Ingested nanoparticles may damage liver

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(Phys.org) —Nanoparticles in food, sunscreen and other everyday products have many benefits. But Cornell biomedical scientists are finding that at certain doses, the particles might cause human organ damage.

A recently published study in *Lab on a Chip* by the Royal Society of Chemistry and led by senior research associate Mandy Esch shows that nanoparticles injure liver cells when they are in microfluidic devices designed to mimic organs of the human body. The injury was worse when tested in two-organ systems, as opposed to single organs – potentially raising concerns for humans and animals.

Esch works in the lab of Michael Shuler, the Samuel B. Eckert Professor of Chemical Engineering. She participated in a widely read 2012 study about toxicity of nanoparticles in chickens.

"We are looking at the effects of what are considered to be harmless nanoparticles in humans," Esch said. "These particles are not necessarily lethal, but … are there other consequences? We're looking at the non-lethal consequences."

She used 50-nanometer carboxylated polystyrene nanoparticles, found in some animal food sources and considered model inert particles. Shuler's lab specializes in "body-on-a-chip" microfluidics, which are engineered chips with carved compartments that contain cell cultures to represent the chemistry of individual organs.

In Esch's experiment, she made a human intestinal compartment, a liver compartment and a compartment to represent surrounding tissues in the body. She then observed the effects of fluorescently labeled nanoparticles as they traveled through the system.

Esch found that both single nanoparticles as well as small clusters crossed the gastrointestinal barrier and reached liver cells, and the liver cells released an enzyme called aspartate transaminase, known to be released during cell death or damage.

It's unclear exactly what damage is occurring or why, but the results indicate that the nanoparticles must be undergoing changes as they cross the gastrointestinal barrier, and that these alterations may change their toxic potential, Esch said. Long-term consequences for organs in proximity could be a concern, she said.

"The motivation behind this study was twofold: one, to show that multi-organ, in vitro systems give us more information when testing for the interaction of a substance with the human body, and two … to look at nanoparticles because they have a huge potential for medicine, yet adverse effects have not been studied in detail yet," Esch said.

The paper, "Body-on-a-Chip Simulation With Gastrointestinal Tract and Liver Tissues Suggests That Ingested Nanoparticles Have the Potential to Cause Liver Injury," is co-authored by Shuler; former postdoctoral associate Gretchen Mahler, now an assistant professor at SUNY Binghamton; and Tracy Stokol, associate professor in the College of Veterinary Medicine.

Provided by Cornell University

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