

Nanoparticle thermotherapy as a chemotherapy alternative

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Using hyperthermia, Virginia Tech engineering researchers and a colleague from India unveiled a new method to target and destroy cancerous cells. The research was presented at the 63rd annual meeting of the American Physical Society Nov. 23 in Long Beach, Calif.

The [cancer treatment](#) uses hyperthermia to elevate the temperature of [tumor cells](#), while keeping the surrounding healthy tissue at a lower degree of [body heat](#). The investigators used both in vitro and in vivo experiments to confirm their findings.

The collaborators are Monrudee Liangruksa, a Virginia Tech graduate student in engineering science and mechanics, and her thesis adviser, Ishwar Puri, professor and head of the department, along with Ranjan Ganguly of the department of power engineering at Jadavpur University, Kolkata, India.

Liangruksa of Bangkok, Thailand, presented the paper at the meeting.

In an interview prior to the presentation, Puri explained that to further perfect the technique they used ferrofluids to induce the hyperthermia. A ferrofluid is a liquid that becomes strongly magnetized in the presence of a magnetic field. The magnetic nanoparticles are suspended in the non-polar state.

"These fluids can then be magnetically targeted to cancerous tissues after intravenous application," Puri said. "The magnetic nanoparticles, each

billionths of a meter in size, seep into the tissue of the tumor cell due to the high [permeability](#) of these vessels."

Afterwards, the magnetic nanoparticles are heated by exposing the tumor to a high frequency alternating magnetic field, causing the tissue's death by heating. This process is called magnetic fluid hyperthermia and they have nicknamed it thermotherapy.

Temperatures in the range of 41 to 45 degrees Celsius are enough to slow or halt the growth of [cancerous tissue](#). However, without the process of magnetic fluid hyperthermia, these temperatures also destroy healthy cells.

"The ideal hyperthermia treatment sufficiently increases the temperature of the tumor cells for about 30 minutes while maintaining the healthy tissue temperature below 41 degrees Celsius," Puri said. "Our ferrofluid-based thermotherapy can be also accomplished through thermoablation, which typically heats tissues up to 56 degrees C to cause their death, coagulation, or carbonization by exposure to a noninvasive radio frequency, alternating current magnetic field. Local heat transfer from the nanoparticles increases the tissue temperature and ruptures the cell membranes."

Puri added that testing showed iron oxide [nanoparticles](#) are "the most biocompatible agents for magnetic fluid hyperthermia." Platinum and nickel also act as [magnetic nanoparticles](#) but they "are toxic and vulnerable" when exposed to oxygen.

The researchers plan to test their analytical approach by conducting experiments on various cancer cells in collaboration with Dr. Elankumaran Subbiah of the Virginia-Maryland School of Veterinary Medicine. A senior design team consisting of five engineering science and mechanics undergraduate Virginia Tech students is fabricating an

apparatus for these tests.

More information: Abstract:
meetings.aps.org/Meeting/DFD10/Event/134121

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