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Beneficial Effect of Waon Therapy on Peripheral Arterial Disease

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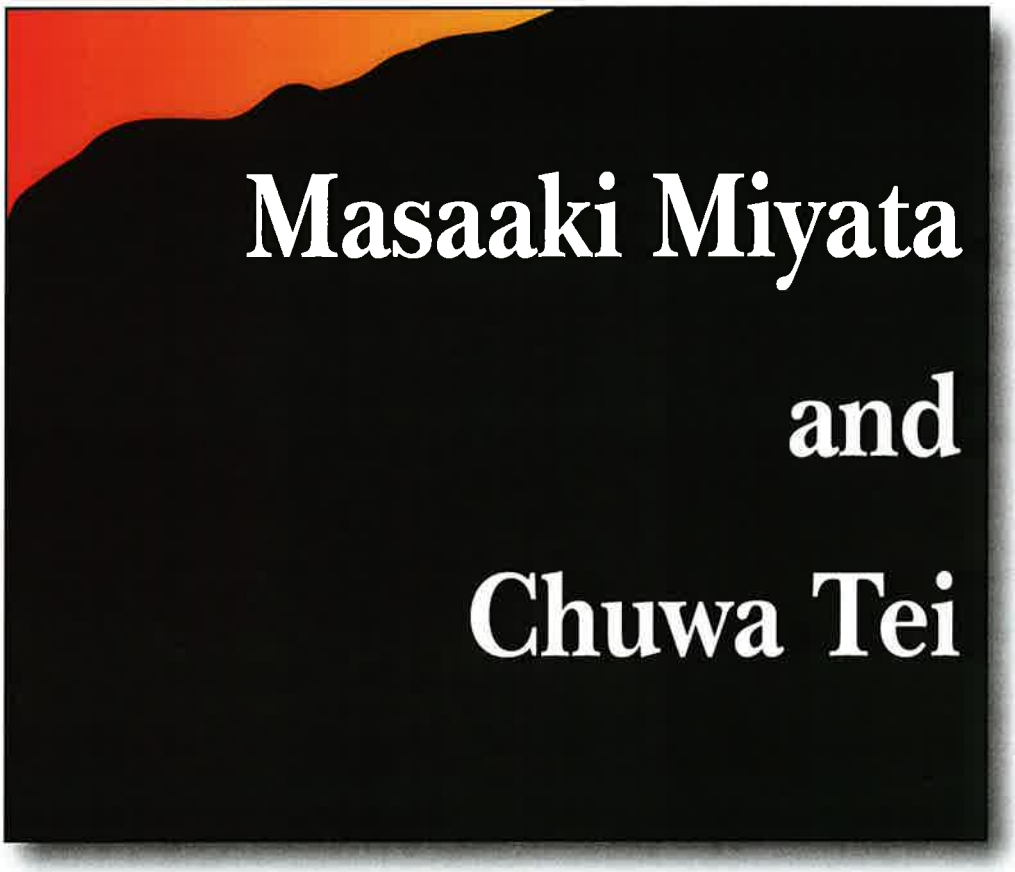

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Chapter XI

Beneficial Effect of Waon Therapy on Peripheral Arterial Disease

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Abstract

We developed a form of thermal therapy, which uses a dry sauna evenly maintained temperature at 60 °C and differs from the traditional sauna. In 2007, we changed the name from thermal therapy to Waon therapy in order to distinguish soothing warm therapy from the thermal therapy for cancer. "Waon; soothing warmth" means warmth that comfortably refreshes the mind and body. Patients are placed in a dry sauna for 15 min at 60°C, subsequently kept in a supine position on the bed with sufficient warmth provided by blankets for additional 30 min outside the sauna room.

We have previously reported that Waon therapy improves hemodynamics, cardiac function, ventricular arrhythmias, vascular endothelial function, neuro-hormonal factors, sympathetic nerve system, and clinical symptoms in patients with chronic heart failure (CHF). We demonstrated that the molecular mechanism by which Waon therapy improves vascular flow and endothelial function is through increased endothelial nitric oxide synthase (eNOS) expression.

