Radiology: Cardiothoracic Imaging COMMENTARY

Clearing the Path to Optimal Care in Patients with Non–MRI-conditional Cardiac Devices

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Early in the clinical use of MRI, concerns were appropriately raised regarding the safety of MRI in patients with cardiovascular implantable electronic devices (CIEDs), typically pacemakers and implantable cardioverter defibrillators. Given the magnetic and radiofrequency fields used in MRI, experimental studies demonstrated the potential for significant complications. Thus, the presence of a CIED was considered an absolute contraindication to MRI of any part of the body. This dictum was subsequently reflected in MRI safety recommendations, device instructions for patients and physicians, and lack of reimbursement for scans performed in patients with these devices. Not surprisingly, this resulted in a serious underutilization of MRI in these patients.

In response, manufacturers developed MRI-conditional cardiac devices which would permit MRI. However, this did not address the large number of patients with non–MRI-conditional devices and leads, sometimes termed *legacy devices*. Over the past 20 years, multiple groups have determined how to perform MRI in such patients. These studies have demonstrated the safety of performing MRI in patients with non–MRI-conditional cardiac devices, as long as the study is performed following an established protocol and with appropriate monitoring (1,2).

The article by Gupta et al in this issue of *Radiology: Cardiothoracic Imaging* (3) adds to the mounting body of evidence documenting the safety and clinical impact of MRI in patients with non–MRI-conditional devices. This registry study involved a standardized clinical protocol at four institutions. Importantly, for cardiothoracic imagers, it included both cardiac and thoracoabdominal MRI. Moreover, in distinction to prior studies, it included patients who were pacemaker dependent (27%) and those with fragmented and abandoned leads (2%). Finally, and most importantly, it surveyed the referring physicians to determine the impact of the MRI performed on diagnosis and management.

As in prior studies, examinations were performed in accordance with a highly standardized protocol which excluded pacemakers implanted before 1998, implantable cardioverter defibrillators (ICDs) before 2000, patients with recent ICD therapies, unresponsive patients without durable power of attorney in whom informed consent could not be obtained, and new or revised leads within 6 weeks of the MRI request date. All studies were performed at 1.5 T using standard imaging protocols. Examinations were performed with hemodynamic monitoring in the presence of an Advanced Cardiovascular Life Support–certified electrophysiology nurse. A physician was immediately available but was not physically present in the MRI suite. The device was interrogated immediately after the examination and at 3–4 months after the examination. Referring physicians completed a survey to assess the clinical impact of the MRI examination performed.

Focusing on the results of most interest to cardiothoracic imagers, there are several important findings. First, a total of 25 examinations were performed in 15 participants with abandoned leads without complication. Abandoned leads have been considered an absolute contraindication, and the outcome of this study indicates that these patients can be imaged safely, if imaged under the highly standardized protocol described.

Second, in participants undergoing cardiac MRI, the diagnosis was altered in 35% and confirmed in 54%, while prognosis was altered in 35% and confirmed in 51%. The fact that diagnosis and prognosis were altered in more than a third of patients indicates the importance of cardiac MRI in an increasing number of cardiac patients, particularly those with infiltrative cardiomyopathies, such as amyloidosis and sarcoidosis, dilated cardiomyopathy, and hypertrophic cardiomyopathy. In addition, techniques are being developed which improve image quality in the setting of metal artifacts (4).

Referring physicians have increasingly argued to expand access to MRI for patients with cardiac devices (5). Given the results of this and prior studies, why do we continue to not perform MRI in these patients? As noted by the authors, there are several reasons: First, performing MRI examinations in patients with non–MRI-conditional devices requires significant investment in time and nonphysician personnel. Although there is now Centers for Medicare and Medicaid Services coverage for MRI in

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See also the article by Gupta et al. Conflicts of interest are listed at the end of this article.

patients with non–MRI-conditional devices (6), the additional costs of nursing support and monitoring may be difficult for hospitals and imaging service lines to recover. However, it is clear from this study that the results of MRI examination in these patients can have an important impact on diagnosis, prognosis, and surgical management that can help justify the investment in time and effort. Second, developing the standard operating procedures and workflow is dependent upon an effective collaboration among radiologists, technologists, cardiologists, cardiac electrophysiologists, and referring physicians to implement. This effort requires a common vision, a project champion to move the project forward, and dedication to providing this option for our collective patients.

Cardiothoracic imagers can play a critical role in increasing the availability of MRI in patients with non–MRI-conditional devices. They interact regularly with cardiologists, cardiac electrophysiologists, and referring physicians. They know the MRI technology involved and its utility in diagnosis and management compared with other modalities. They can serve as a knowledgeable resource to their radiology and clinical colleagues and ensure that MRI is used appropriately and safely in these patients.

In conclusion, this study reinforces the need to increase the availability of MRI for patients with non–MRI-conditional devices, including those being evaluated for cardiac and thoracic disease. The number of centers where this service is available is expanding rapidly as radiologists and cardiologists collaborate effectively. It is critical that radiologists and other providers understand and promote the fact that the presence of a non–MRI-conditional cardiac device is no longer an absolute contraindication to MRI. Cardiothoracic imagers can play an important role in educating their colleagues, hospital administrators, and patients in the safe and effective use of MRI. By doing this they can help clear the path to providing the best medical care of patients with cardiac devices.

Disclosures of Conflicts of Interest: R.M.P. disclosed no relevant relationships.

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