A 51-year-old male, with prior coronary artery bypass grafts and a more recent history of recurrent hospital admissions for refractory heart failure, presented with advanced heart failure caused by ischemic cardiomyopathy. The patient was placed on the heart transplantation list. A subcutaneous-implantable cardioverter/defibrillator (S-ICD; Cameron Health, San Clemente, CA) was electively implanted 1 month later for primary prevention. At implant, sustained ventricular fibrillation was induced and successfully converted to normal sinus rhythm with a submaximal 65 J standard polarity shock with time to therapy of 13 s and impedance of 55 Ω. After an uneventful postoperative period, the patient was discharged home but readmitted a few weeks later with severe heart failure necessitating inotropic support and later emergent placement of a HeartWare Ventricular Assist Device (HVAD; HeartWare International, Inc, Framingham, MA) left ventricular assist device (LVAD) and extracorporeal CentriMag (Levitronix GmbH, Zurich, Switzerland) right VAD as bridges to heart transplantation. The HeartWare HVAD is a magnetically levitated nonpulsatile centrifugal pump. The postoperative chest x-ray (Figure 1) shows the LVAD and the S-ICD adjacent to it. The patient’s condition stabilized and was completely mobilized on LVAD and temporary right VAD. He was transplanted 88 days after LVAD/right VAD support and discharged to rehabilitation center 57 days after transplant.

The S-ICD sensed appropriately in all 3 vectors until the LVAD was implanted. Post-LVAD implantation, the S-ICD sensing in primary and secondary vectors involving the pulse generator, located adjacent to the LVAD, detected noise (Figure 2). The sensing of the third S-ICD vector, the alternate vector, electrode tip to proximal ring, located parasternally and away from the LVAD, remained unaffected, functioning appropriately (Figure 2). There was no therapy delivered by the S-ICD, appropriate or inappropriate, after implant before or during the LVAD support. The S-ICD system was explanted 7 days after transplantation.

**Discussion**

There have been some recent reports describing the interaction of ICDs with LVADs. This case report describes the first patient to our knowledge with simultaneous S-ICD and HeartWare LVAD. The majority of patients with LVAD require ICD protection pre- or perioperatively because ventricular arrhythmias are common in those patients. The HeartWare interference with the primary and secondary sensing vectors of the S-ICD is presumed to emanate from the magnetic field of the LVAD. HeartWare HVAD and HeartMate II (Thoratec Corporation, Pleasanton, CA) are the most commonly used VADs in the clinical practice both generating electromagnetic fields but working with different frequencies, 1800 to 3200 rpm and 6000 to 15000 rpm, respectively. The frequency of the signals generated by the electromagnetic field of the HeartWare LVAD is within the
range of the signals detectable by the S-ICD. These signals are, however, classified as noise and not signals of cardiac origin (N markers in Figure 2) and consequently do not trigger any inappropriate therapy, but would also not deliver appropriate therapy in case a true arrhythmia starts. A further patient at our institution required a HeartWare HVAD support after S-ICD implantation and all 3 S-ICD sensing vectors functioned appropriately. HeartWare pump speeds were 2500 and 2200 rpm for the first and second patient, respectively. Our experience suggests that the S-ICD seems to function in a similar way to conventional ICDs, namely being affected only at higher HeartWare assist device pump speed.3

We strongly recommend re-evaluation of S-ICD functionality after implantation of an LVAD or once LVAD speed is increased to exclude device-device interaction.

Figure 2. The subcutaneous-implantable cardioverter/defibrillator sensing vectors and subcutaneous ECG in the 3 Cameron Health vectors after left ventricular assist device implantation. Primary and secondary sense vectors show noise signals (N markers), whereas sensing (S markers) was unaffected in the alternate sense vector. N indicates noise signal; and S, appropriate sensing.

Disclosures
Dr O’Connor is an employee of Cameron Health Inc. Dr Winter was a member of the Cameron Health Advisory Board. The other authors have no conflict to report.

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Left Ventricular Assist Device in a Patient With a Concomitant Subcutaneous Implantable Cardioverter Defibrillator
Diyar Saeed, Alexander Albert, Ralf Westenfeld, Bujar Maxhera, Hildegard Gramsch-Zabel, Stephen O'Connor, Artur Lichtenberg and Joachim Winter

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