Percutaneous Closure of Ostium Secundum Atrial Septal Defects with Amplatzer Device in Middle-Aged Competitive Female Athlete: The Role of Echocardiography and Brief Review of Literature

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Abstract

Echocardiography is the most widely used method for assessing left and right ventricular function, valvular disease and cardiac abnormalities. Echocardiography is a specific tool for screening of competitive athletes. Focused echocardiography by non-cardiologist sports medicine physicians could also evaluate conditions that are prevalent among athletes, such as congenital heart disease, but very difficult to detect on the basis of current screening strategies. This case report describes the late diagnosis of nonrestrictive ostium secundum atrial septal defects with moderate left to right shunt in a 40-year-old amateur female cyclist that required early closure with Amplatzer percutaneous device. Twelve months after the percutaneous intervention the athlete underwent a new evaluation for sports prepartecipation, following which she returned to take part in competitive races. Patients treated surgically or by percutaneous intervention, six-twelve months after repair and clinical and laboratory evaluation with no evidence of symptomatic arrhythmias or myocardial dysfunction, are allowed to practice any competitive sport.

Keywords — Atrial Septal Defect (ASD), Echocardiography, Amplatzer Device, Athlete

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I. INTRODUCTION

Atrial septal defect (ASD) is the most common congenital lesion in adults after bicuspid aortic valve. ASD may go unrecognized for decades because symptoms are mild or absent and physical signs are subtle.¹ Although the defect is often asymptomatic until adulthood, potential complications of an undetected ASD include atrial arrhythmias, paradoxical embolization, cerebral abscess, right ventricular failure, and pulmonary hypertension that can become irreversible and lead to right-to-left shunting (Eisenmenger syndrome). Most patients are asymptomatic, with indication of surgical or percutaneous intervention in the first years of life.² The increase in left-to-right shunting with age in many patients with uncorrected moderate to large ASDs increases the likelihood of developing symptoms. It is estimated that most patients with an ASD and significant shunt flow (ie, pulmonary to systemic flow (Qp/Qs) more than 2:1) will be symptomatic and require closure of the defect by the age of 40. However, many patients become symptomatic and require closure at older ages.³ ⁴

The Congenital Heart Disease Task Force for the 36th Bethesda Conference on Eligibility Recommendations for Competitive Athletes with Cardiovascular Abnormalities⁵ made several recommendations for athletes with ASD:

1. Those with a small ASD, normal right heart volume, and no pulmonary hypertension can participate fully.
2. Those with a large ASD and no pulmonary hypertension can participate fully.
3. Those with an ASD and mild pulmonary hypertension can participate in low-intensity sports. Any athlete with ASD and associated cyanosis and large right-to-left shunt cannot participate in competitive sports.
4. After a satisfactory recovery, athletes can participate fully after ASD repair (device closure or surgical) after a period of six months.
5. After ASD closure, if an athlete has pulmonary hypertension, arrhythmias, heart block, or impaired heart function, there must be an individualized approach to the issued of continued participation.

The indications for closing the ASDs were: a) Sizable defects with shunt (Qp/Qs) >1.5/1; b) right heart volume overload; and c) development of symptoms. The patient selection for percutaneous closure was based on the morphology of the defect as well as the presence of a sufficient rim around it, particularly at the inferior and posterior parts of the defect.

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Non-restrictive Ostium Secundum Atrial Septal Defect with moderate left-to-right shunt

Figure 1. Panel A Subcostal 4 chamber view / Panel B zoom on Apical 4 chamber view showing an atrial septal defect (arrows) prior to percutaneous closure. Panel A showing an echo free space in the mid of interatrial septum suggestive per ASD; in Panel B Color Flow Doppler showing a typical pattern of predominant left-to-right shunting as seen with ASD (the flow arising from right upper pulmonary vein into left atrium and left-to-right shunt across fossa ovalis atrial septal defect).

