Magnesium alloy with eddy-thermal effect for novel tumor magnetic hyperthermia therapy

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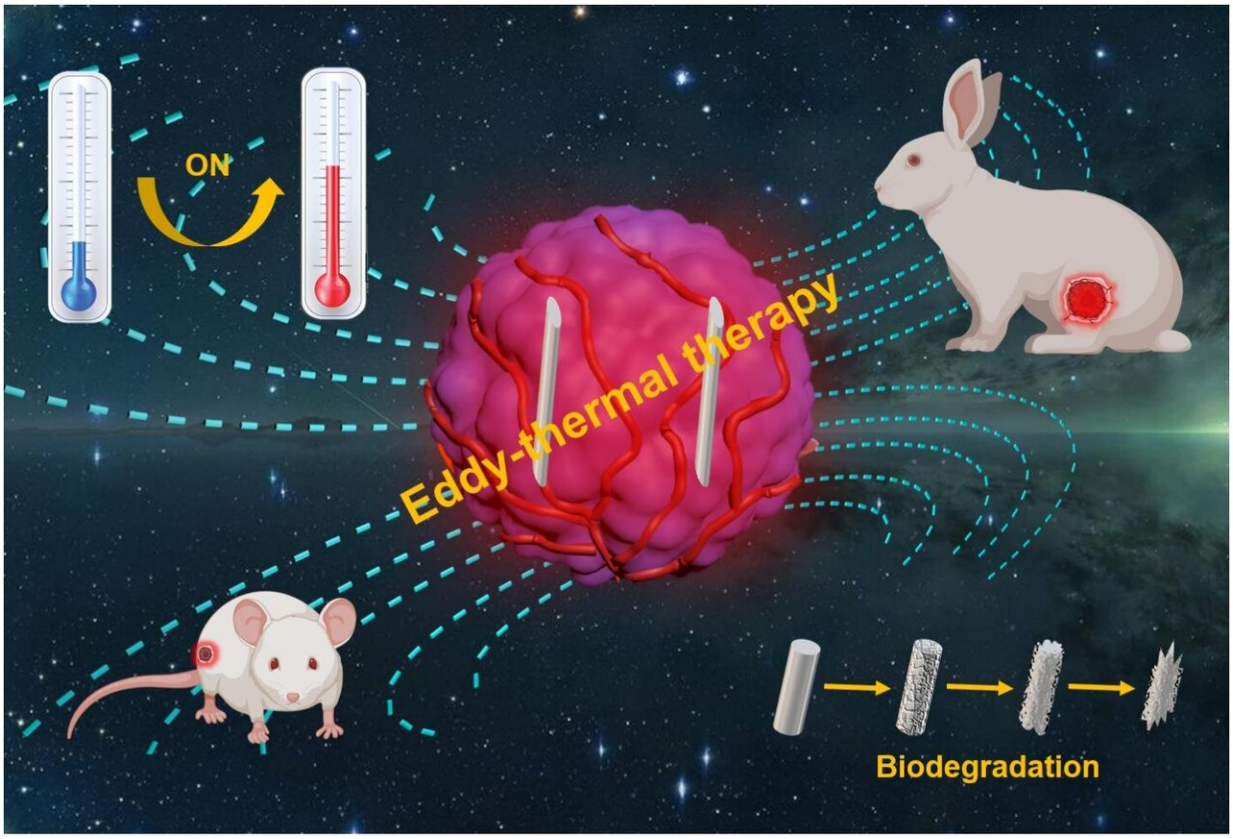

Schematic illustration of MHT based on the eddy thermal effect of the biodegradable MgA rods. Credit: Science China Press

Magnetic hyperthermia therapy (MHT) as a noninvasive local treatment

strategy is able to ablate tumors using an alternating magnetic field (AMF) to heat up magnetocaloric agents (e.g., magnetic nanoparticles) administered into the tumors. For clinical applications, there is still a demand to find new magnetocaloric agents with strong AMF-induced heating performance and excellent biocompatibility.

In addition to magnetic nanoparticles, whose AMF induced heating mechanism is mainly due to the heating power of relaxation loss, bulk conductors such as metals can also be heated under an AMF by the eddy current effect, in which an induced current is generated when a bulk conductor is placed in an AMF. Therefore, it would be significant and interesting to use the eddy thermal effect of bulk metal for tumor ablation. As a kind of biocompatible and biodegradable material, magnesium (Mg) and its alloys have been extensively used in the clinic as an implanted metal.

Recently, the eddy thermal effect of the magnesium alloy (MgA) could be employed for MHT to effectively ablate tumors was reported by Profs. Zhuang Liu and Liang Cheng from Soochow University. Under low-field-intensity AMFs, MgA rods could be rapidly heated, resulting in a temperature increase in nearby tissues. Such AMF-induced eddy thermal heating of MgA could not only be used to kill tumor cells in vitro, but also be employed for effective and accurate ablation of tumors in vivo.

In addition to killing tumor tissue in mice, VX2 tumors of much larger sizes growing in rabbits after implantation of MgA rods could also be eliminated after exposure to an AMF, illustrating the ability of MgA-based MHT to kill large-sized tumors. Moreover, the implanted MgA rods showed excellent biocompatibility and ~ 20% of their mass was degraded within three months. This work not only broadens the application of MgA in biomedicine, but also provides a new strategy for accurate and effective tumor treatment under a low-field-intensity AMF

in a minimally invasive manner, applicable even for deep-set and large tumors. Considering the wide clinical use of implantable MgA devices, such a strategy holds great promise in clinical translation.

More information: Nailin Yang et al, Biodegradable magnesium alloy with eddy-thermal effect for effective and accurate magnetic hyperthermia ablation of tumors, *National Science Review* (2020). DOI: 10.1093/nsr/nwaa122

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