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Iatrogenic Arteriovenous Fistula and Atrial Septal Defect Following Cryoballoon Ablation for Atrial Fibrillation – Two Correctable Causes of Right Heart Failure

Authors' Contribution:
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Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
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Conflict of interest: None declared

Patient: Female, 61
Final Diagnosis: Iatrogenic arteriovenous fistula and atrial septal defect following cryoballoon ablation for atrial fibrillation
Symptoms: Exercise intolerance • exertional dyspnea • peripheral edema
Medication: —
Clinical Procedure: Catheter ablation for persistent atrial fibrillation, corrective surgery for arteriovenous fistula
Specialty: Cardiology

Objective: Diagnostic/therapeutic accidents

Background: Catheter ablation for atrial fibrillation is an important therapeutic intervention. One of the most frequent complications of this procedure is vascular issues including arteriovenous fistula. Iatrogenic atrial septal defect (IASD) has been reported as a complication of transseptal puncture; however, no data are available demonstrating any coexistent of arteriovenous fistula with IASD.

Case Report: A 61-year-old female patient was admitted to our center for catheter ablation for persistent atrial fibrillation. Her past medical history was significant for cryoballoon ablation for atrial fibrillation in 2015, which was subsequently complicated by hematoma and arteriovenous fistula at puncture site. After general surgery consultation, the patient was qualified for conservative treatment. To exclude left atrial thrombus before redo procedure, transesophageal echocardiography was performed which visualized the presence of 9-mm atrial septal defect with left-to-right shunting, detecting right-to-left shunting using Valsalva maneuver. No significant valvular abnormalities were identified. The next day, pulmonary vein isolation for atrial fibrillation was performed. One month later, a control transthoracic echocardiogram (TTE) revealed hemodynamic significant left-to-right shunting with Qp/Qs 2.0 and high probability of pulmonary hypertension. Vascular surgery for arteriovenous fistula was successfully performed in October 2018. Subsequent TTE, performed a month later, confirmed no left-to-right shunting and no signs of pulmonary hypertension or diminishment of the right atrium.

Conclusions: Vascular access during catheter ablation for atrial fibrillation may result in arteriovenous fistula. This condition might affect right atrium pressure leading to increased diameter of previous puncture site at the interatrial septum, causing IASD with significant shunting. In this group of patients, arteriovenous fistula should be treated as soon as possible.

MeSH Keywords: Arteriovenous Fistula • Atrial Fibrillation • Catheter Ablation • Heart Septal Defects, Atrial

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Background

Since the initial discovery of triggers in the pulmonary veins in atrial fibrillation pathogenesis, catheter ablation for atrial fibrillation became a commonly performed procedure to cure atrial fibrillation [1]. When ablation for atrial fibrillation is performed in experienced centers, the treatment is more effective than antiarrhythmic drug therapy. The frequency of complications resulting from this procedure varies widely. Most studies suggest complication rates of between 1% and 8%, including phrenic nerve injury, pericardial effusion, deep vein thrombosis, arteriovenous fistula (AVF), atriopharyngeal fistula, major bleeding, stroke, or death [1–8]. The most frequent are vascular complications. Probably, the prevalence of vascular complication reflects both the number and the size of venous sheaths placed in the setting of intense anticoagulation prior to and following the ablation procedures. In addition, a lack of ultrasound guidance for venous access also increases the risk of accidental artery puncture [9]. Most vascular complications are managed conservatively; however, some require surgical intervention [10]. Catheter ablation for atrial fibrillation requires left atrial access using a transseptal puncture (TsP) which may be further complicated by the development of an iatrogenic atrial septal defect (IASD), high incidence of which has been shown especially with placement of 2 catheters across a single TsP site resulting in interatrial shunting through IASD [11,12]. Usually, these defects close spontaneously but occasionally may cause problems.

