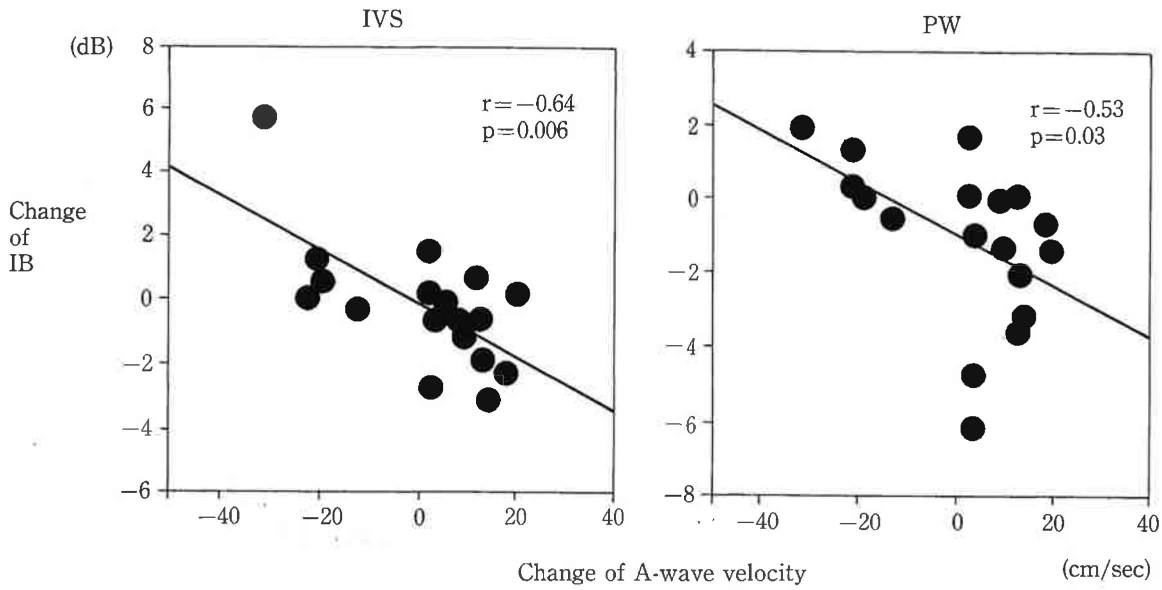

Figure 3. Relationship between changes of A-wave velocity and ultrasonic integrated backscatter from myocardium during protocol of enalapril withdrawal and (re-)administration. IVS: interventricular septum, PW: left ventricular posterior wall, IB: ultrasonic integrated backscatter.

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6. Comprehensive Therapy for Congestive Heart Failure: A Novel Approach Incorporating Thermal Vasodilation

Chuwa Tei and Nobuyuki Tanaka

Key words: congestive heart failure, thermal vasodilation, sauna bathing, warm water immersion

From the Department of Rehabilitation and Physical Medicine, Faculty of Medicine, Kagoshima University, Kagoshima 890

The prevalence of congestive heart failure (CHF) is increasing and mortality remains high in patients with severe symptoms. Patients with CHF in functional class III–IV require intensive long-term follow-up and frequent hospitalization. Up to the late 1980s, bed rest had traditionally been recommended for these patients, but this has never been shown to be beneficial in a randomized controlled trial. Also, prolonged bed rest often causes considerable morbidity, including deep venous thrombosis, pulmonary embolism, muscle weakness and respiratory infections, etc.

In 1988, Sullivan and co-investigators (1) reported that physical training improves maximum exercise tolerance in ambulatory patients with CHF attributable to left ventricular systolic dysfunction and might present a useful therapeutic option in stable patients with this disorder. Subsequently, in 1989 (2), they reported that exercise training improved submaximal, as well as maximal, exercise performance in patients with CHF. These studies were further extended and confirmed by Coats et al (3, 4). In 1992 (4), these investigators examined exercise training in patients with CHF employing a cross-over design and demonstrated significant improvement of exercise tolerance, symptom score, ventilation and sympathetic nervous function. Based on these results, they proposed the use of exercise training in the treatment of patients with chronic CHF.

On the other hand, warm water immersion and sauna, which promote physical and mental relaxation, are usually thought to be inappropriate for patients with CHF. Most public baths, spas, jacuzzis or saunas caution patients with heart disease against bathing, although this has also never been shown to worsen CHF in a randomized controlled trial. Recently, however, we demonstrated the beneficial acute and chronic hemodynamic effects of thermal vasodilation by sauna and warm water immersion in these patients (5–7). This non-pharmacological approach to the treatment of CHF is based on the rationale of pre-load and after-load reduction, similar to that effected by pharmacological agents which have already been established to improve hemodynamics, symptoms, and survival in patients with CHF (8–11).

