ECRONICON OPEN ACCESS

EC CARDIOLOGY
Research Article

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

Amjad Ali* **and B Ramesh**

Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bengaluru, India

***Corresponding Author:** Amjad Ali, Department of Cardiology, Sri Jayadeva Institute of Cardiovascular Sciences and Research, Bengaluru, India.

Received: August 23, 2019; **Pubished:** September 30, 2019

Abstract

Aim: Transesophageal Echocardiographic morphological Characteristics of Secundum-Type Atrial Septal Defect in Adult Patients.

Introduction: There is considerable morphological variation of secundum- type ASDs. 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).

Material and Methods: Between December 2014 and April 2015, 100 patients with isolated ASD-II who were referred to our institution for an evaluation of the defect were included in this study. TEE was performed using an echocardiographic machine interfaced with a transesophageal probe upon the standard method. The maximum defect size (diameter) was measured. The atrial septal rim was divided into 6 sectors: 1) AVrim, 2) Atrial rim, 3) Aortic rim, 4) Posterior rim, 5) SVC rim and 6) IVC rims.

Results: Out of 100 patients, 61 patients (61%) were women. Mean age at the time of evaluation was 33.10 ± 11.5 years. The mean defect diameter in the study was 23.1 ± 6 mm. There is no significant difference between the size of ASD in male and female. 65% of patients have deficient aortic rim, atrial rim was deficient in 5%, AV rim in 3%, IVC rim in 8%, SVC and Posterior rim each in 1% of patients. 14% patients are having septal aneurysm. 8% patients are having fenestrated atrial septal defect.

Discussion: Regarding the morphology of ASD-II, we found 10 morphological variations with a deficiency of 1, 2, and 3 rims. These observations were relatively different to the previous studies where they found 13 types of morphological defect [5,7]. This information regarding adequacy of rims size is important for taking decision regarding device closure.

Conclusion: Understanding the echoanatomic correlation by Transesophageal echocardiography is perhaps the most essential requisite to ensure a successful ASD device closure procedure.

Keywords: *ASD; TEE; Device Closure; RIMS*

Introduction

Atrial septal defect (ASD) accounts for 25 - 30% of congenital heart defects that are diagnosed in adult hood. The most common type is an ostium secundum defect, representing up to 80% of all ASDs. This defect occurs in the area of the fossa ovalis and presumably results from excessive fenestration or resorption of septum primum, underdevelopment of septum secundum, or some combination of the two conditions. Anatomically, a secundum ASD may extend into the superior sinus venosus (without superior-posterior rim), the inferior sinus venosus (without inferior-posterior rim), the mitral annulus (without inferior-anterior rim) and the aortic root (without superior-anterior rim). An untreated symptomatic ASD leads to significant morbidity and reduces life expectancy. Complications of an untreated ASD can include right ventricular failure, atrial arrhythmias, paradoxical embolism, pulmonary hypertension and cyanosis secondary to reversal of shunt from pulmonary vascular disease. The role of echocardiography during interventional procedures is well documented [1,2] and several techniques have been described for the guidance of percutaneous closure of ASD [3].

The anatomic margins (also referred to as "rims") surrounding the atrial septum are defined below and detailed in figure 1:

