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Case Report

Atrial Septal Defect with Paroxysmal Atrial Tachyarrhythmia in Middle Age Soldier Patient: A Case Report

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ABSTRACT

Background: Atrial septal defects (ASDs) are frequently asymptomatic and can remain undiagnosed until adulthood. Atrial tachyarrhythmias are not uncommon seen in patients with ASDs. Atrial fibrillation and atrial flutter are relatively rare in childhood, but become more prevalent with increasing age at time of repair or closure. **Case Summary:** The present case was an active duty 50-year-old male soldier, referred to the arrhythmia division of Gatot Soebroto Army Hospital with palpitations and physical intolerance. Holter examination and electrophysiology study revealed atrial tachyarrhythmias. Transesophageal echocardiography was performed before radiofrequency catheter ablation, and unexpectedly found left to right shunt ostium secundum ASD. Right heart catheterization confirmed left to right shunt ASD with high flow-low resistance. He then underwent paroxysmal atrial tachyarrhythmias catheter ablation, followed by percutaneous transcatheter ASD closure using occluder device without fluoroscopy within six months. Both the procedures went well without any complications. His symptoms had improved during follow up, although he had episode of rapid paroxysmal atrial fibrillation on holter evaluation six months later. **Conclusion:** We conclude that ASD closure is still recommendable even in late middle age patients combined with arrhythmias management.

Highlights:

1. ASD closure is still recommendable in late middle-aged patients, especially one that is combined with arrhythmias management.
2. ASD closure after age 40 seems to not affect the frequency of arrhythmia development during follow up.

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Introduction

Atrial septal defect (ASD) represents a direct communication between right atrial (RA) and left atrial (LA) has a unique slow clinical progression. Ostium secundum type ASD (ASD II) as characterized by a communication at the level of fossa ovalis is the most frequent type, representing 80% of ASDs diagnosed [1]. Isolated ASDs represent about 7% of all cardiac anomalies and can be diagnosed at any age [2]. Patients may be asymptomatic into their fourth and fifth decade [3], and sometimes found incidentally on imaging studies. For this reason, many individuals can be undiagnosed early in life and will be able to serve in the military.

However, majority of the ASDs patient will develop symptoms including reduced functional capacity, exertional shortness of breath, and palpitations (supraventricular tachyarrhythmias), and less frequently pulmonary infections and right heart failure [4]. One of the major sources of morbidity are atrial tachyarrhythmias (ATs). ATs define as atrial fibrillation (AF), atrial flutter (AFL) and supraventricular tachycardias (SVTs). In patients above the age of 40 with unrepaired ASDs, the rate of ATs is even higher, with one study reporting the prevalence as high as 19% [5], which itself may be an underestimation.

Percutaneous closure has lately become the primary treatment option for ASD II, and according to European Society of Cardiology (ESC) guidelines, should be the therapy of choice when anatomical conditions are favorable [1]. The association between percutaneous ASD closure and atrial arrhythmias is controversial. On the one hand, reverse atrial remodeling after closure might lead to a decreased chance of supraventricular arrhythmias [6]. On the other hand, the presence of a closure device has a possible pro-arrhythmogenic effect. [7]

Case Presentation

A 50-year-old male presented to the arrhythmia division of Gatot Soebroto Army Hospital for evaluation. An active-duty soldier, he had noted episodic palpitations and a gradual decrease in exercise tolerance in one month. There were no chest tightness or respiratory symptoms. Physical examination revealed regular pulse 70 beats/min, blood pressure 120/70 mmHg. There was fixed splitting second heart sound, without any audible heart murmur. Patient's resting electrocardiograph (ECG) and chest X-ray posteroanterior view are shown in figures 1 and 2 respectively. Initial transthoracic echocardiography (TTE) was unremarkable. Laboratory examination was within normal limits including thyroid function. He underwent a Holter examination, followed by electrophysiology (EP) study.

The result was paroxysmal narrow complex tachycardia with long accessory pathway et causa atrial tachyarrhythmia (AT), abnormal sinoatrial (SA) node intrinsic function, and normal atrioventricular (AV) conduction. The patient was taken for diagnostic cardiac catheterization, coronary angiogram showed non obstructive coronary artery disease. Transesophageal echocardiography (TEE) was performed prior to the radiofrequency catheter ablation as the next intended procedure. Unexpectedly it revealed 13 mm ASD II left to right shunt (figure 3) with *adequate rims size*; RA and LA dilatation. Right heart catheterization (RHC) showed an oxygen step-up at the atrial level. The calculated flow ratio (FR) was 1.6, pulmonary arteriolar resistance index (PARi) was 1.8 WU, and pulmonary vascular resistance to systemic vascular resistance ratio (PVR/SVR) was 0.04.

