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Changes in blood pressure during walking in the elderly persons with hypertension

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INTRODUCTION

It is well known that hypertension is a strong risk factor for cardiovascular disease. In recent years, many researchers have reported that aerobic exercise programs such as running and cycling were effective methods to depress blood pressure for the mild hypertension[1, 2, 3, 4, 5]. These reports indicate that habitual aerobic exercise from the youth is really important to prevent blood pressure elevation with progressive ages.

Kataoka et al[6] concluded that running exercise with the intensity of 50–75% of HRmax (125–145 beats/min.)lasting at least 15–20min., 2–3 times a week is required to keep blood pressure within a normal range for the mild hypertension. Chrastek et al[2] reported that walking 4–6 hours a day in the middle aged hypertensive persons ranked to stage 2 contributed to depress blood pressure after for 2–4 weeks training. However, there are few studies concerning the effect of walking exercise of mild intensity on blood pressure for the elderly hypertensive.

Therefore, the purpose of the present study were 1) to examine blood pressure response during 5km walking for the hypertensive elderly persons, 2) to investigate the effect of depressors on blood pressure during walking in the elderly persons.

METHODS

1)Subjects.

Eight elderly hypertensive men without depressors (A group, mean age: 68.3±5.97) and four elderly hypertensive persons (three men and a woman) taking depressors everyday (B group, mean age: 70.8±6.18) volunteered for this study. There was no significant difference in age between the two groups. Each subject was fully informed of the procedures of blood pressure measurement in advance. The details of medication, e.g., kind or timing of the depressors in B group could not be obtained from each individual. Participants gathered at the Komazawa park in the morning (10a.m.) and then took a medical check such as health questionnaire, disease history, heart rate and blood pressure measurement. We conformed from their health information that no subjects were suffered from any cardiovascular disease except for hypertension.

2)Walking course.

A walking program was executed on an almost flat city course of 5km length paved from Komazawa Park to Senzoku Park in Tokyo.

3)Blood pressure measurements

Twenties minutes prior to the exercise, resting blood pressure was measured in a sitting position and after 10 deep breathings by Tycos Sphygmomanometer technique. Blood pressure during walking was measured in a sitting position in each point of 1.4km, 2.5km (after resting for 20 minutes) and 5.0km (at the end of walking). Blood pressure of each subject was measured by an experienced technician. Systolic blood pressure(SBP) was recorded as the first phase of the Korotkoff sound and diastolic pressure (DBP) as the fifth phase of the Korotkoff sounds. Pulse pressure(PP) was calculated from the following formula: PP=SBP−DBP

4) Statistics.

Paired t−tests was performed on blood pressure at rest, at the point of 1.4km, 2.5km and 5km(the end of walking). A probability level of $p<0.05$ was used for all values of statistical significance in this study.

RESULTS

1) Blood pressure before walking.

Resting blood pressure (162.4±104.6 mmHg) before walking in A group was significantly lower in systolic and higher in diastolic than that of B group (174.6±90.4mmHg),

2) Blood pressure during walking.

Figure 1 shows the changes (means and SE) in systolic and diastolic blood pressure for 12 subjects during walking. After 1.4km walking (Hikawa Park) only diastolic pressure decreased significantly from that before walking ($p<0.05$). At Nakane Park (2.5km) and Senzoku Park (5.0km), both systolic and diastolic blood pressure declined significantly from that before walking ($p<0.01$ and $p<0.001$).

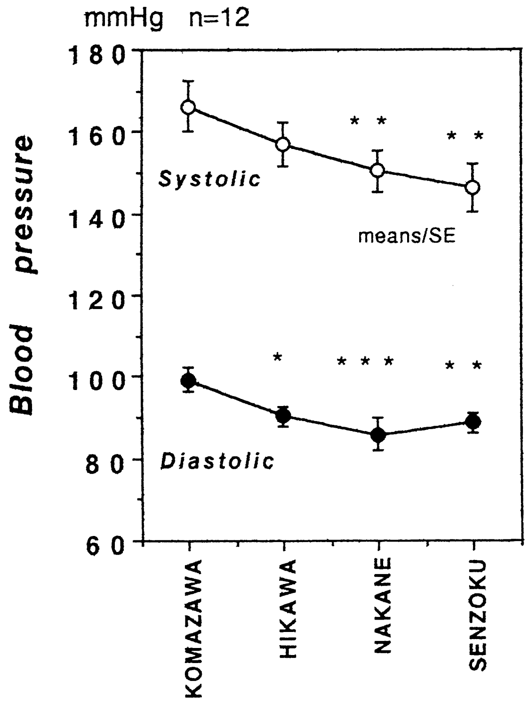

Figure 1. Changes in systolic and diastolic blood pressure for all subjects during walking.(n=12)
Asterisks during walking denote significant differences from values of before walking
***$p<0.001$, **$p<0.01$, *$p<0.05$

