

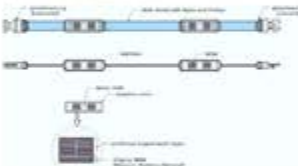


# Application of electromagnetic waves generated by NMR-Pipetector to human circulation induces relaxation and suppression of blood pressure

Naomasa Yamamoto<sup>1,2</sup>, Noboru Kamimeka<sup>2</sup>, Shyogo Kuramitsu<sup>1</sup>, Haruo Nogami<sup>3</sup>, Fumio Fukui<sup>2</sup>, Yuichi Koike<sup>1</sup>, and Katsuyuki Kumano<sup>2</sup>  
 Department of Biochemistry, School of Pharmaceutical Sciences, Ohu university<sup>1</sup>, Life Science Laboratory, Japan System Planning Co., Ltd.<sup>2</sup>,  
 Department of Physical Therapy School of Health Sciences Japan University of Health Sciences<sup>3</sup>, Department of Molecular Patho-  
 Physiology, Faculty of Pharmaceutical Sciences, Tokyo University of Science<sup>4</sup>

NMR Pipetector (PT) is a device to reduce corrosion in water pipe by converting Fe(II) to Fe(III) by the electromagnetic power. We previously demonstrated that PT reduced human oxidative stress by a brief exposure (10 min) to the finger. In this study, we showed the effect of PT on brain wave (BW) and blood pressure (BP).

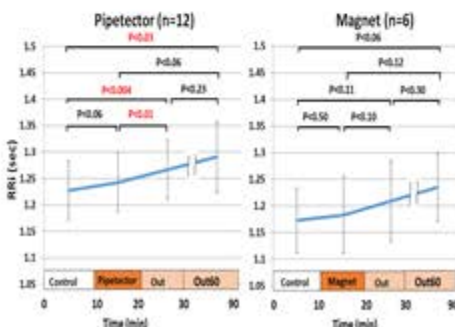
**Methods:** Wrist type PT (its size equivalent to 30DS unit) was used. BP of volunteers (n=19) were monitored for 24 hrs by using Ambulatory BP Monitors TM 2430 (A&D) after obtaining the informed consent from them. Control BP (CN) without PT was measured in every 60 min for 24 hrs at the initial day. On the second day, BP with magnet dummy device (MD) was measured in the same manner of control. In the last day, BP with wrist type PT was measured. The order of examination was not informed to the volunteers. BW and pulse rate were monitored simultaneously by using TSDN121 BW amplifier (ATR Promotions). Control value was measured without the device for 8 min under a comfortable sitting with the volunteer's eyes opened, and was continuously measured for 2 min with eyes closed. Then the device was attached to their wrist and measured in the same way. After removal of the device at 10 min and 60 min, brain wave was also measured again.



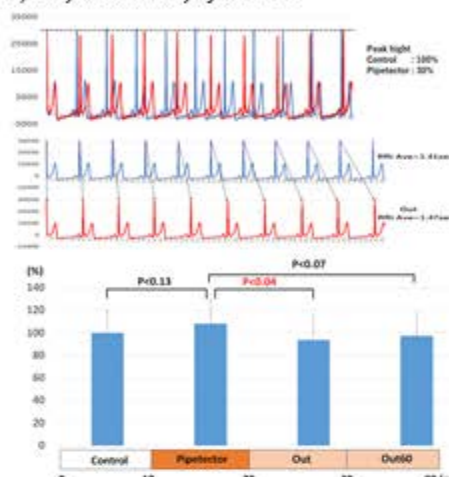
**Fig. 1 Structure of Wrist-type Pipetector**

A pair of NMR Pipetectors is fixed in the belt, it faces in an attractive way when tied to arm. Central core of Pipetector is described in the circle, showing that porous magnet multi layer unit is involved and attached to a ceramic (MRM).

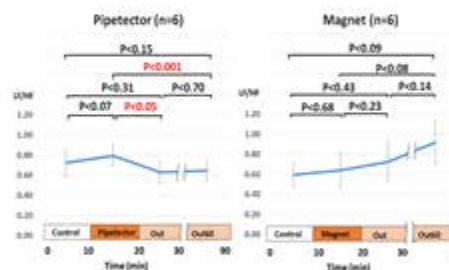
**Results:** LF/HF ratio (Fig.2) and brain wave  $\alpha/\beta$  ratio (Fig. 3 & 4) indicated the induction of relaxation by PT treatment. BP with PT, MD and CN showed 87.8 mean  $\pm$  3.9 mmHg, 93.3  $\pm$  6.3 mmHg, and 91.1  $\pm$  5.1 mmHg respectively. Significant suppression of 3.3 mmHg BP was observed by PT treatment, but no significant change was identified by MD treatment. PT suppressed significantly not only systolic BP by 4.9 mmHg, but also diastolic BP by 2 mmHg (Fig.6&7). The most effectively suppressed period by PT was from 10 am to 17 pm of a day (reduction of mean BP: 4.7 mmHg, systolic BP: 5.7 mmHg, diastolic BP: 4.2 mmHg, Fig.8). During daylight, pulse rate was also suppressed by 5 bpm, indicating RR interval was prolonged significantly. PT treatment reduced oxygen consumption from 8.9  $\pm$  0.6 unit to 8.3  $\pm$  0.6 unit.



