



Research Article

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## Effect of Footbath Therapy in Patients with Refractory Chronic Heart Failure

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### Abstract

**Background:** Waon therapy has been shown to improve symptoms, cardiac function and prognosis in patients with chronic heart failure (CHF). We aim to investigate the utility of a convenient thermal therapy involving a footbath in patients with refractory CHF.

**Method:** We enrolled ten patients who satisfied the following criteria: New York Heart Association (NYHA) functional class III or IV, LVEF <40%, and refractory to the conventional therapy. All patients underwent the footbath therapy daily for 2 weeks.

**Results:** Blood pressure and heart rate did not differ during the footbath therapy. Footbath therapy significantly improved the NYHA functional class ( $p=0.02$ ), plasma BNP level ( $1319.3 \pm 812.4$  vs  $615.6 \pm 490.4$  pg/ml,  $p=0.04$ ), and %FMD ( $3.1 \pm 2.7$  vs.  $6.6 \pm 4.1$  pg/ml,  $p=0.04$ ). In contrast, there was no significant change in LVEF ( $19.6 \pm 10.9$  vs.  $22.3 \pm 9.0$  %,  $p=0.09$ ).

**Conclusion:** Footbath therapy could improve the status of CHF by improving the endothelial function. We think footbath therapy is a novel and convenient non-pharmacological treatment for patients with refractory CHF.

### Keywords

Heart failure; Thermal therapy; Footbath

### Introductions

Thermal therapy involving dry sauna with temperature maintained at 60°C, known as Waon therapy, has been shown to improve symptoms, cardiac function and prognosis in patients with chronic heart failure (CHF) [1-3]. Waon therapy requires a specialized dry sauna room for the treatment of heart failure; therefore, it might be difficult to continue Waon therapy on an outpatient basis, especially in frail patients. The present study investigated the utility of a convenient thermal therapy involving a footbath in 10 patients with refractory CHF with reduced left ventricular ejection fraction (LVEF).

### Methods

Eligible patients satisfied the following criteria: New York Heart Association (NYHA) functional class III or IV, LVEF <40%, and refractory to the conventional therapy including angiotensin-converting enzyme inhibitors or angiotensin II receptor blockers,



**Figure 1:** Footbath therapy. We usually used a bathtub that was maintained at 39-40° C and with bath salts, if available. Patients were placed in the sitting position and the lower legs soaked for 20 minutes. Blood pressure and electrocardiogram were monitored during therapy. After the footbath, patients were placed on bedrest with their lower legs wrapped in a blanket for 30 minutes.

$\beta$ -blockers, and diuretics. We excluded patients with severe aortic valve stenosis, hypertrophic cardiomyopathy, or liver cirrhosis, and patients receiving hemodialysis therapy. Ten patients (7 men and 3 women,  $70.6 \pm 11.8$  years, range 51-94years) were enrolled in the present study. Informed consent was obtained from each patient, and the present study protocol is approved by the institution's human research committee. Baseline characteristics of the patients were poor, 6 patients in NYHA functional class III, 4 patients in class IV, mean LVEF of  $19.6 \pm 10.9$  %, and the mean brain natriuretic peptide (BNP) level of  $1319.3 \pm 812.4$  pg/ml.

We used a bathtub that was maintained at 39-40°C and with bath salts, if available. Patients were placed in the sitting position and the lower legs soaked for 20 minutes (Figure 1). Blood pressure and electrocardiogram were monitored during therapy. After the footbath, patients were placed on bedrest with their lower legs wrapped in a blanket for 30 minutes. All patients underwent the footbath therapy daily for 2 weeks. We did not change the medications for CHF during this study.

