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Case Report

Transvenous Pacing via Superior Vena Cava in a Patient with complex Congenital Heart Disease who Experienced an Unsuccessful Epicardial Pacing after Glenn Shunt

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Abstract

We present the case of a 6-year-old boy with complex heart disease who had undergone two times of cardiac surgery and suffered from complete atrioventricular block (AVB) after the surgery. An epicardial pacing was carried out but failed 9 months later because of lead fracture. A new pacemaker was implanted via anatomically changed superior vena cava system successfully and the pacemaker worked well with no complications in the 6 months follow-up.

Keywords: pulmonary artery; right ventricle; inferior vena cava; superior vena cava

1. Introduction

Epicardial pacing is a preferred choice for the patients who had undergone palliative cavopulmonary shunts and suffered from complete AVB. Conventional transvenous pacing via the subclavian vein is difficult for these patients because of altered anatomy of the superior venous system after surgery. [1]

2 Case Presentation

A 6-year-old boy (20kg, 119cm) was diagnosed as large ventricular septal defect (VSD) which was adjacent to pulmonary, double outlet of right ventricle (DORV), severe pulmonary stenosis (PS). He had undergone bidirectional Glenn shunt operation when he was 1-year-old and Rastelli procedure at 5 years age (Figure 1).

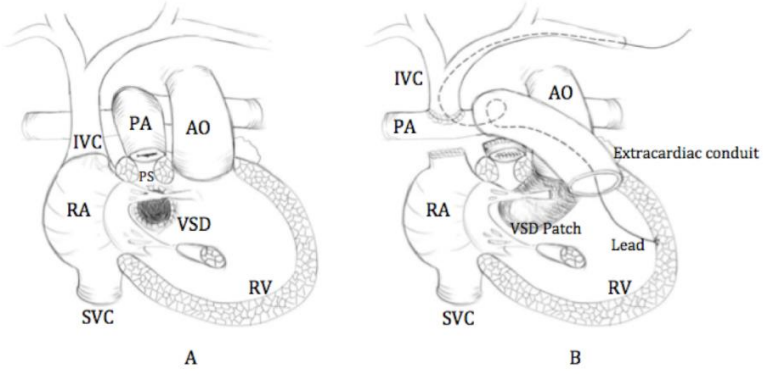

Figure 1: Sketch map of Cardiac structure before and after the surgical correction and path of the lead. Anatomical deformity of the case was double outlet of right ventricle, VSD, PS (A). AO is connected with left ventricle via the correction of VSD and PA is connected with RV via the extracardiac conduit (B).

AO: aorta, **PA:** pulmonary artery, **RA:** right atrium, **RV:** right ventricle, **IVC:** inferior vena cava, **SVC:** superior vena cava, **VSD:** ventricular septal defect, **PS:** pulmonary stenosis.

He suffered from complete atrioventricular block (AVB) due to the second operation. Permanent pacemaker implantation with a single epicardial lead was performed with the pacing mode of VVIR and satisfactory pacing parameters.

Unfortunately, the boy underwent several syncopes due to intermittent complete AVB with insufficient ventricular escape rate 9 months after the epicardial pacemaker implantation. X-ray indicated the lead might had fractured, which was confirmed by an impedance >2000Ω. The temporary pacing electrode was implanted to avoid emergency. The implantation of a new permanent pacemaker was still urgent.

The child had experienced three times of thoracic surgery, so epicardial pacing was not suitable in consideration of the surgical trauma and severe adhesion. Transvenous pacing was preferred. Since his right ventricular outlet was bridged to main pulmonary artery by extracardiac conduit, endocardial pacing via axillary vein was tried. The left axillary vein was accessed and a 7F sheath was inserted under non-intubated general anesthesia. The guide wire(0.32'') passed through the axillary vein, the subclavian vein, the superior vena cava, right pulmonary artery, extracardiac conduit and right ventricular outflow tract, and then reached the right ventricle. A C315 S4 (Medtronic, Inc., St. Paul, MN, USA) sheath was tried to forward into right ventricle along the guide wire. However it twisted and blocked because of the torsion created by the right angle at the junction of superior vena cava and right pulmonary artery (Figure 2).

