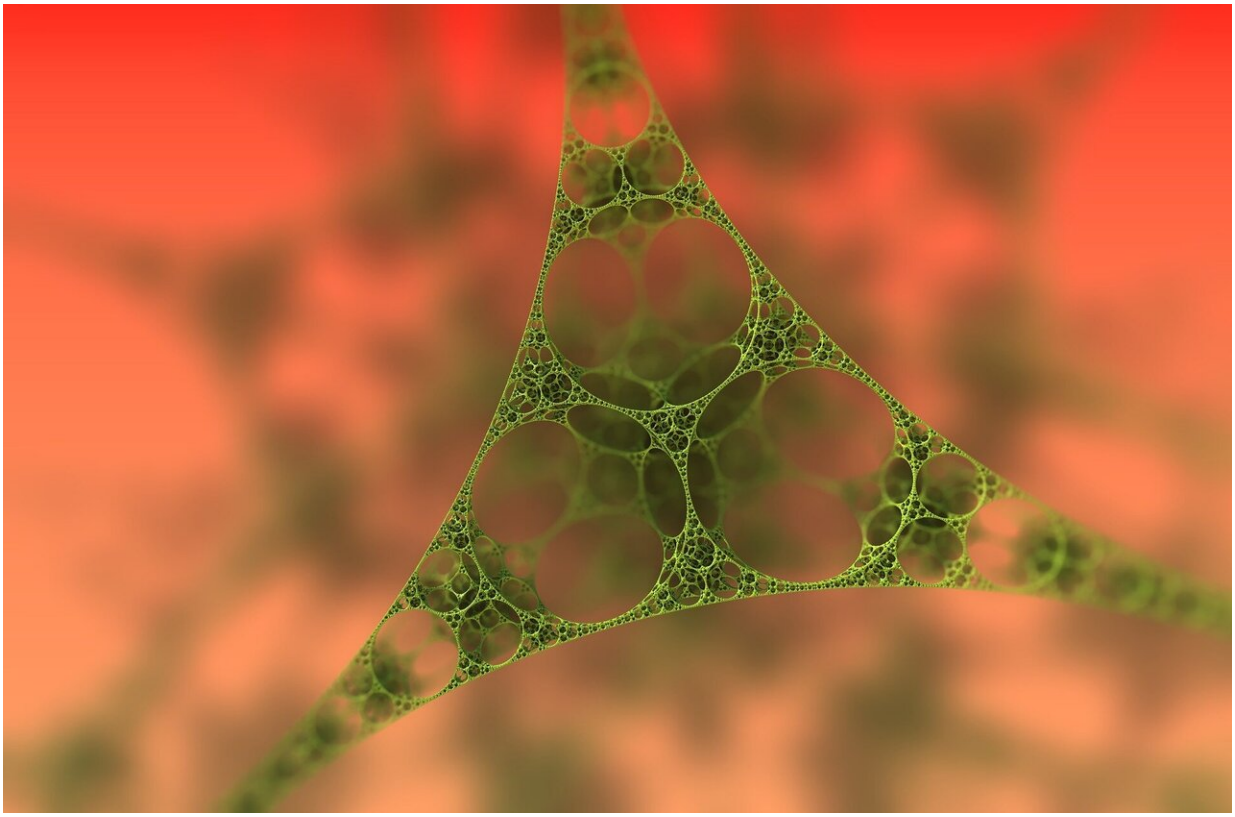
Researchers use nanotechnology to develop new treatment for endometriosis

April 6 2020, by Oleh Taratula



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Scientists have developed a precise, nanotechnology-based treatment to alleviate the pain and fertility problems associated with endometriosis, a common gynecological condition in women of childbearing age.

Research led by Oleh Taratula of the Oregon State University College of Pharmacy and Ov Slayden of the Oregon National Primate Research Center at Oregon Health & Science University used photo-responsive nanoparticles loaded with dye to find and remove the lesions associated with the disorder.

Findings were published today in the journal *Small*.

The endometrium is the innermost layer of the uterus, and endometriosis occurs when endometrium-like tissue forms lesions outside of the uterine cavity—usually involving the ovaries, the fallopian tubes and the tissue lining the pelvis.

On rare occasions, endometrial tissue may spread beyond the pelvic organs.

Roughly 10% of childbearing-age women will experience endometriosis, and 35% to 50% of women with pelvic pain and or infertility suffer from the disorder.

There's no cure, although surgical removal of the lesions can improve fertility. The downside, however, is that the lesions come back about half the time, and more than one-quarter of endometriosis surgery patients need three or more operations because it's hard to find all of the diseased tissue that needs to be removed.

Taratula and Slayden, in a collaboration that also included OSU's Carlson College of Veterinary Medicine, used tiny—less than 100 nanometers in size—polymeric materials packed with a dye that can generate both a fluorescence signal and cell-killing heat under near-infrared light.

For doctors, that means it can be both an imaging tool and a lesion-removal technique.

"We built our strong team to combine expertise in both nanomedicine and endometriosis," said Olena Taratula, also a researcher with the College of Pharmacy. "This is a devastating disease, and we developed and evaluated the photo-responsive nanoagent to detect and eliminate unwanted endometrial tissue with photothermal ablation."

That means injecting the dye-loaded nanoparticles into the body, where they fluoresce to show where the lesions are, and also kil them with heat because the particles soar to 115 degrees Fahrenheit upon exposure to near-infrared light.

"The challenge has been to find the right type of nanoparticles," Oleh Taratula said. "Ones that can predominantly accumulate in endometriotic lesions without toxic effect on the body, while preserving their imaging and heating properties."

By using a clinically relevant animal model of endometriosis developed by Slayden's group at the primate center, the scientists showed that the nanoparticles constructed by the Taratula group can efficiently accumulate in endometrial tissue 24 hours after being administered. Slayden is a professor of reproductive and developmental sciences at the Oregon National Primate Research Center and a professor of obstetrics and gynecology and molecular and cellular biosciences at the OHSU School of Medicine.

"The heat is produced under near-infrared laser light that is harmless to tissue without the presence of the nanoparticles," Oleh Taratula said. "The generated heat eradicates the endometrial lesions completely within a day or two. Dr. Slayden and I built this team years ago to help surgeons to better visualize and treat endometriosis lesions, and we're getting close."

To advance the technology to human clinical trials, future studies are

needed to validate the treatment approach in animals that develop endometriosis similar to how it presents in humans, he added. The research team has received a grant from the National Institutes of Health to evaluate the efficiency of the nanoparticles in macaques with endometriotic lesions.

"We believe that our developed strategy can eventually shift the current paradigm for endometriosis detection and treatment," Oleh Taratula said. "In general, nanomedicine has barely been explored for imaging and treatment of endometriosis. Our results validate that some fundamental principles of cancer nanomedicine can potentially be used for the development of novel nanoparticle-based strategies for treatment and imaging of endometriosis."

More information: Abraham S. Moses et al, Nanoparticle-Based Platform for Activatable Fluorescence Imaging and Photothermal Ablation of Endometriosis, *Small* (2020). DOI: 10.1002/smll.201906936

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