

## Benefits of Electrical Muscle Stimulation for Patients with Chronic Heart Failure (CHF) - Gabriel Ausfresser – Biomedical Engineering - University of Rhode Island

Around 5.8 million people in the United States have heart failure, and 670,000 people are diagnosed with it every year. In 2006, heart failure was a contributing cause of 282,754 deaths. It is a chronic, progressive condition in which the heart muscle is unable to pump enough blood through the heart to meet the body's needs for blood and oxygen. The results of CHF are enlargement of the heart, more muscle mass development, and a faster pumping rate of the heart. These changes lead to shortness of breath, fatigue, weight gain, ankle swelling, coughing, and exercise intolerance.

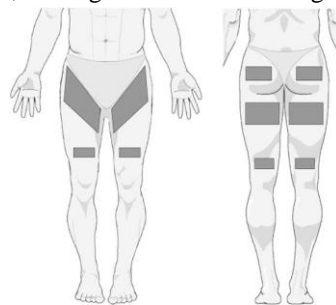
One of the best ways to prolong a chronic heart failure patient's life is to maintain high exercise levels to keep the heart strong. Unfortunately, conventional methods of exercising may not be possible for patients who are elderly and who may have other diseases which make exercising difficult. This is oftentimes the majority of cases of chronic heart failure. Dr. Banerjee, Dr. Caulfield, Dr. Crowe, and Dr. Clark conducted an experiment which shows how Electrical Muscle Stimulation can be a good substitute for conventional exercise programs for patients with CHF.

Electrical muscle stimulation (EMS) is a technique of inducing muscle contraction using electrical impulses. These impulses mimic action potentials that would come from the central nervous system, causing the muscle contraction. A device will generate these impulses which are sent to an electrode which is attached to skin in close proximity to the muscle that requires contraction stimulation.

EMS is a technique that has been used in electrotherapy and muscle strength training. Although EMS has also been used as a weight loss product, it has been proven that the optimal way to burn calories is by a full body exercise as opposed to isolated muscle training. EMS devices are regulated by the FDA in the US.

Dr. Banerjee, Dr. Caulfield, Dr. Crowe, and Dr. Clark found that using EMS is a sufficient way to exercise patients who have CHF. Their experiment comprised of 10 patients who went through an eighteen week training program. The first eight weeks involved using EMS on the patients' legs for a

minimum of an hour a day for five days a week. Then the patients went two weeks without any training. Then they completed an eight week control period of habitual activity. They completed various tests after the EMS training which spanned the first eight weeks, then again after the final eight weeks.



The results of the tests are as follows:

Without EMS training, peak oxygen consumption was 1.7 L/min, treadmill walking time was 9 minutes, 6-minute walking distance was 415 meters, quadriceps strength was 377.9 Newtons, and BMI was 27.9 kg/m<sup>2</sup>. With EMS, peak oxygen consumption was 1.8 L/min, treadmill walking time was 10.68 minutes, 6-minute walking distance was 455 meters, quadriceps strength was 404.9 Newtons, and BMI was 27.5 kg/m<sup>2</sup>.

The conclusions that the doctors could draw after their experiment are that EMS training successfully strengthened the muscles, increased endurance, and lowered the BMI of the patients with CHF. These outcomes are essential for keeping the patient relatively healthier and alive for a longer period of time. The key fact is that patients with CHF can exercise efficiently without even leaving their home and without strenuous exercises which may not be possible for some patients with CHF. Although only in the research phase, EMS can one day be used on these patients with chronic heart failure because no voluntary effort is required to exercise with EMS.

### References:

Banerjee, P., Caulfield, B., Crowe, L., & Clark, A. (2009). Prolonged electrical muscle stimulation exercise improves strength, peak VO<sub>2</sub>, and exercise capacity in patients with stable chronic heart failure. *Journal of Cardiac Failure*, 15(4), 319-326. Retrieved from CINAHL database.  
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