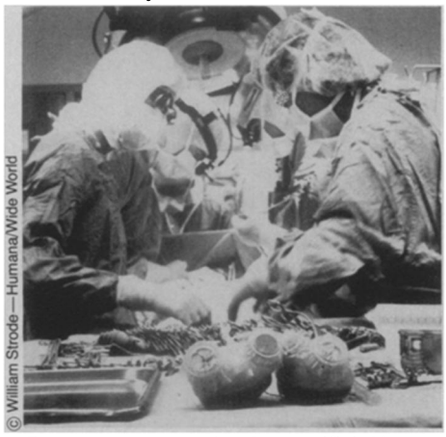
New life for the artificial heart

In a grueling six-and-a-half-hour operation, doctors at Humana Heart Institute in Louisville, Ky., this week pulled the diseased, dying heart from the chest of a 52-year-old Jasper, Ind., man and replaced it with an air-driven, aluminum and plastic mechanical heart. The man's own heart had been damaged by cardiomyopathy, a degenerative heart disease.

Nearly six hours after the operation, implant recipient William J. Schroeder, who is also a diabetic, was taken back into surgery to stop excessive bleeding. The bleeding may have been due to scarring from a coronary bypass operation undergone in 1983. As of midweek, Schroeder was stable and breathing on his own.

Schroeder, a retired Army quality-assurance inspector, is the second person to receive a permanent artificial heart, coined the Jarvik-7 after its developer, University of Utah bioengineer Robert Jarvik. William DeVries, who performed the first implant two years ago at the University of Utah Medical Center in Salt Lake City, headed the 17-member surgical team at Humana, a private, for-profit institution that has pledged to underwrite expenses for 100 such procedures.



Doctors prepare to implant artificial heart.

The current artificial heart is similar to the one given to retired dentist Barney Clark in 1982 (SN: 12/11/82, p. 372). Previously faulty, two-piece valves have been replaced with stronger one-piece titanium ones, and the heart can be hooked for up to three hours a day to a 12-pound portable power pack the size of a camera bag, which can be worn over the shoulder. The pack temporarily replaces a refrigerator-sized $40,000 air compressor.

While the artificial heart is still very much in its infancy, notes William Pierce, chief of the artificial organ division at the Hershey (Pa.) Medical Center, the limiting factor in research is not the level of scientific knowledge but rather the lack of adequate funding. "Successes with this sort of work will hopefully stimulate additional industrial, government and private foundation support," he says.

Hershey researchers have no immediate plans to implant artificial hearts, but the device may someday play a key role in transplantation of human hearts. Nearly two-thirds of heart transplant recipients now survive the first year after surgery and about one-half live five years or more, according to Pierce. "The current model can't improve that," he says, "but if a patient is very ill, the [artificial] heart can serve as a bridge—maybe for several weeks—until a donor heart can be located."

This view is shared by DeVries's former co-workers at the University of Utah, according to university spokesperson John Dwan. Utah researchers have "changed their thinking," he says, and, "at this stage of development, feel it should be used primarily as a holding device" until a transplant can be performed.

In contrast to the bulky 323-pound air compressor that powers Schroeder's heart, Pierce says, the ultimate model—still years away from use in humans—will feature a miniaturized drive system permanently installed inside the chest, alongside the heart, with a portable battery pack worn around the waist.

But will an improved motor-driven artificial heart eventually replace the transplanted human heart as the treatment of choice?

"That'll be an interesting competition," says Pierce. "What we're going to have is a period of time where heart transplants will be used for patients under age 55, and those older than that will get motorized hearts," he says. "Then we'll begin to see if the age for transplants can't be increased, or if the age of a candidate for a mechanical heart might be moved up. There'll be a choice."

—*S. I. Benowitz*

Help to the heart in rejection detection

The health team hovering over Baby Fae in her last weeks of life (SN: 11/24/84, p. 325) battled two problems that had nothing to do with the fact that her new heart wasn't human. Both issues, the small size of the heart and the small size of the infant, complicated the already-narrow line heart transplanters must walk between giving their patients enough of the mix of medications needed to thwart the body's attempts to reject the foreign tissue, and not so much that the drugs' toxic effects are overpowering.

Since the early 1970s, heart surgeons have relied upon periodic biopsies of the heart's inner wall to gain a window on organ rejection and to help monitor the effects of drug therapy. The biopsy procedure involves threading an instrument that is essentially a wire with a clipper on the end through the jugular vein and taking a small snippet of tissue. But in the case of Baby Fae, only the second newborn to receive any sort of heart transplant, it was decided that the biopsy, while relatively safe in adults, might be unduly risky for the infant. The case represented an example of a problem all heart transplanters are eager to solve: how to detect the first signs of rejection sensitively and noninvasively. (Rejection is not a factor in artificial heart implantation.)

"I don't think anybody is yet suggesting that biopsies can be totally replaced," Diane H. Russell, of the University of Arizona in Tucson, told SCIENCE NEWS. "But it is an invasive procedure, so it would be nice to have a biochemical marker, say in urine, that would predict the proliferation and invasion of the white blood cells into the heart muscle." By the time such an invasion is picked up by the biopsy, some damage to the heart has already occurred, she says.

At the recent meeting in Miami Beach of the American Heart Association, where several rejection detection methods were described, one of Russell's co-workers reported a technique that they say "consistently predicts rejection prior to any other clinical test known to date."

The method involves monitoring daily urine levels of acetylputrescine, a substance secreted throughout the body during cell division. In the 16 transplant patients monitored to date, Russell and her co-workers found that anti-rejection drugs generally suppressed the body's overall excretion of acetylputrescine. But among all patients whose biopsies a few days later would show evidence of rejection, the acetylputrescine output was *increased* by 50 to 300 percent.

The test needs to be confirmed in more patients, Russell says, but shows signs of being both sensitive and fairly specific for rejection. Other factors, such as a massive infection, also affect acetylputrescine levels, she says, but the pattern of the increase that seems to signal a rejection episode is clearly distinguishable.

Other noninvasive methods now being tested include:

- A combination of ultrasound and the monitoring of heart valve sounds to check for stiffness in the heart wall during a particular phase of the heartbeat called diastolic relaxation. The method, thus far tested in 24 transplant recipients at Stanford University, is already proving useful in helping doctors determine when a bout of acute rejection has been successfully treated, without necessitating a follow-up biopsy, says Stanford's Randall Morris.
- Screening blood samples for an increase in young, rapidly dividing white blood cells. Pioneered in Germany, the method is helping surgeons to minimize the number of biopsies they do, but is said to require a lot of time and labor.

The ultimate method for monitoring rejection, Morris says, might be one that