Engineering a treatment for cerebral aneurysms: Research leads the way

Part of a series profiling undergraduate researchers provided by University of Pittsburgh Office of the Provost.

By Niki Kapsambelis

In between balancing 19 credits and applying to graduate school, Laura Hansen managed to clear some time in her crowded senior-year schedule to complete a project originally slated for a doctoral student: Build a device that may help scientists better predict the growth of brain aneurysms.

Fortunately, Hansen was no ordinary undergraduate. Thoughtful and passionate about her work, she fit right in with the graduate students who worked in the lab where she built the device, and the system she created is the first of its kind in that facility. Small wonder, then, that her ambition is to obtain her PhD and become a professor.

"I've had some really good students, and Laura is in the top 5 percent for sure," says Anne Robertson, associate professor and graduate coordinator in the Department of Mechanical Engineering. "She's very unassuming. You wouldn't think of her having high ambitions, because she's not talking about it all the time, but she's got a very clear path" in mind for her career, Robertson adds.

The two met when Hansen answered an e-mail from Robertson seeking a student's help on a project. Since the University of Pittsburgh requires all bioengineering undergraduates to work in a research lab for at least a semester, Hansen — then a sophomore — was looking for someplace to fulfill that requirement, and Robertson's project was intriguing.

The main focus of Robertson's group is cerebral aneurysms. When blood vessels rupture inside the brain, the consequences are often tragic. By better understanding the properties of vessels that do rupture, the group hopes to predict aneurysms, and in doing so, help pave the way for more effective prevention and treatment.

Robertson, a recipient of the School of Engineering's Beitle-Veltri Memorial Teaching Award for 2007, has done a lot of work predicting aneurysm development. Hansen's job was to create a device that would provide hands-on experimental work to test those theories.

The device, which was also designed by Michael Lovell, Associate Dean for Research at the School of Engineering, mimics the forces experienced by blood vessels within the body.

"From that, we can determine strain behavior," explains Hansen. "We can come up with equations and numbers to describe how the vessel behaves, (and) its mechanical properties."

The device, which includes a tall, rectangular outer tank fitted with a glass window and camera, is filled with saline to submerge vessels and mimic the wet environment of the human body.

A removable four-sided Plexiglas frame is mounted with a motor attached to a hollow rod and block. After the vessel is tied between the rod and block, it is loaded in two directions through inflation and axial extension. A load cell and pressure transducer are used to measure the applied forces.

"Aneurysms are just like little balloons or bulges in the arteries," says Hansen. "Usually, the walls are weaker there. Once in awhile, (doctors) will be doing a CT or MRI of the brain, and they'll discover them. But they don't have a set way of knowing if they'll rupture."

The first semester that Hansen began working on the device, she concentrated on the designs and obtaining the equipment. The second semester, it was built in the machine shop, a process she spearheaded.

"I really wanted to see us get data; I wanted to stick with it and see something come of it," she says.

Hansen got her wish. Before graduating in the spring, she was able to see the device work. This fall, she will begin graduate school at Georgia Tech, where she plans to pursue cardiovascular research, in part because of her experiences as a Pitt undergraduate.

"I guess it's working in this lab and seeing more about it, and papers we've read and other classwork, too," says Hansen of her interest.

Biology, math, and science always interested her in high school, so she chose Pitt because its engineering and pharmacy schools — both disciplines that she considered — were well-regarded. Scholarships and a campus visit confirmed her choice.

"I'm really glad I came to Pitt," she says. "I really enjoyed the people and the city. The program is great. The longer I was at Pitt, the more I realized there was really good biomedical research going on between the hospital and the School of Engineering."

Robertson, who has worked with more than 30 undergraduates in her group, was impressed with Hansen's dedication.

"Initially, the work she was doing was going to be done by a doctoral student," notes Robertson, but that student preferred theoretical projects. "Laura quickly grasped the central theoretical ideas of the project, and this enabled her to play a critical role in the design process. She did much more than I would have expected an undergraduate to do."

Robertson and her collaborators are working to finalize the data acquisition features so they can begin collecting information.

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