Patient was diagnosed an ASD II left to right shunt, high flow-low resistance, and paroxysmal AT. First, he had ectopic atrial arrhythmia ablation procedure. Six months later percutaneous transcatheter ASD closure using occluder device was performed without fluoroscopy. The procedures went well without any complications. According to patient, his symptoms had improved, and he could go back to work. He had Holter monitor evaluation six months after the ASD closure, it showed episode of rapid paroxysmal AF. Follow up TTE examination one month and one year after the procedure showed normal heart chambers dimension without residual ASD.

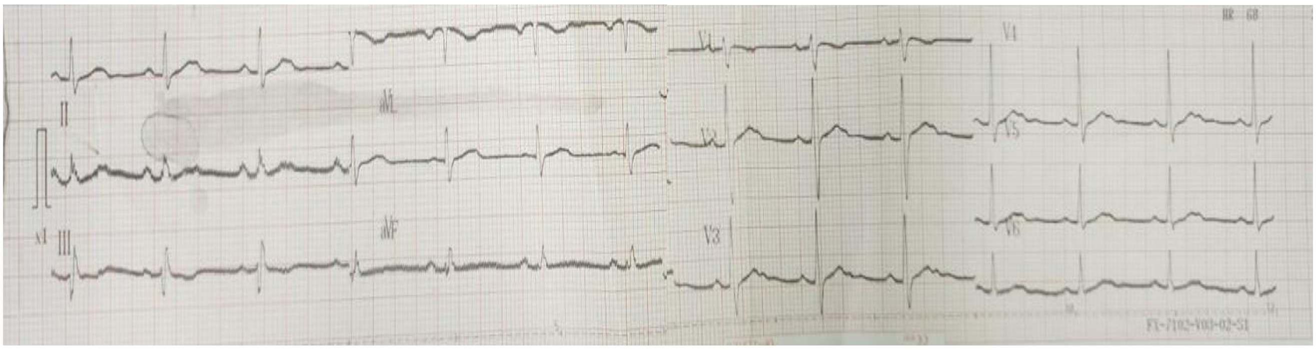

Figure 1. Normal resting ECG

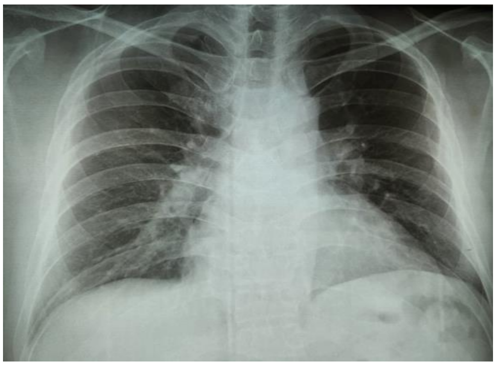

Figure 2. Chest X-ray P/A view showing mild cardiomegaly with prominent right pulmonary artery.

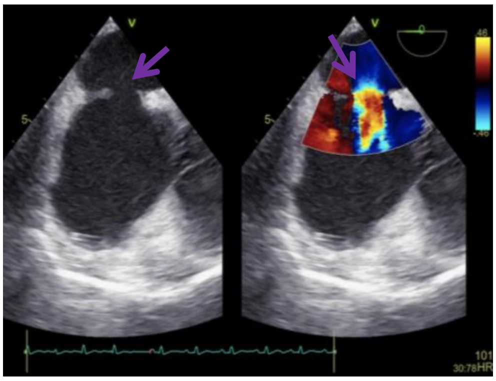

Figure 3. Transesophageal echocardiography showing secundum ASD left to right shunt.

