

## Regeneration Research Could Revolutionize Organ Transplantation

Every day, an estimated 79 people in the United States undergo transplant surgery. But because of a shortage of donated organs, an average of 18 people die waiting, according to the U.S. Department of Health and Human Services. At the same time, many donor organs are deemed unsuitable for transplant and routinely discarded.

**Zain Khalpey, MD, PhD, MRCS (Eng)**, associate professor and surgical director of the UA Heart Transplant and Mechanical Circulatory Support Program, hopes his research will change that situation. He envisions a medical landscape in which fewer organ transplants are needed in the first place, and in which organs typically disposed of as medical waste can be revitalized to help save lives.

Dr. Khalpey's research focuses on three key areas.

First, he aims to reduce the number of patients requiring heart transplants by improving stem cell treatments for failing hearts.

"I would rather not put you on the list for a transplant," Dr. Khalpey said. "I would rather take your fat-derived stem cells, inject them into you, and try to use ventricular assist devices as a bridge to regenerate your heart, rather than using transplanted tissue, where you have to be on immunosuppressive drugs for the rest of your life."

Second, for patients requiring lung transplants, Dr. Khalpey would like to take donor lungs that would have been thrown away and instead recondition them to make them suitable for transplant.

He is developing the UA's Ex Vivo Lung Program, which will explore new



Dr. Zain Khalpey and his research team already have used the bioreactor to successfully grow a new pig heart and lung.

ways to recondition lungs from DCD (donation after cardiac death) donors by manipulating the metabolism of donor lungs with mechanical devices and designer drugs. This summer, the UA will serve as a national trial site for comparing the survival of "normal" donor lungs with DCD lungs resuscitated on a mobile ex vivo circuit.

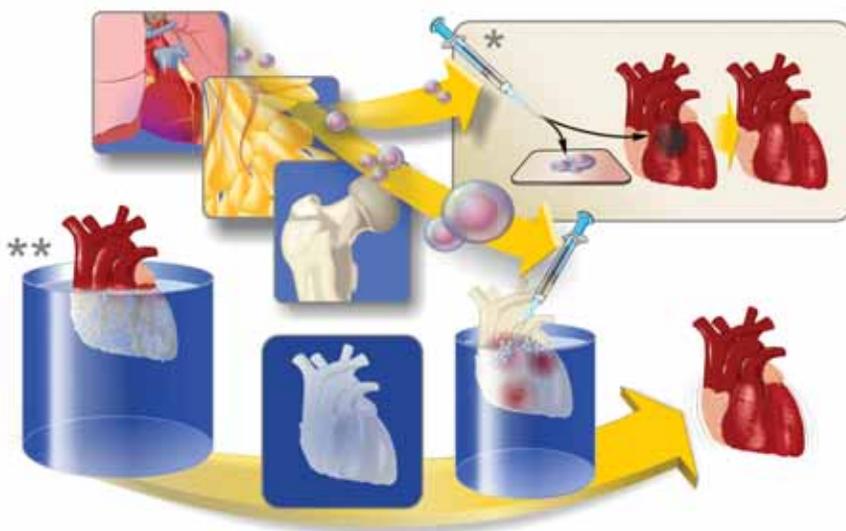
Third, for donor hearts that cannot be regenerated and donor lungs that cannot be reconditioned, Dr. Khalpey hopes to grow new organs (in a process called organogenesis) by combining an otherwise unusable donor organ with a transplant candidate's own stem cells.

The idea is that a donor heart or lung could be put into detergent and decellularized so that nothing but the organ's matrix (essentially its skeleton) remains. The organ then would be seeded with the stem cells of a transplant candidate and left to grow inside a special bioreactor, developed by Dr. Khalpey and his former colleagues at Harvard University and Harvard Bioscience in Boston.

"A bioreactor is like a sterile, intelligent, well-controlled, and monitored incubator, where one feeds and 'cooks' this organ until it reaches a point of clinical integrity ready for implantation," Dr. Khalpey said.

"The biggest problems right now for heart and lung transplantation are bridging the shortage of organs in the pediatric and adult arenas, increasing the donor pool, and reconditioning or retransplanting organs that have worn out due to chronic rejection," he said. "I need to not just reform transplantation, I need to revolutionize it."

### Organ Regeneration and Stem Cell Therapy



\*Stem cells are taken from a patient's organ, fat, or bone and directly injected or placed on a patch to heal a failing heart, eliminating the need for a transplant.

\*\*Heart (or lung) is bathed in a solution to remove all cells, leaving only the organ's matrix (skeleton). Stem cells are "seeded" into the organ and placed in the bioreactor. Cells multiply and grow over skeleton and become a viable organ for transplantation.