Father Tad Pacholczyk
Director of Education
The National Catholic Bioethics Center

The Ethics of Pig to Human Organ Transplants

"Remarkable advancements have been made in 'neutering' pig organs so they no longer provoke a powerful immune response in humans, and striking progress has been made in extending survival times for xenografts..."

Early this year, a Maryland man suffering from severe heart failure underwent a new experimental procedure, receiving a pig heart transplant. His medical team had determined he would be a poor candidate for a human heart transplant or for an artificial heart, so he was offered the opportunity to participate in a novel treatment using a genetically modified pig's heart.

The pig had been specially bred and modified with DNA edits to increase the likelihood of successful transplantation. Three genes of the pig that contribute to the rapid antibody-mediated rejection of pig organs by humans were "knocked out." Six human genes that would produce "human protective proteins" and improve immune acceptance of the pig heart were also inserted into the pig's genome. An additional gene knockout was done to prevent the pig's heart from becoming too large.

The transplantation of animal organs into humans is known as "xenotransplantation" and is a new field that appears poised to expand rapidly in the future. Xenotransplantation can be ethical as long as pilot studies are performed in animals ahead of use in humans, safety issues are carefully addressed, the benefits of the transplantation procedure outweigh the burdens, and risks are reasonably limited.

While we have a duty to treat animals well and should try to avoid causing them undue suffering, it's also clear that human beings have been given by God a legitimate dominion over members of the animal kingdom. Animal trials have always been key to launching new therapies in humans.

Pig organ transplants into baboons and other non-human primates have been taking place for decades. These transplants have become more beneficial and less risky over time, especially as tailored genetic modifications have been introduced into the pigs. Xenotransplantation offers an important advantage over traditional human-to-human transplants: the opportunity to modify the donor organ, rather than only modifying the recipient through suppressing his or her immune system.

In the early days of implanting pig organs into non-human primates, researchers faced the serious problem of immediate organ destruction due to hyperacute rejection, with the failure time being measured in minutes, rather than hours or days. Hyperacute rejection occurred because the baboon's immune system recognized a carbohydrate molecule on the surface of the pig

The Ethics of Pig to Human Organ Transplants

organ. By knocking out the troublesome carbohydrate molecule via genetic engineering, and relying on additional immune-suppression techniques, scientists were able to extend significantly the survival times of transplanted pig organs in baboons, in some studies up to nearly three years.

The very complex changes made in the genetically-engineered pigs, when coupled with continued advances in immune-suppression strategies in organ recipients, led to the realization that it might finally be possible to attempt implantation of a genetically-modified pig heart into a human patient.

In the future, additional and more sophisticated genetic engineering of source animals and the use of new immunosuppressive agents in recipients should further improve compatibility and decrease the chances of xenotransplant rejection.

Still, it should be noted that there are other potential concerns besides organ rejection. Animal retroviruses or diseases could potentially be transmitted to humans when they receive an animal organ. Some have argued, however, that by maintaining strict control over how animals are housed, fed and bred for organ procurement, scientists can achieve a greater degree of assurance in terms of minimizing their exposure to pathogens through the highly biosecure laboratory conditions the animals are raised in; meanwhile, for human organ donors, detailed knowledge of individual exposure profiles may not be available.

Surveys and focus groups assessing attitudes to xenotransplantation generally report public support for the use of pig organs. Such surveys also suggest that many Christians, Jews and Muslims would consider xenotransplantation to be acceptable as a life-saving measure. Some people object to the use of animals, but the fact that more than 100 million pigs in the US are slaughtered annually for human food production lessens for most the concerns around using them to alleviate the chronic shortages of life-saving organs. Thousands of people die every year on waiting lists for human organs.

Moreover, if pig organ transplants into humans were to become standardized and widely available, this could also significantly reduce the illegal trade in human organs like kidneys, where the poor and disadvantaged are often victimized.

Even though remarkable advancements have been made in "neutering" pig organs so they no longer provoke a powerful immune response in humans, and striking progress has been made in extending survival times for xenografts, there are sure to be many more twists and turns along the road of getting our immune systems to cooperate fully with implanted animal organs.

Recent forays into xenotransplantation offer a significant first step on the long journey from yesterday's "scientifically unimaginable," to today's "barely achievable," to tomorrow's basic "standard of care."

Article: The Ethics of Pig to Human Organ Transplants. Date: December, 2021.

Rev. Tadeusz Pacholczyk, Ph.D. earned his doctorate in neuroscience from Yale and did post-doctoral work at Harvard. He is a priest of the diocese of Fall River, MA, and serves as the Director of Education at The National Catholic Bioethics Center in Philadelphia. Father Tad writes a monthly column on timely life issues. From stem cell research to organ donation, abortion to euthanasia, he offers a clear and compelling analysis of modern bioethical questions, addressing issues we may confront at one time or another in our daily living. His column, entitled "Making Sense of Bioethics" is nationally syndicated in the U.S. to numerous diocesan newspapers, and has been reprinted by newspapers in England, Canada, Poland and Australia.