MISMR
Michigan Society for Medical Research

BioFocus

A Newsletter Exploring Science & Biomedical Research Issues For School Educators

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Our Mission

The Michigan Society for Medical Research (MISMR) is a nonprofit educational organization that supports biomedical research and testing and the judicious use of animals in research, education and testing in the interests of human and animal welfare. Established in 1981, MISMR is made up of the state's leading research universities, teaching hospitals, pharmaceutical companies, voluntary health organizations and hundreds of scientists, educators and students who understand and support the importance of animal research and testing in advancing health care and treatment.

MISMR Educational Projects & Activities

ANNUAL ESSAY CONTEST

Every year MISMR sponsors an essay contest open to all Michigan high school students. Students from well over 500 schools in the state have annually participated in the contest to address the benefits of biomedical research. Prizes are awarded.

SPEAKERS BUREAU

MISMR volunteers visit K–12 schools and civic community groups through out Michigan each year to educate the public about biomedical research and to dispel commonly held myths.

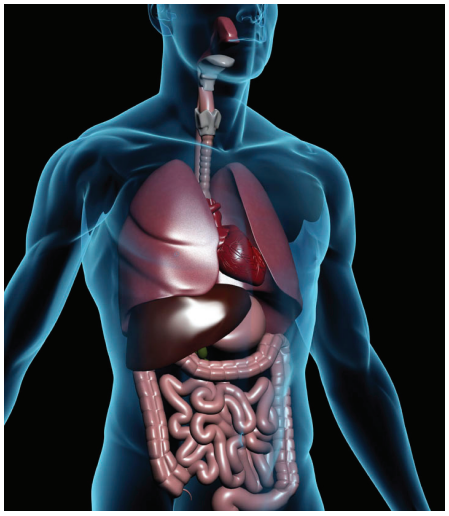
ANNUAL SYMPOSIUM

MISMR's popular annual meetings have often proved to be "standing room only," typically attracting local and national educators and researchers with interactive training workshops and presentations promoting biomedical research.

www.mismr.org

New Organs for Old

By Doug Hagley, BA, MFA



Imagine a world in which, when your heart or other body part fails, your doctor picks up a new one for you at the local tissue engineering lab. Or it might be less expensive to buy one from an organ farm, where domesticated animals produce human-compatible body parts that require no anti-rejection drugs. That will be our world very soon.

We often think of replacing the failing organs of the elderly, but traumatic injuries resulting in tissue and organ damage occur often among the young. For example, nineteen-year-olds suffer more paralyzing spinal cord injuries than any other age group. Think of the benefit of new methods of growing nerve tissue, or of stimulating nerve regeneration by the patient's own body.

Organ replacement falls into one of four categories:

- **Transplantation** — from human donors, alive or dead.
- **Mechanical Devices** — e.g., heart pumps and joint replacements.
- **Xenotransplantation** — from non-human donors.
- **Tissue Engineering** — growing organs from the patient's own cells or the cells of another.

Many organs are transplanted, but the history of heart transplantation reflects major issues and developments in the field as a whole.

South African surgeon, Christiaan Barnard, performed the first successful human-to-human heart transplant in 1967, also the year of the first successful liver transplant. The early medications that Barnard used to prevent the rejection of foreign tissue rendered the patient vulnerable to infection, and he died of double pneumonia 18 days after the surgery.

Wikipedia

Dr. Christiaan Barnard

Outcomes for transplant patients have improved. The longest living recipient of a single heart transplant (in 1978), Tony Huesman,

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Fast Facts...

In 1967, South African surgeon, Christiaan Barnard, performed the first successful human-to-human heart transplant.

In the 1980s, Dr. Robert Jarvik invented the Jarvik-7 — a plastic, rubber, and aluminum heart.

As bridges to human donor transplants, VADs (ventricular assist devices) are implanted to help weakened hearts pump.

In 2008, transplants from human organ donors reached almost 28,000 operations.

Today, about 75% of heart transplant patients survive for five years or longer after surgery.

With a shortage of human donor organs scientists are looking to animals as potential sources.

Valves from pigs' hearts have been used successfully for the past 20 years.

Genetically altering pig organs is one way to avoid rejection.

The liver is the only human organ that can regenerate, from a portion transplanted between patients.

Human bladders, and a patient's trachea, have been successfully produced in the laboratory with biodegradable scaffolding and the patients' own cells.

