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Brain-implanted conductors amplify radiofrequency fields in rodents: Advantages and risks

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Abstract

Over the past few decades, daily exposure to radiofrequency (RF) fields has been increasing due to the rapid development of wireless and medical imaging technologies. Under extreme circumstances, exposure to very strong RF energy can lead to heating of body tissue, even resulting in tissue injury. The presence of implanted devices, moreover, can amplify RF effects on surrounding tissue. Therefore, it is important to understand the interactions of RF fields with tissue in the presence of implants, in order to establish appropriate wireless safety protocols, and also to extend the benefits of medical imaging to increasing numbers of people with implanted medical devices. This study explored the neurological effects of RF exposure in rodents implanted with neuronal recording electrodes. We exposed freely moving and anesthetized rats and mice to 950 MHz RF energy while monitoring their brain activity, temperature, and behavior. We found that RF exposure could induce fast onset firing of single neurons without heat injury. In addition, brain implants enhanced the effect of RF stimulation resulting in reversible behavioral changes. Using an optical temperature measurement system, we found greater than tenfold increase in brain temperature in the vicinity of the implant. On the one hand, our results underline the importance of careful safety assessment for brain-implanted devices, but on the other hand, we also show that metal implants may be used for neurostimulation if brain temperature can be kept within safe limits.

Keywords: brain implants; brain stimulation; implant safety; radiofrequency stimulation.

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