Discussion

Atrial septal defect can remain undiagnosed until adulthood. ASD types include secundum ASD (80% of ASDs; located in the region of the fossa ovalis and its surrounding). The shunt volume depends on right ventricle/left ventricle (RV/LV) compliance, defect size, and LA or RA pressure. A simple ASD results in left to right shunt because of the higher compliance of the RV compared with the LV (relevant shunt in general with defect sizes ≥10 mm), and causes RV volume overload and pulmonary over circulation [1]. A unique feature of ASD is its slow clinical progression with most children and young adults being free of symptoms, contributing to late diagnosis; hence, ASD represents the most common congenital heart disease (CHD) diagnosed in adulthood, accounting for 25–30% of new diagnoses [8]. Thus, it is important for all cardiologists to have a solid foundation of the basic pathophysiology and management of CHD and understand when to make a referral. Besides that, as many forms of simple or maybe moderate-complexity CHD can be asymptomatic at younger age, many such individuals will be able to serve in the military [9]. When symptoms occur, patients often first notice dyspnea, fatigue, exercise intolerance, or palpitations [10]. Some patients may present with syncope or even with peripheral edema from overt right heart failure and others may develop recurrent pulmonary infections [11]. ATs, including AF and AFL, are present preoperatively in about one-fifth of adults with ASDs [12]. Our patient had only one month history of palpitations and physical intolerance.

In adults, an ASD may not be initially considered in the different diagnosis because there is considerable overlap in symptoms. TTE is one of the main initial tests for the evaluation of patients with this constellation of symptoms. The guidelines recommend diagnosing an ASD by demonstration of shunting across the interatrial septum, with evaluation of the right heart and for associated abnormalities [10]. However, the interatrial communication may remain undiagnosed unless there is a high index of suspicion. As with other diagnoses, the sensitivity of echocardiography depends on the echo machine, acoustic windows, ultrasonographer, and echo reader. TEE provides higher definition visualization of the interatrial septum, it can more precisely assess the size of an ASD and guide procedural planning [11]. TEE provides a better appreciation of cardiac anatomy and hemodynamic evaluation than TTE in patients with ASD [12]. Because our patient is a male active duty officer in his fifties, he was not suspected of having a CHD and underdiagnosed in the first place.

The primary indication for ASD closure is a hemodynamically significant shunt (i.e. one that cause RA or RV enlargement), irrespective of age and symptoms, unless severe and irreversible pulmonary arterial hypertension (PAH) is present[1,13]. Available approaches to ASD II closure include percutaneous device closure and surgical closure. Surgical closure is reasonable when the anatomy of the defect is not amenable to a percutaneous approach or when concomitant tricuspid valve repair or replacement is planned. For those who have an ostium primum, sinus venosus ASD, or coronary sinus defect, surgery is the recommended technique [11]. Surgical repair has low mortality <1% in patients without significant comorbidity, and good long-term outcome when performed early (childhood, adolescence) and in the absence of pulmonary hypertension (PH) [13]. A percutaneous approach is preferred when the anatomy of the defect is suitable as it avoids the need for cardiopulmonary bypass, cardioplegia, thoracotomy, sternotomy and related bleeding, or central nervous system complications, while carrying a cosmetic advantage, also allowing a shorter hospital stay with faster rehabilitation [11,14]. A meta-analysis study suggests transcatheter ASD closure resulted safer in terms of in-hospital mortality, perioperative stroke, and post-procedural AF compared to traditional surgery [15]. Percutaneous closure of ASD II under fluoroscopic guidance is now considered a routine procedure. Studies using a variety of devices have reported good success and low complication rates in children and adults, even in the elderly. [16,17]

A low dose of radiation exposure during fluoroscopy can be achieved for transcatheter ASD closure even in complex ASDs by reduction of frame rate, avoidance of lateral view and cine acquisition, and limitation of fluoroscopic time by avoiding unnecessary maneuvers and using echocardiographic guidance as much as possible [18]. But it has been suggested that echocardiography alone could be used to guide device placement. TEE or TTE without fluoroscopy have been used successfully to guide peratrial or periventricular repair of ventricular septal defects [19]. Some studies have reported the use of TEE or TTE to guide percutaneous ASD closure without fluoroscopy [19,20]. The first successful transcatheter closure of ASD II using TEE fluoroscopy-free technique in Indonesia was held by Prakoso R, et al in 2018 [21]. Percutaneous ASD closure under TEE guidance alone is an effective and safe procedure. Nevertheless, the distance to the mitral valve must be considered carefully because it can complicate the procedure if the distance is too short. A potentially important advantage of TEE-guided percutaneous closure over fluoroscopy-guided closure is that it avoids exposure to radiation and contrast agents. In addition to reducing the risks for the patient, TEE-guided percutaneous closure without fluoroscopy also prevents radiation to the medical staff and avoids the need for heavy lead clothing. [22]

