McGowan Institute for Regenerative Medicine

A program of the University of Pittsburgh and UPMC

Creating Medical Devices with Dissolving Metal

University of Pittsburgh researchers recently received another $1.5 million from the National Science Foundation to continue a combined multi-university, private-industry effort to develop implantable medical devices made from biodegradable metals.

Body-degradable metals—usually magnesium based—are not new, having been originally considered in the late 19th century. "But," says McGowan Institute for Regenerative Medicine director William Wagner, PhD, deputy director of the project and a principal investigator, "the question comes when you start to design medical devices for a specific application and a clinical partner says, 'We want that to be gone in a month, or a month-and-a-half, or we want that to be there for a year.'" Then you have to figure out how to meet those specifications, he says.

To that end, the University of Pittsburgh team as well as collaborators at the University of Cincinnati (UC) and North Carolina Agricultural and Technical State University (N.C. A&T) are creating new alloys and new manufacturing processes that suit clinical demands. The consortium seeks to design devices that can adapt to changes in a patient's body and dissolve once healing has occurred, reducing the follow-up procedures and potential complications of major orthopedic, craniofacial, and cardiovascular procedures, and sparing millions of patients worldwide added pain and medical expenses.

Thus far, the consortium has created novel screws and plates for facial reconstruction, a stent to be used in kidney dialysis, a nerve guide, and a ring that will assist in pulling together and healing ruptured ligaments. The group has also created a tracheal stent for pediatric patients whose tracheas are underdeveloped at birth and prone to collapse. Once the stent is implanted, Dr. Wagner—professor of surgery, bioengineering, and chemical engineering in Pitt's School of Medicine and Swanson School of Engineering—says it would dissolve, obviating the need for a second procedure on the young patient.

The consortium's original grant, received in 2008, was for a total of $18.5 million over 5 years, shared by Pitt, UC, and the project's lead institution, N.C. A&T. The total of the grant extension is $4 million, including the $1.5 million received by Pitt.

Dr. Wagner says the project can be funded for up to 10 years, with the hope that the group effort will become self-sustaining. "Several devices are fairly far along in pre-clinical testing and are on the third, fourth, or fifth prototype," he says.

N.C. A&T, a Historically Black College and University with expertise in metallurgy, is serving as the lead institution on the project through its National Science Foundation Engineering Research Center for Revolutionizing Metallic Biomaterials. The University of Cincinnati has brought cutting-edge nano- and sensor technology to the table. Pitt's strength lies in biomaterials, bioengineering, and regenerative medicine.

The universities have also involved several private enterprises in the project, including InCube Labs, nanoMag-Thixomat, ACell, OrthoKinetic Technologies, Fort Wayne Metals, General Nano, and IonBond.

Grant funding has also allowed Pitt to help N.C. A&T establish the first degree-granting program in bioengineering at a Historically Black College and University with the assistance of faculty members in Pitt's Department of Bioengineering and McGowan Institute for Regenerative Medicine. The program currently offers bachelor's and master's degrees and ultimately aims to offer a PhD.

"And there has been a lot of student exchange between the universities," Dr. Wagner says. "It has been a good exercise for the trainees involved, as it spans the individual universities and reaches into active collaborations."

In addition to undergraduate and graduate degrees, the research team, via the grant, has advanced STEM education to K-12 students in the Greensboro, North Carolina, Cincinnati, Ohio, and Western Pennsylvania regions by converting its work into a curriculum for aspiring engineers, with particular attention given to underrepresented groups. K-12 teachers are also invited to spend summer rotations in faculty-member laboratories to further broaden the transfer of scientific knowledge from the research effort.

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