The changes in blood pressure during walking in A and B group are presented in Figure 2 and 3, respectively. In A group, systolic blood pressure declined significantly at the point of 2.5km (Nakane Park. $p<0.05$) and 5.0km (Senzoku Park. $p<0.01$) and diastolic pressure declined significantly at the point of 1.4km (Hikawa Park. $p<0.001$), 2.5km (Nakane Park. $p<0.01$) and 5.0km (Senzoku Park. $p<0.001$). A significant decrease in systolic pressure in B group was observed only at the point of 2.5km

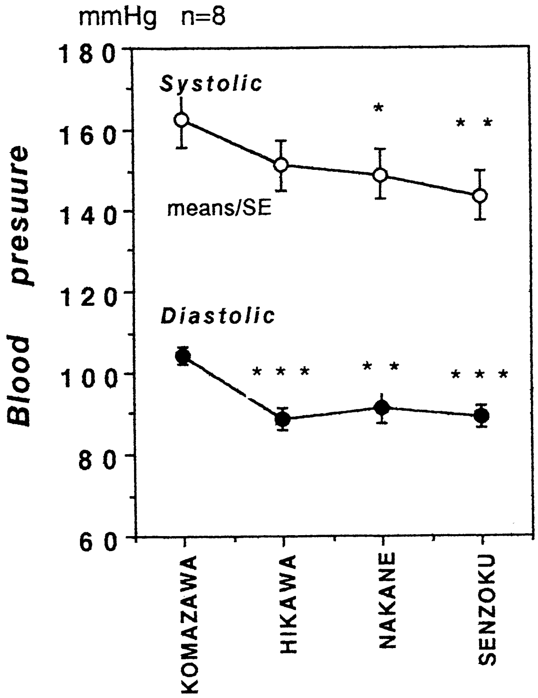

Figure 2. Changes in blood pressure during walking in the A group (n=8)
Asterisks during walking denote significant differences from values of before walking
***$p<0.001$, **$p<0.01$, *$p<0.05$

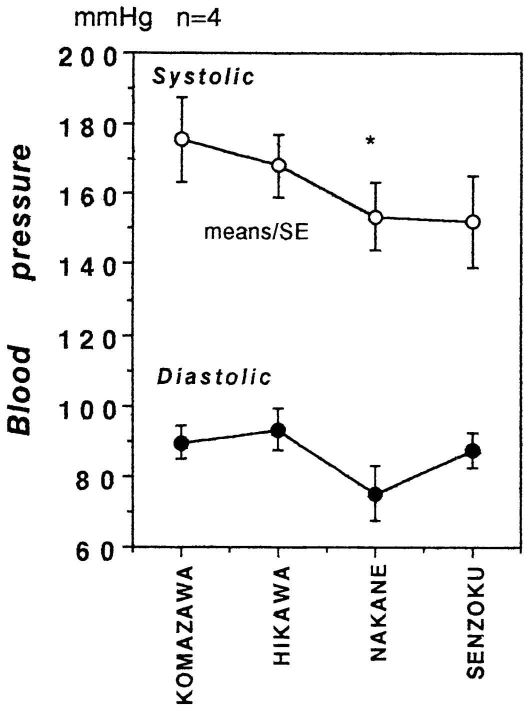

Figure 3. Changes in blood pressure during walking in the B group(n=4)
Asterisks during walking denote significant differences from values of before walking
***$p<0.001$, **$p<0.01$, *$p<0.05$

(Nakane Park. $p<0.05$). Although systolic blood pressure decreased during walking in both A and B groups, different responses between the two groups were obtained in the diastolic blood pressure. Diastolic pressure in A group decreased after walking and increased after resting period (Nakane Park). On the contrary, in B group, diastolic pressure decreased after a resting period (Nakane Park) and increased after walking.

