Artificial Heart

Scott Goyette, *Biomedical Engineering, University of Rhode Island*
BME 281 First Presentation, November 12, 2014 <scott_goyette@my.uri.edu>

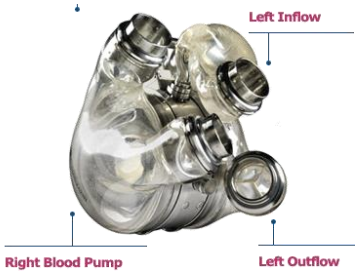
***Abstract*—Artificial Hearts are being used to help patients with total heart failure live normal lives past their life expectancy time line, or to help patients survive until their transplant date either by replacing the heart completely or by replacing the ventricles.**

I. Introduction

Congested heart failure, according to Merriam-Webster Dictionary, is " heart failure in which the heart is unable to maintain an adequate circulation of blood in the bodily tissues or to pump out the venous blood returned to it by the veins." Heart failure can occur from Coronary Artery Disease, high blood pressure, congenital heart disease, infections, and more. As a result many patients will succumb to death if left untreated. Dr. Robert Jarvik was the first to invent the first successful permanent artificial heart known as the Jarvik 7 in 1982. The Jarvik 7 has been able to keep patients alive until their transplant date by aiding the heart as replacement for damaged ventricles. Since then artificial hearts have been researched and developed more to produce better designs with better functions. Today artificial hearts are being used as a last resort option if traditional medicine and procedures did not work, and as a substitute for heart transplants

II. Methods

For total replacement of the heart doctors would use the AbioCor. The AbioCor was developed by engineers at AbioMed and is designed as a fully implantable artificial heart due to the advances of miniaturization, biosensors, plastics, and power. The AbioCor's internal battery uses transcutaneous energy transmission (TET), which sends power through the skin to charge the battery, eliminating any wires that could potentially cause an infection. After the removal of the heart, the AbioCor is implanted into the thoracic cavity where the heart once was. An artificial septum separates both the left and right artificial ventricles, and also provides the energy to pump the blood throughout the device and body by converting electrical energy provided by batteries into fluid motion.



For patients who are experiencing ventricular failure in either of the left or right ventricle and can not receive a donor heart right away, doctors will implant the SynCardia temporary Total Artificial Heart to sustain the patient until a donor heart is available. Doctors first remove the failing left and right ventricles of the heart, as well as all four heart valves. Next they attach connections to the atria, aorta, and pulmonary artery. Finally the SynCardia temporary Total Artificial Heart is implanted and attached to the connections and begins to act as the new left and right ventricles of the heart. This stays implanted in the patient until a donor heart is available.

III. Results

The AbioCor provided patients who were given a few weeks to live to extend that time period between 10-17 months to live. Tom Christerson was given a 20% chance of surviving 30 days lived for an extra 512 days after the implantation of the AbioCor. The SynCardia temporary Total Heart has the highest bridge to transplant rate of 79% in its patients. 65% of patients were able to get out of bed after 5 days, and 60% of patients were able to walk more than 100 feet with the implantation.

IV. Discussion

The AbioCor is big and weighs about 2 pounds, meaning that patients have been mainly men with big chests. Small men, woman and children can't receive the AbioCor. A new model, AbioCor II, is being developed. It is 30% smaller than the original model so small men and woman can receive the device. The device is still unavailable to children. The external battery only lasts for 4 hours, therefore a longer lasting battery is needed. A future direction of the AbioCor would be a permanent solution and provide a normal full life for the user. The SynCardia temporary Artificial Heart is only a temporary solution for patients to help them live until transplant surgery. Future outlooks for the device would be a permanent solution to ventricular failure.

References

[1] Westaby, S. "The Need for Artificial Hearts." *Heart* (1996): 200-06. Print <http://heart.bmj.com/content/76/3/200.full.pdf+html?sid=d7f0a0b3-6216-4547-8134-540558a68fe1>

[2] "Artificial Heart." *Wikipedia*. Wikimedia Foundation, 11 May 2014. Web. 9 Nov. 2014.

[3] "AbioCor." *Wikipedia*. Wikimedia Foundation, 28 Aug. 2014. Web. 9 Nov. 2014.

[4] "Abiomed." *AbioCor* -. Web. 9 Nov. 2014. <http://www.abiomed.com/products/heart-replacement/>.

[5] "Total Artificial Heart Facts." - *Total Facts*. Web. 9 Nov. 2014. <http://www.syncardia.com/total-facts/total-artificial-heart-facts.html>

[6] "What Is a Total Artificial Heart?" - *NHLBI, NIH*. Web. 9 Nov. 2014. <http://www.nhlbi.nih.gov/health/health-topics/topics/tah/>.

[7] "Resources." *Jarvik Heart*. Web. 9 Nov. 2014. http://www.jarvikheart.com/basic.asp?id=69

[8] Web. 9 Nov. 2014. <http://www.abiomed.com/assets/2010/11/abiocor.gif>.