Delivering Drugs to the Right Place

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More than a quarter of U.S. adults live with chronic pain caused by both injuries and a host of diseases. In fact, this physical suffering is the leading complaint of older Americans—and the reason one in five of them takes painkillers. (Back pain leads the list, followed by headaches.) Unfortunately, in 70 percent of cases, medication does not work. As a result, patients miss work and increase healthcare costs by frequently visiting doctors.

Jeff Koberstein and his team are figuring out how to deliver pain-relief drugs to the right place. With Prof. Richard Ambron from the Columbia University Medical Center, they are creating tiny, easy-to-swallow particles—known as drug-delivery vehicles—that would carry medication to its target. Ordinarily, a mass of nerve cells, called ganglia, shuttles a pain signal to the central nervous system. For them to send this pain signal, they need to create a certain protein. If scientists can stop production of this protein, they can prevent the transmission of pain. They stop production of this protein through a process called RNA interference, which helps control which genes are active and how active they are.

In the future, Koberstein and his team plan to use their “molecular toolbox” to help deliver other drugs. As a result, they should be able to more efficiently and cost-effectively treat patients with many conditions and diseases.

Koberstein has also collaborated with colleagues Professors Jingyue Ju and Nicholas Turro on a project that has firmly established the feasibility of using novel fluorescent nucleotides, surface chemistry and molecular engineering for DNA sequencing on a chip.

“This is a key step to advancing the field of DNA sequencing by synthesis through fluorescence imaging or by single molecule detection,” says Ju.

Koberstein’s other research interests lie in developing fundamental relationships between molecular structure and properties of polymers and other soft matter, and particularly how polymer surfaces and interfaces can be designed from a molecular perspective. The goal of this work can be generally considered as gaining a molecular design capability to change the chemical composition of a polymer surface through external controls.

Koberstein, who is the Percy and Vida Hudson Professor of Chemical Engineering, is a former department chair and is currently co-director of a National Science Foundation IGERT grant on Soft Materials. In 2006, he was awarded the Charles M.A. Stine Award of the American Institute of Chemical Engineers, Division of Materials Science and Engineering, its highest award. He taught at Princeton University and the University of Connecticut before coming to Columbia Engineering in 2000.

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