Heart failure remains a major epidemic in today’s society, which makes development of novel treatment strategies critical. In cases of end stage heart failure, heart transplantation is the only viable option. However, the number of donor organs is significantly lower than the number of patients needing transplants.

Biological bioartificial heart research conducted by biomedical engineers at UH Cullen College of Engineering’s Artificial Heart Laboratory (AHL) could potentially help many of these patients.

The American Society for Artificial Internal Organs (ASAIO) journal recently published, “Establishing the Framework for Fabrication of a Bioartificial Heart,” a UH study that could also benefit researchers around the world. Furthermore, the journal selected Cullen College’s illustrations to serve as cover art for the July/August 2015 edition. This marks the second time in six months that the scholarly publication has featured the work of Ravi Birla, UH associate professor of biomedical engineering, on its cover. His research also appeared on the front of the January/February 2015 edition.

Ze-wei Tao, post-doctoral fellow in Birla’s lab and current faculty member at the University of Arkansas Medical School, served as lead author on the paper. Matthew Hogan, Betsy Salazar and Nikita Patel, all recent AHL alumni, and Mohamed Mohamed, an AHL doctoral student, also made significant contributions.
In this study, the researchers used detergent-based decellularization to remove all cellular components from rat hearts, leaving behind intact extracellular matrixes. The advantage of using acellular scaffolds was that their distribution and composition of extracellular proteins closely approached those of mammalian tissues. Primary cardiac myocytes were then transplanted in the acellularized hearts and the recellularized hearts were cultured in a custom perfusion apparatus. After two days, the hearts contracted like mammalian hearts, and the researchers observed these contractions in culture for as many as eight days. As with human hearts, the bioengineered hearts responded to various electrical pacing frequencies and pharmacological agents.

“The most remarkable outcome from this study was that the bioartificial hearts respond to external stimulation the same way ours hearts respond, highlighting the similarity between engineered and human hearts,” Birla said.

At this stage of development, much research is still needed to bridge the performance gap between bioengineered and mammalian hearts. Birla and his team continue to explore strategies such as enhancing cellularization, using bioengineered heart muscle, conditioning with electrical stimulation bioreactors and pulsatile fluid flow.

Read the July/August 2015 ASAIO journal article featuring Birla’s research and images here.

© University of Houston Cullen College of Engineering