European Review for Medical and Pharmacological Sciences 2015; 19: 1249-1251

A plea for the single-lead ICD with atrial sensing due to anatomical considerations

C. FASTNER, M. BEHNES, J. KUSCHYK, I. AKIN

First Department of Internal Medicine, Medical Faculty Mannheim, University Heidelberg, Mannheim, Germany

Abstract. – We present the case of a 46-year old male patient suffering from non-ischemic cardiomyopathy and intermittent atrial tachycardia. According to guidelines an implantable cardioverter defibrillator (ICD) was planned to implant through the left subclavian vein. During the procedure the angiography revealed a persistent left superior vena cava (PLSVC) with moderate stenosis of the subclavian vein. Due to this we decided not to implant a dual chamber ICD but to implant a single chamber lead with additional atrial sensing capacity. The procedure as well as the follow-up was uneventful. Follow-up revealed good ventricular as well as atrial signals.

Key Words:
ICD, Single-lead, Atrial sensing, Atrial fibrillation.

Introduction

A persistent left superior vena cava (PLSVC) is a rare congenital vascular anomaly affecting 0.3-2% of the population[1]. In the majority of cases the PLSVC drains into the right atrium directly or most often through a dilated coronary sinus. A subclavian vein stenosis is a rare condition[2]. In case of a cardiac device-implantation, this might progress to a complete occlusion, which is associated with worse clinical outcomes. Here we present the case of a patient with a PLSVC and subclavian stenosis receiving an implantable cardioverter defibrillator (ICD) implantation.

Case Report

A 46-year-old male patient with non-ischemic cardiomyopathy and severe impaired left ventricle ejection fraction (LVEF) of 20% in a functional New York Heart Association stage II suffering from ventricular tachycardia and paroxysmal atrial fibrillation was referred to our department for ICD implantation. The duration of the QRS complex on electrocardiography was < 120 ms; thus we decided to implant a dual chamber ICD with a lead in right atrium and one in right ventricle. During subclavian vein puncture, ICD implantation the venography revealed a PLSVC without a bridging innominate vein draining into the right atrium through a dilated coronary sinus with a moderate stenosis in the subclavian vein (Figure 1). Due to this stenosis the Lumax VR-T DX defibrillator with a Biotronik Linox ^{SMART} S DX lead was used and introduced into the right atrium through the coronary sinus. With a U-shape stylet and through a wide loop within the right atrium the lead was easily introduced and fixed to the apex of the right ventricle (Figure 2). Measurements confirmed good electrical parameters (R-wave was 14.0 mV, slew rate 3 V/s, impedance 538 Ohm, and pacing threshold was 0.6 V/0.5 ms with an atrial P-wave of 3.8 mV) (Figure 3). With 45 minutes the total procedure time and with 5 minutes fluoroscopy time the implantation was similar to that of the classical ICD implantation. Electrical parameters as well as a chest X-ray were performed 24 hours and revealed stable location of the lead as well as stable electrical parameters.

Discussion

A PLSVC with absent of the right superior vena cava, which is reported to occur in 10% to 36%, is a very rare venous malformation[3]. Through normal embryogenesis, the left-sided anterior venous cardinal system regresses to the coronary sinus and the ligament of Marshall being the distal connection of coronary sinus and left subclavian vein. In the majority of cases, as well as in our case, the PLSVC drains to the right atrium via a dilated coronary sinus, while in 10% of cases it connects directly to the left atrium. A thrombosis of upper extremity deep venous system in whole population is rare and accounts for nearly 1-4% of all episodes of deep venous

Corresponding Author: Ibrahim Akin, MD; e-mail: ibrahim.akin@umm.de

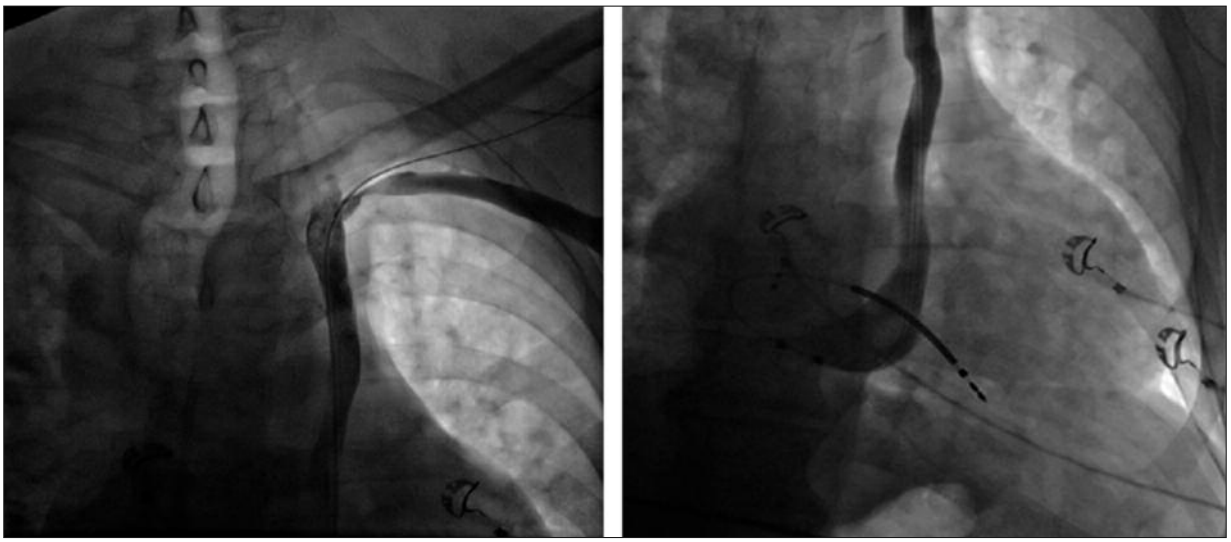

Figure 1. Venography of the left subclavian vein showing a moderate stenosis and a persisting left superior vena cava draining into the enlarged coronary sinus (*left panel*). ICD lead with a loop in the right atrium (*right panel*).