Furthermore, in a mouse model of hindlimb ischemia, we demonstrated repeated Waon therapy increased eNOS protein expression, blood flow, and capillary density. Moreover, Waon therapy did not increase blood flow and capillary density in eNOS-deficient mice, and we concluded that eNOS is a critical regulator of angiogenesis by Waon therapy. Recently, we have shown that repeated Waon therapy is safe for patients with severe peripheral arterial disease (PAD) and potentially effective as evidenced by substantial decrease in the pain score, by increases in ankle-brachial pressure index and blood flow assessed by laser Doppler perfusion imaging, and by formation of new collateral vessels on angiography. In addition, ischemic ulcers heal or improve markedly.

In conclusion, Waon therapy is an innovative, safe, and highly promising strategy for treating PAD.

How to Perform Waon Therapy

Waon therapy uses a special far-infrared ray dry room, which is evenly maintained at 60°C, and has an absence of hydration pressure. The patients were placed in a supine or sitting position in the dry room at 60°C for 15 min, and once removed, allowed to rest on a bed in a supine position with a blanket to keep them warm for an additional 30 min. They were weighed before and after Waon therapy, and oral hydration with water was used to compensate for weight loss.

We have treated many CHF patients with Waon therapy, and none of the patients so far have shown any deterioration in their condition. However, Waon therapy does not appear to be indicated for CHF patients with severe aortic stenosis or obstructive hypertrophic cardiomyopathy, because the pressure gradient might be increased during Waon therapy. Patients with infectious disease are also excluded from Waon therapy.

Effects of Waon Therapy on CHF and its Mechanism

For the better understanding of Waon therapy for PAD, first, we would like to summarize the effects of Waon therapy on CHF and its mechanism. Regarding the acute effect of Waon therapy, we have reported that 60°C dry sauna therapy for 15 minutes improved acute hemodynamics in patients with CHF, including cardiac index, mean pulmonary wedge pressure, systemic and pulmonary resistance, and cardiac function (4). Subsequently, we examined the chronic effects of repeated Waon therapy on clinical symptoms and cardiac function in patients with CHF and have reported that 4 weeks of Waon therapy significantly improved clinical symptoms, increased ejection fraction, and decreased cardiac size on the echocardiogram and chest X-ray (4, 5). Furthermore, we demonstrated that a daily Waon therapy for 2 weeks decreased ventricular premature contractions and increased heart rate variability (SDNN, standard deviation of normal-to-normal beat interval) in patients with CHF, suggesting that Waon therapy decreased sympathetic nervous activity and improved ventricular arrhythmias (6). Recently, in a prospective multicenter study, we have confirmed that Waon therapy is safe, improves clinical symptoms and cardiac function, and decreases cardiac size in CHF patients (15).

We then investigated the vascular endothelial function to clarify the mechanisms of the effect of Waon therapy on CHF, since vascular endothelial function had been reported to be impaired in CHF. We have reported that 2 weeks of Waon therapy significantly reduced brain natriuretic peptide (BNP) concentrations and improved endothelial function in patients with CHF. There was a significant correlation between the change in flow-mediated dilatation (%FMD) and the percent improvement in BNP concentrations (7).

In order to confirm the effect of Waon therapy on CHF and clarify its mechanism, we performed experimental studies using TO-2 cardiomyopathic hamsters with heart failure. We reported that the repeated Waon therapy improved survival in TO-2 cardiomyopathic hamsters with heart failure (16). We clarified that one of the molecular mechanisms by which repeated Waon therapy improved endothelial function was an increase in mRNA and protein of endothelial nitric oxide synthase (eNOS) in Syrian golden hamsters (9) and TO-2

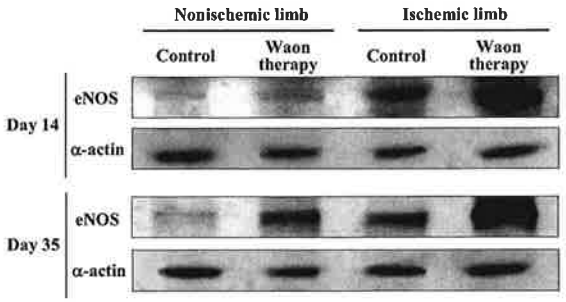

Figure 2. Western blotting of eNOS protein in muscle of mouse hindlimb. Waon therapy markedly increased eNOS protein expression not only in the ischemic hindlimb but also in the nonischemic hindlimb at Day 14 and 35. (Cited part of reference 12)

Effects of Waon Therapy on PAD

We evaluate the effect of repeated Waon therapy on 20 patients with PAD, including 15 patients with bilateral limb ischemia and 5 patients with unilateral limb ischemia (13). Waon therapy was performed once a day for 5 days per week for a period of 10 weeks. All patients completed the study without any adverse events.

