The pigs had been dead for an hour. Scientists made their hearts beat again.

By Amy Cheng
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Hours after pumping synthetic fluids through the bodies of dead pigs, a team of researchers from Yale University observed their hearts beginning to beat faintly. Blood circulation was restored, and some cellular functions were revived in vital organs such as the heart and liver.

The peer-reviewed findings, published Wednesday in Nature, have far-reaching consequences in medical fields such as organ transplantation. But they also add to the thorny ethical issues surrounding the definition of death, as the distinction between the dead and the living becomes increasingly blurred.

According to the Nature article, the Yale research team used the OrganEx system — consisting of a device similar to the heart-lung machines used in surgery and the experimental mixture of fluids that promotes cellular health and reduces inflammation — on pigs one hour after they no longer had a pulse.

Another group of dead pigs was put on ECMO, a life-support measure that oxygenates the blood outside of the body. By the end of the six-hour trial, the scientists found that the OrganEx technology was capable of delivering "adequate levels of oxygen" to the pigs' whole bodies, which restored certain key cellular functions in organs such as the heart, liver and kidneys.

"Under the microscope, it was difficult to tell the difference between a healthy organ and one which had been treated with OrganEx technology after death," Zvonimir Vrselja, a neuroscientist at the Yale School of Medicine who took part in the study, said in a news release.

The dead pigs connected to ECMO machines, however, failed to have their blood supply oxygenated. Their bodies were left stiff with rigor mortis, unlike the ones put on OrganEx.

nother attention-grabbing result from the experiment — one that also took the Yale team by surprise — was involuntary movement in the head and neck areas of the dead pigs hooked up to the OrganEx system. This was an indication that some motor functions were preserved, Nenad Sestan, one of the study's authors, said in the news release.

The OrganEx study builds on a 2019 project from Yale's medical school that restored some cellular function in pig brains four hours after the animals had been decapitated.

"What research like this suggests is that death does not occur at a particular time," said Nathan Emmerich, a bioethicist from Australian National University who is not affiliated with the Yale studies. Instead, he explained, death takes place over time as the processes keeping an organism alive gradually cease — and the new findings suggest some of the damage caused by the loss of those functions can be repaired.

"The fruits of this research are unlikely to enable us to revive just anyone but may help us save a limited number of people in certain circumstances," Emmerich said.

The team of researchers from Yale underscored the importance of future research, as well as input from bioethics experts. Emmerich foresees many challenges before technologies such as OrganEx can be used in humans. For instance, they must show the ability to revive organisms, rather than merely cell functions, he said, adding that laws governing organ transplants would also need to adapt to the evolving definitions of death.