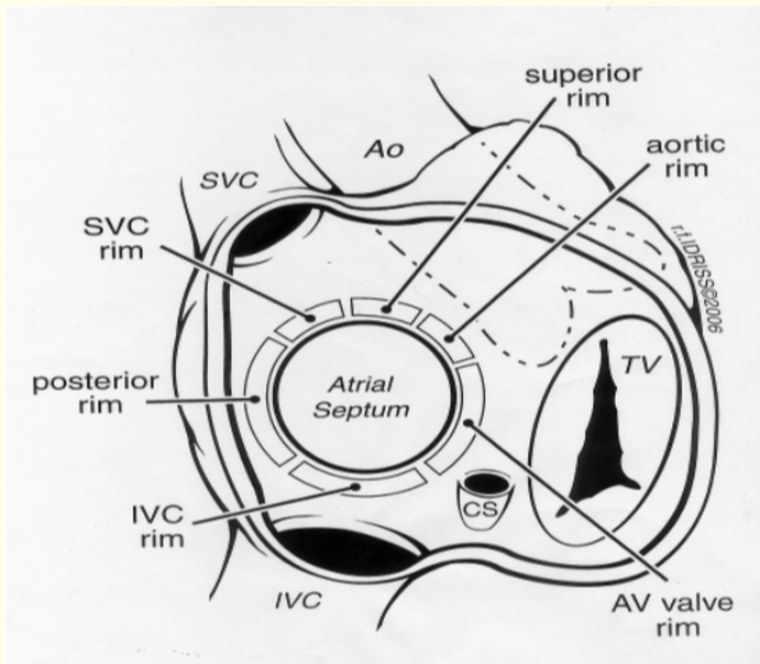

Figure 1: *Different ASD rims.*

- Aortic rim: Rim related to the aorta that abuts the anterior-superior septum of the defect. It may also be called the anterior-superior rim, retro-aortic rim, or retro-aortic mound.
- Superior (atrial) rim: The rim that abuts the superior wall of the atrium.
- Atrioventricular Valve (AV) rim: Rim that abuts the atrioventricular valves or crux of the heart, also called the inferior-anterior rim.
- Inferior Vena Cava (IVC) rim: Rim that abuts the inferior vena cava, also called the inferior-posterior rim.
- Posterior rim: Most rightward and posterior rim opposite the aortic rim, and anatomically related to the right upper pulmonary vein.
- Superior Vena Cava (SVC) rim: Posterior-superior rim which is bordered by the superior vena cava and is near the upper pulmonary vein.

The defect should have substantial tissue rims to anchor the device. By conventional definition, a margin > 5 mm is considered to be adequate [4].

There is considerable morphological variation of secundum- type ASDs. Podnar., *et al.* reported the echocardiographic findings of 190 patients with isolated secundum ASDs referred for device closure [5]. Twenty four per cent had centrally placed defects but the remaining 144 patients had morphological variations. A deficient superior anterior rim was seen in 42%, a deficient inferior posterior rim in 10%, perforated aneurysm of the interatrial septum was seen in 7.9% and 7.3% of patients had multiple septal defects. Given the dearth of data in the existing literature on the size and morphologic variability of secundum-type atrial-septal defect (ASD-II) in Indian adult patients, we aimed to address this issue in a series of consecutive adult patients evaluated by transesophageal echocardiography (TEE).

Aim of the Study

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

Materials and Methods

Between December 2014 and April 2015, 100 patients with isolated ASD-II who were referred to our institution 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. TEE was performed using an echocardiographic machine interfaced with a transesophageal probe upon the standard method. The maximum defect size (diameter) was measured. The atrial septal rim was divided into 6 sectors: 1) AVrim, 2) Atrial rim, 3) Aortic rim, 4) Posterior rim, 5) SVC rim and 6) IVC rims. 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 [6].

TEE evaluation begin in the mid-esophageal 4-chamber view at 0° [7,8]. This view permits localization of the atrial rim , and the AV rim. To achieve proper visualization of the Aorta, the probe kept at a mid-esophageal level, at 45° with a leftward (counter-clockwise) rotation of the probe to allow simultaneous visualization of the aorta (AA) and the ASD. From the mid-esophageal four-chamber view, the multiplane angle is rotated approximately 90° to the 2-chamber view. With slight probe rotation to the right (clockwise rotation of the shaft of the probe), the IVC and the superior vena cava (SVC) are seen. The SVC rim is measured from the superior lip of the ASD to the insertion of the rim into the SVC. The mid-esophageal bi-caval view provides an excellent view of the inter-atrial septum, allowing interrogation of the septum. The categorical data were presented as frequencies and percentages, and the continuous variables were expressed as mean ± SD.

Results

Between December 2014 and April 2015, 100 consecutive adult patients having isolated ASD II were evaluated at our institution and all were included in this study. In all, 61 patients (61%) were women. Mean age at the time of evaluation was 33.10 ± 11.5 years. The mean defect diameter in the study was 23.1 ± 6 mm. There is no significant difference between the size of ASD in male and female. 65% of patients have deficient aortic rim, atrial rim was deficient in 5%, AV rim in 3%, IVC rim in 8%, SVC and Posterior rim each in 1% of patients. 14% patients are having septal aneurysm. 8% patients are having fenestrated atrial septal defect.

