Upgrade Procedure of DDD Pacemaker to CRT-P in a Patient with Previously Unrecognized Persistent Left Superior Vena Cava

Daha önce tanıısı konulmamış persistan sol süperior vena kavası olan hastanın DDD kalp pilinin CRT-P ye upgrade işlemi

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ABSTRACT
A persistent left superior vena cava (PLSVC) is the most common congenital venous anomaly in the cardiovascular system. A PLSVC can be accurately diagnosed by echocardiography, CT or MR imaging, or intraoperatively during vascular access by noting an unusual course of a guide wire, catheter, or pacing lead. We present a 75-year-old man who a history of dual-chamber (DDD) pacemaker implantation because of clinically diagnosed sick sinus syndrome and electrophysiologically diagnosed impaired atrioventricular conduction. He had NYHA class III-IV symptoms despite optimal heart failure medical treatment and these complaints were disappeared with cardiac resynchronization (CRT) therapy. We upgraded procedure of DDD pacemaker to CRT-P in previously unrecognized persistent left superior vena cava. We emphasize the need for awareness of this condition and call attention to the these anatomic variations.

Keywords: Persistent left superior vena cava, cardiac resynchronization therapy, heart failure.

ÖZET
Persistan sol süperior vena kava (PSSVC) kardiyovasküller sistemde en yaygın görülen konjenital anomalidir. PSSVC tanısı; ekokardiyografi, BT, MR veya vasküler girişim esnasında pace leadi, kateter veya kılavuz telin alışılmamış bir bölgeye seyri ile kesin olarak konulabilir. Biz 75 yaşında bir erkek hastayı sunduk. Hastanın optimal kalp yetersizliği medikal tedavisi almasına rağmen NYHA klası III-IV semptomları mevcuttu ve şıkayetleri kardiyak resenkronizasyon tedavisi (CRT) ile ortadan kalktı. DDD kalp pilli CRT-P ye upgrade etme işlemini PSSVC tanısı konulmadan önce gerçekleştirdik. Bu tip anatominik varyasyonlar konusunda dikkatli olmanın gerekçiliğini vurguladık.

Anahtar Kelimeler: Persistan sol süperior vena kava, kardiyak resenkronizasyon tedavisi, kalp yetersizliği.

Introduction
A persistent left superior vena cava (PLSVC) is the most common congenital venous anomaly in the cardiovascular system. This anomaly is noted to occur in between 0.3-0.5% of all patients (1). A PLSVC forms when the left anterior cardinal vein is not obliterated during normal fetal development, and it then drains directly into the coronary sinus (CS) in 90% of cases or rarely directly into the left atrium creating an insignificant right-to-left shunt (2). These anatomic variations can make the implantation of cardiac devices challenging, and a complete understanding of the anatomy is critical for success (2). Up to one-third of patients may have a suitable bridging innominate vein to the right SVC to more easily allow lead implantation. We describe a patient with upgrade procedure of DDD pacemaker to CRT-P in previously unrecognized PLSVC.

Case
A 75-year-old man was admitted to our clinic with symptoms of left ventricular heart failure (NYHA Class IV) despite optimal medical treatment. He had a
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history of dual-chamber (DDD) pacemaker implantation because of clinically diagnosed sick sinus syndrome and electrophysiologically diagnosed impaired atioventricular conduction in 2008. He had history of controlled hypertension for ten years with regular medical treatment. During his initial implant, a right subclavian approach was utilized due to patient preference. Ejection fraction (EF) was 60%, heart chambers were in normal size, valve morphology and functions were normal, pulmonary artery systolic pressure was 25 mmHg, grade I diastolic dysfunction was detected at transthoracic echocardiography in 2008.

Over the last couple of years, the patient was mentioned to have increasing fatigue and exertional dyspnea during outpatient pacemaker clinic controls. EF was noted to be gradually decreased from 60% to 40% at outpatient pacemaker clinic controls. But he had NYHA class II symptoms and these complaints were disappeared with optimal heart failure medical treatment (beta-blocker, ACEI, spironolactone, furosemide). This was the first time that he experienced NYHA class IV symptoms. He was hospitalized in CCU. Rhythm was atrial sense and ventricular pace with QRS duration of 170 msec (Figure 1) and aortic VTI was 12 cm/sec on echocardiography. He was noted to have paroxysmal atrial fibrillation and non-sustained VT during monitoring in CCU. His clinical status was improved to NYHA class II after iv diuretic and levosimendan therapy. Echocardiography revealed a depressed ejection fraction of 25-30% and increased left ventricular chambers and dilated coronary sinus. A cardiac catheterization revealed no significant coronary artery disease and showed dilated coronary sinus with suitable lateral branches for LV lead at antegrade coronary sinus venography during coronary angiography (Figure 2).