thrombosis[4]. The pathogenesis of venous stenosis after implantation of a transvenous ICD system, described in 32.9%, is multifactorial. Endothelial mechanical trauma caused by ICD leads may cause an inflammatory response of the vessel wall with subsequent thrombus formation and scarring[5,6]. Clinical predictors for the development of stenosis were atrial fibrillation at baseline and the number of implanted leads. The incidence of new venous obstruction at 6 months was 13% for both single- and two-lead systems, and 33% among those with three leads[2,7]. These lesions may necessitate extraction of old leads, may predispose pulmonary emboli, induce superior vena cava syndrome, or may even result in upper extremity gangrene. The presence of a moderate subclavian stenosis in our case may predispose to complete occlusion in case of lead implantation. Due to the fact, that this occlusion is predicted by the number of leads and there is no indication for atrial stimulation but for sensing to discriminate atrial signals and thus to avoid inadequate ICD shocks, we decided to implant a single lead with the capacity for atrial sensing. This ICD system with integrated atrial sensing rings mounted 15cm from the tip of the ICD lead obviated the need to implant a separate atial lead. Implantation was uneventful and intraoperative as well as follow-up electrical parameters were excellent. Effectiveness of this lead was tested in 249 patients with standard ICD indications but no requirement for antibradycardia pacing. They were randomized to receive an ICD lead with the capacity of atrial sensing (n=124) or a two leads (n=125). The implantation time was significantly shorter in the first group. Mean P-wave amplitudes were 3.5+-0.8 mV (first group) and 3.2+-0.6 mV (second group) and remained stable during the follow-up period of 12-months. All ventricular tachyarrhythmia episodes were correctly discriminated. However, atrial lead dislodgement occurred in 4% of patients in the second group[8]. In conclusion, we recommend the use of ventricular leads with the capacity of

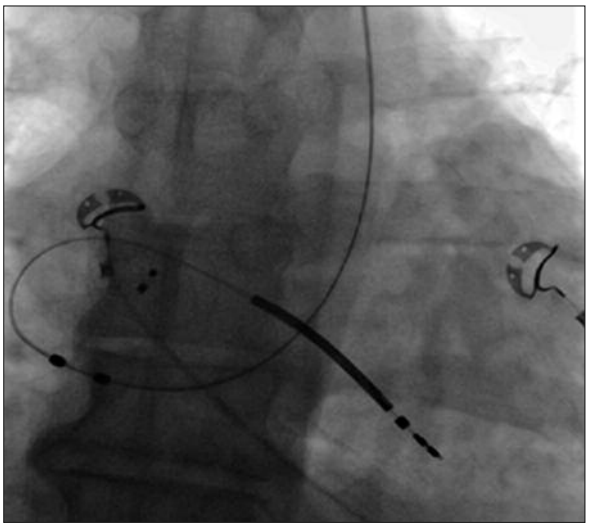

Figure 2. Final position of the ICD lead with atrial sensing electrodes. Patient had received an PFo occluder two years ago.

Figure 3. Intracardiac measurements showing good singals on ventricular as well as free-floting atrial sensing electrodes.

atrial sensing to avoid venous occlusion in case of venous stenosis. Additionally, the use of such leads may be of advantage in case of PLSVC to minimize the rate of leads dislodgements.

Conflict of Interest

The Authors declare that there are no conflicts of interest.

References

1) Ratliff HL, Yousufuddin M, Lieving WR, Waton BE, Rosencrance G, McCowan RJ. Persitent left superior vena cava: case report and clinical implications. Int J Cardiol 2006; 113: 242-246.
2) Korkeila P, Nyman K, Ylitalo A, Koistinen J, Karjalainen P, Lund J, Airaksinen KE. Venous obstruction after pacemaker implantation. Pacing Clin Electrophysiol 2007; 30: 199-206.
3) Biffi M, Bertini M, Ziacchi M, Martignani C, Valzania C, Diemberger I, Branzi A, Boriani G. Clinical implications of left superior vena cava persistence in candidates for pacemaker or cardioverter-defibrillator implantation. Heart Vessels 2009; 24: 142-146.
4) Hill SL, Berry RE. Subclavian vein thrombosis: a continuing challenge. Surgery 1990; 108: 1-9.
5) Pauletti M, Pingitore R, Contini C. Superior vena cava stenosis at site of intersection of two pacing electrodes. Br Heart J 1979; 42: 487-489.
6) Oginosawa Y, Abe H, Nakashima Y. The incidence and risk factors for venous obstruction after implantation of transvenous pacing lead. Pacing Clin Electrophysiol 2002; 25: 1605-1611.
7) Bulur S, Vural A, Yazici M, Ertas G, Özhan H, Ural D. Incidence and predictors of subclavian vein obstruction following biventricular device implantation. J Interv Card Electrophysiol 2010; 29: 199-202.
8) Sticherling C, Zabel M, Spencker S, Meyerfeldt U, Eckardt L, Behrens S, Niehaus M; ADRIA Investigators. Comparison of a novel, single-lead atrial sensing system with a dual-chamber implantable cardioverter-defibrillator system in patients without antibradycardia pacing indications: results of a randomized study. Circ Arrhythm Electrophysiol 2011; 4: 56-63.