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Performing magnetic resonance imaging in patients with implantable pacemakers and defibrillators: results of a European Heart Rhythm Association survey

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The purpose of our survey was to evaluate the experience, current practice and attitudes of performing magnetic resonance imaging (MRI) studies in patients with cardiac implantable electronic devices. Fifty-one centre-members of European Heart Rhythm Association Research network have responded to the survey. According to the obtained data, 55.2% of responding centres do not perform MRI scans in patients with non-MRI-certified pacemakers and 65.8% in patients with such implantable cardioverter defibrillators (ICDs). Reported complication rate in patients with non-MRI-certified devices is low and conforms to the literature data. Experience with newer MRI-compatible pacemakers and ICDs is limited to single cases in most centres. This survey shows limited experience with performing MRI studies in patients with implanted pacemakers and ICDs. In concordance with available guidelines, most centres limit MRI scans in patients with non-MRI-certified devices. The implant numbers for MRI-certified devices and experience with performing MRI scans in these patients are still low.

Keywords Pacemaker • ICD • Magnetic resonance imaging

Introduction

The number of implanted cardiac implantable electronic devices (CIEDs) is constantly growing. An appreciable proportion of patients has a condition requiring magnetic resonance imaging (MRI) prior to CIED implantation, or develops this problem thereafter. Although it has been shown that performing MRI in such patients may cause a problem with CIED functioning, other studies have been done showing that MRI is indeed safe in most of patients with implanted CIEDs. Newest MRI-certified devices and leads have been elaborated and approved for clinical use. The purpose of this survey was to analyse the experience and practices of performing MRI studies in pacemaker and implantable cardioverter defibrillator (ICD) patients in centre-members of EHRA Research Network.

Methods and results

Characteristics of centres

Responses were received from 51 of the European Heart Rhythm Association (EHRA) Research Network Centres. Centre distribution by nation in alphabetical order was: Armenia 1, Austria 1, Belgium 1, Bulgaria 1, Denmark 2, Estonia 1, Germany 4, France 3, Georgia 1, Greece 3, Iceland 1, Italy 8, Lithuania 2, the Netherlands 2, Poland 6, Portugal 1, Romania 1, Spain 3, Sweden 2, Switzerland 1, and UK 6.

Responding centres were mostly characterized by high CIED implant numbers. For the first half of year 2012, only 13.9% of responders indicated <50 pacemaker implants, 58.3%—from 50 to 200, and 27.8%—more than 200. For the same period of time, 33.3% of centres implanted <50 ICDs, 50%—from 50 to 100 ICDs,

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and 16.7%—more than 100 ICDs. In all, 71.7% of centres were university hospitals; 13.2% were private; and 15.1% other types of hospitals.

Experience of performing magnetic resonance imaging scans in device patients

To evaluate the extent of using cardiac MRI, centres were asked to give yearly numbers of cardiac MRI scans. These numbers varied from <100 per year (36.8% of centres) and 100–1000 per year (42.1%) to 1000 and more per year (21.1% of centres). Number of MRI scans in CIEDs patients varied significantly between centres. Overall reported numbers of cardiac MRI scans in CIED patients are presented in *Table 1*.

As seen in *Table 1*, about one half of responders did not perform MRI scans in patients with implanted CIEDs. Those who have such an experience reported some problems. For non-MRI-certified devices, three centres reported problems with sensing and pacing, and two centres had to perform system revision with lead/device exchange, with no fatalities reported. For MRI-certified devices, only transitory problems with sensing/pacing were reported by one centre.

Current practices and attitudes regarding magnetic resonance imaging scans in implanted cardiac implantable electronic device patients

The decision to perform MRI in non-MRI-certified pacemakers and CIEDs is influenced by some factors and clinical situations; approximately one-third of responders indicated that they perform MRI in urgent clinical situations when benefits of MRI outweigh risks. Other than thoracic scan locations (abdominal, limb) would be considered possible to perform by 10–13% of responders. The strength of magnetic field also was also considered important: 32% of responders would consider MRI in pacemaker patients possible when performed with 0.5–1.5 T field strength, but not with stronger fields. For non-MRI-certified ICDs, even with weaker magnetic field, MRI was considered possible by only 13.2%. Considering risk of asystole during scan for non-MRI-certified devices, good intrinsic heart rates would decrease possible risks and make MRI possible (16% of responders indicated this for pacemakers and 8% for ICDs).

