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Soft robots, origami combine for potential way to deliver medical treatments

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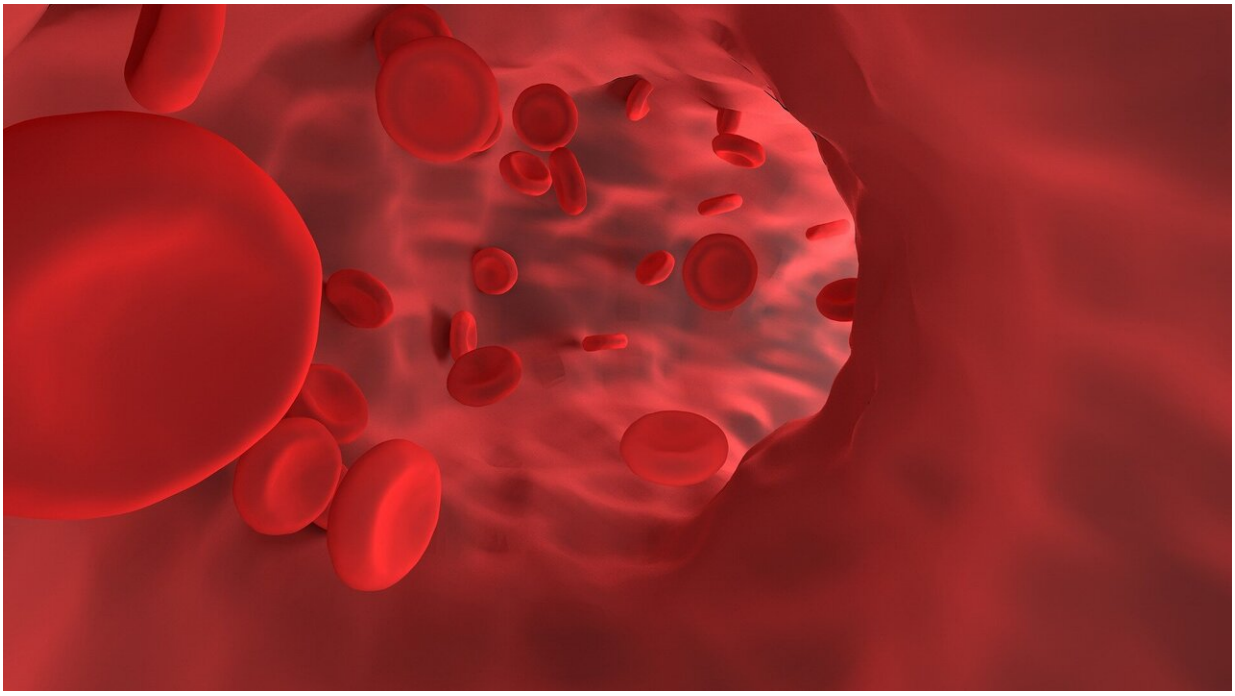

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Researchers have found a way to send tiny, soft robots into humans, potentially opening the door for less invasive surgeries and ways to deliver treatments for conditions ranging from colon polyps to stomach cancer to aortic artery blockages.

The researchers from The Ohio State University and the Georgia

Institute of Technology detailed their discovery, which makes use of the ancient Japanese practice of origami, in a study published Sept. 14 in the *Proceedings of the National Academy of Sciences*.

Under this system, doctors would use magnetic fields to steer the soft robot inside the body, bringing medications or treatments to places that need them, said Renee Zhao, corresponding author of the paper and assistant professor of mechanical and aerospace engineering at Ohio State.

"The robot is like a small actuator," Zhao said, "but because we can apply magnetic fields, we can send it into the body without a tether, so it's wireless. That makes it significantly less invasive than our current technologies."

That soft robot is made of magnetic polymer, a soft composite embedded with magnetic particles that can be controlled remotely. Robotic delivery of medical treatment is not a new concept, but most previous designs used traditional robots, made of stiff, hard materials.

The 'soft' component of this robot is crucial, Zhao said.

"In biomedical engineering, we want things as small as possible, and we don't want to build things that have motors, controllers, tethers and things like that," she said. "And an advantage of this material is that we don't need any of those things to send it into the body and get it where it needs to go."

The soft origami robot in this case can be used to deliver multiple treatment selectively based on the independently controlled folding and deploying of the origami units. The origami allows the material to 'open' when it reaches the site, unfurling the treatment along with it and applying the treatment to the place in the body that needs it.

This origami-style delivery of medication is also not new, but because previous designs relied on more cumbersome, bulky ways of activating or opening the origami to deliver the medication, those deliveries were often slow. Some did not allow for medication to be delivered to a pinpointed location in the body.

The soft robot, Zhao said, removes some of that bulkiness. The magnetic fields allowed the researchers, in the lab, to control the direction, intensity and speed of the material's folding and deployment.

Researchers conducted this work in a lab, not in the human body. But the technology, they think, could allow doctors to control the robot from outside the body using only magnetic fields.

"In this design, we don't even need any chip, we don't need any electric circuit," she said. "By just applying the external field, the material can respond itself—it does not need any wired connection."

These findings may have applications beyond delivering medicine, said Glaucio Paulino, a co-author on the paper and professor and Raymond Allen Jones Chair in the Georgia Tech School of Civil and Environmental Engineering.

"We anticipate that the reported magnetic origami system is applicable beyond the bounds of this work, including future origami-inspired robots, morphing mechanisms, biomedical devices and outer space structures," Paulino said.

More information: Larissa S. Novelino et al, Untethered control of functional origami microrobots with distributed actuation, *Proceedings of the National Academy of Sciences* (2020). DOI: 10.1073/pnas.2013292117

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