EFFECTS OF QIGONG ON BLOOD PRESSURE, BLOOD PRESSURE DETERMINANTS AND VENTILATORY FUNCTION IN MIDDLE-AGED PATIENTS WITH ESSENTIAL HYPERTENSION

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Abstract:
This study was designed to measure changes in blood pressure (BP), urinary catecholamines and ventilatory functions of patients with mild essential hypertension after 10 weeks of Qigong (Shuxinpingxuegong). Fifty-eight patients volunteered to participate in this study and were randomly divided into either a Qigong group (n = 29), or a control group (n = 29). Systolic blood pressure and diastolic blood pressure decreased significantly in the Qigong group such that both became significantly lower after 10 weeks in the Qigong than in the control group. Also, there was a significant reduction of norepinephrine, metanephrine and epinephrine compared to baseline values in the Qigong group. The ventilatory functions, forced vital capacity and forced expiratory volume per sec, were increased in the Qigong group but not the control. These results suggest that Qigong may stabilize the sympathetic nervous system is effective in modulating levels of urinary catecholamines and BP positively, and in improving ventilatory functions in mildly hypertensive middle-aged patients.

Keywords: Qigong; Essential Hypertension; Blood Pressure; Blood Pressure Determinants; Catecholamines; Ventilatory Function.

Introduction:

Generally, essential hypertension is high blood pressure (BP) where there is no detectable medical cause or organ pathology but treatable risk factor for cardiovascular disease (Turner, 1994). Untreated hypertensives are at greater risk for heart failure, stroke and renal failure (Johnston, 1991). The standard medical treatment for essential hypertension consists primarily of the use of antihypertensive drugs. However, there are potential problems with drug therapy due to their side-effects and consequent lowering of quality of life (Croog et al., 1986; Houston, 1989; Swislocki et al., 1989). With respect to this concern, there has been increasing interest in non-pharmacological treatments of hypertension (Frumkin et al., 1978; Joint National Commitee, 1986). For instance, there are reports regarding the efficacy of behavioral intervention for the control of BP such as meditation, relaxation, autogenic training, hypnosis, stress management and biofeedback (Andrews et al., 1982; Davison et al., 1991; Henderson et al., 1998; Raskin et al., 1999; Schneider et al., 1995).

Medical Qigong as a major branch of traditional Chinese medicine (TCM) has been used clinically for preventing and curing disease, as well as improving and maintaining health. And Qigong is a generic term used to denote methods used to cultivate, regulate and harness Qi (vital energy) for general self-preservation and health, healing, self-defense, longevity, and, particularly, spiritual development (Lee and Lei, 1999). Medical Qigong is divided into two parts: internal and external. Internal Qi is developed by individual practice of qigong and it is more beneficial for self-help health promotion. Lee and Lei (1999) divided internal Qigong into three types: movement-oriented Qigong, meditation-oriented Qigong and breathing-oriented Qigong. As far as healing is concerned, beneficial effects on mindbody health may be the same in spite of style differences.

Data from controlled trials suggest that Qigong is effective in lowering BP (Bornoroni et al., 1993; Hong, 1996; Lee et al., 2000; Li et al., 1993; Xing et al., 1993; Youshan et al., 1993). Although these investigations have reported that Qigong may play a positive role on hypertension patients, these studies have used limited methods, e.g. the reception of Qi from a Qi master. Then it is needed and potentially beneficial for many people to extend previous findings related with Qigong and hypertension by using self-training methods. Accordingly, the primary purpose of this study is to test the hypothesis that 10 weeks of self-help Qigong exercise will reduce the BP of patients with mild essential hypertension.

The second aim is to examine the underlying mechanism of reducing BP by measuring BP determinants in Qigong groups. And the third aim is to investigate changes of ventilatory functions that may be related with BP indirectly. To accomplish these aims, the BP, urinary catecholamines levels, the ventilatory functions, forced vital capacity (FVC) and forced expiratory volume per sec (FE[V.sub.1]), were measured before and after 10 weeks of self-help Qigong in patients with essential hypertension.

