Case report of an anomalous single azygos venous coil insertion to reduce the defibrillation threshold in a patient with a right-sided deltopectoral ICD implant

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Implantable cardiac defibrillators (ICDs) reduce the incidence of sudden death in persons at high risk for lethal arrhythmias. The life-saving potential of ICDs depends on their ability to effectively deliver an adequate current density through a sufficient proportion of the ventricular myocardium to terminate ventricular fibrillation. High defibrillation thresholds (DFTs) are an important contributing factor to mortality in ICD recipients.¹

High DFTs are more common in patients with right-sided implants, as well as patients on amiodarone, patients with hypertrophic cardiomyopathy and patients with large chest size.

Some patients require right-sided ICD implants because of left innominate vein occlusion. A number of strategies have been described to improve the DFT in these patients, including using higher output devices, avoiding DFT raising drugs and using alternate vectors.

The use of an extra coil in the superior vena cava (SVC), coronary sinus, azygos vein and hemiazygos vein have all been described in the literature.^{2–7}

Other effective methods of lowering the DFT in this patient subpopulation include insertion of a subcutaneous array.⁸ A recent case report documented the use of a combination of an azygos venous coil and a subcutaneous array.⁶ There is no documentation as yet of the implantation of a coil placed on an anomalous single azygos vein to effectively lower the DFT. We present the case of a man with high DFTs and a right-sided prepectoral ICD implant. Initially, he was implanted with a left-sided ICD for an ischaemic cardiomyopathy in 2005, which was then upgraded to a biventricular system in 2007.

Unfortunately, this system required extraction in 2011, following left prepectoral pocket infection associated with skin erosion. Following appropriate antimicrobial therapy, he was implanted with right-sided leads (right atrial impedance, 380 Ω ; right ventricular impedance, 532 Ω ; left ventricular impedance, 912 Ω) and a right deltopectoral PROTECTA CRT-ICD (Medtronic, Minneapolis, Minnesota, USA). The device successfully sensed ventricular fibrillation induced by 50 Hz pacing; however, defibrillation at 25 J and maximum output was unsuccessful. Termination of ventricular fibrillation required external defibrillation with 150 J biphasic energy.

Six days later the patient returned to the electrophysiology laboratory. The existing pocket was

opened, and testing of the leads was satisfactory, measuring the same impedances mentioned above.

The right subclavian vein was accessed with a guide wire using a modified Seldinger technique. A 9 Fr peel-away sheath was inserted over the wire. A 6 Fr Judkins-right-4 (JR4) catheter (100 cm) was then introduced into the SVC over a 0.35-inch J-tipped wire. Contrast venography in the posteroanterior and left anterior oblique views were employed to clarify the patient's venous anatomy. This identified a left-sided descending branch of the left innominate vein (see figure 1). As this large calibre vessel was in the midline and anterior to the vertebral column, it was felt to represent an anomalous single azygos vein. Access to this vein was obtained using the 0.35-inch J-tipped wire and the JR4 catheter. Access was straightforward and no special equipment was required. A Transvene SVC coil (Medtronic) was then passed into the anomalous azygos vein under fluoroscopic guidance (figure 2). Coil impedance was measured at 62 Ω .

The new lead was connected to the PROTECTA CRT-D device, which was then placed back in the existing subcutaneous pocket and the pocket was closed.

Figure 1 Injection of contrast through a Judkins-right-4 catheter in the left anterior oblique view showing the ascending single azygos vein, with the internal jugular vein arising from the junction with the left brachiocephalic vein.

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Figure 2 Fluoroscopic images in the anteroposterior view showing the transvenous coil (arrowed) in the anomalous azygos vein.

Under conscious sedation, ventricular fibrillation was induced by 50 Hz pacing, sensed appropriately and terminated with a single 25 J shock via the ICD. The patient was well post-procedure, and posteroanterior and lateral (see figure 3) chest radiograms confirmed lead and coil positions.

At 6-month follow-up, impedance in the azygos coil was measured at 72 Ω . No episodes were detected during this follow-up period.

DISCUSSION

This case report describes the use of an anomalous single azygos vein for venous coil placement in a patient with a right-sided

Figure 3 Chest radiogram in the lateral position showing posterior location of the azygos venous coil (arrowed). The dashed line represents the junction between the superior vena cava and the right atrium.

ICD implant. This previously undescribed approach has proved a safe and effective option, with no periprocedural complications and achievement of a satisfactory DFT.

In this case, the use of a single azygos venous system for venous coil placement was a successful and effective option to lower the DFT. In patients with high DFTs and right-sided implants, with a large single azygos vein, placement of a transvenous coil may be considered. An alternative option in such patients is the insertion of a subcutaneous array. This has proved extremely effective for lowering high DFTs, although it requires additional skin incisions, tunnelling and may be more prone to lead fracture due to its superficial position.

Several case reports have shown the effectiveness and ease of implant associated with SVC and azygos vein coil insertion, and to date there is only one case report of the use of the hemiazygos vein for coil placement.

Wide anatomical variation is a recognised feature of the azygos venous system. The variations of this system are of clinical importance when considering suitability for transvenous coil placement. Imaging and mediastinal surgery are other instances where the importance of these anatomical variations is realised.

In conclusion, individual patient anatomy should be accounted for in all cases of venous coil insertion, and where suitable, a single azygos vein may be considered.

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