First implantable robot to treat chronic atrial fibrillation

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Project description

Atripump is an intelligent implantable robot designed to restore the pump function of the atrium in patients suffering from chronic atrial fibrillation. Atripump consists of a contractile synthetic tissue based on shape memory alloys technology and controlled by a microcomputer sensing cardiac activity. It is implanted to the exterior of the upper chamber of the heart assisting the contraction of a weak natural muscle, without replacing it and significantly improving the patient's QOL. Atripump provides the key technology for medical and non-medical applications of artificial muscles.

Scientific/technical/business objectives

From the scientific point of view, Atripump represents the first atrial assist device therefore a new strategy in the treatment of chronic atrial fibrillation. This results in cardiac function improvement (better quality of life and reduction in cardiotonic drugs consumption) and avoids anticoagulation therapy that can have dangerous side effects. Patients that can barely walk because of cardiac failure, can find the energy to start a second life thanks to the Atripump. Moreover, this pump sets them free of dangerous anticoagulation therapy.

From the technical point of view, this project represents a great challenge. We aim to adapt the well know technology of smart materials to the body environment. And many aspects concerning the interaction body-robot have to be cleared off.

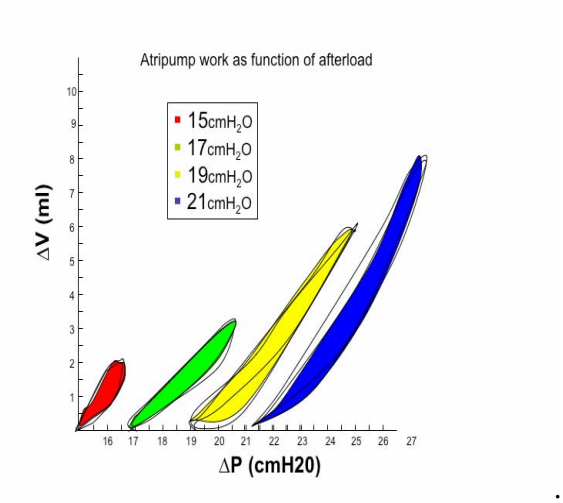
The business objective is very exiting because this is a very new product with no competitors and a huge market (chronic cardiac failure).

Results

A dedicate bench model of atrium has been developed to assess the circulatory support that such pump can provide.

It consists of an open circuit made of latex bladder 60mm in diameter filled with water. The bladder is connected to a vertically positioned tube that is filled at different levels reproducing changes in cardiac pre-load. The Atripump was placed on the outer surface of the bladder. A pacemaker like control unit drives the actuator.

Pressure, volume and temperature changes were recorded



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The contraction rate was 1Hz with power supply of 12V, 400mA for 200ms. Pre-load ranged from 15 to 21cmH2O. Graphic resumes pressure volume relationship. Maximal silicone membrane temperature was 55 C° and maximal temperature of the liquid environment was 35 C°.

Beating mesh applied on the external surface of the heart

Implementation stage/perspectives

Atripump is the first clinical application of artificial muscles assisting the contraction of a weak natural muscle, without replacing it. This is expected to become the key technology for the development of the artificial myocardium and artificial skeletal muscles. This technology can be used in applications far beyond atrial fibrillation. Extension of this technology to the treatment of congestive heart failure in pediatric and adult as well, could represent the natural evolution of this project. Moreover, since the product is essentially an artificial muscle, there are numerous additional potential applications in the medical field such as the treatment of neuromuscular diseases causing paralysis and post traumatic paralysis of lower and/or upper extremities, or to increase muscular strength. The non-medical applications of this technology need to be studied.