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Heating Effects of Magnetic Resonance Imaging on Epicardial Pacing Leads

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Introduction: Nowadays, most manufacturers offer standard transvenous cardiac pacemaker systems that are not contraindicated for MR imaging (MRI conditional). In infants and children, epicardial pacing leads (epiL) are preferably used compared to the transvenous pacing leads (transL). Up to now, no epiL has been labeled as MR conditional. The aim of this study was to investigate the potential risk of epiL during MRI with a series of in vitro measurements. The situations of an intact pacing system and of abandoned leads were simulated.
Methods: Heating effects of MRI in a 1.5 T Scanner (Achieva, Philips) were measured at the tip of the pacing lead during a TurboSpinEcho sequence with a whole body SAR of 2W/kg (upper limit for normal operating mode) during 2 minutes. The transL (CapSureFix MRI SureScan, 5086-45cm, Medtronic) was compared with the epiL (CapSureEpi 4968-35cm, Medtronic) in a gel filled tank (as described in ASTM F2182-11a) in a worst case linear configuration parallel to the tank wall.
Results: Three series of temperature measurements were undertaken: (1) Lead connected to a pulse generator (PM; EnRhythm MRI SureScan, Medtronic): There was a temperature rise of + 2.5°C in the transL (= reference for all following results. This setup is MR conditional). The epiL showed a 4 x higher heating, (2) lead without PM: TransL 4 x higher heating, epiL 30 x higher heating and (3) epiL coiled to 20cm length without PM to mimic the shortened (cut-off) lead: 9 x higher heating.
Conclusion: There is a significant heating effect and the current epicardial pacing systems cannot be exposed to an MRI without risk of thermal damage at the tips of the lead, even in case of abandoned leads. MRI of a patient with an abandoned epicardial lead cannot be performed without a high risk of thermal damage at the tips of the lead. Therefore, these patients must be excluded from MRI for lifetime. With increasing role of MRI in postoperative imaging of the heart, concerted efforts are warranted to develop MRI compatible electrodes for children.