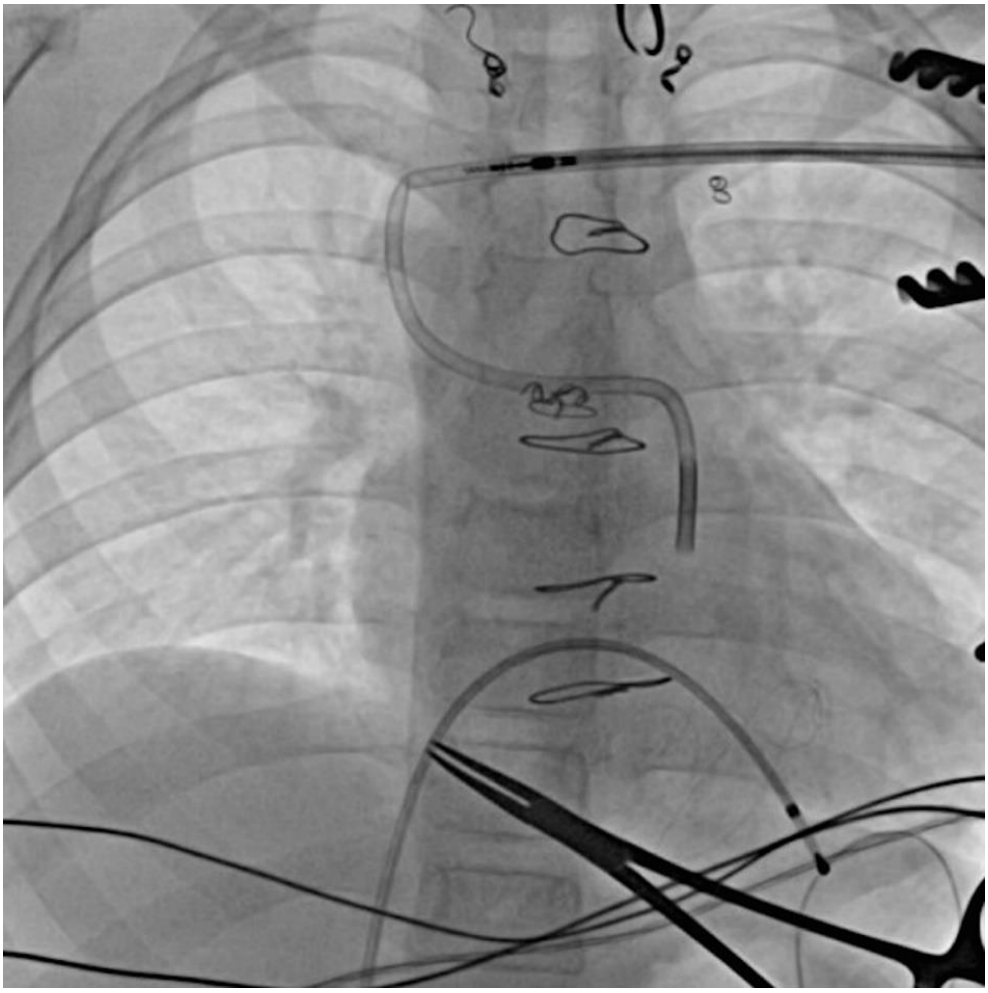

Figure 2: The outer sheath was twisted and blocked because of the torsion created by the right angle at the junction of superior vena cava and right pulmonary artery.

6250VIC(Medtronic) was applied and succeeded. Then a screw-in lead (5076, Medtronic) was delivered to the lower part of right ventricle through the sheath. The lead was screwed after achieving acceptable pacing parameters, and the sheath was peeled away. The capture threshold was 0.8mV, measured R wave amplitude was 12.5mv and the impedance was 753 ohms. The pacing generator (EN1SR01 Medtronic Inc. Minneapolis, USA, VVI) was implanted into a subcutaneous pocket and was programmed to a lower rate of 70bpm in the VVIR mode (Figure 3). The post-procedure ECG showed consistent ventricular pacing during the follow-up of 6 months (Figure 4), the pacemaker worked well with no complications related to the implantation.

