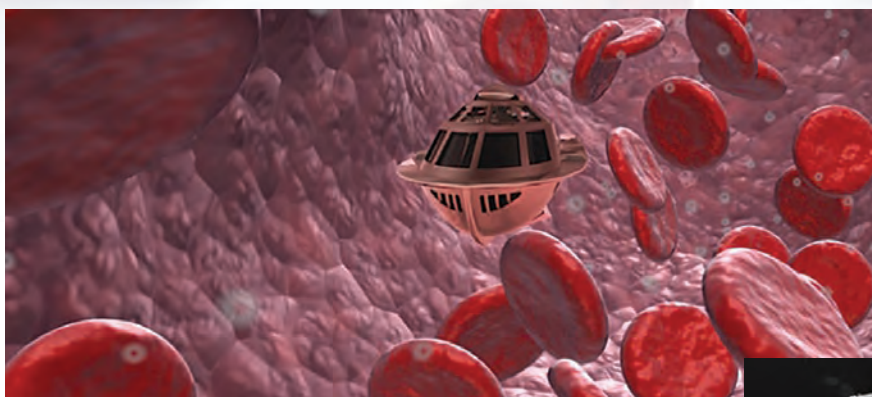


A SUBMARINE FOR YOUR STOMACH

A New Delivery System for Antibiotics?

Do you remember the 1966 science fiction adventure film *Fantastic Voyage* starring Donald Pleasence and Raquel Welch? For those who don't, the story concerns a group of scientists who are shrunk to microscopic size and enter the body of an ailing secret agent in a high-tech submarine in order to perform delicate lifesaving surgery on his



A clip from the *Fantastic Voyage* thanks to the *Museum Of The Moving Image*

brain. Well, we are nowhere near possessing that sort of technology, but soon the idea of a miniature submarine swimming around your body won't be classified solely as science fiction anymore. While the sub of *Fantastic Voyage* carried doctors to the patient's brain, this mini-sub will be headed to the stomach on its medical mission.

A tiny self-propelled drug-delivery device might someday make taking antibiotics safer and more efficient, at least that's what Liangfang Zhang, a professor at the department of nano-engineering at the University of California, San Diego, hopes. And while it won't be manned by miniaturized people, it is essentially a tiny submarine designed to scoot around inside a patient's stomach, fueled by the acid there. The study, which was announced in January, was inspired by an obscure, but no less pressing, medical issue.

Oral antibiotics are commonly prescribed life-saving drugs. When an antibiotic is swallowed, it takes a trip to the stomach, where there's lots of acid. Unlike ordinary foodstuffs that are supposed to be broken down in the stomach, the antibiotic's effectiveness can be severely impaired by the stomach acid, which can break the chemical bonds in the antibiotic and deactivate. So far the only way to keep this from happening was for a patient to take acid-reducing medications like Prilosec or Prevacid before they take their regular antibiotics. While doctors often prescribe

such drugs, they can cause a number of nasty side effects such as headaches, diarrhea, and fatigue.

So scientists at the University of California, came up with a device designed to both reduce stomach acid and deliver medication without the side effects. The swallowable submarine reacts with stomach acid to release tiny hydrogen bubbles. The bubbles move it around the stomach, and a magnesium core reduces acidity as it goes. This is especially helpful in targeting ulcer-causing bacteria that hide out behind a layer of stomach mucus. Normal antibiotics don't actively penetrate that layer, but this device does. The tiny device is covered by a special polymer that is sensitive to changes in the acidity. Once the acid in the stomach is neutralized, the polymer dissolves and the submarines unload their antibiotic payload.

The micro-sub is only 20 microns across, about one-fifth the width of a human hair. "It looks like a mini submarine," Zhang said in an interview with NPR.



Scanning electron microscopy image of the micromotors. These tiny motors, each about one-fifth the width of a human hair, may someday offer a safer and more efficient way to deliver drugs or diagnose tumors.

The study was led by Joseph Wang, the chair of nanoengineering at the University of California. He says that the way that the miniature submarine delivers the drug actually helps the drug work better. "This active movement of the carrier improved the therapeutic efficiency in

addition to the neutralization of the stomach acid."

The device isn't ready for use in humans yet, but preliminary testing in mice shows that it's safe and effective, at least there.

For their part, the authors of the study think it could be a big improvement in drug delivery. While their device may seem farfetched to some, but given the incredible advances in technology we've witnessed in the past decade it is increasingly clear that the line between science fiction and science fact has been erased. Now the only question remaining is, when are they going to get around to miniaturizing people?



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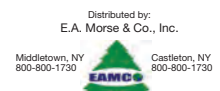
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