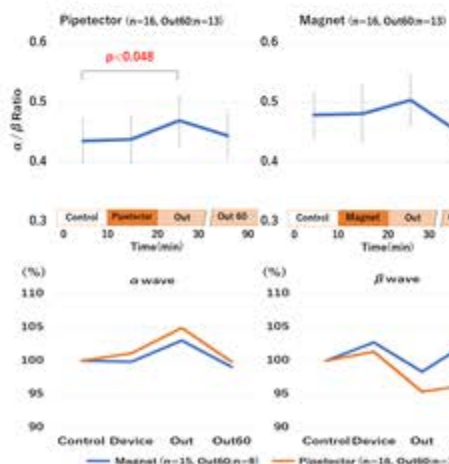
**Fig. 2 Increase of RR interval by PT-treatment** PT treatment significantly increased RR interval after removal of PT at 20 min (P<0.01, n=12)(left panel). The effect of PT continued for 60 min after removal of PT (P<0.03). Control magnet also showed increase tendency but it had no significant increase of RR interval (Right panel).



**Fig. 3 Alteration of electro-cardiogram by PT-treatment** Electro-cardiogram from a volunteer is shown in the upper panel. Pulse that exceeded a line at 25,750 was calculated, result showed on right. Puls with PT treatment (colored in red) appeared lower than that with Con To confirm it, Peak height was compared by using the peak area locate a certain window setting on the top of R wave. Peak height decreased significantly after the removal of PT (n=11), but not after that of MG.



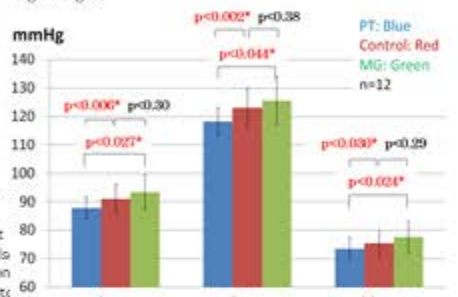
**Fig. 4 Decrease of LF/HF ratio by PT-treatment** Heart rate variability was calculated by using RRI power spectrum. LF/HF ratio was significantly decreased after PT treatment. In contrast, MG treatment increased LF/HF, however no significant change was observed by MG treatment. This result suggests that PT treatment induces relaxation by shifting volunteers to a parasympathetic dominant state.



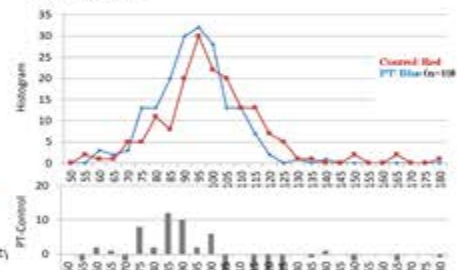
**Fig. 5 Increase of brain wave  $\alpha/\beta$  ratio by PT-treatment** PT treatment significantly increased  $\alpha/\beta$  ratio at 10 min after the removal of PT, but one significant effect was observed by MG treatment (Upper panel). The increase of  $\alpha/\beta$  by PT treatment may be caused by increase of  $\alpha$  and decrease of  $\beta$  (lower panel), indicating PT induces relaxation in brain.



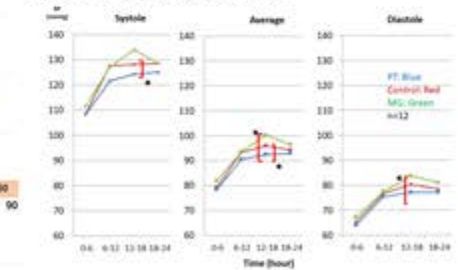
**Fig. 6 Simple diagram explaining PT-induced relaxation and suppression of BP** Wrist type PT induced increase of brain wave  $\alpha/\beta$  ratio, RRI in electro cardiogram, and decrease of LF/HF ratio. All these activations may result in following BP suppression described in Fig. 6 Fig. 8.



**Fig. 7 Effect of PT-treatment on BP** Blood pressure was monitored for 24 hours with and without the device. PT-treatment reduced not only average BP and systolic BP, but also diastolic BP.



**Fig. 8 Histogram of BP frequency between PT-treatment and Control** Histogram of BP from 19 donors was summarized. Lower panel showed Frequency difference (PT Control). Frequency of lower pressure was increased by PT treatment. Instead of lower pressure, high pressure was decreased.



**Fig. 9 Effect of PT-treatment on circadian rhythm of BP** BP was monitored for a whole day with and without the device. PT treatment reduced BP significantly from 12 to 18 O'clock.

### Conclusion

1. PT induces mental relaxation associated with  $\alpha/\beta$  and LF/HF via circulation.
2. PT treatment prolonged RRI and shortened R height, which may be involved in induction of relaxation.
3. Wrist-type PT can be a new device to induce relaxation and to prevent hypertension related diseases.

### Conflict of interest

This study was supported by Japan System planning Co.,LTD.