The Ochsner Journal 10:27–31, 2010

Implantation of Cardioverter Defibrillator After Percutaneous Closure of Atrial Septal Defect

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INTRODUCTION

For patients with cardiac septal defects, transvenous pacing and defibrillation lead implantation can result in complications such as lead misplacement and systemic venous to arterial thromboembolic events. To the best of our knowledge, only a single study exists of a pacemaker lead implantation after transvenous atrial septal defect (ASD) occlusion.[1] Therefore, we report the percutaneous closure of an ASD in a pediatric patient, followed by implantation of a transvenous cardioverter defibrillator lead.

CASE REPORT

A 13-year-old boy experienced aborted sudden cardiac death. He was resuscitated and transported to our institution for advanced cardiovascular care. His medical history was significant for pentalogy of Fallot that was surgically repaired with a transannular right ventricle-to-pulmonary artery patch, closure of his ventricular septal defect, and ''suture'' closure of his ASD at age 3 months, with reoperation for the implantation of a valved pulmonary conduit at age 11 years. The patient experienced a pulseless syncopal event while at school. The emergency medical system was activated, and he was found in ventricular fibrillation. He subsequently received a single 200-J shock, which restored him to normal sinus rhythm. On arrival at our institution, the patient was alert and talkative, and his physical examination was remarkable only for the presence of a fixed split of second heart sound with II/VI systolic pulmonary ejection murmur. An electrocardiogram showed normal sinus rhythm and right bundle-branch block with QRS duration of 160 milliseconds (Figure 1). The echocardiogram was consistent with repaired pentalogy of Fallot, showing mild right ventricular and right atrial dilation, mild pulmonary stenosis, severe pulmonary valve insufficiency, and mild tricuspid regurgitation with normal left ventricular systolic function. In addition, a moderate-sized secundum ASD measuring 8 mm with left-to-right shunt was detected.

A cardiac catheterization with transesophageal echocardiography was performed using general anesthesia for hemodynamic evaluation and septal defect occlusion. During the catheterization, balloon stop-flow measurements of his ASD demonstrated it to be 11 mm (Figure 2). A 20-mm septal occlusion device (Helex, W.L. Gore & Associates, Inc, Newark, DE) was subsequently used to occlude the defect (Figure 3). No residual postocclusion shunt was detected by transesophageal echocardiography. No complications occurred during the procedure.

Three days after ASD occlusion, the patient underwent placement of an implantable cardioverter defibrillator (ICD). A 6F 65-cm lead was advanced transvenously from the left subclavian vein into the right ventricle. A prepectoral pocket was fashioned in a standard manner, and an ICD (Atlas II VR V-168, St Jude Medical, Inc, St Paul, MN) was successfully implanted (Figure 4). Testing of the lead revealed excellent capture threshold to 0.5 V at 0.5 milliseconds, with a pacing impedance of 420 Ω and sensing exceeding 15 mV. A defibrillation threshold of 25 J was confirmed during device testing (Figure 5). No complications occurred during implantation or testing of the ICD. At follow-up 6 months later, the patient had no complaints, and device interrogation revealed excellent thresholds.

DISCUSSION

Tetralogy of Fallot occurs in approximately 6% of all congenital heart defects. It includes a large ventricular septal defect, right ventricle outflow tract obstruction, right ventricle hypertrophy, and over-

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Key Words: Congenital heart disease, implantable defibrillator

