- Transplantation of organs, tissues, etc

Gene-edited pig kidneys transplanted into living human patients

A pair of ground breaking surgeries offers new hope for ending a deadly shortage.

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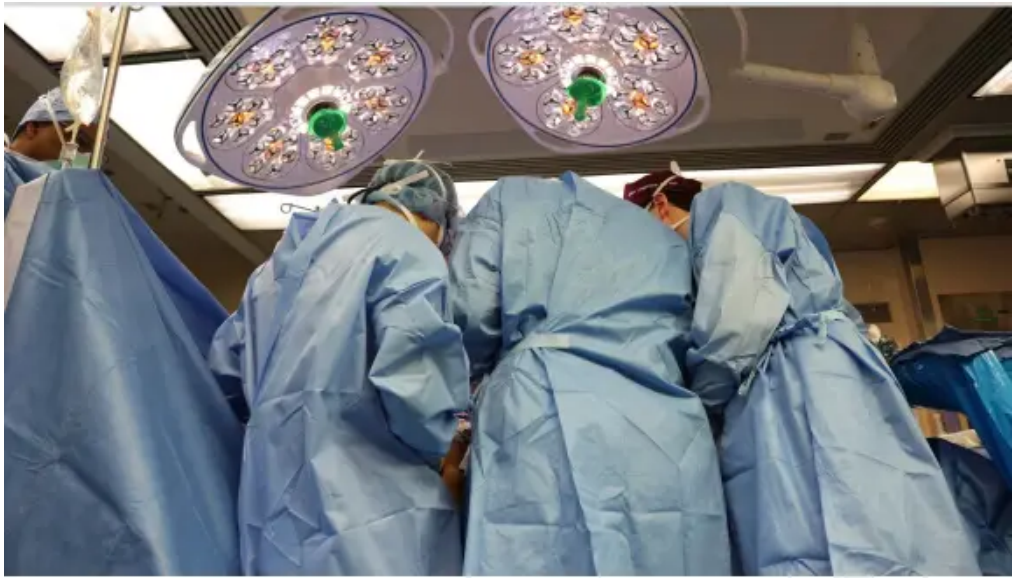
THE QUEST TO make cross-species organ transplantation, or xenotransplantation, a practical reality took a major step forward in March, when surgeons at Massachusetts General Hospital transplanted a kidney from a genetically engineered pig into a patient with end-stage renal disease — the first time an animal kidney had been successfully transplanted into a living human.



Although the recipient, 62-year-old Richard Slayman, died of a cardiac event seven weeks later, tests showed that the kidney was still functioning perfectly.

The donor animal was provided by the biotech company eGenesis, which removed three pig genes and inserted seven human genes to prevent rejection. Even with these edits, Slayman's immune system began to attack the kidney after a few days — a common occurrence with human-to-human transplants, as well. Doctors were able to control that response using conventional immunosuppressant drugs. "The xenotransplant does not appear to have been the cause of his demise," says Winfred Williams, associate chief of Mass General's renal division and the patient's longtime nephrologist.

Slayman had suffered from diabetes and hypertension for decades. After his kidneys failed, he spent seven years on dialysis before receiving a transplant from a human donor. But that organ gave out and he went back on the machine. By then, his blood vessels had been damaged by fluid buildup, making it difficult to administer dialysis. Repeated surgeries brought little improvement. Without another transplant, he was unlikely to live much longer. "He was becoming increasingly depressed and despondent," Williams recalls. "He said, 'Doc, I can't go on like this. I don't want to go on like this.' "

Slayman faced a dilemma shared by millions of people around the world. In the U.S. alone, nearly 100,000 patients are on a waiting list for a kidney transplant. Yet, fewer than 30,000 such surgeries are performed each year, due to a perpetual dearth of donor kidneys.

Organs from genetically modified animals could eliminate the shortage — if the challenges of using them can be overcome. The first two pig-to-human heart transplants, in 2021 and 2022, both failed within two months, for reasons still under investigation. But when Williams asked Slayman if he'd consider receiving a pig kidney under the Food and Drug Administration's expandedaccess program

(commonly known as "compassionate use"), he jumped at the chance. "I saw it not only as a way to help me," he said in a statement, "but a way to provide hope for thousands of people who need a transplant to survive."

Sadly, Slayman's death denied him the opportunity to see that goal fulfilled. His xenotransplant's success, however, had just the effect he intended. The pioneering procedure was followed in April by the second pig kidney transplant in a living human — Lisa Pisano, 54, who also became the first person to receive a heart pump along with a kidney transplant of any kind. The heart pump failed due to cardiovascular complications, and Pisano passed away five weeks after its removal. Still, the New Jersey grandmother survived longer than she might have without the transplant, and her kidney worked well until drops in blood pressure damaged it.

Such experiments open "a new landscape where the issues of supply of organs could be a thing of the past," says David Klassen, chief medical officer for the United Network for Organ Sharing, which oversees the nation's transplant system. "I think we're heading toward a world where this becomes the standard of care."

BEYOND THAT,

Slayman's bold step holds particular importance for Black Americans like himself, whose risk of

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kidney disease is triple that of white Americans. "One of the intractable problems in transplant medicine is unequal access for ethnic minority patients to transplant organs," says Williams. "If you had an abundant supply of organs, it could go far to achieve health equity for all patients."

At Slayman's funeral service, the nephrologist and his team delivered a heartfelt eulogy. "We told the congregation that Rick's sacrifice would not be in vain. He was a remarkably steadfast, courageous, and generous man."