Our goal in the treatment of CHF is to improve quality of life, to decrease symptoms, to increase exercise tolerance and to improve survival in these patients. Based on our favorable experience, thermal vasodilation has the potential for use as a new modality of therapy in CHF similar to the expanding role of exercise training in the rehabilitation of patients with chronic CHF. In the present paper, we summarize our previous results of acute and chronic thermal vasodilation therapy in patients with CHF (5–7).

We studied acute hemodynamic effects of thermal vasodilation using a warm water bath and sauna in 34 patients with chronic CHF, of whom 26 (19 males, 7 females) had idiopathic dilated cardiomyopathy and 8 (7 males, 1 female) had ischemic cardiomyopathy (7). The mean age of these patients ranged from 58±14 years. According to the NYHA classification, symptoms at hospitalization were grade II in 2 subjects, grade III in 19 and grade IV in 13. The mean left ventricular ejection fraction was 25% (range 9–44%). Physical activity was minimized by aiding the subject during bathing. As a result, both warm water immersion and sauna bathing were safely accomplished without any significant arrhythmia, dyspnea or angina and an increase in oxygen consumption of only 0.3 METs.

In the acute study, we confirmed that warm water immersion for 10 minutes at a temperature of 41°C or sauna bathing for 15 minutes at 60°C decreased systemic and pulmonary vascular resistance and increased cardiac index and stroke index following transient thermal exposure as indicated by a mean rise in pulmonary arterial blood temperature of 1.0–1.2°C. In addition, right atrial, pulmonary arterial and pulmonary capillary wedge pressures decreased with improvement of ejection fraction after bathing. Both left and right ventricular function improved consequent to the reduction in afterload (total peripheral vascular resistance for the left ventricle, and pulmonary vascular resistance for the right ventricle) effected by thermal vasodilation. Mitral regurgitation associated with CHF decreased significantly, though to varying degrees, during the bath. We have also confirmed that thermal vasodilation causes a decrease in coronary vascular resistance, an increase in coronary sinus blood flow and improvement of myocardial metabolism during and after sauna in patients with idiopathic dilated as well as ischemic cardiomyopathy (12). These data suggest that thermal vasodilation may be responsible for the increased myocardial blood flow and clinical improvement in these patients.

Body warming is also expected to dilate the venous system (13, 14). The redistribution of blood from the intrathoracic compartment toward the peripheral venous system with thermal venous dilatation results in a decrease in pulmonary congestion. The increase in venous capacity is important in preload reduction as indicated by a decrease in right atrial pressure and left atrial and left ventricular dimensions. The increase in heart rate might be associated with a vasodilation-related reflex, or a direct cardiac effect of warming or stimulation of sympathetic nervous system; however, the increase in stroke index suggested improvement of cardiac function by afterload reduction.

Attention should be paid, however, to the effects of hydrostatic pressure during warm water immersion. Right sided intracardiac pressures increased significantly during warm water immersion and decreased with abolition of hydrostatic pressure after bathing. Therefore, in the case of warm water immersion for severe CHF, it may be important to ensure that the bath depth does not exceed that of the subclavicular region. As anticipated, the right heart pressures were not significantly altered (and in fact, decreased) during sauna bathing. Thus, the absence of a hydrostatic component during sauna makes this method of bathing preferable to warm water immersion particularly for patients in severe CHF.

The sustained effect of repeated thermal vasodilation is a subject of great clinical interest. Thermal vasodilation for 4 weeks (once or twice/day) caused a significant improvement of clinical symptoms and ejection fraction, and decreased cardiac size on the chest X-ray (5). We also observed that repeated thermal vasodilation improved the quality of life of patients with CHF by promoting appetite, sleep quality and general well-being. In addition, our preliminary data also suggests that thermal vasodilation therapy may impact favorably on the prognosis of patients with severe CHF (unpublished). However, further randomized controlled investigations are necessary to further define the survival benefit of thermal vasodilation therapy in patients with severe CHF.

Compared to other forms of treatment, there are numerous advantages of thermal vasodilation therapy for CHF. It is non-pharmacological, devoid of adverse effects, and readily available as well as easily repeatable. This form of therapy promotes mental and physical relaxation and improves fundamental daily activities such as appetite and sleep quality. Unlike exercise training, patients who are aged or have severe CHF (NYHA class IV), peripheral edema and orthopedic limitations are not exempt from undergoing thermal vasodilation therapy. Finally, this intervention promises to be a very economical means of therapy even for severe CHF.

In summary, thermal vasodilation represents a new non-pharmacological therapy for CHF and potentially important adjunctive treatment for patients with this disorder. A comprehensive treatment incorporating the three modalities of pharmacological manipulation, exercise and thermal vasodilation may be the most effective approach to the treatment of CHF.

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