BioFocus

WE WANT TO HEAR FROM YOU!

We want to include your stories, comments or questions relating to animals in your classroom in upcoming editions of *BioFocus*. Please email stories to: mismr@umich.edu

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New Organs for Old... *Continued from page 1*

died of cancer in 2009. Today, about 75% of heart transplant patients survive for five years or longer after surgery.

Dr. Denton Cooley at Baylor Medical School implanted the first artificial heart in 1969 under a cloud of controversy because he'd proceeded without official review. The device was intended as a bridge until a human heart could be found for the patient (which is what artificial heart pumps are still used for). The patient lived for 4 days with the artificial heart, but died of pneumonia and kidney failure after receiving the human donor heart.

Wikipedia

The Jarvik-7 artificial heart

In the 1980s, Dr. Robert Jarvik invented a plastic, rubber, and aluminum heart — the Jarvik-7 — which was powered by an external compressor. The first recipient survived for 112 days, the second for 20 months. The Jarvik-7 heart's dependence on an external power source, besides restricting mobility, provided a vehicle for deadly infection. Today, completely implantable VADs (ventricular assist devices) that avoid the infection problem, and help weakened hearts pump are still used as bridges to human donor transplants.

Transplants from human organ donors reached almost 28,000 operations in 2008, of which 2,163 were heart transplants. Kidney, liver, pancreas, lung, intestine, and multiple organ replacements accounted for the remainder. A chronic shortage of donor organs means that as of August 2009, with 103,047 patients on organ waiting lists, 6,623 patients died before an organ became available.

The University of Michigan Medical Center in Ann Arbor and a joint program of the Henry Ford Health System and the Children's Hospital for Michigan in Detroit are currently authorized to perform heart transplants in Michigan. Henry Ford Hospital in Detroit is rated one of the top cardiovascular hospitals in the U.S., while the U-M Transplant Center performs over 400 operations (counting all organs) a year.

The shortage of human donor organs, though, is causing scientists to look to other animals as potential sources. Valves from pigs' hearts — which are similar in many ways to human hearts — have been used successfully for the past 20 years, but other transplants from animals to humans have consistently failed because the recipient's immune system rejects the implant.

The passing of diseases between animal donors and human recipients is also an area of concern. However, testing of a sample pathogen, the porcine endogenous retrovirus (PoERV), produced promising results: PoERV cannot effect human cells.

One way to avoid the rejection of pig organs is to genetically alter them so that it is more difficult for the human immune system to recognize the transplanted tissues. Small amounts of genetic material mimicking human DNA are put into a fertilized egg, then implanted into a sow. The resulting offspring can then be cloned to produce multiple animal donor organs. This technique has already addressed pig organ rejection in non-human primates and human trials are expected in the next few years. Entrepreneurs are planning extensive "organ farms" to meet the anticipated demand. Although two out of three Americans surveyed approve of animal-human organ transplants, this is a future hot-button issue for animal rights activists.

Perhaps the best — and least controversial — way of replacing damaged or aging human organs is to regrow them, either inside or outside the body. While limb regeneration occurs among amphibians, it doesn't appear in reptiles, birds and mammals. The liver

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New Organs for Old... *Continued from page 2*

alone among human organs can regenerate, from a portion transplanted between patients. The donor's liver regrows, and the recipient's portion also shows appropriate increases in size.

Wake Forest University researcher, Anthony Atala, MD, reported in 2006 that he had successfully grown bladders in the laboratory from patients' own cells. Cells from the muscle and lining of the bladder were biopsied, grown on a biodegradable scaffold shaped like a bladder, then attached to the patients' existing bladders.

In late 2008, a 30-year-old tuberculosis patient's trachea was replaced, this time by growing her own cells on a sanitized scaffolding from a human donor. The recipient didn't require any drugs to suppress her immune system.

In the future, a scaffold might be constructed from a pig heart by dissolving away the "meaty" part, then using the patient's own cells to repopulate it. Researchers at the University of Minnesota have already created a beating rat's heart with this technique.

Do these rapid leaps of knowledge mean that humans are destined to cheat death by simply replacing parts as they wear out? What would happen to the planet and to the quality of human life if no one dies, even as the number of people born every day explodes?

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BioFocus is published by the Michigan Society for Medical Research. Please send your questions, comments, and suggestions to:

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