Internal Cardioversion of Atrial Fibrillation in a Patient with Persistent Left Superior Vena Cava

Dimitrios Evangelou[1], Michalis Efremidis[1], Antonis Sideris[1], Ioannis Kokotsakis[2], Dimitrios Manolatos[1], Dimitrios Oikonomou[1], Fotios Kardaras[1]

[1]Second Department of Cardiology, [2]First Cardiothoracic Surgery Department, General Hospital "Evangelismos", Athens, Greece

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Internal atrial defibrillation is a safe and effective method for sinus rhythm restoration in patients with atrial fibrillation refractory to drug therapy. Standard internal cardioversion uses a biphasic shock with the vector of the defibrillation wave heading from the right atrium towards the coronary sinus. We present the case of a patient with atrial fibrillation where the catheterization of the coronary sinus revealed the existence of a left persistent left superior vena cava. The delivery of a low energy shock to the right atrium - superior vena cava vector cardioverted atrial fibrillation to sinus rhythm.

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Address:
Dimitrios Evangelou

1 Kritonos St.,
116 34, Athens, Greece
e-mail:
dimitrisevangelou@yahoo.com

Persistent left superior vena cava (PLSVC), is an abnormality of the venous system with no hemodynamic consequences. We report a case of internal cardioversion of atrial fibrillation in a patient with PLSVC

Case report

An obese 45 year old man with a history of rheumatic heart disease, hypertension and paroxysmal atrial fibrillation was admitted to our hospital because of a new episode of atrial fibrillation. The patient had a prosthetic mitral valve which was implanted two years ago because of severe mitral stenosis. He was on medication with beta-blocker, ACE inhibitor and oral anticoagulant (acenocumarol). Atrial fibrillation was well tolerated and the patient only suffered from palpitations.

The patient's ECG showed possible left ventricular hypertrophy and atrial fibrillation with rapid ventricular response. The transthoracic echocardiogram showed concentric left ventricular hypertrophy with normal contractility of the left ventricle and moderate left atrium dilatation (LA=48 mm). Intravenous administration of amiodarone failed to restore sinus rhythm and in order to cardiovert atrial fibrillation we decided to apply an internal electrical shock.

Electrophysiology procedure

A 7F quadripolar catheter, was introduced percutaneously into the femoral vein and positioned at the right ventricular apex under fluoroscopic guidance. The cardioversion catheter was positioned at the coronary sinus ostium. While advancing the cardioversion catheter through the coronary sinus an unusual course of the catheter outside the heart's borders until it reached the left subclavian area was revealed. (Figure 1). Infusion of contrast agent into the left subclavian vein revealed a persistent left superior vena cava. The left superior vena cava drained into the right atrium via a dilated coronary sinus. (Figure 2).

The patient was subsequently cardioverted with the delivery of a low energy (7 joules) synchronized biphasic shock, which succeeded in restoring sinus rhythm. The distal coil of the cardioversion catheter was placed in the persistent left superior vena cava while the proximal coil was located inside the right atrium.

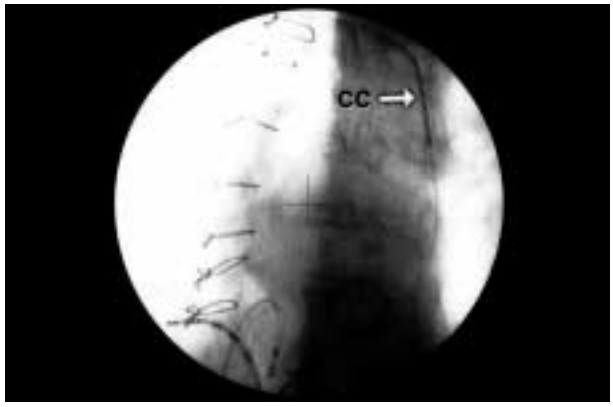

Figure 1. Anteroposterior view showing the position of the defibrillator catheter (CC). The distal coil of the defibrillator catheter is positioned in the left persistent superior vena cava (PLSVC) and the proximal coil at the right atrium.

