# The beat goes on: Artificial heart technology holds promise for alternatives

October 9 2008

Pictured is a device similar to the less-costly, smaller pulseless artificial heart to be created that will perform the function of both the right and left ventricles of the heart. Credit: Thomas Shea

Patients on the waiting list for a heart transplant soon may have more options thanks to a new device being developed by the Texas Heart Institute in collaboration with two University of Houston professors.

As part of a biomedical research team working to create a pulseless total artificial heart (TAH), Matthew Franchek and Ralph Metcalfe, both mechanical engineering professors in the Cullen College of Engineering at UH, are focusing on developing a control system that emulates how the natural heart responds to physiological conditions within the body. The TAH is designed to perform the function of both the right and left

ventricles, and these advancements in technology are meant to enable it to respond to the body's changing need for blood.

The professors say the complexity of existing devices that just mimic the pulsating pump action of the natural heart not only makes their size nearly impossible for use in smaller adults and children, but also causes reliability concerns, such as failure due to mechanical fatigue. The proposed TAH replaces the pulsatile feature with two pulseless continuous flow pumps, each about the size of a C battery. The pumps also are unique in that their cardiac output automatically adjusts to physiological needs. To ensure proper integration of the TAH on a patient-to-patient basis, the UH team will be adding onboard intelligence to the TAH using automatic controls.

One pump would be dedicated to the pulmonary loop, carrying oxygen-depleted blood away from the heart to the lungs and returning oxygenated blood back to the heart. The other pump would drive the systemic loop, carrying oxygenated blood away from the heart to the body and returning deoxygenated blood back to the heart.

Franchek's and Metcalfe's roles in the project will focus on the mathematical modeling of the cardiovascular system to create a feedback controller that will seamlessly integrate the device with a recipient's body. The overarching goal is to create a robust continuous-flow ventricular assist device that is smaller and more reliable than the current pulsating pumps that mimic the natural heart. The mathematical models of the cardiovascular system also will be evaluated as a possible means to health prognostics and diagnostics. In addition, information from the controllers will be used to assess current conditions of the blood, including viscosity, which is critical to maintaining patient health.

The UH professors are among those named on a $2.8 million federal grant from the National Institutes of Health. During the next four years,

Franchek and Metcalfe will work alongside the lead investigator and inventor of the proposed TAH, Dr. O.H. "Bud" Frazier, chief of the Center for Cardiac Support and director of surgical research at the Texas Heart Institute, as well as professors from Rice University, other Texas Heart Institute physicians and researchers from MicroMed Technology of Houston, to create this breakthrough device.

"We are very much looking forward to a long-term collaboration with this excellent biomedical engineering team and to the potential development of an effective, reliable mechanical replacement for the failing human heart," says Metcalfe, who also is a professor of biomedical engineering and mathematics. "With heart disease being the leading cause of death in the United States, this is crucial research that constantly needs fresh approaches and interaction across disciplines."

Echoing his colleague, Franchek, who is the director of UH's biomedical engineering program and chair of the mechanical engineering department, adds, "What we have here is a good partnership between engineers and physicians. We are harvesting knowledge from a fertile ground where many new discoveries lie, and at the end of the day our goal is to improve many people's quality of life."

Source: University of Houston