

**Abstract 11**

**Biofeedback in the Treatment of Heart Failure**

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Biofeedback training can be used to regulate the autonomic nervous system. Specifically, patients can be trained to up-regulate the contribution of their parasympathetic nervous system while decreasing the sometimes deleterious overactivation of the sympathetic nervous system. In patients with advanced heart failure, the sympathetic nervous system is up-regulated, in an attempt to compensate for decreased pumping ability of the heart. Numerous studies have shown that increased sympathetic nervous system activity is a predictor of worse prognosis in heart failure patients. The most successful treatments for heart failure include drugs, such as beta-blockers, that interfere with this hyperactivation.

We hypothesized that biofeedback training could be used to train patients with advanced heart failure to augment the activity of their parasympathetic nervous system while decreasing the activity of their sympathetic nervous system. Our study was designed to test this hypothesis, and to further investigate the potential role of this training in altering the cellular and molecular changes in the heart that result in decreased cardiac output.

After obtaining informed consent, we have enrolled patients with end-stage heart failure who are awaiting heart transplanta-

tion at the Cleveland Clinic, one of the busiest centers for heart transplantation in the country. While awaiting heart transplant, patients participate in 11 one-hour individual sessions with a certified biofeedback therapist. During these sessions, psychophysiologic reactivity is assessed and patients receive training in biofeedback-mediated stress management techniques. Patients are asked to practice the techniques at home between sessions, for 20 minutes per day, using a handheld biofeedback device that is provided. Initial assessment includes functional capacity (measured by 6-minute walk), degree of sympathetic nervous system activation (measured by plasma catecholamines), and overall as well as heart-failure-specific quality of life (measured by standardized and validated questionnaires). Progress in psychophysiologic control is monitored and analyzed over the 11 sessions, along with clinical status and quality of life.

At the time of heart transplantation, heart tissue from each patient is studied. Measurements of muscle function, inotropic responsiveness, calcium cycling proteins, beta-adrenergic receptor density, and atrial natriuretic factor are compared between patients who have had biofeedback training and those who have not. Our hypothesis is that changes in relative activation of the autonomic nervous system in patients who are able to regulate their own physiological state using biofeedback will produce meaningful changes in the biology of the heart, in the direction of recovery. Since we have previously shown such changes in heart failure patients with other types of interventions (left ventricular assist device), comparison can be made to a positive control group.