Successful Cardiac Resynchronization Defibrillator Placement in a Patient with Tetralogy of Fallot, Widened QRS Duration, and Mechanical Tricuspid Valve Replacement Using Dual-Site Left Ventricular Venous Lead Placement

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ABSTRACT. Mechanical tricuspid valves present a challenging scenario when patients develop a need for cardiac pacing or defibrillator placement. Total transvenous lead placement has proven to be both safe and efficacious. A 46-year-old male with a history of tetralogy of Fallot and mechanical tricuspid replacement for past endocarditis developed worsening fatigue and shortness of breath. He was found to have developed depressed left ventricular systolic function, widened QRS, and atrial flutter with controlled response and intermittent atrioventricular block. After successful right atrial flutter ablation, pacing leads placed in the anterior interventricular and posterolateral branch veins achieved cardiac resynchronization, thus avoiding having to cross the tricuspid prosthesis. An azygous defibrillator coil and subcutaneous array were utilized for defibrillator therapy and demonstrated adequate defibrillator thresholds. One month after the procedure, the patient demonstrated recovery of his left ventricular systolic function and remains asymptomatic 1 year after device placement with normal function. This represents a novel way of achieving both cardiac resynchronization and defibrillator therapy with a mechanical tricuspid valve.

KEYWORDS. congenital heart disease, cardiac resynchronization therapy, tricuspid valve prosthesis.

Introduction

Patients with tricuspid valve replacement pose a difficult dilemma if they require permanent ventricular pacing cardiac, given the challenges in placing a right ventricular endocardial lead placement across the prosthesis. However, the increasing use of coronary sinus lead placement has provided a safe and effective alternative for various conditions requiring single-lead ventricular pacing, bifocal-lead pacing, and even implantable cardioverter-defibrillator (ICD) therapy. We now present a case report of a patient who showed clinical improvement and echocardiographic evidence of recovered systolic left ventricular (LV) function after utilizing the anterior interventricular and lateral cardiac veins for cardiac resynchronization therapy (CRT).

Case report and procedure

A 46-year-old male with a history of tetralogy of Fallot status post traditional childhood repair and a history of...
Infective endocarditis requiring aortic, tricuspid, and pulmonic valve replacements 16 years prior to presentation was referred for fatigue and dyspnea. At the time of his valve surgery, a pacemaker was placed in the subcostal position, and apparently this was abandoned as the patient presumably resumed anterograde conduction. On electrocardiogram he was found to have bifascicular block (right bundle branch block and left posterior inferior hemiblock, QRS duration 178 ms) and atrial flutter with controlled ventricular response. A prior Holter recording revealed a ventricular rate in the 40s–90s bpm with intermittent atrioventricular (AV) block. A transthoracic echocardiogram was thus performed and showed reduced LV systolic function with an ejection fraction (LVEF) of 30%.

He was therefore referred for electrophysiological evaluation, ablation, and possible CRT/ICD therapy. Intracardiac recordings revealed typical counterclockwise atrial flutter with concealed entrainment within the tricuspid valve isthmus. Ablation of the isthmus was successful and uneventful with a return to sinus bradyarrhythmia and continued bifascicular block and long first-degree AV block. The following day, an attempt at CRT and ICD implantation commenced. Via his left axillary vein, a coronary sinus lumen catheter was utilized to selectively engage the azygous vein. A defibrillator coil (Medtronic model 69373A, 65C, Medtronic Inc, MN) was then deployed into the azygous vein via a long peel-away sheath and Amplatz wire.

Subsequently, a coronary guide sheath and inner lumen catheter was deployed to the coronary sinus, where contrast venography was performed to locate the anterior interventricular vein and posterolateral branch

Figure 1: Posterior-anterior (a) and lateral chest radiograph post procedure. The large black arrows identify the left ventricular leads in the anterior interventricular vein and posterolateral branch vein. The large white arrow depicts the azygos coil. The open arrows indicate the coils for the subcutaneous array. The thin black arrow marks the right atrial lead. Note the abandoned pacer in the subcostal position from the patient’s prior surgery.
defibrillator function and shocking impedance. He remains asymptomatic with normal LV function and normal prosthetic valve function.

Discussion

Pacing leads placed across prosthetic tricuspid valves can lead to valve damage, acute valve failure, and even death, especially with mechanical tilting-valve replacements. Epicardial lead systems provide an alternate means of pacing; however, this involves a more invasive procedure including general anesthesia, thoracotomy, and increased procedural risk. Bai et al first described utilizing coronary veins for LV leads, and since then multiple case reports have shown the efficacy of total transvenous lead placement in tricuspid repair patients with a variety pacing needs.

Lopez and Mihalick have demonstrated successful pacing and ICD lead placement in patients with a classic Fontan procedure, tetralogy of Fallot with-third degree AV block, and Ebstein’s anomaly, all with tricuspid obstacles to endocardial placement. In the patient with the previous Fontan operation and tricuspid atresia, they placed the pacing lead in the anterolateral vein and the ICD lead in the coronary sinus. They utilized the middle cardiac vein for ICD lead placement and a lateral vein for the pacing lead in the patient with tetralogy of Fallot and third degree AV block who had prior prosthetic tricuspid valve place. The same configuration for ICD and pacing was employed as well in the patient with Ebstein’s anomaly and significant congestive heart failure. In two other patients, one with Ebstein’s anomaly and second-degree AV block and another patient with rheumatic tricuspid valve disease and high-grade AV block, Lopez and Mihalick placed pacing leads in the anterior interventricular vein and posterolateral veins, similar to the configuration we used in our patient. In both patients, they demonstrated using tissue Doppler echocardiography of the septal and lateral LV walls that there was no significant delay to the peak systolic myocardial velocity. In other words, mechanical LV desynchronization was avoided with this approach.

To our knowledge, our case report demonstrates for the first time successful recovery of LV function after cardiac resynchronization therapy in a patient with a mechanical prosthetic tricuspid valve using a bifocal transvenous LV lead placement system and the combination of an azygous coil and subcutaneous array to achieve defibrillation. The anterior interventricular vein and lateral vein locations for pacing leads appears to optimize the timing of septal and lateral wall contraction, respectively, thus making this a viable alternative to the traditional CRT approach employing right ventricular pacing and a single coronary sinus lead. In addition, this is the first report utilizing an entirely transvenous approach for biventricular defibrillator placement utilizing both an azygos vein coil and a subcutaneous array. This approach is a viable long-term solution to a patient with a mechanical tricuspid valve replacement and cardiomyopathy requiring biventricular ICD therapy.

References