EP CASE REPORT

The vortex of three-dimensional mapping with a centrifugal ventricular assist device

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Introduction

Left ventricular assist devices (VADs) are increasingly utilized for mechanical support in medical therapy refractory advanced heart failure. Third- and fouth-generation VADs have a miniaturized intrapericardial design. The HeartWare HVAD is FDA approved for bridge to transplantation, while the HeartMate 3, which has a similar design, remains investigational in the USA. These centrifugal pumps use magnetic levitation to both suspend and drive their impellers.[1] As the body of the VAD is immediately adjacent to the inflow cannula at the apex, there is potential for interaction with electroanatomic mapping (EAM) systems used in electrophysiology due to interactions with the electromagnetic field of the VAD.

Ventricular tachycardia ablation in patients with an HVAD has been previously described;[2] however, the interaction between EAM systems and an HVAD has not. This issue has important clinical implications for the electrophysiologist.

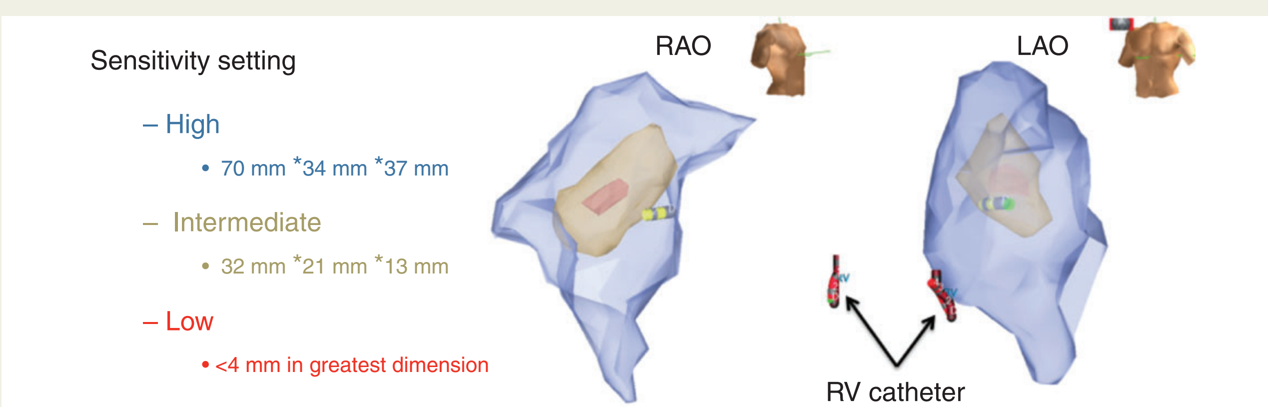
Methods and results

A 67-year-old man implanted with a HeartWare HVAD for ischaemic cardiomyopathy presented with poorly tolerated recurrent, refractory monomorphic ventricular tachycardia despite optimized volume status, VAD speed, and drug therapy. Morphology was consistent with a mid-anteroseptal left ventricular exit and catheter ablation was performed.

It has been observed that the VAD produces' interference with echo imaging acquisition.[3] Electrostatic noise generated by the VAD was also present on 12-lead ECG. Anticipating similar noise in the EAM environment, we prepared for the use of either EAM systems available at our hospital (Biosense Webster CARTO and St Jude Medical Ensite). We used an open irrigation mapping/ablation catheter (Thermocool ST, Biosense Webster). The CARTO EAM system generates a three-dimensional matrix using the relative magnetic strength of a navigation-enabled catheter to register an impedance map such that catheter localization can be determined by local impedance. A profound catheter motion artefact was noted with the CARTO system. This was more pronounced near the apical inflow. Neither the virtual geometry nor the catheter position was sufficiently reliable in the left ventricle and we switched to the Ensite system. Of note, the bipolar electrograms recorded from the mapping catheter did not demonstrate significant artefacts.

Ensite triangulates catheter position using local impedance within a 5 kHz current applied through orthogonal skin patches. With nominal sensitivity settings and system reference, motion artefact was significant and again worse near the HVAD. It persisted despite changing the reference to a right ventricular catheter (see Supplementary material online, *Video S1*). We reduced the motion sensitivity setting from nominal to least sensitive on the Ensite system, which substantially reduced artefactual movement. Using this setting, we were able to generate a left ventricular geometry, where catheter position and contact was verified by intracardiac echo. The extent of catheter movement using three sensitivity options is illustrated the figure.

The tachycardia was successfully mapped and ablated using entrainment mapping, fluoroscopy and EAM in the least sensitive setting. Neither of the two mapping systems interfered with HVAD function.



Conclusions

The magnetically suspended impeller and intrapericardial location of intrapericardial VADs causes significant interaction with EAM systems that rely on a stable electromagnetic environment for catheter localization. Electrophysiologists need to be aware of these challenges for procedure planning.

Supplementary material is available at *Europace* online.

References

1. Larose JA, Tamez D, Ashenuga M, Reyes C. Design concepts and principle of operation of the HeartWare ventricular assist system. *ASAIO J* 2010;**56**:285–9.
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3. Lesicka A, Feinman JW, Thiele K, Andrawes MN. Echocardiographic artifact induced by HeartWare left ventricular assist device. *Anesth Analg* 2015;**120**:1208–11.