Leg pain was scored by a visual analogue scale, using a marked 10-cm line extending from "no pain: 0" to "severe pain: 10". The pain score significantly decreased after 10 weeks of Waon therapy (Fig. 3). Exercise performance, evaluated by the 6-min walking distance, improved in all 18 patients after 10 weeks of Waon therapy (Fig. 4). We measured ankle-brachial pressure index (ABI) in 31 limbs, and the mean ABI significantly increased after Waon therapy (Fig. 5). Serial assessment of leg blood flow was performed with a laser Doppler imaging. It showed that blood flow increased after 10 weeks (Fig. 6). Digital subtraction angiography was performed to evaluate new collateral vessel formation in 20 legs (13 patients), which showed a dramatic increase in the visible collateral vessels in 12 ischemic legs after 10 weeks of Waon therapy. In addition, ischemic ulcers healed in all of 7 limbs, resulting in successful limb salvage.

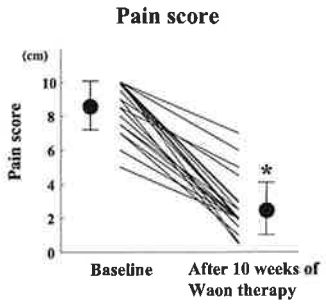

Figure 3. Improvement in pain score evaluated by a visual analogue scale (10: severe pain, 0: no pain) after 10 weeks of Waon therapy. n=20, * P<0.01 vs. baseline. (Cited part of reference 13)

We described one of the impressive patients (17). Although this patient had undergone femoro-popliteal bypass surgery, all toes on his right foot, except for the fifth toe, had to be amputated. Furthermore, the patient developed a severe foot ulcer with intolerable pain and therefore a below-knee amputation was thus being considered. He received Waon therapy without any changes in medication. The skin ulcer healed completely in 15 weeks, limb amputation was avoided, and he was discharged. After being discharged, he continued to receive Waon therapy twice per week at our outpatient clinic and no recurrence of the skin ulcer has been seen during 3 years of follow-up (Fig. 7). Patients followed at our out-patient clinic after discharge continued Waon therapy at least twice per week, and none of them showed the worsening symptoms of PAD. Therefore, to maintain the effect of Waon therapy, we believe that it should be continued at least twice per week after discharge.

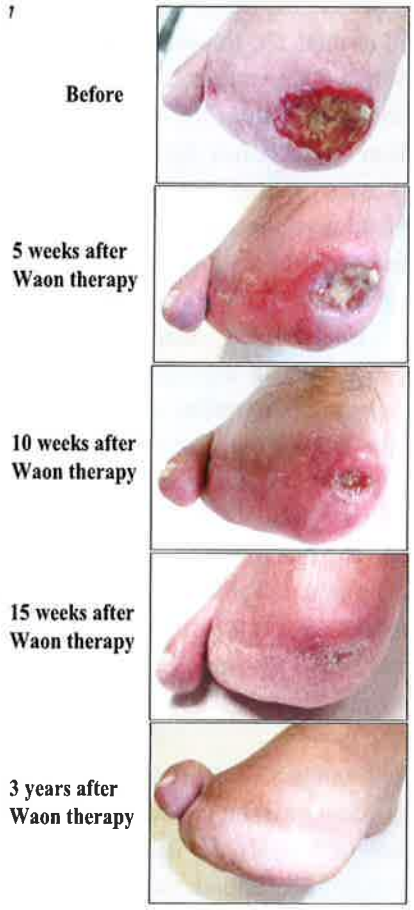

Figure 7. Limb salvage by Waon therapy. The skin ulcer healed completely in 15 weeks after Waon therapy, and he was discharged. After being discharged, he continued to receive thermal therapy twice per week and no recurrence of the skin ulcer has been seen during 3 years of follow-up. (Cited part of reference 17)

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