

'Dragon Heart' Holds Promise as Flexible, Cost-Effective Treatment for Heart Failure



Dr. Amy Throckmorton (on sabbatical from Drexel University) and Vakhtang Tchantchaleishvili are collaborating locally on a new cardiac assist and replacement device as part of a national team funded by NIH. The laboratory is located in the College Building on Walnut Street.

Could congestive heart failure (CHF) be treated with a total artificial heart that contains just two moving parts?

That's one of the questions that cardiac surgeon, Vakhtang Tchantchaleishvili, MD, and biomedical engineer Amy L. Throckmorton, PhD, an associate professor at the Drexel University School of Biomedical Engineering, Science and Health Systems, are collaborating to answer.

Known as "Dragon Heart," the device they are testing is an advanced cardiac assist and replacement technology designed and developed by Dr. Throckmorton, who is currently on sabbatical at Jefferson. She and Dr. Tchantchaleishvili are part of a national team that in July 2020 secured a four-year, \$1.5 million research grant from the National Heart, Lung, and Blood Institute within the National Institutes of Health to support this pre-clinical development phase.

If proven effective, the Dragon Heart would offer a compact, multi-functional total artificial heart that could help both adult and pediatric patients with CHF. To do so, it relies on two moving parts: an axial impeller for pulmonary circulation and a centrifugal impeller for systemic circulation.

CHF is a costly disease in terms of human and financial impact. This progressive and debilitating disease affects about 5.1 million people in the United States alone, with about 670,000 new cases diagnosed every year. Treating patients with CHF costs the healthcare industry more than \$35 billion annually, and existing treatments, including transplantation,

are not always available or effective for all patients.

"My vision of the Dragon Heart has been to provide as much versatility as possible in giving clinical management teams the ability to offer the right treatment for the right patient at the right time," says Dr. Throckmorton, who used pump design equations, computational modeling, and benchtop prototype testing to inform device design and performance.

The Dragon Heart has been designed to support the left or right side of the heart, to partially support both ventricles, or to fully support both ventricles as a total artificial heart, providing a viable alternative to heart transplantation. Dr. Tchantchaleishvili puts it even more succinctly – referring to the Dragon Heart as "the Batmobile of cardiac assist and replacement technologies."

Dr. Tchantchaleishvili says the device is also noteworthy because of its use of full magnetic levitation technology, one of most recent innovations in cardiac replacement technology.

"The Dragon Heart is one of only three total artificial hearts that are continuous-flow devices," he says. "This device also supports pulsatile flow, adding to its clinical versatility."

While at Jefferson, Dr. Throckmorton is continuing to build prototypes of the Dragon Heart and is working with Dr. Tchantchaleishvili, H. Todd Massey, MD, Surgical Director, Cardiac Transplantation and Mechanical Circulatory Support, and others to prepare for additional studies of the device's efficacy.



General Surgery Continues Journey as Enterprise Service Line

As Jefferson Health has grown to include 14 acute-care hospitals, the system continues to make the strategic shift from "holding company" to "operating company." The General Surgery service line – which includes all services within the Department of Surgery except for Cardiac, Thoracic, Transplant and Vascular – has made significant progress in the journey to a truly enterprise approach.

With the General Surgery service line formally established in October 2019, surgical leaders from across Jefferson Health have converged around shared strategic planning and clinical and operational support.

"Greater communication and transparency are critical when making a shift to an enterprise model. There is always more work to do, but we have made great progress," says Charles J. Yeo, MD, who leads the service line in his capacity as Senior Vice President and Chair, Enterprise Surgery, Jefferson Health. Other General Surgery leaders include Mohammad I. Khan, MD, Vice Chair at Jefferson Health – Northeast, Orlando Kirton, MD, Vice Chair at Jefferson Health – Abington, Roy L. Sandau, DO, Vice Chair at Jefferson Health – New Jersey, and Francesco Palazzo, MD, Vice Chair at Jefferson Methodist Hospital.

As Vice President and Service Line Administrator Adam Messer explains, the Integrated Strategic Financial Planning (ISFP) process is serving as the formal process and mechanism to ensure that general surgeons are operating not as individual physicians or hospitals, but as an enterprise.

"For example, a surgeon from one of our hospitals may have a recommendation for a new surgical service, device or technique," says Messer, who assumed administrative responsibility for the General Surgery service line last December. "We're now evaluating such proposals at the enterprise level. Based on the idea's merits, we may decide to put it on pause, or we may opt to deploy it across the service line."

In addition to the ISFP, the General Surgery service line is working to create a series of Clinical Pathways (CPs) to establish consistency in surgical patient diagnosis, treatment and follow-up. Each CP will outline the most appropriate, evidence-based standard of care that every Jefferson Health surgeon should follow when delivering a specific procedure.

"Think of Clinical Pathways as a guardrail around a particular clinical episode that ensure we have consistently good outcomes," Messer says. "We want to use evidence and consensus to ensure that no matter who your surgeon is or where your surgery is performed, you'll have the same type of care."

Messer notes that the upcoming enterprise launch of the Epic electronic medical record (EMR) system to include all Jefferson Health hospitals will be critical enabler for CPs.

"The 2021 launch of Epic will put everyone on the same integrated EMR from inpatient to outpatient and will be a foundational tool for developing CPs and establishing enterprise-wide standards of care," Messer concludes.

"I'm thankful to be collaborating with Dr. Tchantchaleishvili and his team to complete the critical acute testing studies in animals," Dr. Throckmorton says. "These are a necessary step toward achieving successful translation of the Dragon Heart blood pump technology. His

research team at Jefferson is ideally suited to lead and conduct these animal studies."

For more information, please visit: Research.Jefferson.edu/labs/researcher/tchantchaleishvili-laboratory.html