The chronic left-to-right shunt associated with ASDs leads to increased hemodynamic load and geometric remodeling, both at a cellular and macroscopic level. This is most commonly seen in the RA and RV, but has also been described in left heart structures [17,23]. Furthermore, this chronic volume stress leads to the electrical remodeling that may precipitate development of arrhythmias. Atrial myocyte electrophysiologic properties are altered, with increased intra-atrial conduction time a common finding, likely from combination of interstitial fibrosis and chamber enlargement [24,25]. Sinus node conduction properties may also be as altered, even in the pre-operative state [25,26]. ATs are commonly seen in patients with ASDs, regardless of ASD type. AFL and AF are relatively rare in childhood, but become more prevalent with increasing age at time of repair or closure [17]. AFL and AF in patients with ASDs may be treated in similar fashion to the general population, with appropriate consideration for rhythm control strategies with anti-arrhythmic medications and electrical cardioversion as indicated. [23]

Appropriate anti-coagulation guidelines should also be followed [27]. All patients with symptoms consistent with potential arrhythmias should be referred for EP assessment prior to ASD closure, and assessed with at least a 24-hour Holter ECG monitoring. If indicated, any EP study with or without ablation must be performed before device implantation as this will make access to the LA more complicated afterwards, although still feasible.[28]

Closure of an existing ASD, in isolation, is generally insufficient to abolish an existing AT and catheter ablation should be considered before defect closure [29]. Ablation procedures have inconsistent medium-term results in patients with documented atrial arrhythmia prior to device closure with about 50% having symptomatic arrhythmia on follow-up. [30]

However, this should not preclude ablation procedures wherever possible**.** Surgical treatment of ASD, which had been the only treatment method for more than 45 years, may be associated with the occurrence of rhythm disorders such as AF or SVT, although some authors noted a reduction in supraventricular arrhythmic burden after closure. [31]

As a treatment option, percutaneous ASD II closure is also associate with this. A prospective study showed transcatheter closure of ASD II does not reduce arrhythmia that appears prior to ASD closure [32]. It is associated with a transient increase in supraventricular premature beats and a small risk of AV conduction abnormalities and paroxysmal AF in early follow-up. Larger device size and longer procedure time are associated with increased risk of supraventricular arrhythmia on early follow-up. [33]

Atrial septal defect closure after the age of 40 years appears not to affect the frequency of arrhythmia development during follow-up. However, the patient's morbidity benefits from closure at any age (exercise capacity, shortness of breath, right heart failure), particularly when it can be done by catheter intervention [32]. The remodelling process and associated increase in cardiopulmonary function commence immediately after closure and continue for several years [34]. Decreased RV volume improves ventricular interaction and LV filling. Subsequent increase in LV stroke volume and cardiac output is probably the main mechanism behind the improvement of exercise capacity after closure. These effects occur in patients of all ages, both symptomatic and asymptomatic [35]. This supports timely closure of sizeable ASD II, regardless of age and symptoms [36]. Patients who have had percutaneous ASD device closure should have an TTE performed at 24 hours to assess for device malposition, residual shunt, and pericardial effusion. Repeat TTE is recommended at 3, 6, and 12 months. A routine clinical follow-up and TTE should be done every 1 to 3 years thereafter. [37]

Following closure of ASD, other considerations arise for evaluation and treatment of ATs. Incidence of ATs is decreased post-closure, but recurrence rate may still be significant, particularly in patients who underwent ASD closure at older age, had larger shunts, or with other comorbidities [23,25,30]. It is therefore advisable to conduct a thorough follow-up after ASD II closure, including ECG monitoring, especially in the early post-procedural period. [33]

In this case report, our patient had arrhythmia catheter ablation after was uncovered AT on Holter examination and EP study. He had percutaneous transcatheter ASD II closure without fluoroscopy procedures six months later, because of many considerations which had been mention above. He stated a physical improvement after the procedures, and was able to carry out activities as before.

However, this case report had a limitation because the absence of an objective assessment for patient's quality of life. We did not perform the 6-minute walking test (6MWT) as an assessment of the functional capacity or other cardiopulmonary exercise test. Because he is still at risk of having heart rhythm disturbances in the future, he should have a thorough follow-up periodically.

Conclusion

Atrial septal defect as a common congenital heart disease in adult is still undersuspicious and can remain undiagnosed. Early diagnosis and follow-up of ASDs offers the best opportunity to avoid late complications

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