Extracts

Nanocapsules May Help Reverse Overdoses

Trauma doctors may one day have a new weapon against drug overdoses: "nanocapsules" that sponge up the drugs and render them harmless.

University of Florida researchers reported at a meeting of the American Chemical Society that they used tiny oil-filled capsules to absorb a common antidepressant from rodent heart cells. People attempting suicide often use the antidepressant, amitriptyline, which causes heart attacks in overdose quantities.

"The heart cells' beating characteristics change when exposed to the drug," said Randy Duran, an associate professor of chemistry at UF and one of five researchers on the National Science Foundation-funded project. "Then they revert back to normal as the cell is being cleansed with the nanocapsules."

Some 300,000 patients are treated for drug overdoses annually in the nation's trauma centers. While some drugs, such as heroin, can be treated with antidotes, others, including amitriptyline, offer doctors few options beyond standard treatments, such as flushing the drug from the body. An overdose of amitriptyline interferes with the heart's electrical impulse channels, causing arrhythmic abnormalities and, if taken in sufficient quantities, heart failure.

Seeking a new approach, researchers at UF and the Max Planck Institute for Polymer Research in Mainz, Germany, decided to try experimenting with tiny nanocapsules to sop up the drug.

"Nano" refers to almost unimaginably small molecule- or atom-sized elements, with 1 nanometer equaling a billionth of a meter. For the project, the team developed capsules ranging from 150 to 600 nanometers, said Aleksa Jovanovic, a UF chemistry doctoral student and the lead researcher on the project. Each capsule consists of a polymer-coated silica shell surrounding a droplet of ethylbutyrate oil, a type of oil used in pharmaceutical products.

Magnet-like, amitriptyline molecules are attracted to oil, and they seek to bind with these capsules when the two are in close proximity, Jovanovic said.

The team placed rat heart cells on electrodes sensitive to the electric activity of the heart cells. The electrodes detect the activity and transmit the signal to a computer, conveying a unique real-time view of the heart cells' beating status, he said.

The team next dispensed a solution containing the nanocapsules on the cells. When the team added the amitriptyline, the cells continued to beat normally for a period of six minutes. Without the nanocapsules — that is, with only the amitriptyline — the cell beats became both weaker and farther apart, Jovanovic said.

Bert Meijer, a professor of chemistry and chemical engineering at Eindhoven University of Technology in Eindhoven, the Netherlands, and an expert on polymer chemistry, said the team's experiments are novel and the results show promise.

"The way the nanocapsules are made is very elegant and shows the control that Professor Duran's group has in performing chemistry in self-assembled systems," he said. "I am very impressed by the results, and they open a new way of using nanosystems in biomedical applications."

Jovanovic emphasized the findings are preliminary and that many steps lie ahead before the nanocapsules could be used to treat overdoses.

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