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# New technology may prolong the life of implanted devices, from pacemakers to chemotherapy ports

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By creating a unique system of blood vessels that is engineered to interact with the tissue surrounding an implanted device, the longevity and function of these devices may be better preserved, according to a study led by researchers in the University of Louisville/ Jewish Hospital's Cardiovascular Innovation Institute (CII).

The study was published early online on August 23, 2010 in the *Journal of Biomedical Materials Research* and was funded by the National Institutes of Health.

"One of the biggest problems with any kind of implanted device, such as pacemaker, a chemotherapy port or the glucose sensors necessary to monitor blood sugar levels in diabetic patients, is the body's natural reaction to recognize it as foreign and form a scar around it," said Stuart Williams, PhD, scientific director of the CII and a senior investigator on the study. "Scars have very little blood flow and because this connection between the body and the device is compromised, the function of the device over time can decline, threatening health and leading to additional interventions to replace it."

The researchers sought to prevent the formation of scar tissue around an implanted device by "pre-vascularizing" the device just prior to implantation. The investigators call this a microvascular construct (MVC) consisting of tiny blood vessel fragments suspended in a collagen

gel. The combination of the MVC, already rich with blood vessels, and the device appears to provide an environment that resists the formation of scar tissue once the device is implanted, Williams said.

"This study built on our earlier work that showed that this material, what we call an MVC, stimulates circulation and prevents scarring when implanted in the body, in animal models," said James Hoying, PhD, director of cardiovascular therapeutics at the CII and a senior investigator on this study. "We wanted to next see if we could maintain that circulation in order to prevent scarring over the long term and thus prolong the function of any number of implanted devices."

The researchers compared the tissue surrounding a bare expanded polytetrafluoroethylene material - implanted biomaterial many devices are made of - embedded in collagen alone to one embedded in collagen and the MVC, and found that the latter both promoted and maintained circulation in the area around the implant, Williams said. Animal models were used. Collagen is a naturally occurring protein found in the flesh and connective tissue of animals and humans. It has been found to mediate the inflammatory reaction that often occurs when an implanted device interacts with surrounding tissue.

"We found that the presence of the MVCs and collagen altered the way tissue formed around the implants, restricting the formation of scar tissue because there was so much blood vessel activity," Williams said. "The presence of the MVCs and collagen also reduced the number of white blood cells that stimulate inflammation, where the device was implanted. The vessels associated with the implant were seen to be capable of sustainable blood delivery over time."

All of these factors are important in sustaining circulation and suppressing scar formation, he said.

Williams and colleagues are now working to design an operating room-compatible device that could bring this technology to patients.

"This could have implications for patients who have any number of implantable devices, from those on dialysis to patients with devices that help failing hearts to function, to those receiving chemotherapy, catheters and multiple other indications," Williams said.

Provided by University of Louisville