Age and sex

Sex code	Mean age	N	Std. Deviation
Male	29.79	39	9.913
Female	35.21	61	12.131
Total	33.10	100	11.575

Table 1

ASD Size

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
ASD size	100	0.8000	3.9000	2.326000	0.6697836

Different rims

	N	Minimum	Maximum	Mean	Std. Deviation
AV Rim	100	0.4	2.7	0.967	0.4073
Atrial Rim	100	0.4000	2.0000	1.031000	0.4391670
SVC Rim	100	0.4000	2.0000	1.022000	0.3780813
IVC Rim	100	0.0000	3.0000	1.219000	0.6344798
Aortic Rim	100	0.0	2.5	0.352	0.3457
Post. Rim	100	0.4000	2.5000	1.105000	0.4604291

Average size of AV rim is 0.96 ± 0.4 cm, atrial rim 1.03 ± 0.4 cm, SVC rim 1.02 ± 0.37 cm, IVC rim 1.21 ± 0.6 cm, aortic rim 0.352 ± 0.3 cm and posterior rim 1.1 ± 0.46 cm. Aortic rim is deficient in maximum numbers of patients (65%), out of which 32% have bald aortic rims. 29% of all patients have adequate all rims. There was a significant correlation between the defect size and the number of deficient rims (P value < 0.05); a higher number of deficient rims was accompanied by a larger defect.

There are 10 types of morphological variants present as mentioned in table.

All Rims Adequate	29
Deficient Aortic Rim	65
Deficient Aortic and SVC Rim	1
Deficient Aortic and Atrial Rim	4
Deficient Aortic and AV Rim	3
Deficient Aortic and AV Rim and Atrial Rim	1
Deficient Aortic and AV Rim and Atrial Rim and SVC Rim	0
Deficient Aortic and IVC Rim and Atrial Rim and SVC Rim	0
Deficient AV and SVC Rim	1
Deficient SVC and Posterior Rim	1
Deficient IVC and AV Rim	1
Deficient SVC Rim	1
Deficient SVC and IVC Rim	0

Discussion

In the last few years, percutaneous treatment of atrial septal defects has developed significantly. It is now established as a feasible, safe and effective therapeutic modality. Echocardiography has a primary role in this scenario, identifying suitable candidates for the procedure, monitoring the device implantation and evaluating the rate of occlusion during follow-up. In this study, we analyzed the echocardiographic characteristics of isolated ASD-II in 100 adult patients. The mean age of our patients in this study was 33.10 ± 11.5 years with a defect size of 23.1 ± 6 mm. Whereas, the age of the patients studied by Prokselj., *et al*. was 43.6 years with a defect size of 22.2 mm [7]. In another study performed on children, Podnar., *et al*. found a mean defect size of 14.7 mm and 79.5% of children were suggested for ASD closure by device [5]. The mean age of the adult population in the present study was lower than that of the patients studied by previous investigators [8]; but the mean defect size was similar in our study. As for the size and morphologic variability of ASD II in a series of consecutive adult patients, data from this study demonstrated the large size of defects in adult patients. The mean defect diameter in the study was 22.2 mm. In a comparable study performed in 190 consecutive children the mean defect diameter was only 14.7 mm [5]. This finding is expected on the basis of the natural history of the growth of ASD II demonstrated in two-thirds of patients [6]. Regarding the morphology of ASD-II, we found 10 morphological variations with a deficiency of 1, 2, and 3 rims. These observations were relatively different to the previous studies where they found 13 types of morphological defect [5,7]. This information regarding adequacy of rims size is important for taking decision regarding device closure. In the majority of previous studies of transcatheter closure of secundum ASD, TEE and/or ICE were commonly used for guiding ASO implantation, whether for central ASD or ASD with a deficient superior-anterior rim [12,14]. Although a few studies showed that TTE can be used for guiding or assisting the ASO implantation, a specific large-sample study of TTE-guided ASO implantation in patients with ASD and a deficient superioranterior rim is lacking [10,11,13]. As a result of the increasing global experience in the percutaneous treatment of ASD, as well as the development of occlusion devices and the improvement of the quality of echocardiographic images, including high-resolution TEE, three-dimensional reconstruction and intracardiac echocardiography (ICE), the indications, previously restricted to unquestionably favorable cases, were expanded to include the so-called complex cases, in which the implant is known to be feasible and effective. Complex anatomy ASD is considered when it has the following characteristics: stretched diameter > 26 mm; deficient rims, measuring less than 4 mm in the anterior, posterior or inferior septal region; two orifices that are apart; multifenestrated interatrial septum and interatrial septum aneurysm (redundant and mobile interatrial septum with an excursion > 10 mm) [15]. In our study 14% patients have atrial septal aneurysm and 8% patients have fenestrated ASD.

