Forces on cardiac implantable electronic devices during remote magnetic navigation.

Remote magnetic navigation systems are used for catheter navigation in cardiac electrophysiological ablation procedures. In this setting, ferromagnetic particles will be moved by changes in the magnetic field. It is unknown to what extent cardiac implantable electronic devices (CIED) are affected by the magnetic field when using magnetic navigation, and whether these forces may exceed the limit of 5 N that is set forth by German and European norms for implanted electrodes. A total of 121 rhythm devices were examined in a magnetic field of 0.1 T using the NIOBE II(®) Magnetic Navigation System (Stereotaxis, St. Louis, USA). Forces acting on the devices were measured with the force measurement tool Futek LRF 400 (Futek Advanced Sensor Technology Inc., Irvine, CA, USA). A standardized protocol of different movements of the magnetic field including all three dimensions was performed and maximal forces on the CIED were assessed. Out of 121 devices, 78 different pacemakers (54 different model families from 11 manufacturers) and 43 different cardioverter-defibrillators (26 different model families from 6) were examined. The mean force that could be observed was $0.33 \pm 0.13$ N for pacemakers (range 0.16-1.12 N) and $1.05 \pm 0.11$ N for cardioverter-defibrillators (range 0.86-1.38 N) when exposed to the magnetic field.
pacemakers or implantable cardioverter-defibrillators to a magnetic field of 0.1 T does not result in a force exceeding the regulatory demanded 5 N that could damage the connected leads.