Attitudes towards performing MRI in abandoned leads are similar: 63% of responders never perform MRI scans in such patients. Some (11%) of responders would consider weaker magnetic fields (0.5–1.5 T) may make MRI scanning possible, and 8% of responders would consider that it is possible to perform MRI in non-pacemaker-dependent patients.

When asked about the possible differences between various models of non-MRI-certified CIEDs, 19% of responders would prefer some models comparing with others as less problematic during MRI scanning. The rest 81% of responders do not see any differences between non-MRI-certified models.

The number of implanted MRI-certified CIEDs for the first 6 months of year 2012 varied between the responding centres. For pacemakers, 17.1% of centres did not implant any device, 34.3% implanted <10 devices, 40%—from 10 to 50 devices, and 8.6%—more than 50 devices. For ICDs, 60% of centres did not implant any MRI-certified device, 34.3% implanted <10 devices, and 5.6% implanted 10 and more devices.

Only 5.7% of centres stated that MRI-certified devices represent more than half of total implants.

With regard to institutional policy to perform MRI scans in CIED patients, 19.4% of centres indicated that they do not have policies/protocols for those procedures but just perform MRI scans as needed, and 30.6% reported having institutional policies for such procedures.

When asked if lead extraction with system replacement would be a reasonable procedure in order to perform MRI in patients with older CIED systems, 79.4% responded negatively and 20.6% positively. The main indication to implant MRI-compatible CIED system was considered a present clinical condition which needs MRI study (73.5% of centres). One-fifth of responders stated that MRI-certified systems should be implanted in all patients. When asked to indicate main obstacles to implant MRI-certified devices, 70.9% would consider higher device price as important factor. About one half of responders indicate, as relevant factors, also too small spectrum of available devices and lead design that may render implantation more difficult. One half of responders indicated that time should pass to evaluate the clinical performance and longevity of MRI-certified devices. Lack of reimbursement was indicated as a possible obstacle to implant more MRI-certified CIEDs by 47.1% of responding centres.

Table 1 Responding centres' experience in performing magnetic resonance imaging scans in implanted cardiac implantable electronic device patients (total numbers)

	Never (no experience) (%)	1–5 cases (%)	5–20 cases (%)	More than 20 cases (%)
Non-MRI-certified pacemakers	55.2	18.4	23.7	2.6
Non-MRI-certified ICDs	65.8	26.3	7.9	None
MRI-certified pacemakers	35.1	43.2	13.5	8.1
MRI-certified ICDs	73	21.6	5.4	None

Discussion

The number of patients with implanted CIEDs is growing and has recently been estimated at 5 million patients worldwide.[1] Due to their age and co-morbidities, up to 75% of these patients can be expected to have an indication for MRI.[2] Current European and American guidelines are based on data obtained before routine clinical availability of MRI-certified pacemakers and ICDs and discourage the use of MRI studies in patients with CIEDs, except in urgent and life-threatening cases.[3,4] The number of MRI studies

performed in published trials with non-MRI-certified devices does not exceed 1500 cases worldwide, and the data with MRI-certified devices are not abundant.

The results of this survey showed that centres of EHRA Research network mostly conform to published recommendations. The number of reported MRI scans are not high (about 140 scans for both non MRI-certified and MRI-certified pacemakers and less than 70 scans for ICDs), and reported problems (sensing, pacing threshold changes) are similar to those reported in the literature. More than half of centres did not perform MRI scans in patients with devices not certified for this, and experience with newer (MRI-compatible) devices is still low. In some contrast to published data on good performance of some newer non-MRI-certified devices,[1] most of the responders (81%) do not consider any of these devices safer than other types.

Most of the responding centres (73.5%) consider implantation of MRI-certified pacemakers and ICDs in patients with present medical conditions that have indications for MRI investigations. The prices of MRI-certified systems are considered high by 70.9% of responders, and about half of responders would have financial restrictions to implant more of these devices. Bearing in mind that available data with MRI-certified devices are limited and do not cover all clinical scenarios (most of them avoided scans in the thoracic area and were limited to 1.5 T field strength), awaited newer recommendations still need much more clinical data and long-term follow-up.

Conclusion

This survey on clinical practice to perform MRI scans showed limited experience of performing MRI studies in patients with implanted pacemakers and ICDs. In concordance with available guidelines, most centres limit MRI scans in patients with non-MRI-certified devices. The implant numbers for MRI-certified devices and experience with performing MRI scans in these patients are still low.

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A list of the Research Network can be found on the EHRA website.

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