Pig kidneys for transplantation could help thousands of patients with kidney failure

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(Medical Xpress)—Kidney failure patients in the not-too-distant future may have a new option that sidesteps the current organ shortage, lengthy wait and potential rejection: Grow your own.

University of Florida researchers are using a pig kidney as a "scaffold" in which they are building a human version by injecting it with stem cells grown from the patient. Those cells will "take over" the pig kidney, allowing it to be transplanted into humans.

If successful, the researchers say, the process could reduce the wait for a kidney from years to several months and save tens of thousands of lives annually.

"It is so exciting, this whole new therapeutic path," said Dr. Edward Ross, a nephrologist and professor of medicine at UF Health. Ross is collaborating on the project with Chris Batich, a professor of materials science and engineering and biomedical engineering at UF.

The challenge that prompted them and their team into action is daunting. More than 106,000 people in the United States await kidney transplants, according to data from the Organ Procurement and Transplantation Network. But because so few kidneys are available, fewer than 17,000 receive transplants each year and nearly 500,000 undergo chronic dialysis treatments.

Batich and Ross want to change that, and they say the process is

relatively simple in theory.

Step one is to take a kidney failure patient's skin cells and turn them back to stem cells by adding certain chemicals and growth factors.

Step two is to wash the pig kidney of all of its cells, a process called decellularization. Ross said this is a crucial step and must be done carefully to avoid harming the structure of the organ, or washing away the chemical signals that cause the cells to differentiate.

After pumping in just the right amount of detergent to clean out the swine cells, the almost translucent organ becomes a scaffold – something like a building in which the human cells can grow.

"The idea was to use a natural architecture, something we could never craft synthetically," Ross said. "The idea is if you put the human stem cells in, they will start to differentiate and remodel the scaffold."

Ross said they are moving forward with the next steps of seeding the cells and then incubating them for growth. To get the human skin cells to turn into structures such as blood vessels, they need to be placed in the correct region of the scaffold. The kidneys are hooked up to devices containing pumps and vacuums to help push the cells to their new homes.

"There are certain chemicals in the scaffold that tell them what to become, so different parts of the scaffold have different signals," Ross said. "If stem cells land in a particular spot, they will know how to develop."

The cells could then begin to "talk" to each other, reproduce and claim the pig kidney's blood vessels and other structures as their own. Although the team is still waiting to see that happen in the pig kidneys,

they have successfully proved it using rat organs in a study the group published in the journal Organogenesis in 2012.

Because the kidney would contain the patient's own cells, using these modified pig kidneys could ultimately reduce the need for anti-rejection drugs that cause harsh side effects.

Ross said about six research teams are working on similar studies around the country, but UF is the only group that has tinkered with the idea of using a human patient's own stem cells. Researchers at Harvard have used somewhat mature cells and rodent scaffolds, but Ross said for the process to work ideally, he believes stem cells are the way to go.

Although the UF study is still in its preliminary stages and a transplant using a converted pig kidney could be 10 years away, the team is optimistic. But Batich said the success will depend on the amount financial support given to support this area of research.

"Our next step is to overcome the barriers to get the cells to grow long enough and to differentiate," Ross said.

Batich said his goal of working toward solving the transplant problem was made possible by the collaborative nature at UF.

"UF is probably the only place in the country that has so many departments and groups in walking distance of each other and so it's a really unique opportunity to be able to do this type of work," Batich said. "Wouldn't it be wonderful if we could actually push this ahead so someone succeeds in getting it?"

Provided by University of Florida