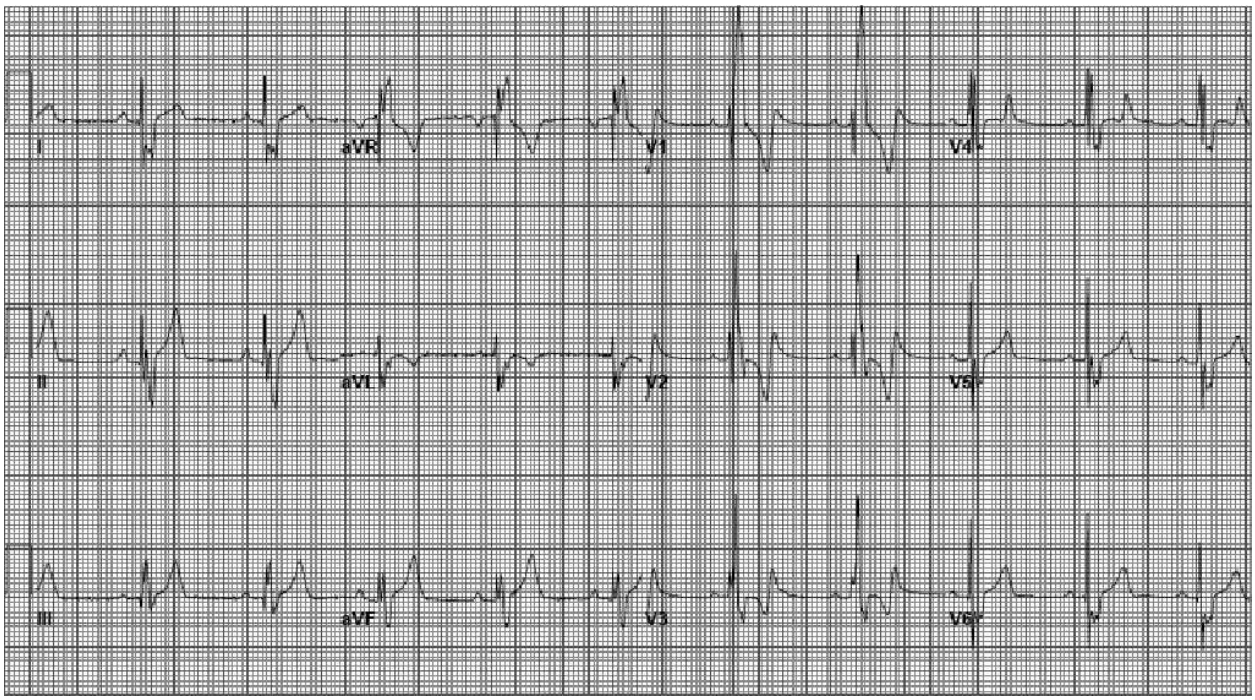

Figure 1. Baseline electrocardiogram illustrating sinus rhythm with right bundle-branch block.

