Letters to the Editor

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Do we need pacemakers resistant to magnetic resonance imaging?

We read the article of Irnich et al.1 with great interest. Although we agree that magnetic resonance imaging (MRI)-related asynchronous stimulation may constitute a risk with the potential for induction of fatal ventricular arrhythmias, several statements made in this article require substantial clarification.

(1) The authors state that inhibition of pacemakers ‘[...] is a minor risk’. This statement contradicts all other previously published reports in the field of pacemakers and MRI,2–4 and also goes against our own experimental results. The attached figure documents sustained complete inhibition of pacemaker output (pacemaker programmed to DDD mode) by time-varying gradient fields during an MRI scan performed in vitro, belying the statement that ‘[... ] prolonged inhibition due to gradient fields seems to [them] to be unlikely to occur in MRI examinations’ and that pacemaker inhibition is ‘[... ] a myth, narrated among radiologists since the beginning of MRI examination of pacemaker patients, and not on experimental evidence’ (Figure 1). This observation is of paramount importance, as complete and sustained inhibition of pacemaker output will be fatal for pacemaker-dependent patients. Therefore, it was with great surprise and concern that we read the conclusion that ‘[...] pacemaker-dependent patients may form the safest population [...]’.

(2) Irnich et al.1 claim that ‘heating of the electrode(s) is not a real problem [...]’, although as they acknowledge, in vitro and in vivo measurements have shown temperature increases up to 20.4 °C at 1.5 T (SAR 3.9 W/kg), measured directly at the lead tip.5 They base these conclusions on theoretical considerations, underestimating the importance of two facts: First, these calculations are true only in the case of a thermal isolator, which is not the situation in the presence of surrounding human tissues. Second, their argument fails to explain the findings in recent studies, reporting a temporary loss of capture in an animal model after performing MRI,5 and a significant change in pacing capture threshold of 9.4% after performing MRI.6 Unless proven otherwise, these findings must be regarded as alterations at the lead tip—myocardial interface due to RF-related heating.

(3) Although the pacemaker gating system proposed in the manuscript may prove to be a useful advance for safe imaging of patients with pacemakers, the authors have not provided evidence to justify this conclusion. Their report of 12 examinations performed in eight patients, without any documentation of pacemaker or patient status before or after the MR study, does not demonstrate the safety of their technique. That the authors based their assumptions on just six reported deaths (and perhaps up to 90 unreported) shows that one would certainly need to perform more than 12 MR examinations to conclude that the method proposed by the authors results in a statistically lower incidence of death, let alone that it is safe for clinical use.

When publishing in off-label use areas, especially when such use has led to patient deaths, authors must ensure that their statements and conclusions take all other published data into account in a balanced fashion, even more so, if these results are contradictory to previously reported results, to ensure patient safety and to minimize the risk of medicolegal consequences for the physician. Therefore, all physicians performing MRI on pacemaker patients must be very cognizant of possible thermal myocardial injury resulting in loss of capture and of possible pacemaker inhibition during MR imaging, both of which may lead to patient morbidity.

References


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Figure 1 ECG strip (50 mm/s) recorded in vitro during exposure of a dual-chamber pacemaker programmed to synchronous pacing at a rate of 85 bpm. Exposure of the PM to the time-varying gradient fields (black arrows) leads to inhibition of the PM output (asterisks), which resolves after the time-varying gradient fields have been switched off.