Conclusion

There is considerable variation in atrial septal defect anatomy. A small proportion of patients with an ASD have more than one defect. Echocardiography plays a critical role for patient selection, guidance, and post-deployment evaluation for transcatheter closure of ASDs. Understanding the echoanatomic correlation by Transesophageal echocardiography is perhaps the most essential requisite to ensure a successful procedure. Defects in adult patients are large and morphologically variable. Because others have demonstrated growth of ASD II over time, we presume that in some patients, defect growth is associated with attenuation or even disappearance of defect rims causing changing defect morphology with increasing defect size. Therefore, evaluation of patients having ASD II should be performed in childhood to afford as many patients as possible the advantages of percutaneous treatment. TEE is mandatory for precise evaluation of ASD II size and morphology.

Bibliography

1. Silvestry FE., *et al.* "Echocardiographyguided interventions". *Journal of the American Society of Echocardiography* 22.3 (2009): 213-231.

2. Zabal C., *et al.* "Percutaneous closure of an interatrial communication with the Amplatzer device. The first case in Mexico". *Archivos del Instituto de Cardiología de México* 68.2 (1998):147-152.

3. Boccalandro F., *et al.* "Comparison of intracardiac echocardiography versus transesophageal echocardiography guidance for percutaneous transcatheter closure of atrial septal defect". *The American Journal of Cardiology* 93.4 (2004): 437-440.

4. Cooke JC., *et al.* "Echocardiologist's role in the deployment of the Amplatzer septal occlude device in adults". *Journal of the American Society of Echocardiography* 14.6 (2001): 588 -594.

5. Podnar T., *et al.* "Morphological variations of secundum-type atrial septal defects: feasibility for percutaneous closure using Amplatzer septal occluders". *Catheterization and Cardiovascular Interventions* 53.3 (2001): 386-391.

6. McMahon CJ., *et al.* "Natural history of growth of secundum atrial septal defects and implications for transcatheter closure". *Heart* 87.3 (2002): 256-259.

7. Prokselj K., *et al.* "Echocardiographic characteristics of secundum-type atrial septal defects in adult patients: implications for percutaneous closure using Amplatzer septal occluders". *Journal of the American Society of Echocardiography* 17 (2004): 1167-1172.

8. Shanewise JS., *et al.* "ASE/SCA guidelines for performing a comprehensive intraoperative multiplane transesophageal echocardiography examination: recommendations of the American Society of Echocardiography Council for Intraoperative Echocardiography and the Society of Cardiovascular Anesthesiologists Task Force for Certification in Perioperative Transesophageal Echocardiography". *Anesthesia and Analgesia* 89 (1999): 870-884.

9. Denault AY. "Transesophageal echocardiography multimedia manual: a perioperative transdisciplinary approach". New York. Taylor and Francis (2005): 581.

10. Li GS., *et al.* "Reliability of transthoracic echocardiography in estimating the size of Amplatzer septal occluder and guiding percutaneous closure of atrial septal defects". *Chinese Medical Journal* 121.11 (2008): 973-976.

11. Li GS., *et al.* "Safety and efficacy of transcatheter closure of atrial septal defects guided by transthoracic echocardiography: a prospective study from two Chinese Medical Centers". *Ultrasound in Medicine and Biology* 35.1 (2009): 58-64.

12. Huang CF., *et al.* "Transcatheter closure of atrial septal defects with superior-anterior rim deficiency using Amplatzer septal occlude". *Journal of the Formosan Medical Association* 106.12 (2007): 986-991.

13. Lin SM., *et al.* "Supplementing transesophageal echocardiography with transthoracic echocardiography for monitoring transcatheter closure of atrial septal defects with attenuated anterior rim: a case series". *Anesthesia and Analgesia* 96.6 (2003): 1584-1588.

14. Du ZD., *et al.* "Comparison of transcatheter closure of secundum atrial septal defect using the Amplatzer septal occluder associated with deficient versus sufficient rims". *American Journal of Cardiology* 90.8 (2002): 865-869.

15. Pedra CA., *et al.* "Transcatheter closure of secundum atrial septal defects with complex anatomy". *Journal of Invasive Cardiology* 16.3 (2004): 117-122.

Volume 6 Issue 10 October 2019