The assessment was performed using a transesophageal echocardiogram (TEE), either two-dimensional (2D TEE) or real time three-dimensional (RT 3D TEE) for the last 32 patients.6 The incidence of percutaneous closure of secundum atrial septal defects (ASD) and patent foramen ovale (PFO), which has become an established therapy, is constantly increasing.7 One of the devices that have received FDA approval for percutaneous closure of ASD and PFO are the Amplatzer devices. At present, these devices are the most commonly used devices for percutaneous closure of ASD8 and the results are quite encouraging.9 Here the author describes and illustrates the diagnosis, management and follow up of a competitive athlete suffering from a non-cyanotic congenital heart disease, ie ostium secundum non-restrictive atrial septal defect that required the timely closure with percutaneous Amplatzer device.

II. OUR EXPERIENCE

A 40-year-old female athlete practicing cycling came to our sports cardiology center to get screened for pre-competitive sports. In previous years she had always been considered suitable for competitive sport by cardiologists and sports medicine physicians. The family history was negative for heart disease and sudden death. The physical examination, however, revealed the presence of a fixed split S2, and a 3/6 holosystolic murmur, along the left sternal edge. No other abnormalities were found on examination. Resting electrocardiogram showed a right bundle branch block and signs of right atrial dilatation, while exercise stress testing was negative for ischemic ECG changes or arrhythmias. A subsequent Two Dimensional Trans Thoracic (2D TT) echocardiogram showed an echo-free space in the mid portion of the atrial septum (figure 1 Panel A; see arrow) suggestive for nonrestrictive ostium secundum atrial septal defect about 13.9 mm.

Color flow imaging confirmed that the echo-free space is a true tissue defect with moderate left to right shunt (Figure 1 Panel B; see arrow - Video 1-2) visualized in multiple echocardiographic view. Pulsed Doppler imaging demonstrated low flow velocity (Figure 2 Panel B), left to right flow extending from mid-systole to mid-diastole, with a second phase of flow coincident with atrial systole. The echocardiogram also showed the presence of a moderate mitral regurgitation, while the global systolic function was preserved with normal ejection fraction of the left ventricle. The right heart chambers instead appeared slightly dilated for volume overload (Figure 2 Panel A) and a tricuspid regurgitation with PAPs about 40 mmHg was evident. The magnitude of the shunt was estimated by the calculation of pulmonary and systemic cardiac output with Qp/Qs ratio > 1.5:1. Given the significant secundum atrial septal defect in an athlete with right volume overload due moderate left to right shunt, the patient underwent successful atrial septal defect closure with percutaneous implantation of Amplatzer device (ASO St. Jude Medical, Device Size/ Waist Diameter 16 mm, Waist Length 4mm).

Percutaneous intervention was a complete success and no complications occurred. Twelve months later the athlete requested medical check-up for sports prepartecipation screening. The athlete underwent follow-up cardiovascular examination with 2D TT echocardiogram, which showed a perfect placement of the Amplatzer occluding device (see Video 3-5), well positioned within the ASD with equal distribution of the retention discs around the ASD for stability, with no residual shunt (Video 4).
Figure 2: Panel A showing enlarged right ventricle; Panel B showing low flow velocity with pulsed Doppler imaging.

The echo examination showed also a decrease of the size of the right heart chambers and residual mitral regurgitation. Trivial tricuspid regurgitation was present with normal PAPs. Resting ECG and ECG exercise stress testing was normal, therefore the athlete was considered eligible for competitive sports.

III. DISCUSSION

Atrial septal defect is the most frequently encountered major congenital cardiac disorder in the adult population, with a prevalence of 0.2 to 0.7 per thousand.10 Most (75%) are ostium secundum defects; the remainder are ostium primum (20%), sinus venosus defects (<5%), and the rare coronary sinus (<1%). Patients often present late symptoms in life and physical findings may go undetected.11 Ostium secundum atrial septal defects are among the most common congenital cardiac malformations in adults and account for 30% to 40% of patients over 40 years of age who have not undergone an operation.12

Patients often survive to advanced age, but life expectancy is not normal. The typical natural history involves the onset of atrial fibrillation, with an incidence ranging from 13 to 52 percent among patients older than 40, as well as the progression of pulmonary arterial hypertension in up to 53 percent of patients, which results in congestive heart failure and functional limitation.13 Patients with hemodynamically significant shunts and/or symptoms who meet current criteria should be referred for closure (surgical or percutaneous) of their defect.14-15

