The Society of Thoracic Surgeons
633 N. St. Clair, Suite 2100
Chicago, IL 60611
www.sts.org

News

Media Contact:
Jennifer Bagley
312-202-5865
jbagley@sts.org

Embargoed until Monday, January 28, 2019, at 3:30 p.m. ET (12:30 p.m. PT)

Transplanting Pig Hearts into Sick Babies May Be Promising Temporary Treatment Option

Living with a genetically engineered heart from another species may be achievable in the relatively near future

SAN DIEGO, CA—Xenotransplantation—transplanting organs from animals into humans—is one step closer to becoming a possibility for infants awaiting human heart transplantation, according to research presented today at the 55th Annual Meeting of The Society of Thoracic Surgeons.

"Our study showed a high probability that a genetically engineered pig heart could be implanted in an infant to keep the baby alive until a human heart becomes available, without concern for early rejection," according to David C. Cleveland, MD, of the University of Alabama at Birmingham (UAB). "The ability to use pig hearts would provide an inexhaustible source for organ transplantation."

Dr. Cleveland and colleagues from UAB analyzed how an infant's blood serum would react to a "triple-knockout" (TKO) pig—a pig that has been genetically modified to delete all three major antigens that are known to react with natural human anti-pig antibodies. This immune monitoring was conducted in 70 infants less than 1 year of age using a blood test known as flow cytometry.

KEY POINTS

- A genetically engineered pig heart transplanted into an infant would minimize the risk of early rejection.
- Pig heart transplants could potentially save the lives of infants with life-threatening heart diseases.
- Genetically engineered pigs could provide an unlimited source for organ transplantation.

The 70 infants were separated into two groups. Group 1 consisted of 50 infants who had never been exposed to any surgical procedure or blood transfusion, and Group 2 consisted of 20 patients who had undergone previous heart surgery, blood transfusions, or exposure to biologic tissue patches (pig or cow).

The level of reactivity of human antibodies to pig cells is important because, if the level is high, it suggests that early rejection would occur following a heart transplant. In this respect, the researchers found that no infants in Group 1 had any immunoglobulin M (IgM) antibodies directed to TKO pig red blood cells, while only one infant showed a "very weak" immunoglobulin G (IgG) reaction. IgM is usually the first antibody to react against pig tissue; IgG is the most abundant antibody in the human body. In Group 2, one of the 20 patients had an IgM reaction to TKO pig blood cells, and two had an IgG reaction, but in all cases the reactions were very weak.

"The reactivity of the infant's serum to TKO pig red blood cells was almost zero, indicating no antibody binding and therefore no killing of the pig cells," said Dr. Cleveland. "The ability to eliminate the pig antigens to which humans react, combined with the ability to introduce selected human 'protective' genes into the pig genome, offers the potential for successful pig heart graft survival in infants with life-threatening heart diseases."

Scarcity of Organs in the US

Encouraged by the UAB findings and the tremendous progress that has been made in the field of xenotransplantation research over the past 20 years, Dr. Cleveland said he is confident that there is potential for a genetically engineered pig heart to support the life of an infant for weeks or months until a human donor heart becomes available. "This would be especially important because very few human organs become available for transplantation into infants—particularly those with complex congenital heart disease," he said. "Furthermore, using mechanical assist devices in infants is suboptimal."

According to the United Network for Organ Sharing, more than 114,000 people are on the waitlist for organs in the US; nearly 3,200 of them are waiting for new hearts. Of those 3,200, approximately 50 are infants. The relative sizes of both the patient's body and the donor organ are considered when matching donors to recipients, which is why small children most often receive donations from other infants or young children. Information from the US Department of Health & Human Services shows that, in 2016, 135 pediatric organ donors were babies younger than 12 months. In addition, each year the number of people added to the waitlist continues to be much larger than the number of donors who become available, exacerbating the organ shortage in the US.

Previous Xenotransplantation Experience

In 1985, Leonard L. Bailey, MD, from Loma Linda University Medical Center in California, transplanted a baboon heart into an infant with hypoplastic left heart syndrome (HLHS). The child, known as "Baby Fae," survived 20 days. This was achieved without genetic engineering of the donor organ.

"If we can genetically engineer pig hearts to achieve successful cardiac transplantation, the care of children with HLHS would be revolutionized," explained Carl L. Backer, MD, Surgical Director of the Pediatric Heart Transplant Program at Ann & Robert H. Lurie Children's Hospital of Chicago. Dr. Backer was not directly involved with this study.

Why Pigs?

Material from domestic pigs (e.g., heart valves) has been used routinely and safely for medical purposes for a long time. Importantly, pigs can be bred and raised in large numbers, and genetic engineering of their hearts is relatively easy, according to Dr. Cleveland.

Provided that the pigs are treated humanely, use of pig parts may present less of an ethical dilemma than using organs from other animals. Dr. Cleveland and his team are sensitive to public opinion and are currently evaluating surveys that were completed by patient families, physicians, nurses, and other health care providers who are involved in the care of babies with congenital heart diseases.

"The present evidence is that the public would accept a pig heart transplant if it were life-saving," said Dr. Cleveland.

Future of Xenotransplantation

Although much more work is needed before xenotransplantation trials in humans can begin, this research has moved an important area of study significantly forward. “The next phase,” said Dr. Cleveland, “is the transplantation of TKO pig hearts into non-human primates to demonstrate long-term survival. This is necessary before any clinical trials in human infants. I look forward to continuing these studies, if we can obtain adequate funding.”

###

The other authors of the study were CA Banks, H Hara, DK Cooper, DC Mauchley, RJ Dabal, S Borasino, and T. Yamamoto.

The genetically engineered pig cells were provided by David Ayares of Revivicor Inc., in Blacksburg, VA.

Find comprehensive medical information presented for patients by leading experts in cardiothoracic surgery on the STS Patient Website (ctsurgerypatients.org). For more information, contact Media Relations Manager Jennifer Bagley at 312-202-5865 or jbagley@sts.org.

Founded in 1964, The Society of Thoracic Surgeons is a not-for-profit organization representing more than 7,400 cardiothoracic surgeons, researchers, and allied health care professionals worldwide who are dedicated to ensuring the best possible outcomes for surgeries of the heart, lung, and esophagus, as well as other surgical procedures within the chest. The Society’s mission is to enhance the ability of cardiothoracic surgeons to provide the highest quality patient care through education, research, and advocacy.