Upgrade procedure of DDD pacemaker to CRT-P and EP study for VT stimulation was decided. Before CRT-P upgrade procedure, venography from right and left vena brachialis was performed which revealed persistent left superior vena cava (PLSVC) and patent right subclavian vein (Figure 3). Venous access was obtained in the right subclavian vein, and an EP study was performed through right femoral vein. The patient was not inducible into sustained VT, and we proceeded with LV lead placement. The coronary sinus ostium was cannulated with a CS sheath (Attain, Medtronic).

Initially a hand injection at the junction of coronary sinus and PLSVC demonstrated a markedly dilated coronary sinus (Figure 4) and despite advancing a cs sheath distally, we were unable to advance the sheath into main body of coronary sinus (Figure 4). We decided to use telescopic method. An inner catheter (JR 4) was advanced into the main body coronary sinus over 0,035 inch hydrophilic guidewire

Figure 2. Coronary angiography of left system revealed no significant coronary artery disease (left). Coronary sinus antegrade angiography image obtained with extended cine film during left system coronary angiography at same projection with left image (right). Coronary sinus antegrade angiography revealed a lateral cardiac vein which was suitable for LV lead implantation (*), a posterior cardiac vein (**)

Figure 3. Persistent left superior vena cava was revealed during left subclavian venography (left). Right subclavian venography showed patent right subclavian vein with mild stenosis at the entering site of initial pacemaker leads.

Figure 4. Coronary sinus venography revealed extremely dilated coronary sinus and persistent left superior vena cava (left). Main body of coronary sinus was away from the ostium portion of coronary sinus system which was composed of persistent left superior vena cava and extremely dilated (middle). Initial attempts for cannulation of main body of coronary sinus with coronary sinus sheath were failed.

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and then an attempt to subselect a side branch, due to this massively dilated coronary sinus, we lost cs catheter position several times. Then, we were able to pass the cs catheter to the main body of coronary sinus and place 0.035 inch hydrophilic guide wire into lateral branch (Figure 5).

**Figure 5.** Telescopic method was used to cannulate the main body of coronary sinus (left top). Coronary sinus venography was showed a suitable lateral vein for LV lead implantation after cannulation of main body of coronary sinus (right top). 0.014 inch guidewire was placed in lateral vein (left bottom). LV lead was placed in lateral vein by over-the-wire technique with desired pace-sence measurements and cs sheath was removed (right bottom).

We changed the 0.035 inc guidewire with 0.014 inch guidewire (Figure 5). We were able to place LV lead over the 0.014 inch guidewire into lateral branch of CS with desired lead measurements (impedance 350 ohm, threshold 0.3 V, R wave 28mV and slew rate >4V/sec ) without diaphragm stimulation with high output pacing voltages (Figure 5). ECG showed marked narrowing of QRS duration with aortic VTI of 24 cm/sec on echocardiography (Figure 6). The patient was discharged after third day of the procedure. He was asymptomatic at 12 month control and EF was measured as 55%. Diuretic treatment was stopped at third month control.

**Discussion**

A persistent left superior vena cava (PLSVC) is the most common congenital venous anomaly. In this case, the patient had a previously implanted right-sided dual-chamber pacemaker and undiagnosed PLSVC. We describe a case with upgrade procedure of DDD pacemaker to CRT-P in previously unrecognized persistent left superior vena cava.

During normal fetal development, the left cardinal vein typically regresses after the innominate vein is formed to become the ligament of Marshall. Individuals with PLSVC generally possess a normal right superior vena cava; rarely, the PLSVC is the only venous drainage for the upper body with regression of the right cardinal vein during development (2). Diagnosis often occurs incidentally during vascular imaging or procedures involving placement of pacing leads or central venous catheters. An innominate vein is absent in 65% of cases, which is an important consideration during left-sided device implantation (2). A PLSVC can be accurately diagnosed by echocardiography, CT or MR imaging, or intraoperatively during vascular access by noting an unusual course of a guide wire, catheter, or pacing lead. This can be confirmed with contrast injection during device implantation, and this may also define the presence (or more likely, the absence) of an innominate vein (3, 4).

When available with the finding of a PLSVC at the time of left-sided device implantation, one can either attempt the implant via the coronary sinus or abandon the left-sided approach and place the device via a right-sided SVC if present. In our case, the patient already had a previously implanted right-sided dual-chamber pacemaker and undiagnosed PLSVC. Utilization of current implant tools, including direct delivery of an LV pacing lead via a telescoping sheath system, was critical in the successful implant of this device. Ultimately, it was the ability to image the lateral LV branch via the middle cardiac vein that allowed us to accomplish effective CRT in this case.

In conclusion, summarizing the presented variation of lead implantation via PLSVC this approach seems to be successful. Careful imaging before implantation is essential for the understanding of the individual anatomy and in order to choose adequate material and implantation strategy.

**Conflicts of interest**

There are no conflicts of interest.
References


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