UCI researchers develop world's first plastic antibodies

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“Plastic antibodies” that UCI scientists used to stop the spread of bee venom in mice could be designed to combat deadlier toxins and pathogens. Photo by Hoang Xuan Pham

UC Irvine researchers have developed the first "plastic antibodies" successfully employed in live organisms - stopping the spread of bee venom through the bloodstream of mice.

Tiny polymeric particles - just 1/50,000th the width of a human hair - were designed to match and encase melittin, a peptide in bee venom that causes cells to rupture, releasing their contents. Large quantities of melittin can lead to organ failure and death.

The polymer nanoparticles were prepared by "molecular imprinting" a technique similar to plaster casting: UCI chemistry professor Kenneth Shea and project scientist Yu Hoshino linked melittin with small molecules called monomers, solidifying the two into a network of long polymer chains. After the plastic hardened, they removed the melittin, leaving nanoparticles with minuscule melittin-shaped holes.

When injected into mice given high doses of melittin, these precisely imprinted nanoparticles enveloped the matching melittin molecules, "capturing" them before they could disperse and wreak havoc - greatly reducing deaths among the rodents.

"Never before have synthetic antibodies been shown to effectively function in the bloodstream of living animals," Shea says. "This technique could be utilized to make plastic nanoparticles designed to fight more lethal toxins and pathogens."

Takashi Kodama of Stanford University and Hiroyuki Koide, Takeo Urakami, Hiroaki Kanazawa and Naoto Oku of Japan's University of Shizuoka also contributed to the study, published recently in the Journal of the American Chemical Society.

Unlike natural antibodies produced by live organisms and harvested for medical use, synthetic antibodies can be created in laboratories at a lower cost and have a longer shelf life.

"The bloodstream includes a sea of competing molecules - such as proteins, peptides and cells - and presents considerable challenges for the design of nanoparticles," Shea says. "The success of this experiment demonstrates that these challenges can be overcome."

Provided by University of California - Irvine

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