

Case Report

Right-Sided Implantation of a Cardiac Resynchronization Therapy Defibrillator in a Case of Persistent Left Superior *Vena Cava*

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Persistent left superior *vena cava* represents a congenital venous anomaly that poses a particular obstacle to the implantation of cardiac rhythm management devices. In the present report we briefly describe the right-sided implantation of a biventricular defibrillator in a patient with persistent left superior *vena cava*. We also briefly discuss the technically challenging procedures applied in such cases.

Persistent left superior *vena cava* (PLSVC) represents a congenital venous anomaly that poses a particular obstacle to the implantation of cardiac rhythm management devices. In the present report we briefly describe the right-sided implantation of a biventricular defibrillator in a patient with PLSVC.

Case presentation

A 77-year-old man with ischemic cardiomyopathy (previous coronary bypass surgery) and congestive heart failure (New York Heart Association class III) on optimal medical therapy was referred for cardiac resynchronization therapy (CRT). He had severe left ventricular (LV) systolic dysfunction (LV ejection fraction 25-30%). His ECG showed sinus rhythm with left bundle branch block (QRS duration: 160 ms).

In accordance with the current guidelines, the patient was scheduled for implantation of a CRT-defibrillator (CRT-D) system. At the start of the procedure, the left subclavian vein was punctured and insertion of the guidewire raised the suspicion of a PLSVC. A venogram con-

firmed the diagnosis, showing a PLSVC draining into a large coronary sinus (Figure 1, arrows). Multiple attempts to implant the right ventricular (RV) defibrillator lead using different hand-shaped stylets were unsuccessful. After a right venogram had confirmed the existence of the right superior *vena cava*, the surgical wound was closed and the procedure was continued in the right infraclavicular area. The right subclavian vein was cannulated, and the RV defibrillator lead was placed in the RV apex and the atrial lead in the right atrial appendage (active fixation leads). The coronary sinus was engaged using a guiding catheter specialized for right-sided access (Attain Command[®] model 6250-MPR). A coronary sinus venogram using the guiding catheter failed to show any vein side branches (Figure 2). Owing to the large size of the coronary sinus, an occlusive venogram was not feasible. Subsequently, using the LV lead (Attain Ability[®], model 4196) and a special hybrid guidewire (Attain[®], model GWR419678) we were able to cannulate a lateral cardiac vein and to successfully place the lead, having a pacing threshold of 1.2 V with no phrenic

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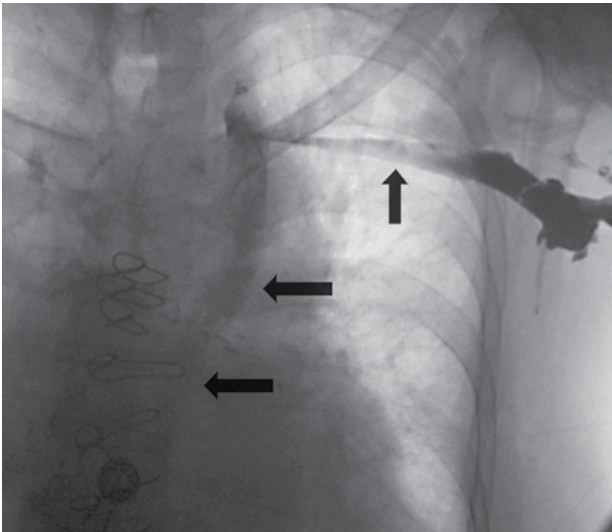


Figure 1. Visualization of the persistent left superior *vena cava* by contrast injection in the left subclavian vein.

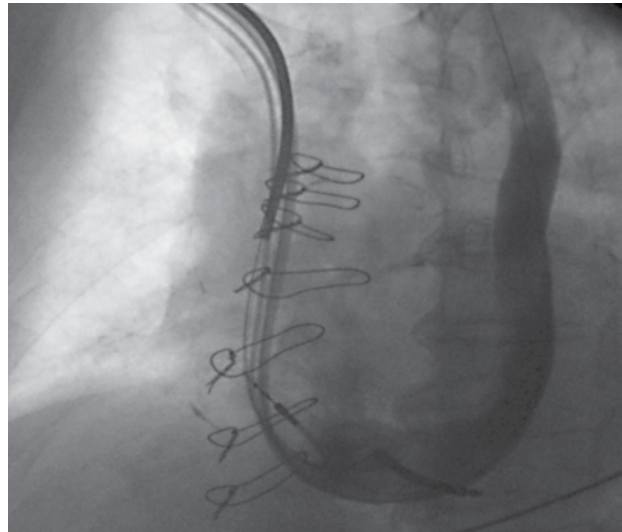


Figure 2. Cannulation and venogram of the markedly enlarged coronary sinus.