Case Report

A 61-year-old female patient was admitted to our hospital in order to perform catheter ablation for persistent atrial fibrillation. Her past medical history was significant for an ineffective cryoballoon ablation for atrial fibrillation in 2015, which was further complicated by hematoma and AVF at the sheath puncture site in the right groin (Figure 1). After general surgeon consultation, the patient was qualified to conservative treatment; however, the situation remained unchanged up to 2018 due to an unwillingness by the patient to undergo any invasive procedures despite symptoms related to atrial fibrillation and right-side heart failure (peripheral edema). Before a redo procedure, transesophageal echocardiography (TEE) was performed which excluded left atrial thrombus but an additional TEE indicated the presence of a 9-mm atrial septal defect with left-to-right shunting. Right-to-left shunting was also detected using a Valsalva maneuver, but no significant valvular abnormalities were identified at that time (Figure 2A, 2B). The next day, pulmonary vein isolation for atrial fibrillation was performed using radiofrequency technique and point-by-point approach. Vascular access was achieved using both femoral veins, facilitated by ultrasound visualization. TsP was not

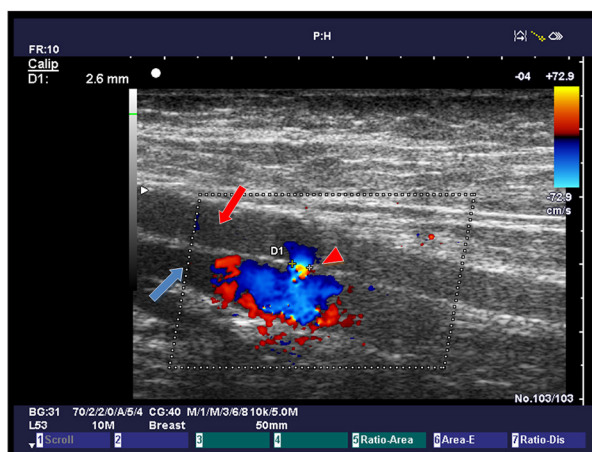


Figure 1. Arteriovenous fistula. Diameter of A-V (D1). Femoral vein (blue arrow). Femoral artery (red arrow). Place of connection of artery wall with vein wall (red arrow head).

necessary, due to the existence of IASD and easy access with long sheaths. The IASD was revealed at the beginning of the procedure using intracardiac echocardiography probe. Firstly, the pulmonary veins were checked and 3 remained isolated whereas the right inferior pulmonary vein was not isolated. This vein was subsequently re-isolated using radiofrequency energy. The low potential area was depicted with a PentaRay catheter and confidence mapping module (Biosense Webster, Diamond Bar, CA, USA) on the posterior wall of the left atrium. Ablation in that area resulted in sinus rhythm restoration and no complications were observed in the post-procedure period. Control transthoracic echocardiogram (TTE) was performed and showed slightly accelerated pulmonary artery flow velocity (Qp/Qs 1.3), a dilated inferior vena cava, and mild pericardial effusion (6 mm max). A control TTE, performed 1 month later, revealed hemodynamic significant left-to-right shunting with Qp/Qs 2.0, a high probability of pulmonary hypertension: tricuspid regurgitation with peak velocity 2.9 m/s, dilated pulmonary trunk with short acceleration time (90 ms), and dilated inferior vena cava (24 mm) (Figures 3A, 4A). The patient remained in sinus rhythm during that time and, occasionally, junction rhythm was observed. Because of the coexistence of AVF with IASD at the place of TsP causing left-to-right shunting, the patient was qualified first to surgery for AVF. Corrective surgery for AVF was performed in October 2018 in the tertiary vascular surgery department. The effectiveness of the procedure was confirmed with a control ultrasound examination. The subsequent TTE, 1 month after fistula closure, did not show any interatrial shunting provided normalization of right heart chamber's size was depicted (Figures 3B, 4B).

