MRI-safe pacemakers and reduction of cardiac MRI artefacts with right-sided implantation

Jamal N. Khan*1, Anvesha Singh1, Mini V. Pakkal2, and Gerry P. McCann1

1Department of Cardiology, Glenfield Hospital, Groby Road, Leicester LE3 9QP, UK and 2Department of Radiology, Glenfield Hospital, Groby Road, Leicester LE3 9QP, UK

* Corresponding author. Tel: +44 0116 258 3244, Fax: +44 0116 258 3422, Email: jk211@le.ac.uk

Patients with implanted cardiac pacing devices have a 50–75% likelihood of an indication for cardiac MRI (CMR) during the device lifetime. Three pacemakers (Medtronic Ensura™, St Jude Accent™, and Biotronik Evia™) and one implantable cardioverter-defibrillator (Biotronik Lumax 740™) are approved for CMR. Pacing devices cause CMR artefacts due to differing magnetic susceptibilities in metal and human tissue. These can render scans suboptimal (Panels B–D). Devices are typically implanted on the non-dominant side (left), but resultant artefacts can degrade image quality.

A 69-year-old male was admitted following recurrent syncope in the presence of a bifascicular block and mildly elevated Troponin-I levels (157 ng/L). Echocardiography demonstrated severe left ventricular hypertrophy. A stress CMR for ischaemia and to assess for hypertrophic cardiomyopathy was requested after implantation of an MRI-safe pacemaker due to the risk of asystole with adenosine. A Medtronic Ensura™ pacemaker was implanted in the right deltopectoral groove to minimize metallic artefacts over the heart. CMR performed on a 1.5 T scanner (Avanto™, Siemens, Germany) with the pacemaker programmed to DOO confirmed hypertrophic cardiomyopathy. Standard CMR sequences were undertaken with artefact absent apart from a small area of non-significant signal loss (susceptibility artefact) in the right ventricular cavity due to the pacing lead. All images were of good quality and superior to the degraded images produced on a recent patient with an identical left-sided implant (Panels F–H). The patient has had no limitation of function related to device implantation.

Where a pacemaker or implantable defibrillator is required before CMR, we recommend right-sided implantation to minimize cardiac artefacts.

Images from the patients with left- and right-sided pacemakers (artefacts labelled with white arrows). Both patients had identical right atrial and right ventricular apex lead/electrode positions. Top row (left-sided), left to right: (A) chest X-ray. (B) two-chamber steady-state free precession (SSFP) CMR cine with distortion over anterior wall and apex. (C) Two-chamber LGE CMR sequence with distortion artefact over basal to mid-anterior wall. (D) Short-axis LGE CMR sequence demonstrating severe distortion artefact. Bottom row (right-sided). (E) Chest X-ray. (F) Two-chamber SSFP cine with no artefact, despite using SSFP, which is particularly prone to metallic artefacts. (G) Two-chamber LGE and with no artefact; patchy fibrosis associated with HCM seen in inferior wall (labelled asterisk). (H) Short-axis LGE with no artefact; fibrosis in septum and anterior wall (labelled asterisk).

Acknowledgements

Berntom Ouma (CMR radiographer) for image acquisition. Written consent obtained from both patients. J.N.K. wrote the manuscript. A.S., M.P., and G.P.M. undertook the CMR scan and helped revise the manuscript. All authors were involved in patient care.