall, 13 morphological variations were detected (Table 2). Deficiency of one rim was detected in 14 (28%) patients, two rims in 16 (32%), three in 2 (4%), and four in 2 (4%) (Table 3). Deficiency of the superior anterior rim, which is the most frequent variation of ASD-II, was found in 12 (24%) patients. The defect was located in the center of the interatrial septum in 16 (32%) patients. Seven (14%) patients had associated interatrial septal aneurysm. Four patients had a small fenestration up to 2 mm in diameter; and one had two large fenestrations, each with a diameter of about 4 mm.

Table 2. Categorized morphological variations of secundum type atrial septal defect in 50 study patients

Definition	No. of patients	Recommendation	
		Device closure	Open surgery
No rim deficiency	14	12	2
Single rim deficiency (anterior-superior)	12	10	2
Single rim deficiency (other than anterior-superior)	2	0	2
Two deficient rims (anterior-superior + other rims)	12	0	12
Two deficient rims (none is anterior-superior)	4	0	4
Three deficient rims (anterior-superior + two other rims)	1	0	1
Three deficient rims (none is anterior-superior)	1	0	1
Four deficient rims (anterior-superior + three other rims)	2	0	2
Four deficient rims (none is anterior-superior)	0	0	0

Table 3. Morphological variations of secundum type atrial septal defect in 50 study patients

Deficient rims	No. of patients	Recommendation	
		Device closure	Open surgery
Centrally placed defects	14	12	2
Deficient anterior-superior rim	12	10	2
Deficient anterior-superior and posterior-superior rims	4	0	4
Deficient anterior-superior and superior rims	4	0	4
Deficient anterior-superior and anterior-inferior rims	4	0	4
Deficient anterior-superior, anterior-inferior and superior	1	0	1
Deficient anterior-superior, anterior-inferior, posterior-superior and superior	1	0	1
Deficient anterior-superior, posterior-superior, posterior-inferior and superior rims	1	0	1
Deficient anterior- inferior and posterior-superior rims	1	0	1
Deficient posterior-superior and inferior	1	0	1
Deficient posterior-inferior and inferior	2	0	2
Deficient posterior-superior rim	2	0	2
Deficient posterior-superior and posterior-inferior and posterior-inferior rims	1	0	1

There was a significant correlation between the defect size and the number of deficient rims ($\gamma=0.558$, P value<0.001); a higher number of deficient rims was accompanied by a larger defect.

Forty-eight (96%) patients emerged for defect closure. Twenty-two (46.2%) patients were suitable for percutaneous closure: 12 (24%) with a centrally located defect and 10 (20%) with a deficient superior anterior rim. Twenty-six (53.8%) patients were not considered suitable for percutaneous closure and were thus referred for surgical closure. Despite having an acceptable rim size, two patients were recommended for surgical closure because their rimes were very loose. The remaining two patients with small and hemodynamically insignificant ASD were referred neither for percutaneous nor open surgery closure, but were recommended for medical follow-up.

Discussion

In this study, we analyzed the echocardiographic characteristics of isolated ASD-II in some adult patients. Our data showed that 46.2% of the patients emerging for defect closure in our institution fulfilled the criteria for percutaneous closure.

The effect of aging on ASD size has been evaluated previously[12] and the authors concluded that two thirds of ASD-II might enlarge over time; there is, consequently, a potential for this type of ASD to outgrow the transcatheter closure suitability criteria. The mean age of our patients in this study was 33.62 years with a defect size of 20.80 mm; 46.2% fulfilled the criteria for device closure. The age of the patients studied by Prokselj et al.[7] was 43.6 years with a defect size of 22.2 mm and 45.3% were recommended for device closure. In another study performed on children, Podnar et al.[1] found a mean defect size of 14.7 mm and 79.5% of children were suggested for ASD closure by device. The mean age of the adult population in the present study was lower than that of the patients studied by previous investigators;[7] as a result, the mean defect size was lower and device closure was recommended relatively more frequently in our study.

Regarding the morphology of ASD-II, we found 13 morphological variations with a deficiency of 1, 2, 3, or 4 rims. These observations were relatively similar to the variations reported in 64 adult patients elsewhere.[7] Morphological defect variations reported in children are fewer, showing only 8 for 190 children with a deficiency of 1 or 2 rims.

This finding also shows that with increasing age, ASD-II morphological characteristics become more complex and may lose its suitability for percutaneous closure. Prokselj et al. also inferred that in some patients, defect growth was associated with the attenuation or even disappearance of defect rims, causing changing defect morphology with increasing defect size.

Conclusion

The frequency of adult patients recommended for the percutaneous closure of ASD-II using TEE findings in our institution is compatible with the data reported by other centers. Investigators have reported the growth of defect size over time, and we observed a greater defect size in adults compared to the figure reported in children. ASD-II is larger and more morphologically variable in adults than in children. Based on the findings of the present and previous studies and given the advantages of percutaneous treatment, it is advisable to make a decision on ASD-II closure in childhood and perform percutaneous closure for as many patients as possible.

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