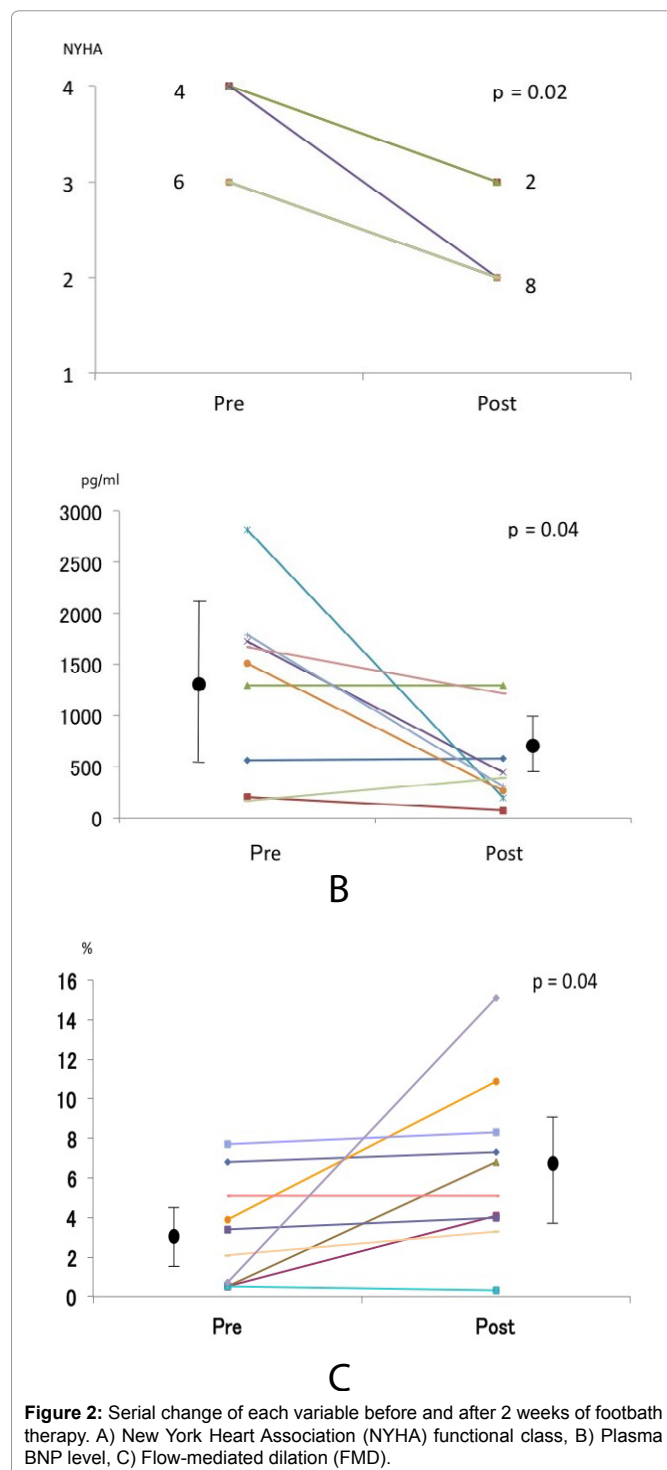
We assessed NYHA functional class, LVEF, plasma BNP level, and vascular endothelial function before and after 2 weeks of therapy. Vascular endothelial function was evaluated by flow-mediated dilation (FMD) of the brachial artery [4]. Vasodilation responses of the brachial artery were measured by noninvasive ultrasonography, using a semi-automatic device (EF18G II; UNEX, Nagoya, Japan). This study complied with the Declaration of Helsinki in regard to investigation in humans and was approved by the institutional ethics committees.

### Results

Blood pressure and heart rate did not differ during the footbath therapy. Figure 2 shows the comparison of each variable before and

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after 2 weeks of therapy. Footbath therapy significantly improved the NYHA functional class ( $p=0.02$ ), plasma BNP level ( $1319.3 \pm 812.4$  vs  $615.6 \pm 490.4$  pg/ml,  $p=0.04$ ), and %FMD ( $3.1 \pm 2.7$  vs  $6.6 \pm 4.1$  pg/ml,  $p=0.04$ ). In contrast, we found no significant change in LVEF ( $19.6 \pm 10.9$  vs  $22.3 \pm 9.0\%$ ,  $p=0.09$ ).

## Discussion

The present study indicates that repeated footbath therapy improved cardiac symptoms, BNP level, and endothelial function

in patients with refractory CHF. Endothelial dysfunction is known to be associated with the pathophysiology of heart failure and is an independent predictor of poor prognosis in patients with CHF [5]. Decreases of peripheral blood flow and nitric oxide release from the endothelium are associated with worsening CHF. Previous studies have reported that Waon therapy could improve the endothelial function and endothelial nitric oxide synthase activity, resulting in an improvement of clinical symptoms [6,7]. However, Waon therapy requires a specialized sauna room; thus, it may be inconvenient for outpatients. In contrast, the footbath therapy described in the present study is easily administered using a bathtub at home. In the present study, daily footbath therapy for 2 weeks also improved the endothelial function, BNP level, and cardiac symptoms.

Furthermore, footbath therapy is safe. In the present study, the oldest patient was 94 years old, blood pressure and heart rate during footbath did not significantly change, and no adverse cardiac events occurred. These results indicate that footbath therapy is an encouraging strategy for frail patients. The population of patients with CHF is currently aging in response to the advance of pharmacological treatment for CHF; therefore, we think that non-pharmacological treatments such as footbath therapy will be important.

The present study was limited by a modest number of patients and lack of a control group with Waon therapy. Despite these limitations, we think that footbath therapy is a novel and convenient non-pharmacological treatment for patients with refractory CHF.

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