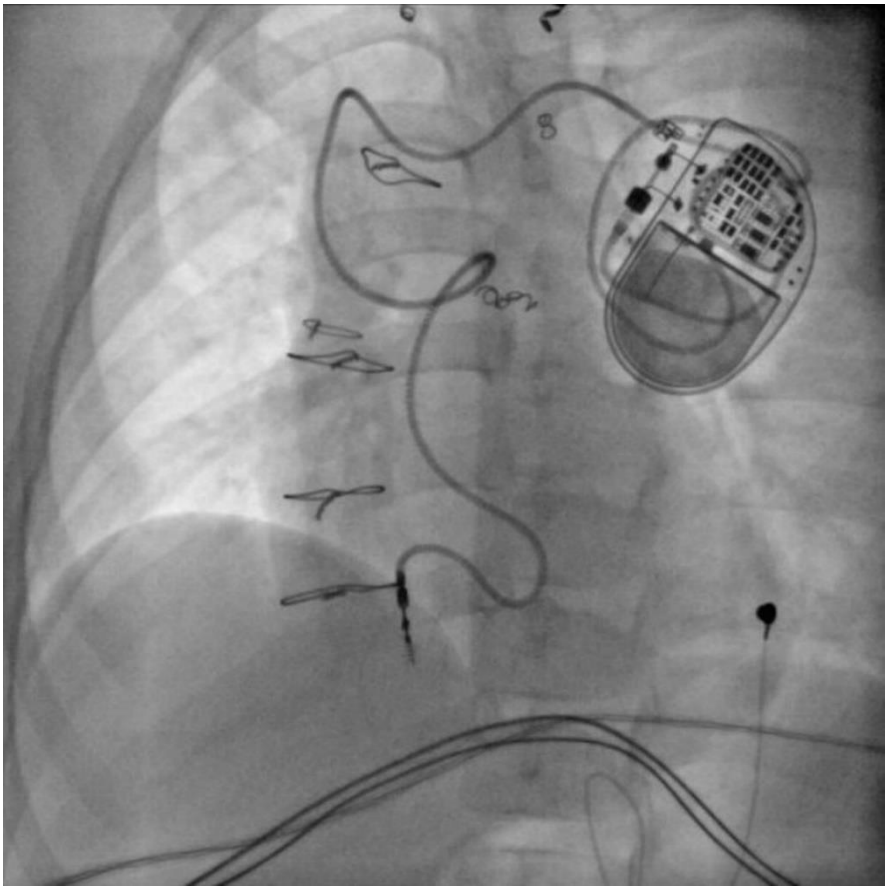

Figure 3: The AP radiographic view of the pacemaker after the implantation.

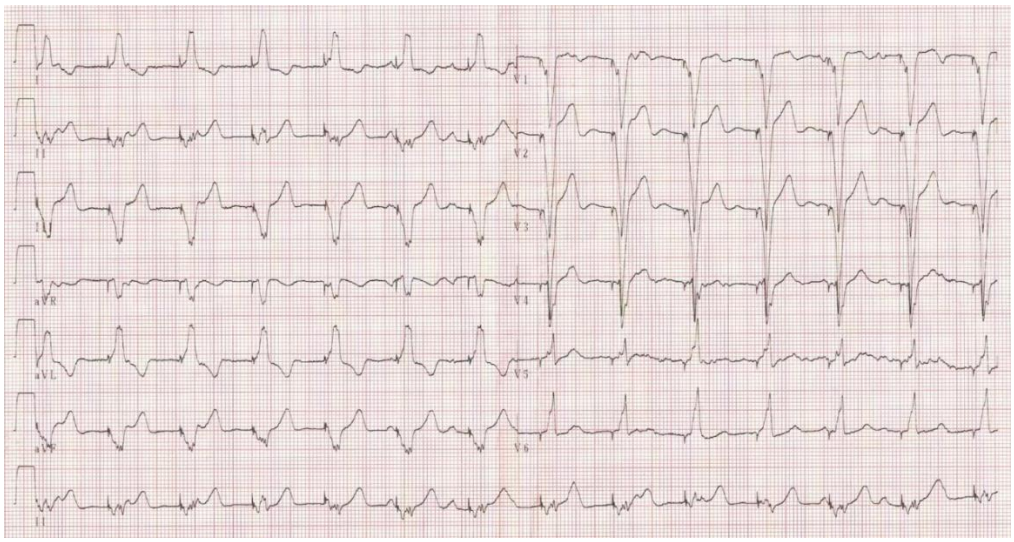

Figure 4: The post-procedure ECG showed consistent ventricular pacing during the follow-up.

3 Discussion

Epicardial pacing, the preferred choice for the patients after cavopulmonary shunt and suffered from AVB, [2] was carried out in this boy the first time he was found complete AVB. When the boy was threatened by complete AVB again 9 months later due to the lead fracture, epicardial pacing was not preferred on the consideration of severe tissue adhesion after three times of thoracic surgery. Transhepatic venous approach is an alternative option for this boy but excluded because of the risk of peripheral hepatic vein puncture associated complications and gravity induced lead dislocation. [3] Transcutaneous approach via the femoral vein was reported but had a high risk of lead wire fracture due to the movement of the hip joint. [4] Retroperitoneal approach via the inferior vena cava was another reported option but was too complex to this boy. [5] Though tortuous, the path from subclavian vein to right ventricular chamber was confirmed unobstructed by echocardiogram, so transvenous pacing via superior vena cava was the most feasible choice for this boy.

It was much difficult to deliver the sheath into the right ventricle though the guide wire could reach the right ventricle smoothly during the procedure, because the sheath was much thicker than and not as flexible as the guide wire. To made matters worse, the outer sheath twisted and blocked after

withdrawing the inner sheath because of the torsion created by the right angle at the junction of superior vena cava and right pulmonary artery. C315 S4 was tried but failed, and 6250VIC was finally coaxed to the right ventricular outlet tract successfully. We encountered the next problem when trying to fix the lead into the ventricular septum. Because of the poor conductivity of the patch used in the septal repair, a large part of the septum was not suitable as an anchor point for the lead. It took a lot of time to screw in the lead firmly with the ideal parameters possible.

The lead wire in the low velocity blood flow in pulmonary artery increased the risk of developing thrombosis, [6] so aspirin was taken after the implantation. In the 6 months follow-up, the pacemaker worked well and no thrombosis was found. Further follow-up is needed to learn more about this patient.

4. Conflict of Interest

The authors declare that there is no conflict of interest.

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