# Magnetic Nanoparticles for cancer treatment

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***Magnetic Hyperthermia**: magnetic nanoparticles heated by an alternating magnetic field could be used to treat cancers, either alone or in combination with radiotherapy or chemotherapy.*

## SITUATION

Nude mice with subcutaneous squamous cell carcinomas (SCCVII) implanted in their legs were treated with magnetic nanoparticles to eliminate cancer cells.

## APPROACH

We describe use of a magnetic nanoparticle that, with a well-tolerated intravenous dose, achieved a tumor concentration of 1.9 mg Fe/g tumor in a subcutaneous squamous cell carcinoma mouse model, with a tumor to non-tumor ratio >16. With an applied field of 38 kA/m at 980 kHz, tumors could be heated to 60°C in 2 minutes, durably ablating them with millimeter (mm) precision, leaving surrounding tissue intact.

## RESULTS

The tumor heating rate shown in Figure 1 reflects that tumors could be rapidly heated to ablative temperatures (60°C in 2 minutes) after a well-tolerated IV injection of MNPs, while normal tissue was found to have a temperature of 36°C after 2 minutes.

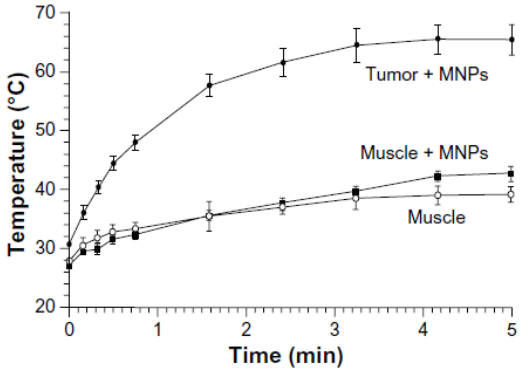


**Figure 1**_Heating of tissues in the magnetic field: 24 hours after an intravenous injection of magnetic nanoparticles – tumor (filled circles) and leg muscle (no tumor, filled squares) tissues.

Successfully treated tumors were rapidly liquefied and resorbed in 1–2 days (Figure 2). After complete remission (at 160 days), mice had virtually the same leg diameter at the place of the tumor (5.47 mm average) as at their untreated contralateral leg (5.53 mm average) with no leg dysfunction, indicating that the treatment was well confined with less than ~1 mm of normal tissue damage.

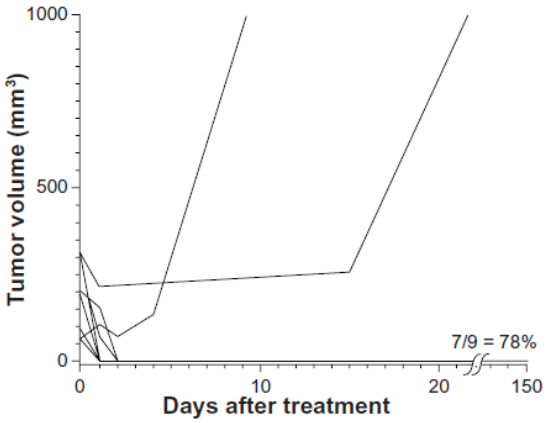


**Figure 2**_ Decrement in the volume of most tumors and debris was resorbed in 1–2 days, completely deflating fairly large tumors.

*Magnetic hyperthermia is an experimental treatment for cancer. It is theoretically based on the fact that magnetic nanoparticles can transform electromagnetic energy from an external high-frequency field to heat. As a result, if magnetic nanoparticles are put inside a tumor and the whole patient is placed in an alternating magnetic field, the tumor temperature will rise. The elevation of temperature may enhance tumor oxygenation and radio- and chemosensitivity, hopefully shrinking tumors.*

Kumar et al. Adv Drug Del Rev. 2011

**Magnetic nanoparticles are powerful enough to heat and ablate tumors in 1-2 days in mice**

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