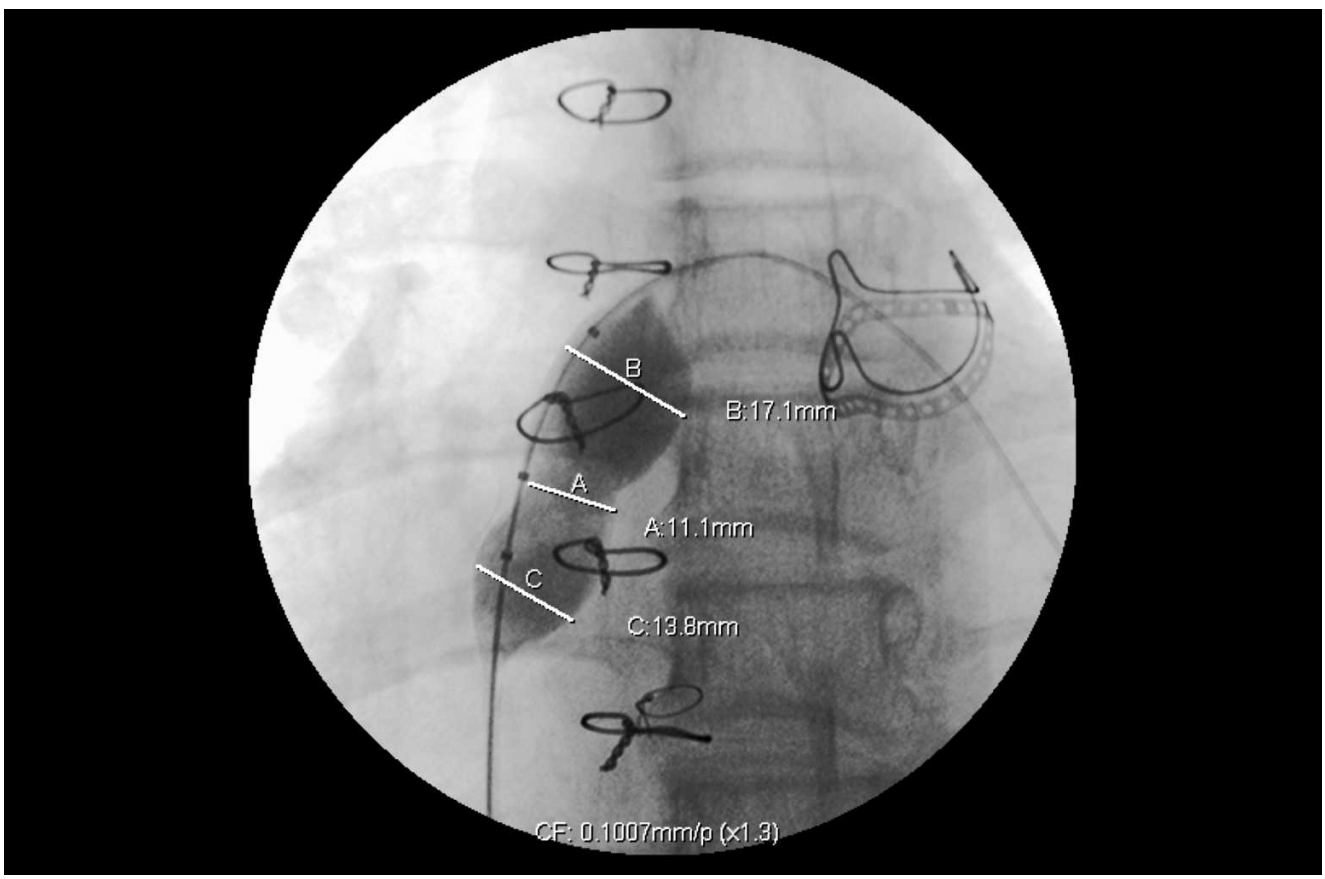

Figure 2. Balloon stop-flow measurement of atrial septal defect.