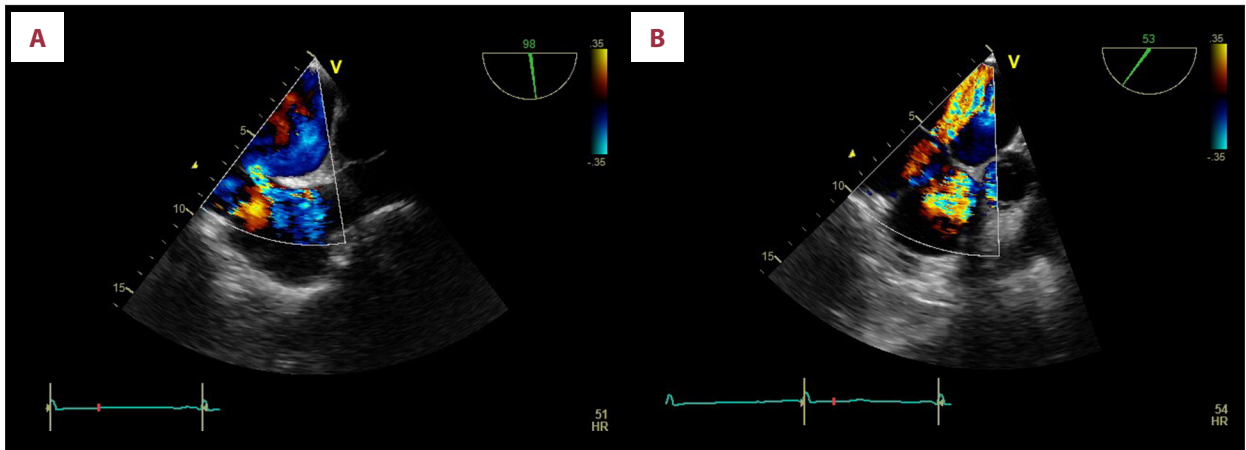


Figure 2. (A, B) Iatrogenic atrial septal defect on transesophageal echocardiography. Color flow Doppler demonstrates a left-to-right shunt.

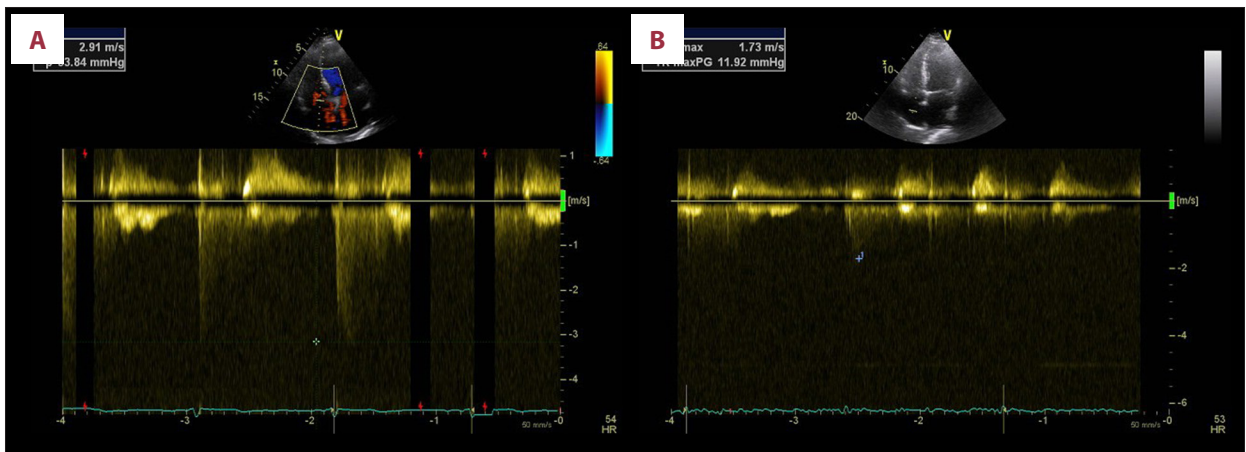


Figure 3. (A) Transesophageal echocardiography before vascular surgery. Moderate tricuspid valve regurgitation with peak velocity 2.9 m/s. (B) Small tricuspid valve regurgitation with peak velocity 1.7 m/s after vascular surgery.