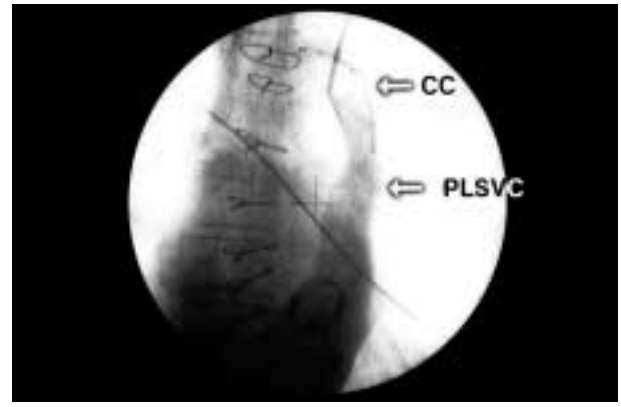

Figure 2. Left persistent superior vena cava (PLSVC) drainage in the right atrium through dilated coronary sinus.

Discussion

Persistent left superior vena cava is the most common congenital anomaly of the systemic venous system. Its incidence is reported in between 0.3-0.5% in the general population[1]. It results from persistent patency of the left anterior cardinal vein that drains into the coronary sinus. During early embryological development, venous return from the head and upper extremities normally drains into the right atrium via the left and right anterior cardinal veins. At approximately 8 weeks gestation, the left brachiocephalic vein develops as a bridge between the left and right anterior cardinal veins. The portion of the left anterior cardinal vein caudal to the left brachiocephalic vein normally collapses and then degenerates, leaving only the right anterior cardinal vein which becomes the superior vena cava. If the caudal portion of the left anterior cardinal vein remains patent, it becomes a PLSVC which drains into the right atrium via a dilated coronary sinus. In at least 67% of cases of PLSVC the right anterior cardinal vein remains patent as well, resulting in bilateral superior vena cavae[2].

The presence of PLSVC has no hemodynamic consequences. It usually accompanies other cardiac anomalies, especially atrial septal defect. Less commonly it coexists with Fallot tetralogy and pulmonary veins anomalous drainage[3]. PLSVC is often an accidental finding during central venous system catheterization. It may also be demonstrated with transesophageal echocardiography especially if contrast agent is used.

In our patient's case there were no other coexisting anomalies. Placing the quadripolar catheter in the high right atrium we could not find the right superior vena cava ostium. We concluded that the right superior vena cava didn't exist and the total venous drainage from the head and upper extremities was conducted only via the persistent left superior vena cava.

Several studies have shown that low energy internal cardioversion is a safe and effective method of converting refractory to antiarrhythmic therapy atrial fibrillation to sinus rhythm[4-7]. Borianni et al in a review of 19 clinical studies reports that the efficacy of internal cardioversion for terminating atrial fibrillation is as high as 92-100% for spontaneous episodes of paroxysmal AF and 70-100% for persistent AF[8]. In particular, internal cardioversion is very efficient in persistent atrial fibrillation and this is supported by the high efficacy obtained in patients with previously unsuccessful external cardioversion[9-11]. Internal atrial cardioversion is usually performed by two approaches either (1) by placing the leads in the right atrium and the coronary sinus or (2) in right atrium and left pulmonary artery. Atrial defibrillation threshold is dependent on clinical issues, on electrode coil length[12], and electrode position[13,14]. Moreover, atrial defibrillation threshold is lower when biphasic versus monophasic shock waveforms are delivered and when asymmetrical waveforms with the second phase shorter than the first are used[15]. Patient tolerability of shocks is variable and is influenced by psychological status, the number of shocks delivered, the amount of energy delivered,

and lead position[16,17,4]. The feasibility of the procedure with no or mild sedation has been described in a substantial proportion of patients[18]. The greatest potential risk of atrial defibrillation is provocation of ventricular fibrillation. To minimize this risk, shock delivery must be synchronized to the QRS and should be avoided during rapid RR cycles (<300 ms)[19]. Although there are no standard guidelines regarding the indications of internal atrial defibrillation, most clinicians agree that this procedure should be used in obese patients with high thoracic impedance, in patients with previously unsuccessful external cardioversion and in those susceptible to sinus node depression following shock delivery, who may need temporary pacing.

In our patient's case we preferred internal atrial cardioversion because he was obese and medication had failed to restore sinus rhythm. As we found out despite his peculiar anatomy, low energy internal atrial delivery succeesful in converting atrial fibrillation in sinus rhythm.

In conclusion, low energy internal atrial defibrillation is a safe method of sinus rhythm restoration, with high success rates even in cases of atrial fibrillation refractory to external cardioversion. Persistent left superior vena cava is a benign anomaly with no hemodynamic consequences. Its presence is not an obstacle to successful internal cardioversion of atrial fibrillation.

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