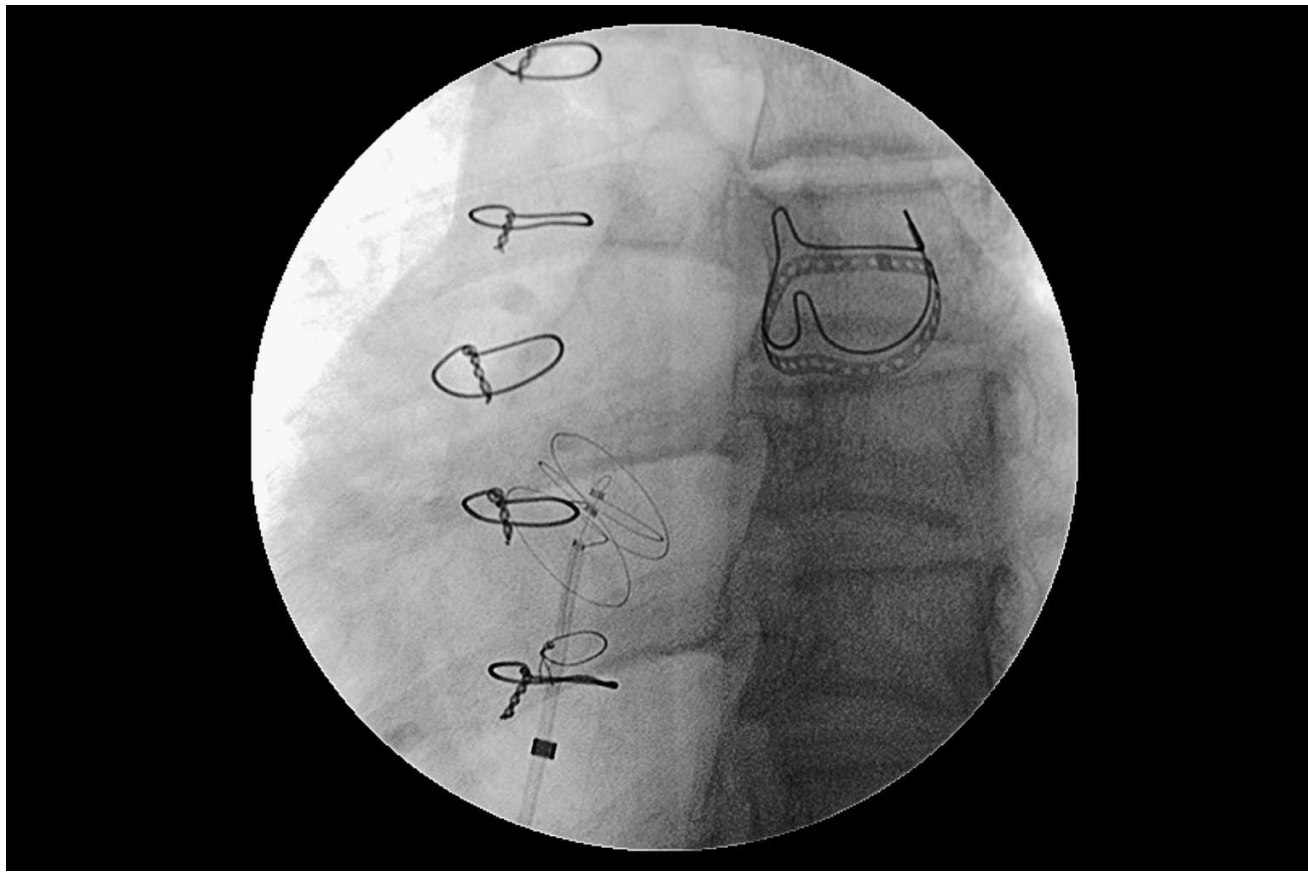

Figure 3. Helix septal occluder being placed in atrial septum.

riding of the aorta. Up to 82% of patients with tetralogy of Fallot also have an ASD, which is referred to as pentalogy of Fallot.[2,3]

Over the past decade, transcatheter closure of ASDs has become a widely accepted alternative to surgical closure. The device used to close this patient's ASD is the Helex septal occluder, which was recently approved for percutaneous closure of small to moderate-sized centrally located secundum ASDs. It has a rounded, flexible, atraumatic shape and a low profile that theoretically poses little risk of late erosion or penetration of any adjacent vascular walls.[4]

Transvenous cardiac pacemaker lead insertion in patients with septal defects has been associated with complications such as lead malposition and systemic thromboemboli.[5–7] When pacer leads are inserted through the venous system, they may cross the ASD from the right atrium to the left atrium and possibly through the mitral valve into the left ventricle. Any residual right-to-left shunting may result in lead malposition or stroke. In fact, episodes of transient neurologic deficits secondary to embolic events have been reported, as well as cases with thrombus detected within the thoracic aorta and left ventricle.[6,8]

In a previous study[1] of pediatric patients with ASD and long QT syndrome, the authors closed the ASD with a clamshell device, and they implanted the transvenous lead 8 weeks later. The authors gave no recommendations concerning the time between ASD closure and transvenous lead implantation. In our patient, we performed ASD closure and transvenous lead implantation during the same hospitalization but not during the same procedure.

SUMMARY

The treatment of this child with a residual ASD after surgical repair of pentalogy of Fallot and aborted sudden cardiac death is unique because both ASD occlusion and ICD implantation were performed during the same hospitalization. We believe that all patients with ASD should be evaluated for transvenous occlusion before implantation of transvenous leads. By occluding their septal defect, one may avoid the potential complications of lead malposition and systemic thromboembolic events.

