BIOMECHANICAL CARDIAC ASSIST: PRESENT AND FUTURE PERSPECTIVE

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In "biomechanical cardiac assist", transformed fatigue resistant Type I skeletal muscle is used as the power source for cardiac assistance. The advantages with this approach include: no need for donor organ; no rejection and immunosuppression; no need for an external power source, and the long life expectancy of synchronizable burst stimulator required for such procedures (currently over 4 years).

The direct wrap of transformed latissimus dorsi muscle around failing ventricles and stimulate it to contract in synchrony with cardiac systole, known as dynamic cardiomyoplasty, is currently undergoing clinical prospective randomized study. Improvement in the patients' quality of life has been reported, and since many of them succumb to sudden death, the survival may also improve with the advent of combined cardiomyostimulator-cardioverter-defibrillator in the near future. The procedure of wrapping the transformed skeletal muscle around the thoracic aorta and stimulate it during cardiac diastole to produce counterpulsation is known as aortomyoplasty, and both experimental and clinical trials are ongoing.

Various devices powered by the skeletal muscle to achieve either counterpulsation or cardiac bypass are being tested. The "skeletal muscle ventricle" connected to the thoracic aorta has been able to deliver counterpulsation for more than 2 years in animal studies. Future development in this field will require 1) improvement of muscle transformation protocol to attain fatigue resistance without losing power; 2) optimization of techniques to harvest power produced by the skeletal muscle to do hemodynamic work, such as to utilize linear contractile force of the muscle; 3) development of an "energy converter" to generate electricity from skeletal muscle contractions which can then be used to power future mechanical cardiac assist devices; and 4) manipulation of gene phenotype expression to achieve "cellular or molecular cardiomyoplasties".