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Original Research Article

Assessment of the Transvenous Dual-Chamber Pacemaker Implantation in Patients with Persistent Left Superior Vena Cava

Abu Huraira[1], Aman Sinha[2], Brajesh Kumar[3]

[1]Senior Resident, Department of Cardiology, Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India

[2]Senior Resident, Department of Cardiology, Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India

[3]Senior Resident, Department of Cardiology, SMS Hospital Jaipur, Rajasthan, India

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Corresponding author: Dr. Aman Sinha

Conflict of interest: Nil

Abstract:

Aim: The aim of the present study was to assess the transvenous dual-chamber pacemaker implantation in patients with persistent left superior vena cava.

Methods: The present study was conducted in the Department of Cardiology, 20 patients were enrolled retrospectively in this observational study. The present study was performed in accordance with the Declaration of Helsinki (2000), and All patients and relatives were given full explanations of the procedures, and written informed consent was obtained from all subjects.

Results: The average age of the 20 patients with PLSVC was 67 ± 13 years (52–77 years). Indications for pacing were symptomatic third-degree atrioventricular (AV) block in 2 (10%) and sick sinus syndrome in 18 patients (90%). AV block after mitral valve replacement. The pacemaker pocket was performed entirely in the left subclavian region irrespectively of the PLSVC. Total procedure time and fluoroscopy time was 85.5 ± 12.4 min and 4.5 ± 1.2 min respectively. There were no complications during any of the procedures. Furthermore, no late complications such as lead fracture, lead dislodgement, pericardial tamponade, or chest pain were observed during a mean follow-up of 4 years. In addition, pacing impedance, pacing threshold, P-wave and R-wave amplitude did not change significantly during the follow-up.

Conclusion: PPI through PLSVC may be technically feasible, safe, and effective. A venography in patients with PLSVC prior to pacemaker implantation is not necessary. Double active fixation leads may be standard for patients with PLSVC, and most of the ventricular leads could be placed at the RVOT septum.

Keywords: The Transvenous Dual-Chamber Pacemaker, Left Superior Vena Cava.

Introduction

Vascular access for implantation of permanent pacemaker leads can be challenging, particularly in the patients with vascular variations. PLSVC is the most common variation in the systemic venous return which accounts for 0.2-4.3% of all congenital cardiac anomalies. [1] In 80% of patients with PLSVC, RSVC is present, however, in 20% of these patients RSVC may be absent. [2] These venous malformations are usually asymptomatic and discovered incidentally during echocardiographic imaging, aberrant position of a pacemaker lead or central venous catheters during interventions. [3,4]

Persistent left superior vena cava (PLSVC) is the most common venous drainage anomaly of the systemic thoracic veins, with its prevalence among the general population ranging from 0.5 to 2%. In 80–90% of the cases, the PLSVC drains into the right atrium via a dilated coronary sinus. [5-6] PLSVC is commonly associated with a normal right-sided superior vena cava. However, in 10–20% of cases, an isolated PLSVC may be present, frequently coexisting with other cardiac congenital disorders or arrhythmias. [7-9] In up to 10% of the patients with PLSVC, it is possible for the vein to drain into the left atrium via an unroofed coronary sinus or directly into the left atrium, an even more uncommon condition. [9,10] A right-to-left shunt is thus formed, and the patient is susceptible to several complications including cyanosis, cerebrovascular embolism (especially venous air embolism after injections into the left arm) and heart failure. [11,12]

The aim of the present study was to assess the transvenous dual-chamber pacemaker implantation in patients with persistent left superior vena cava.

Materials and Methods

The present study was conducted in the Department of Cardiology, Rajendra Institute of Medicine Sciences (RIMS), Ranchi, Jharkhand, India for one year and 20 patients were enrolled retrospectively in this observational study. The present study was performed in accordance with the Declaration of Helsinki (2000), and All patients and relatives were given full explanations of the procedures, and written in- formed consent was obtained from all subjects.

Preoperative Preparation

All patients received a dual-chamber pacemaker with double active fixation leads. 58-cm bipolar active fixation leads with steroid-eluting electrodes were used for both atrial and ventricular pacing in all patients.

PPI was performed during the fasting state under local anesthesia. Prophylactic intravenous antibiotic was ad- ministered 30 min prior to the procedure. The procedures were undertaken under strict aseptic precautions with venous access gained by the left axillary vein or the left subclavian vein in all patients. Meanwhile, the pace- maker pocket was performed routinely in the left subclavian region. Venous access for the atrial and the ventricular leads was gained through two separate punctures without any complications.

Implantation Procedure

Venography was performed to confirm the presence of PLSVC if necessary. The ventricular lead was attempted to be placed in the RVOT septum. Otherwise, the ventricular lead was placed in the right ventricular apex (RVA) region. Both atrial and ventricular pacing leads were advanced into the right atrium with the original soft straight stylet first. Then a "C" shaped stylet or J-shaped stylet was used to introduce the ventricular lead via the tricuspid annulus to the RVOT. And then, the ventricular lead pointed toward the tricuspid annulus with a slight withdrawal and clockwise rotation, so it could be advanced into and placed at the RVOT. The atrial lead was positioned in the lateral atrial wall or the right atrial appendage (RAA) without using other differently shaped stylets. The final position of the double pacing leads was evaluated during the procedure using fluoroscopicprojection including anterior-posterior (AP) view, right anterior oblique (RAO) 30°view, left anterior oblique (LAO) 45°view and left lateral (LL) 90° view. Pacing parameters were obtained at the end of the procedure, including pacing impedance (Ω), pacing threshold (V), P-wave and R-wave amplitude (mV).