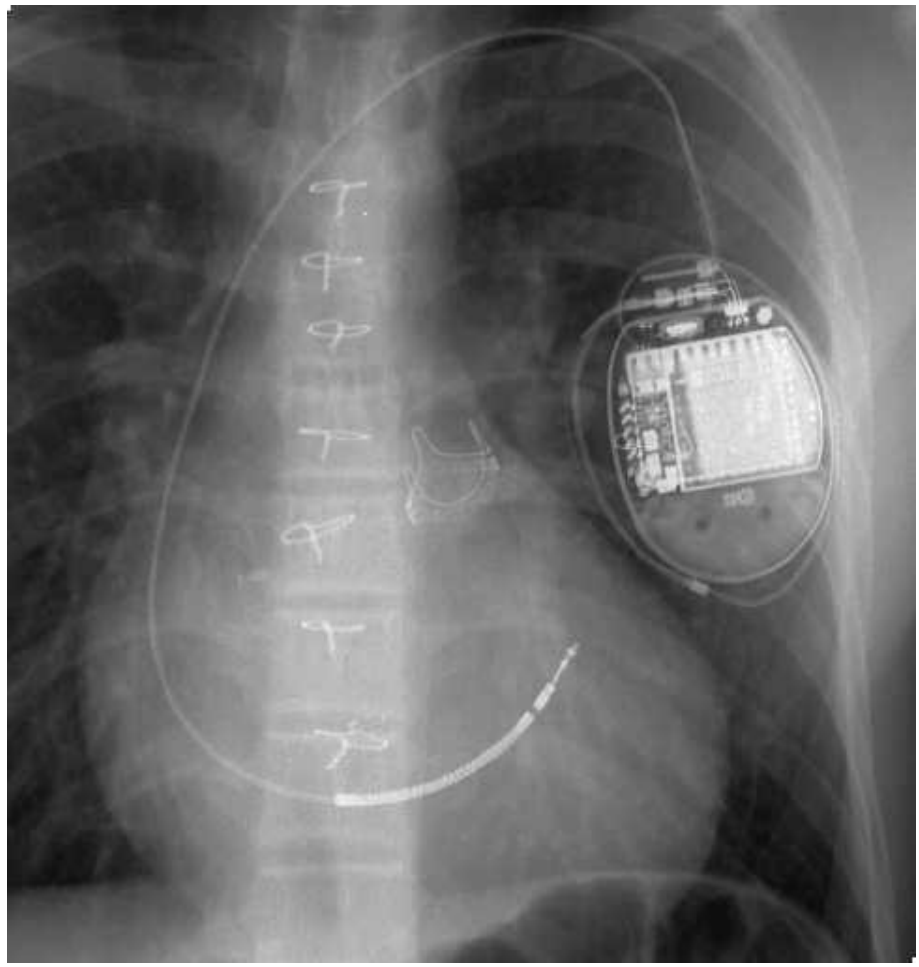

Figure 4. Location of the implantable cardioverter defibrillator lead.

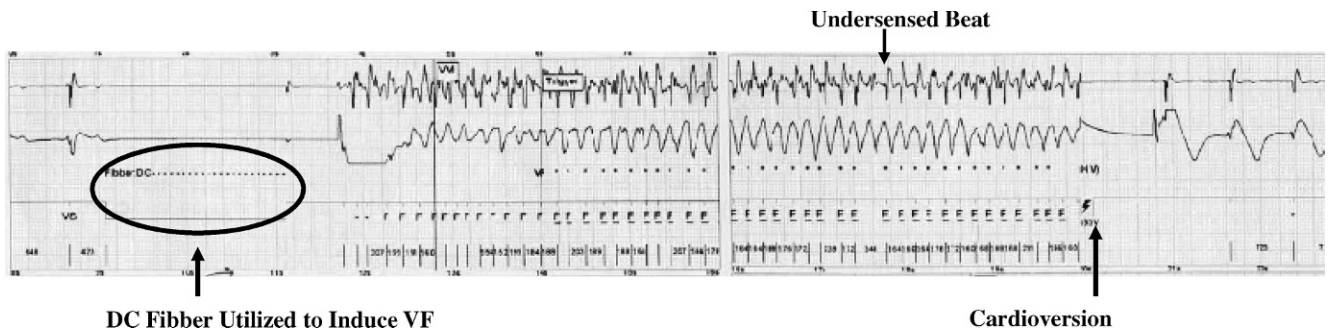

Figure 5. Implantable cardioverter defibrillator testing.

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