The First Pig Kidney Transplant

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On March 16, 2024 at Massachusetts General Hospital, Harvard Medical School physician-scientists transplanted a kidney from a genetically modified pig into a 62 year old male. The patient is Richard (Rick) Slayman, who received the kidney in a four hour surgery. He has type 2 diabetes and high blood pressure, the most common causes of chronic kidney disease. Even though many questions remain regarding the viability of the newly transplanted organ, the procedure marked a significant milestone in the effort to alleviate the critical shortages of human kidneys for patients with end-stage kidney failure.

Mr. Slayman was on dialysis for seven years after his kidneys failed. He eventually received a human kidney in 2018, but that organ failed within five years, leading to other complications. Mr. Slayman resumed dialysis in 2023, however, this time experiencing severe vascular complications that required frequent hospitalization. Dr. Winfrend Williams, associate chief of the nephrology division at Mass General, claimed that Mr. Slayman "would have had to wait five to six years for a human kidney. He would not have been able to survive it."

Currently, more than 550,000 Americans have kidney failure and require dialysis, a procedure that filters toxins from the blood (Rabin, 2024). Over 100,000 people in the US are currently waiting for an organ for transplant, yet only 25,000 kidney transplants are performed annually (Mass General Brigham Communications, 2024). While dialysis is able to keep people alive, their only secure treatment is an organ transplant. Therefore, many researchers have been exploring the transplantation of organs or tissues from animals via a procedure called

xenotransplantation. Xenotransplantation involves the transplantation, implantation or infusion of live cells, tissues, or organs from a non-human animal into a human recipient (Xenotransplantation, 2021). It has been discussed for decades as a possibility for solving the issue of organ shortages, but experts point out that long-term rejection from the human immune system can happen even when donors are well matched, which can lead to potentially fatal consequences.

As a result, researchers have made scientific advancements in order to solve these issues. These advances have included gene editing and cloning, which make it possible to modify animal genes to make the organs even more compatible. CRISPR-Cas9 is a gene-editing technology which was used in this new surgery to modify the kidney through a total of 69 genomic edits (Mass General Brigham Communications, 2024). CRISPR-Cas9 is necessary for the removal of certain pig genes that produce antibodies to which our immune systems react, and for the addition of certain human genes that improve the kidney's compatibility with the recipient. Additionally, gene-editing technology inactivates porcine endogenous retroviruses present in all pig genomes to eliminate risk of infection in the recipient (Mass General Brigham Communications, 2024).

In the groundbreaking surgical procedure led by a team at Mass General, a kidney transplant was successfully completed for Mr. Slayman. There was cheering in the operating room when the new organ began to produce urine right away. After over a week, Mr. Slayman recovered well and was released shortly after. Dr. Madsen, a surgeon on Mr. Slayman's surgical team, highlights that Mr. Slayman's bravery was crucial to the accomplishment of this ground-breaking surgery, which was previously thought to be unthinkable, representing a major turning point in medical history.

Despite this one-time success, the long term results of the transplant is still unclear. The team of surgeons hope that Mr. Slayman will not need to go back on dialysis and the pig kidney improves his health. The FDA acknowledged the lack of alternative treatments and therefore granted this surgery under a compassionate-use protocol. Researchers hope the pig kidney will endure for a few years, but larger clinical trials are required to properly evaluate safety and efficacy. The potential of xenotransplantation from pigs to replace dialysis and serve as a bridge to human kidney transplants offers hope for the future of transplantation.

Works Cited

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