3)Comparison of pulse pressure before and after walking

Pulse pressure at rest before walking (Komazawa Park) related to those after the end of walking (Senzoku Park) is represented in Figure 4, in which a significant positive correlation was observed ($r=0.731$ $p<0.01$). The slope of the regression was 0.54. These results indicated that pulse pressure decreased after walking. However, no significant differences between pulse pressure before(67.0±27.1mmHg) and after(57.0±28.2mmHg) walking were recognized. A decrease in pulse pressure after walking was larger in B group (21mmHg in average) than in A group (4.5mmHg in average)

4)Systolic blood pressure after ten deep breathings before walking, and before and after walking

Figure 5 shows the relationship between the amounts of changes in systolic blood pressure after ten deep breathings measured before

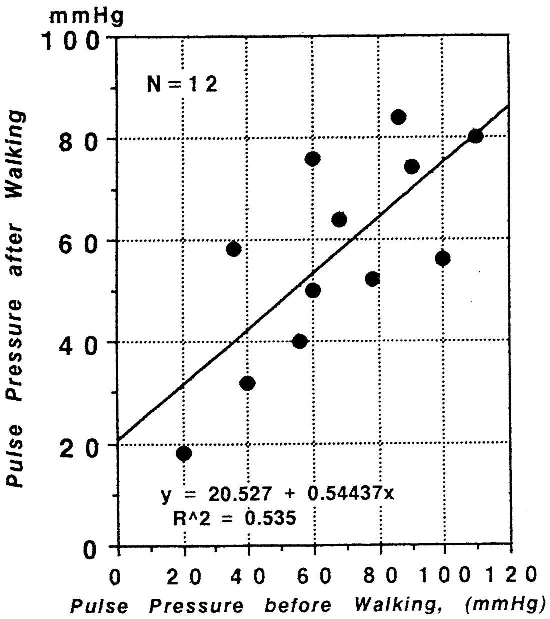

Figure 4. The relationship between pulse pressure at rest before walking and that of after the end of walking

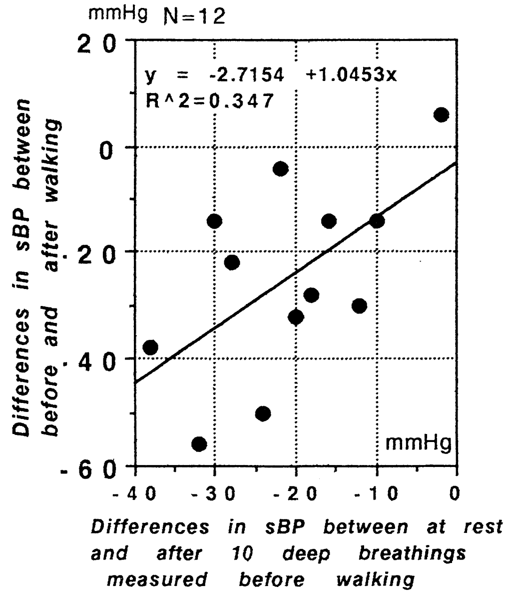

Figure 5. The relationship between the differences in systolic blood pressure after ten deep breathings before walking(△SBPbre) and that of before and after walking (△SBPwk).

walking(△SBPbre) and that of before and after walking (△SBPwk). A significant relationship was revealed between the two △SBP ($r=0.589$ $p<0.05$). However, no significant relationship in △DBP was observed.

DISCUSSION

The objective of this study was to examine the effect of walking on blood pressure for elderly persons with and without depressors. Blood pressure declined significantly by walking, although pulse pressure slightly decreased after walking. These results suggest that both systolic and diastolic pressure decrease by walking, and that peripheral blood circulation was improved by walking, possibly by rhythmic muscle contractions, deep breathing actions and increment in pumping action.

Kataoka et al[7] reported changes in blood pressure in middle–aged and elderly persons with hypertension caused by running exercise lasting more than one hour. In case of high speed running, the heart rate exceeds 160 beats/min. The systolic pressure continuously kept high levels and the decline of diastolic pressure were slight. On the other hand, in the case of slow pace running resulting in the heart rate under 140 beats/min., systolic and diastolic pressure declined gradually during running and reached a level lower than the resting level and the decline of diastolic pressure was especially conspicuous. As shown in the previous studies[8, 9, 10] on young and the trained persons, a decline of diastolic pressure after aerobic exercise training indicates the improvement of peripheral circulatory function.

In the present study, a positive relationship was obtained in the amount of changes in systolic pressure between at rest and after 10 deep breathings before walking and that of between before and after walking. The result indicates that by measuring differences of systolic pressure after ten deep breathings before walking, it may be possible to predict the magnitudes of decrease of systolic pressure by walking.

Imano et al[11] have reported that the magnitude of changes in diastolic pressure after 20 deep squats from those at rest revealed a positive relationship with the magnitude of decrease of the mean blood pressure after three months training in the middle aged hypertension. It might be worthy of noting that the circulatory changes due to a simple exercise, such as deep breathings or a squat exercise before training could in part predict the magnitudes of the circulatory changes after training. Duration of walking in the present study was approximately one hour. It might be an effective duration to expect blood pressure depression for the hypertensive. Imano et al.[12] reported that the most effective duration of walking program to depress blood pressure for the hypertensive was 60−90 minutes a day, 7 days a week, for three months. Based on the Imano's report, 5km walking in the present study could be considered as an effective distance to depress blood pressure.

