LOCAL DELIVERY, SUSTAINED RELEASE

Michael Cima

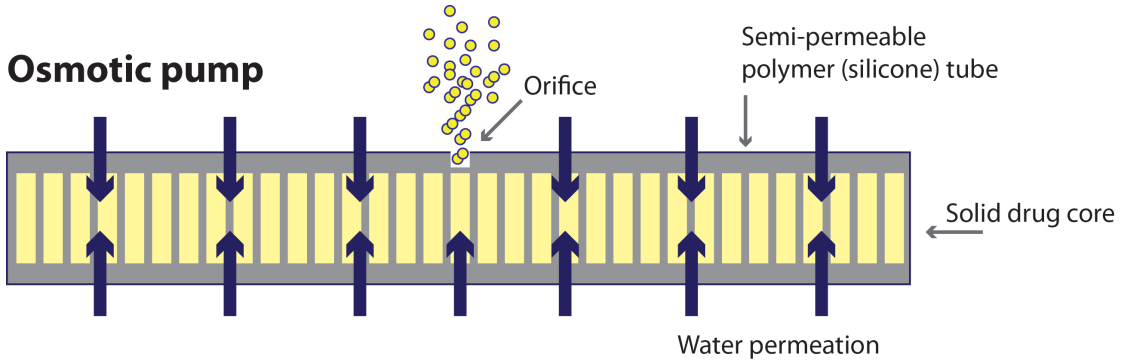
MIT Professor of Materials Science and Engineering; investigator at the Koch Institute for Integrative Cancer Research; co-founder of TARIS Biomedical

For people living with bladder diseases, traditional treatment approaches are often therapeutically inadequate, very uncomfortable, and offer only fleeting relief from debilitating pain. Oral therapies can't be taken in sufficiently high doses due to side effects. A more direct approach, bladder instillation, requires frequent doctor visits and catheterization: the bladder is filled with a solution containing medicine, which the patient can only retain briefly.

ONE ADMINISTRATION, WEEKS OF RELIEF

Professor Michael Cima proposed to solve this problem by creating a device that could deliver diverse therapies directly to the bladder using minimally invasive urologic procedures. Sustained drug release over weeks or months would provide extended treatment and relief from symptoms. With a grant from the Deshpande Center, Cima built a prototype of an osmotic pump: a semi-permeable silicone tube with a solid drug core. Through osmosis, water dissolves and releases the medicine at a controlled rate.

This work led to the founding of TARIS Biomedical whose first therapeutic offering—for treatment of interstitial cystitis, a chronic and painful inflammatory disease—is now in Phase 2 human clinical trials. Potential therapeutic uses are also being considered for bladder cancer and incontinence.



SUSTAINED DRUG RELEASE

An osmotic pump based on Professor Michael Cima's research is the core component of TARIS Biomedical's sustained-release drug therapies for bladder disease. The pump consists of a slender, semi-permeable silicone tube with a solid drug core. Folded into a small pretzel shape using shape-memory technology, the device can be inserted into the bladder via catheterization or flexible cystoscopy. Through osmosis, water permeates the tube and dissolves and releases the medicine at a controlled rate over weeks or months.

A BIG DEAL IN BIG DATA

Michael Stonebraker

Adjunct Professor, MIT CSAIL1 and founder of Vertica Systems

Organizations struggle to harness the flood of data that has been unleashed by the rise of the Internet, the growth of mobile devices, and the use of sensors to monitor "the Internet of things." Early on, Michael Stonebraker recognized that traditional relational database (RDB) management systems are poorly suited to the task of analyzing big data at the speed and scale necessary for today's needs. And he should know: a database pioneer, he invented some of the technology that underlies most commercial RDB systems.

With colleagues at other institutions, Stonebraker proposed a scheme for supplanting the row-optimized architecture of RDBs with a column-oriented architecture that would yield much faster performance and more efficient data storage. Building on the group's work, he used a grant from the Deshpande Center to develop a proof of concept that delivered performance 50 times faster than traditional solutions. Having already founded several companies, Stonebraker was able to quickly attract venture funding and launch Vertica Systems, which was acquired by HP in 2011. Today, many leading companies use Vertica's real-time analytics platform to comb through massive amounts of data and glean insights that accelerate innovation, improve agility, and strengthen decision-making.

1 Computer Science and Artificial Intelligence Lab

LIVELY LITTLE LIVERS

Sangeeta Bhatia

Professor of Health Sciences and Technology and Professor of Electrical Engineering;
Director, Laboratory for Multiscale Regenerative Technologies

"The liver is the main organ for metabolizing drugs in the human body," says Dr. Sangeeta Bhatia, an authority on tissue engineering. "And liver toxicity has been a major reason pharmaceutical companies recall existing drugs or halt development of new drugs." Until recently, researchers could not accurately predict the toxicity of a drug until its effects could be studied in humans, either during clinical trials or after being on the market for a time. As Bhatia explains, "It's challenging to keep human liver cells alive in the lab for more than a day or two. So toxicity and metabolism studies had to rely on less accurate predictors, such as animal testing."

HUMAN MICROLIVERS: ALMOST AS GOOD AS THE REAL THING

Bhatia's team solved that challenge. Applying tissue engineering and micropatterning methods, they developed a microliver that can survive up to six weeks and continue performing liver functions, such as synthesizing albumin and making enzymes necessary to break down toxins. A microliver consists of colonies of hepatocytes (liver cells) arranged in a hexagonal pattern and surrounded by a matrix of fibroblasts, which bolster liver functions.

With support from the Deshpande Center and Catalyst/mentor Carmichael Roberts, Bhatia defined a business model for launching a startup and devised scalable techniques for fabricating and packaging microlivers so they can be handled by robots in the drug-screening industry.

In 2007, Bhatia launched Hepregen Corporation with colleague Salman Khetani and biotech luminary Bonnie Fendrock, who is also a Catalyst/mentor. Current products enable predictive testing of human drug toxicity and metabolism. Future products will include models of animal livers, which could reduce reliance on animal testing.