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Effect of Exercise Therapy on Elasticity of the Blood Vessels

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Abstract. [Purpose] The purpose of this study was to determine how a compound exercise program affected the elasticity of the blood vessels of middle aged obese women. [Methods] The research subjects were 40–50 year old women who had excess body fat (30%). The experimental group performed warm-up and cool-down: walking at 3.5–4.0 km/h for 5 minutes and exercised using nine kinds of machinery. A analysis of covariance (ANCOVA) was used for statistical analysis. [Results] In the experimental group, LH PWV, RH PWV, HF PWV, RF PWV significantly increased compared to the control. [Conclusion] The compound exercise program designed for middle aged obese women had affected the elasticity of the blood vessels.
Key words: Compound exercise, Elasticity, Blood vessel

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INTRODUCTION

Atherosclerosis is a condition in which the arterys wall thickens because of the accumulation of cholesterol[1, 2)]. The causes of cardiovascular system diseases in the middle aged are hereditary, gender, increasing age, obesity, smoking, hyperlipidemia, hypercholesterolemia, and lack of exercise; therefore, it is important to prevent and reduce the incidence of cardiovascular disease the middle-aged by improving the risk factors of the disease. A aerobic exercises such as walking, swimming, and cycling are well known as activities which have positive effects on cardiovascular disease risk factors. Participating in regular aerobic exercise improves risk factors such as obesity, hyperlipidemia, hypercholesterolemia vascular endothelial growth[3)], aortic elasticity[4)], and vessel diameter[5–7)].

Many researches have shown that the vascular function is related to arterial pulse wave velocity which changes with increasing age[4, 8)]. However, recently, research has been conducted on how the elasticity of blood vessels change with exercise. A study reported that the elasticity of blood vessels was changed significantly following an aerobic dance program compared to the non-exercise group[9)]. Continuous exercise and resistance exercise also improved the elasticity of blood vessel[10)]. Participant in a moderate intensity exercise program showed a positive improvement in blood vessels elasticity[11)]. Also, a yoga exercise delivered the same result as other physical activities[12)].

Many previous studies have been conducted of the effect of a variety of exercises on cardiovascular function of the middle aged women with exposures to various diseases. However, no study has conducted a detailed investigation of the elasticity of blood vessels in middle-aged women. The purpose of this study was to investigate the effect of a compound exercise program on the elasticity of blood vessels in the middle-aged women and to provide the basic information on how obesity and coronary artery disease can be reduced and treated by an exercise program.

SUBJECTS AND METHODS

The subjects of this study were 40 middle-aged women. They were selected using a bioelectrical impedance method which showed a body fat rate of over 30%. The subjects had not participated in exercise or training for at least 6 months. They were randomly assigned to two groups; the experimental group, n=20, and the control, n=20 (Table 1).

The exercise method used in this study was determined based on exercise prescriptions, such as intensity, frequency and time of the exercise which were suggested by ACSM

Table 1. Physical characteristics of the subject

Group	Age(yrs)	Height(cm)	Weight(kg)	(%fat)
Experimental	54.3 ± 4.38	153.2 ± 2.13	63.2 ± 3.3	37.9 ± 5.8
Control	55.5 ± 3.49	154.3 ± 2.33	62.2 ± 2.6	38.5 ± 2.9

*Values are mean ± SD.

Table 2. Changes in the elasticity of the blood vessels

Variable	LH PWV		RH PWV		LF PWV		RF PWV	
	pre	post	pre	post	pre	post	pre	post
Experimental	210.6 ± 6.18	215.7 ± 3.74*	211.3 ± 5.26	219.2 ± 5.25*	282.8 ± 5.44	299.5 ± 6.24*	294.3 ± 3.45	301.5 ± 7.13*
Control	212.4 ± 5.13	213.1 ± 5.74	212.4 ± 4.31	213.2 ± 6.52	286.4 ± 4.33	288.9 ± 5.42	292.6 ± 7.24	293.4 ± 8.47
F	12.41		15.75		12.17		16.45	

*Values are mean ± SD. Unit: m/s *Significantly different between groups. LH: left hand; RH: right hand; LF: left foot; RF: right foot; PWV: pulse wave velocity.

(2009) after implementing an exercise load test[13]. The type of exercise focused on walking (quick pace), and the intensity of exercise focused on low intensity (40–60% of HRmax), long-time exercise, rather than high intensity, short-time exercise. The intensity of exercise was monitored with a Polar heart rate checker. Weight training was performed, as a kinetic load exercise, and was conducted applied with a composition factor (intensity of 40–60% of 1RM and repeat time of 10–15) which was recommended by ACSM for muscle fitness. Circulatory weight training which is useful for a beginner was used, and was designed to stimulate the global muscles. The exercises were performed 15 times per set and 2, 3 sets for each type of exercise at an intensity of 40–60% of 1RM, and subjects trained for 40–50 minutes breaks of 30 seconds between exercise types and 2 minutes between sets. The aerobic exercise was performed 5 times per week, and anaerobic exercise was performed every two days. A one-day program was composed of warm up, main exercise and cool down. Data are shown as mean ± SD. The t□test and analysis of covariance (ANCOVA) were used for statistical analyses of the data. Statistical significance was accepted for values of p less than 0.05.

RESULTS

Table 2 shows the results of the ANCOVA for the changes in the elasticity of the blood vessels. The experimental group showed a significant difference between before and after exercise in the elasticity of the blood vessels ($p<0.05$).

DISCUSSION

Elasticity of the blood vessels can be measured using magnetic resonance imaging (MRI) and a computed tomography (CT), sectioning of the body. It can also be measured by putting a pressure sensor into the blood vessel, an invasive method. However, these methods observe structural change rather than the severity of arteriosclerosis and are costly and time-consuming.

An important characteristic of the blood vessel in the middle- aged is the elasticity, which has a strong relationship with blood pressure, arteriosclerosis, and cerebrovascular diseases. A longitudinal study showed that the arterial pulse wave velocity reduce with increasing age[14–18]. The elasticity of the blood vessel is determined by the characteristics of the elasticity of the arterial wall and the factors determining the elasticity of the arterial walls collagen and the functional elements of the smooth muscle cells which induce contraction of the blood vessel[8].

It has been reported that the elasticity of the blood vessels, which induce associated with the functional change of endothelial cells, decreases with increasing age[14]. This change starts at the age of 30 to 40, and features endothelial cell degeneration[2], calcium and fiber accumulation in the endothelial cells[1], and increasing systolic blood pressure[4]. However, regular exercise can prevent decrease in the vascular elasticity[4], and aerobic exercise has a positive effect on the blood vessel elasticity, increasing blood level, pressure, and activating the sympathetic nerve system[3, 6].

Many studies have reported that athletes have high vascular elasticity compared to sedentary subjects, and it is thought that the higher aerobic capacity is the higher the vascular elasticity of the arterial walls is[4, 6, 8, 15, 16]. A study showed that participating in aerobic exercise improved the elasticity of the carotid artery and aorta in middle aged women which explained the decrease in cardiovascular disease seen in the exercise group[17, 18]. The flexibility of the arteries increases after long-term aerobic exercise, but not after short-term exercise[4].

In this study, although 12 weeks of the compound exercise did not show a statistically significant difference in the elasticity of the blood vessels, the experimental group did show an increase in the elasticity of blood vessels due to the compound exercise. A aerobic exercise increases blood flow, increasing the arterial pressure, expanding the blood vessel, and increasing collagen fibers. Also, regular exercise stimulates catecholamine which affects the blood vessel.

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Comments