Medicine by John Grauerholz, M.D.

Artificial heart technology advances

Continued development of materials and of an internal power source will produce a reliable, durable artificial heart.

Amid the chorus of critics of artificial heart implants, the technology itself continues to progress, to their evident dismay. The Jarvik-7 heart which William J. Schroeder received has been improved over the heart which Barney Clark received by a new drive unit and the addition of new valves machined from titanium.

According to Dr. Robert Jarvik, inventor of the Jarvik-7 heart, the major problem with the mechanical heart itself at this point is breakage of the pump diaphragms, which must flex 40 million times a year. His estimate is that the present pump could last as long as five years, but would probably fail before then.

Dr. William DeVries, the surgeon who performed the implant, noted that Schroeder has already lived longer than he probably would have with his natural heart. In addition, a commitment to fund the artificial heart program at the level proposed in the 1960s would virtually guarantee development of better materials within the additional lifespan potentially available to Schroeder.

The Jarvik-7 heart consists of two chambers, each measuring 3.5 inches in height and 10.6 inches in circumference. The chambers are molded from polyurethane, supported on an aluminum base, and are held together as a unit by a Velcro patch. The valves are machined from titanium. The unit weighs approximately ⅔ of a pound (280 grams).

The heart is implanted by removing the two larger chambers of the natural heart, known as the ventricles, and then sewing dacron-felt cuffs to the two remaining chambers, known as atria, and to the aorta and pulmonary artery. The aorta supplies oxygenated blood from the lungs to the body and the pulmonary artery pumps oxygen depleted blood from the body to the lungs. The two artificial chambers are then snapped into the four cuffs, and two thin plastic tubes which provide the air pulses to drive the heart are led out through the skin of the upper abdomen and connected to an external air compressor.

The other major advance over the original implant in Barney Clark relates to the external unit which powers the heart. The main drive unit is a console which weighs 323 pounds and is 42 inches high, 31 inches wide, and 24 inches deep. It weighs 52 pounds less than the unit used to drive Clark's heart, and delivers compressed air through two 8-foot-long ⅝-inch plastic tubes.

More significant is the portable drive unit developed by Dr. Peter Heimes, the head of the West German arm of Jarvik's firm, Symbion, Inc. The portable drive is an 11 pound shoulder-slung unit which resembles a large camera case. It is powered by a rechargable nickel-cadmium battery, and will enable the patient to leave his hospital room for four to five hours at a time.

The battery can be changed in seconds without interrupting operation of the unit, and an emergency battery will operate the unit for almost 12 hours if necessary. Like the large Utahdrive unit, the Heimes drive contains two complete air compressors, a primary unit and a backup. The heart rate is automatically adjusted to the body's needs by a microprocessor.

The unit was supposed to be tested on Clark, but his condition was never good enough. In Schroeder's case, the unit has functioned as anticipated, and Schroeder and his wife are now taking classes on how to switch from one drive to the other, in anticipation of his discharge from the hospital.

Development of the portable system is a key step in bringing the artificial heart implant from the status of an interesting experiment to an accepted treatment for end-stage heart disease. The ability of the patient to ambulate independent of a large compressor unit is necessary if he is to be discharged from a hospital and carry on normal daily activities at home. The Heimes drive is a significant step in that direction.

Continued development of materials and ultimate development of an internal power source will make the artificial heart a much more acceptable method than transplantation, which relies on the death of another person and the persisting problems of graft rejection.

The Humana Hospital Audubon has been given approval for six implants of the Jarvik-7 heart next year. Humana, Inc., the for-profit hospital group that owns Humana Hospital Audubon, is financing Schroeder's treatment and has agreed to underwrite up to 100 such operations, at an estimated cost of $100,000 to $150,000 each, as part of the arrangement by which they recruited surgeon William DeVries from the University of Utah Medical Center.