In the present study, the effect of taking depressors on blood pressure responses to walking was expressed as the changes in diastolic blood pressure in comparison with those in systolic blood pressure. Different responses in the diastolic pressure in B group from A group, i.e., diastolic pressure increasing after walking and decreasing after a resting period, might be considered as a feature of having depressors. In addition, a larger decrease in pulse pressure after walking in B group than in A group suggests that taking depressors may be unfavorable for exercises in the elderly persons because of less improvement of peripheral blood circulation induced by exercise. This is an important suggestion when conducting exercise program to the elderly persons with hypertension.

In conclusion, the major finding of this study was a significant decrease of blood pressure by walking in the elderly persons with hypertension. This result would have an important implication for the elderly people with hypertension. Secondly, our findings show that pulse pressure before walking are positively related to that after walking($r=0.731$ $p<0.01$). This result may imply that both systolic and diastolic blood pressure declined with walking and that an improvement in peripheral blood circulation occurred. Finally, the relationships between the amount of changes in systolic blood pressure due to ten deep breathings before walking and that of before and at the end of walking was significant ($r=0.589$ $p<0.05$). However, no significant relationship was seen in the diastolic pressure. This result strongly suggests that getting the information of the changes of systolic blood pressure induced by ten deep breathings measured before walking could predict the decrease of systolic blood pressure by walking.

REFERENCES

1) Boyer.L.and Kasch W. Exercise therapy in hypertensive men. J.A.M.A.211(10): 1668−1671, 1970

2) Chrastek J. Adamirova J. Kriz V. Boudava L. Krizek V. Benes K. Kavankova M. Fabryova D. and Souckova V.: Testing the cardio−respiratory capacity and training in hypertension

disease stage 2. Rev. Czechoslovak Med. 20(20):58−75, 1975

3) Ressel J. Chrastek J. and Jandova R: Heamodynamics effects of physical training in essential hypertension. Acta. Cardiologica T. 32: 121−133, 1977.

4)Kataoka,Y, Ikuyama,T, Wada,M, Sano,Y and Osanai,H: A study of therapeutic effect of physical training on hypertension. Bull. of Phys. Fit Res..Inst. 36:52−66 , 1977 (in Japanese)

5) Roman O.A. Lcamuzzi E. Villalon and Klenner C.: Physical training in arterial hypertension. A long term prospective follow up. Cardiology 67: 230−243.1981

6)Kataoka,Y, Ikuyama,T, Wada,M, Sano,Y, Imano,H, Kawamura,K and Osanai,H: A study of therapeutic effect of physical training on hypertension (report3) The effective doses of exercise for improving the hypertension. Bull. of Phys. Fit. Res. Inst. 55: 41−54, 1983 (in Japanese)

7)Kataoka,Y, Ikuyama,T, Wada,M, Sano,Y, Imano,H, Kawamura,K, Watanabe,T. Nishida,A and Osanai,H: Changes in blood pressure in middle and elderly persons with hypertension due to long time running. Bull. of Phys. Fit. Res.. Inst. 60:13−24, 1985 (in Japanese)

8)Kataoka,Y, Imano,H and Kataoka,I :Effect of aerobic rhythm exercise training on blood pressure at rest and during pedaling exercise. Chiba J Phys.Ed. 5:14−23,1983 (in Japanese)

9)Kataoka,Y,Imano,H,Sano,Y: Changes of arterial blood pressure during submaximal and maximal work with bicycle ergometer. J. Coll. Arts Sci. Chiba. B−18:151−161, 1985 (in Japanese)

10)Kataoka,Y, Sano,Y. Nishida,A, Fujita,Y and Osanai,H: Effect of exercise program for the hypertensive on blood pressure during exercise (case study). Chiba J Phys. Ed. 15:63−69, 1992 (in Japanese)

11)Imano,H. Kataoka,Y. Ikuyama,T. Wada, M . Sano,Y. Watanabe,T. Kawamura,K. Nishida,A and Osanai,H: The method of blood pressure measurement in order to forecast the improvement of hypertension by physical training. Bull. of Phys. Fit. Res.. Inst. 59:27−39, 1985 (in Japanese)

12)Imano,H. Wada,M. Nishida,A. Kataoka,Y. Ikuyama,T. Sano,Y. Watanabe,T. Kawamura,K and Osanai,H:Therapeutic effect of walking on hypertension. The proceedings of 35th Japanese Society of Physical Education, 1984 (in Japanese)

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