Hemodynamically insignificant atrial septal defects (Qp/Qs < 1.5) do not require closure; however, if the patient has had a stroke secondary to paradoxical embolism such defect can be closed to prevent another stroke. Significant atrial septal defects i.e. Qp/Qs > 1.5 or associated with right ventricular volume overload, should be closed if closure criteria are met. There is an improvement in exercise capacity in asymptomatic and mildly symptomatic adults after atrial septal defect closure.16 A recent study, which included 151 patients who underwent successful percutaneous closure of a secundum ASD, showed good long-term results (complete closure of the defect, with consistent results, free of death or significant complications, at three-year follow up).17

A Canadian study published in 2005 showed a sustained improvement of left and right ventricular function following percutaneous closure as well as reduction of the left atrial size.18 Another recent study, concerning the four-year follow up of 103 patients who underwent percutaneous ASD closure with Amplatzer device, showed a very low rate of immediate and long term complications.19 Here the authors report a case of Grown Up Congenital Heart disease (GUCH) with late diagnosis of ostium secundum atrial septal defects that was detected during sports prepartecipation screening for cyclism in a 40-year-old competitive female athlete. There is no consensus in literature about which tests are required for pre-participation evaluation in athletes. Unfortunately echocardiogram is not always part of the diagnostic resources.

The American Heart Association recommends only examination of medical history (family and personal history) and clinical examination while the consensus of the European Society of Cardiology includes 12-lead electrocardiogram preferably performed by a specialist in cardiology or sports medicine. In Italy, since 1982, there has been a specific federal legislation requiring the implementation of prior medical evaluation for all competition athletes, but only in 1994 the echocardiogram was added to the assessment for only professional soccer players, boxers and cyclists.20-21 Echocardiography is the most widely used method for assessing left and right ventricular function, valvular disease and cardiac abnormalities.22 Echocardiography is a specific tool for screening of competitive athletes. Focused echocardiography by non cardiologist sports medicine
physicians could also evaluate conditions that are prevalent among athletes, such as congenital heart disease, but very difficult to detect on the basis of current screening strategies. On the other hand, athletes with cardiovascular abnormalities continue to go undetected, leading to frequent cases of sudden death or irreversible cardiac damage. As Maron reports that “is necessary to answer how athletes should be effectively screened for cardiovascular pathology” a response is certain: although there are cost-effectiveness issues, echocardiography is a valuable non invasive method for differentiating cardiac pathologies from the athlete’s heart and the only practical way to detect abnormalities that escape from the routine tests. Echocardiography plays an integral role in the diagnosis and management of atrial septal defects.

IV. CONCLUSIONS
Despite the consensus that routine cardiovascular screening for athletes is warranted, there is ongoing debate regarding the specific components of sports pre-participation screening that should be incorporated. First of all, this case report discusses and confirms the importance and usefulness of echocardiogram in the setting of sports medicine. In particular, the early diagnosis of this disease is hardly detectable by routine tests as required by international guidelines. Apparently, this report does not seem to add anything to the current literature, however, the novelty lies instead in both the late diagnosis with echocardiography examination of atrial septal defect previously unrecognized by other colleagues devoted to screening of pre-competitive sports. In particular, this report shows how sports cardiology center of first level is able to manage the clinical course in GUCH athletes who are sent to a cardiology center of excellence for the best treatment.

V. APPENDIX
This article contains the following supplementary information:
Video 1: 2D TT echocardiogram in apical 4 chamber view showing left to right shunt across ostium secundum ASD and moderate mitral regurgitation, both magnified in Video 2.
Video 2: magnification of Video 1.
Video 3: Follow up with 2D TT echocardiogram in apical 4 chamber view showing a Amplatzer device in situ with both disks flat and parallel.
Video 4: 2D TT subcostal 4 chamber view showing a well-seated Amplatzer device without residual interatrial shunt at Color Doppler imaging.
Video 5: 2D TT modified parasternal long axis view showing right ventricle inflow: note the acoustic shadow cast by the Amplatzer device and seen in the right atrium.

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