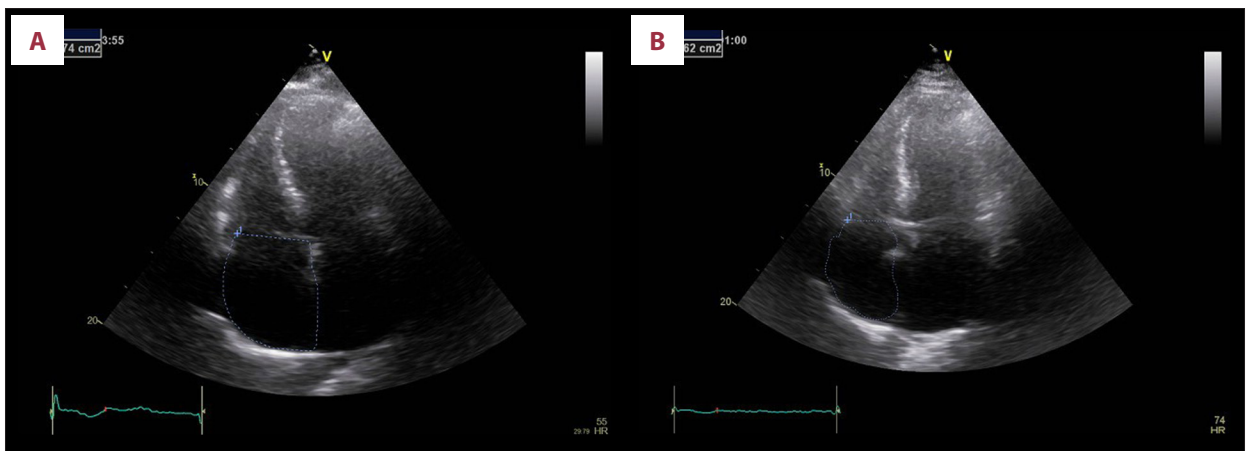


Figure 4. (A) Transesophageal echocardiography before vascular surgery: apical 4 chamber view: dilated right atrium and (B) diminished right atrium area after vascular surgery.

Discussion

AVFs are serious and potentially life-threatening complications of cardiac catheterization which can, however, be treated successfully [13]. Complications related to vascular access are significant problems and are associated with increased morbidity and mortality. Iatrogenic fistulas occurring as a complication of femoral artery puncture may undergo spontaneous closure over time due to their usually small size [14]. However, if they persist, increased shear stress along the luminal endothelial cell surface in the artery proximal to the fistula stimulates the release of endothelium-derived relaxing factor and subsequently causes the relaxation of arterial wall smooth muscle. Prolonged exposure to increased blood flow induces change in the vascular wall by precipitating damage to elastic fibers, which leads to further dilatation and increases shunt flow. Excessive blood flow through an AVF may lead to volume overload-induced cardiac remodeling, ventricular dilatation, and congestive heart failure [15–17]. Coexistence of AVF with intraseptal puncture using a wide sheath of over 14 Fr may result in IASD. Persistent IASD is the most common complication after pulmonary vein isolation by cryoballoon catheter. Nevertheless, the clinical significance of this remains unclear. Patients treated with cryoballoon ablation should be examined in order to detect the possible presence of persistent IASD. Individuals with this complication require periodic clinical and

echocardiographic follow-up, paying special attention to left-to-right shunting. Persistence of ASD with right-to-left shunting has been identified as a risk factor for paradoxical embolism and cerebral or peripheral ischemic events. Closure of an ASD either percutaneously or surgically is also recommended for right atrial and right ventricular enlargement as well as net left-to-right shunt sufficiently large enough to cause physiological sequelae, regardless of either the presence or absence of symptoms [11,18–20].

Conclusions

All AVFs, as complications of accidental arterial puncture in the process of obtaining vein access for ablation procedures in patients with atrial fibrillation, should be surgically closed. Therefore, vascular access at the groin should be achieved with ultrasound support in order to minimize the risk of AVF creation. TsP during catheter ablation for atrial fibrillation in case of simultaneous AVF existence can lead to the formation of IASD and hemodynamically significant left-to-right shunting.

Conflict of interest

None.

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