Follow-up

After pacemaker implantation, all patients were followed up every 6 months regularly as outpatients. Pacing parameters including pacing threshold, electrode impedance, P-wave and R-wave amplitude were assessed. Chest X-ray and transthoracic echocardiography were performed during follow-up if necessary.

Results

Table 1: Patient's baseline and implant data

Patients	**N=20**
Age (years)	67 ± 13
Male, n (%)	7 (35%)
LVEF (%)	63 ± 5
AVB, n (%)	2 (10%)
SSS, n (%)	18 (90%)
Ventricular leads position, n (%)	
RVOT septum	16 (80%)
RVA	2 (10%)
Free wall of TV	2 (10%)
Threshold (V)	
RA lead	1.0 V ± 0.4
RV lead	0.9 ± 0.2
Amplitude (mV)	
P-wave	3.2 ± 1.2
R-wave Impedance(Ω)	10.5 ± 2.2
RA lead	562 ± 118
RV lead	552 ± 98
Procedure time (min)	85.5 ± 12.4
Fluoroscopy time (min)	4.5 ± 1.2

The average age of the 20 patients with PLSVC was 67 ± 13 years (52–77 years). Indications for pacing were symptomatic third-degree atrioventricular (AV) block in 2 (10%) and sick

sinus syndrome in 18 patients (90%). AV block after mitral valve replacement. The pacemaker pocket was performed entirely in the left subclavian region irrespectively of the PLSVC. Total procedure time and fluoroscopy time was 85.5 ± 12.4 min and 4.5 ± 1.2 min respectively. There were no complications during any of the procedures.

Outcomes During Follow-Up

Furthermore, no late complications such as lead fracture, lead dislodgement, pericardial tamponade, or chest pain were observed during a mean follow-up of 4 years. In addition, pacing impedance, pacing threshold, P-wave and R-wave amplitude did not change significantly during the follow-up.

Discussion

Persistent left superior vena cava (PLSVC) is a rare congenital vascular anomaly, occurring in 0.3 to 0.5% of individuals in the general population. [13] Transvenous permanent pacemaker implantation (PPI) in patients with PLSVC is challenging because of the complex anatomy. The coronary sinus (CS) may be dilated, which render pacing leads positioning from the left subclavian region difficult, especially the ventricular lead. The literature regarding PPI in patients with PLSVC is sparse and limited to a few case reports. [14-16] The use of active fixation leads with special curved stylet may help in overcoming this technical difficulty. [14]

The average age of the 20 patients with PLSVC was 67 ± 13 years (52–77 years). Indications for pacing were symptomatic third-degree atrioventricular (AV) block in 2 (10%) and sick sinus syndrome in 18 patients (90%). AV block after mitral valve replacement. The pacemaker pocket was performed entirely in the left subclavian region irrespectively of the PLSVC. Total procedure time and fluoroscopy time was 85.5 ± 12.4 min and 4.5 ± 1.2 min respectively. There were no complications during any of the procedures. Furthermore, no late complications such as lead fracture, lead dislodgement, pericardial tamponade, or chest pain were observed during a mean follow-up of 4 years. In addition, pacing impedance, pacing threshold, P-wave and R-wave amplitude did not change significantly during the follow-up. In our study, the ventricular lead of most cases was placed at the septum of RVOT. This position of the ventricular lead seems hemodynamically more profitable than the classic RVA pacing. Furthermore, all PPI was performed in the left subclavian region irrespective of the PLSVC. This was an operator preference. In our center, operators are used to operating on the right subclavian region. At the same time, the absence of right superior vena cava (RSVC) also exists in some patients. Although venography prior to the incision of the pocket device may be helpful in identifying the anatomy and the condition of the veins [17], the majority of our patients under- went device implantation safely and successfully without venography. Less experienced surgeons more often choose a right-sided device implantation after confirming a PLSVC by venography, and sometimes the leads can be easily replaced in the right atrium and the right ventricle via the RSVC. In general, a specific J-shaped stylet designed to facilitate positioning of active fixation ventricular lead into the RV septum was used in patients without PLSVC. [18,19] Instead, the major challenge for the operator is to advance the ventricular lead into the RVOT via the PLSVC. The existence of an acute angle between the CS ostium and the tricuspid valve makes the advancement and the placement of the lead into the right ventricle technically difficult. Various techniques such as the use of standard, special shaped and right ventricular septal stylets facilitating ventricular lead implantation have been reported. [14]

In previous case reports [14,20], the ventricular leads were fixed only in the RVA rather than the RVOT septum and a right-sided implantation of the ventricular lead is suggested in case of unsuccessful stable ventricular lead position via the PLSVC. [15] In our study, all stable ventricular leads were positioned successfully and safely via a PLSVC. In most of the patients, the ventricular lead was advanced into the RVOT easily with a "C" shaped stylet. Active fixation lead offers the advantage of flexibility of choosing an optimal pacing site in the setting of heart abnormalities and particularly for patients with PLSVC. However, despite several at- tempts with different shaped stylets, we failed to advance the ventricular leads into the RVOT in two patients which is probably due to the moderate to severe enlargement of the cardiac chamber

Conclusion

PPI through PLSVC may be technically feasible, safe, and effective. A venography in patients with PLSVC prior to pacemaker implantation is not necessary. Double active fixation leads may be standard for patients with PLSVC, and most of the ventricular leads could be placed at the RVOT septum.

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