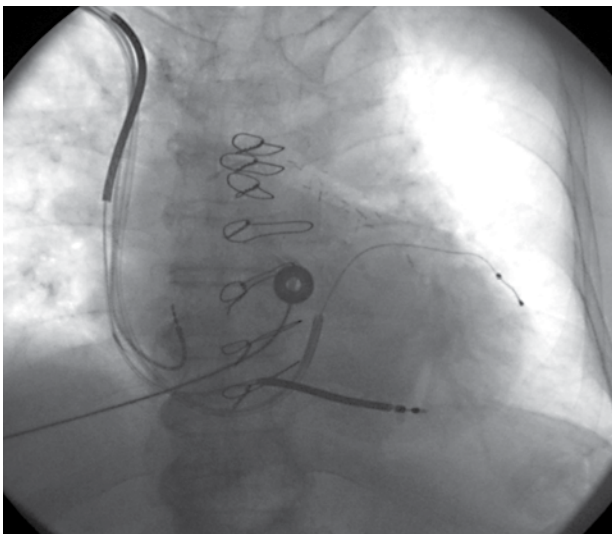


Figure 3. Placement of the left ventricular lead in a lateral vein (right-sided approach).

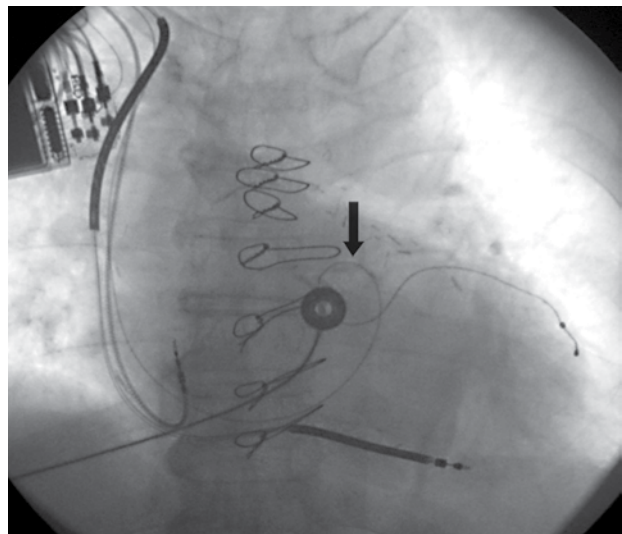


Figure 4. Final position of the leads (right-sided implantation). The arrow indicates a loop of the left ventricular lead that formed after cutting the guiding catheter.

nerve stimulation (Figure 3). After the guiding catheter had been cut, a loop of the LV lead was formed within the enlarged coronary sinus but remained stable until the end of the procedure (Figure 4, arrow). The leads were secured and connected to the CRT-D device (Medtronic® PROTECTA D 364TRG), which was placed in a prepectoral pocket. A defibrillation test of the device (verification protocol) was successfully performed under conscious sedation and the shock therapy was appropriately programmed.

Specifically, after ventricular fibrillation induction (R on T protocol) the device detected the arrhythmia and discharged with an active can configuration (AX>B, namely a vector from the can and SVC coil to the RV coil). A 14 J shock was effective for successful cardioversion. Subsequently, the device was programmed with an initial shock of 25 J (14 J plus 11 J for a safety margin). Six months after the operation the leads were stable and the pacing checks were excellent.

Discussion

PLSVC is present in 0.3-0.5% of the general population and in 0.66% of patients undergoing ICD implantation.^{1,2} Notably, the prevalence of PLSVC is particularly high in patients with congenital heart abnormalities (5-10%). This anomaly is usually found incidentally during the implantation of cardiac rhythm devices.^{1,2}

The implantation of atrial and ventricular leads in the setting of PLSVC is often a difficult challenge that requires the creation of special shapes for the stylets, skilled manipulations, and sometimes the use of special tools.¹⁻⁴ Placement of the LV lead in the setting of PLSVC is a particularly demanding procedure.^{2,5,6} Indeed, visualization of cardiac veins through occlusive venography is often infeasible, given that the coronary sinus is enlarged and forms a common body with the PLSVC. In the present case, we achieved vein cannulation using a commercially available hybrid guidewire that has both the properties of a stylet and a flexible guidewire as the distal part. The use of a special guiding catheter specific for a right-sided approach facilitated the procedure. Some other tips and tricks that may facilitate the LV lead placement in similar cases include the use of Swan-Ganz balloon catheters to perform occluding venograms; the use of coronary angiography catheters to perform subselective venograms of the side branches; the use of different angioplasty guidewires with different shaped tips to engage side vein branches; and the use of subselective catheters with different angles at the tip, which can be used for LV lead placement (the subselective catheters can be withdrawn by cutting).

Another issue that needs special attention is the efficacy of a right-sided implantable defibrillator system, taking into account the altered shock vector.⁷ For that reason a defibrillation test during implantation is imperative in order to exclude a particularly high threshold. A recent study showed that defibrillation thresholds and mortality were lower with left-sided systems compared to right-sided systems.⁷ However, after programming an appropriate safety margin there were no significant differences in spontaneous or induced shock conversion efficacy.⁷ It has also been shown that when right-sided implantation is required, active can devices result in lower defibril-

lation thresholds than “cold can” devices.⁸ An alternative option would be to implant the leads using a right-sided approach and then tunnel them into a left sided pocket. Also, combined right-left placement of the leads has been described.⁹ However, we have to acknowledge that tunneling is a challenging technique, especially in thin individuals, while the long-term reliability of tunneled leads is questionable.

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