An Artificial Heart in Search of a Patient

The world's first really workable artificial heart may be implanted in a human this spring

BY JOAN AREHART-TREICHEL

Imagine a person being kept alive by an artificial heart that, thanks to an influx of air, pumps blood into the body at the normal 100 beats per minute. Such a vision would have been science fiction a quarter-century ago. Not so today, for such a device may be implanted into a human this spring, provided research at the University of Utah School of Medicine in Salt Lake City goes as planned. And if the heart *is* implanted, it would be only the second or third artificial heart ever put into a human, and the first with a good chance of working days or weeks, not just for a few hours, as the previously implanted artificial hearts did.

For 14 years biologists, polymer chemists, heart surgeons, computer engineers and others in Salt Lake City have been working on the artificial heart — following the pioneering efforts of William J. Kolff, who was at the Cleveland Clinic before coming to the University of Utah School of Medicine. The researchers tried numerous concepts, materials and experimental animals before they finally arrived at an artificial heart they believe can truly work in humans. The model was designed primarily by bioengineer Robert Jarvik and has been dubbed "the Jarvik Number Seven" artificial heart. It has two polyurethane ventricles and no auricles.

Prior to implantation of the heart the patient's ventricles would be removed. Then the artificial ventricles would be attached to the patient's auricles with Dacron or polyurethane cuffs and to the patient's own natural aorta and lung arteries with Dacron or polyurethane tubes. Two tubes from a portable air console (about the size of a breadbox) would be surgically inserted into the patient's chest and hooked to the ventricles. As air flowed into each ventricle from the air console, it would push against a diaphragm in each ventricle, and the diaphragm pressure in turn would push blood out of the ventricles into the aorta and lung arteries. The air console would control the rate at which the diaphragms pressed — in other words, the rate at which the artificial ventricles pumped blood, or beat. Although the ventricles would be capable of beating up to 900 times per minute, they would usually be kept beating at around 90 to 100 beats a minute, the average rate of a normal human heart.

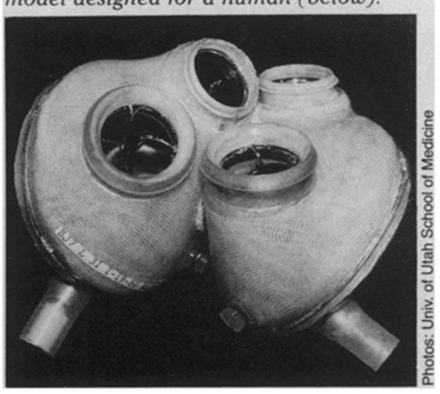
The reason the Utah investigators believe that their Jarvik Number Seven artificial heart could keep a human alive and well for days or even weeks is that it or similar models have done so in calves in their lab. The record so far was set by a calf named Tennyson that lived 268 days with the heart.

In January the artificial heart researchers approached the university's review committee for research with human subjects in hopes that it would allow them to implant the heart in a human patient. The committee granted its approval on Jan. 27. Last month the researchers submitted an application to the U.S. Food and Drug Administration, which has national jurisdiction over clinical trials of new medical devices. An FDA reply is expected any time. What are the chances of the FDA giving the green light? As Donald Olsen, director of the University of Utah School of Medicine's artificial heart lab, told SCIENCE NEWS, "The mechanism under which we are trying to get permission would indicate that we have a good chance to do it on a very limited, controlled study basis. They will not at this time give permission for mass use. To get that requirement would mean a great amount of additional research, studies and documentation."

If FDA approval on the basis of limited use comes through, Olsen and his colleagues foresee the Jarvik Number Seven artificial heart being implanted in a human as early as this spring. William C. DeVries, a Utah heart surgeon with experience in implanting artificial hearts in animals, is expected to do the operation. The patient will have to be someone who could not survive conventional heart surgery or whose only hope of life would be with an artificial heart. Such a patient might then be maintained on the artificial heart for days or weeks until a suitable natural heart could be found.

One of the major drawbacks of the Jarvik Number Seven heart, of course, is that the air console attached to it would greatly inhibit a patient's mobility, but the next goal of the scientists is to design a heart that would make a patient more independent. For instance, they are trying to convert the Jarvik Number Seven so that it gets its energy from an electrical device implanted in a patient's chest. The ultimate artificial heart, Jarvik asserts, must "be more than functional, reliable and dependable. It must also be forgettable."

Olsen with calf Tennyson, which lived 268 days on artificial heart similar to Jarvik-7 model designed for a human (below).



Photos: Univ. of Utah School of Medicine

Although transplanted natural hearts have kept some patients alive up to 10 years, the heart transplant success rate for most patients is low — only 65 percent survive one year. The reasons are that it's hard to match patients and donor organs immunologically and that donor hearts are in short supply. Because the Jarvik Number Seven artificial heart does not present an immunorejection problem, and because it could be manufactured in large quantities, Olsen foresees artificial hearts eventually surpassing natural heart transplants. In fact, he predicts that a decade from now, many heart patients will be wearing artificial hearts. □