Materials and Methods:

Subjects: Participants were recruited from members of a Catholic Church and Credit association from two regions of Mokpo-Shi in Korea on a voluntary basis. Ninety-seven exhibited resting BP in a sitting position in the range of essential hypertension (140 mmHg < systolic blood pressure (SBP) < 180 mmHg and 90 mmHg < diastolic blood pressure (DBP) < 100 mmHg) and 65 volunteered to participate in the study. They were assigned to either a Qigong group (n = 33) or control group (n = 32) by their living regions. Four subjects dropped out of the Qigong group and three subjects out of the control group. Finally, there were 29 in the Qigong group (age: 55.8 [+ or -] 6.3 years; height: 161.6 [+ or -] 6.6 cm; weight: 62.9 [+ or -] 9.5 kg; illness duration: 3.89 [+ or -] 2.57 years; male: n = 10, female: n = 19) and 29 in the control group (age: 57.1 [+ or -] 7.6 years; height: 162.6 [+ or -] 6.6 cm; weight: 65.2 [+ or -] 9.5 kg; illness duration: 4.4 [+ or -] 3.6 years; male: n = 13, female: n = 16). Exclusion criteria included: current involvement in a health promotion program; unwillingness to accept randomization into either study group; self-reported pregnancy or parental report of subjects' history of congenital heart defect, diabetes, asthma or any chronic illness that requires regular pharmacological intervention.

None were affected and all consented to participate in the study. Patients with secondary forms of hypertension were excluded on the basis of a complete history and physical examination, radiologic and ultrasound examinations, and urinalysis.

Measurement of Blood Pressure: After 10 minutes of rest prior to intervention, BP was measured twice in succession by the auscultatory method (Deluxe Aneroid Spygmomanometer, Mac-check, Japan) with a contact microphone secured on the left brachial artery. Two assistants measured BP and pulse rate (PR) consecutively and the values were averaged.

Urinary Catecholamines: All urine samples were taken for 12 hours between 8 am and 8 pm because of sampling problems for 24 hours. Urine samples were refrigerated during the 12-hour collection period without preservatives. At the end of collection and after the evaluation of volume, aliquots were frozen at-80[degrees]C without preservatives until assayed. They were analyzed by the Center of Pathology in the Green Cross Reference Laboratory. Urinary catecholamines were assayed using high performance liquid chromatography (HPLC) with Electrochemical Detection at 0.65 v and metanephrine (ME) was analyzed by UV spectrophotometer-4020.

Ventilatory Function: The maximum FVC measure used a microspirometer (Micro-spirometer Kent ME 1 2A, England) and evaluated how strongly and rapidly a person exhales after inhaling until reaching total lung capacity. The amount of expiration in one second is measured as FE[V.sub.1]. These measures allow an experimenter to evaluate a lung capacity and circulation ability.

Intervention: The Qigong treatment was Shuxinpingxuegong, which was developed by a Chinese named Zhang GuangDe (Jang, 1998). Shuxinpingxuegong, which is composed of eight types of movement (Table 1), and was known empirically to benefit in preventing and treating circulatory system disease but this was not scientifically proven. Before the Qigong, to validate that this instrument was appropriate for the high BP patients, a group of three athletic physiology professors and two Qigong experts helped to reconstruct this instrument as warming-up exercise, Qigong and cool-down exercise. To test the effect of the Qigong, the magnitude and strength of the Qigong was measured by the change in the indirect heartbeat. The calculated target heart rate was used to determine the exercise strength. This experiment was carefully designed so that the exercise strength did not exceed 50% through 60% maximum exercise capacity.

The warming-up exercise, which was designed for relaxing the body, was a sequence of breathing exercise, neck exercise, arm exercise, waist exercise and leg exercise. The Qigong exercise was performed with inhalation when the muscles were contracted and inhalation when the muscles were relaxed. This exercise started with stage 1 two-arm motion and ended at the 8th stage with massage (Table 1). The cool-down exercise was performed with the magnetic-massage method in which a subject touched the head and lightly massaged the hands and legs for about 5 minutes.

The entire exercise time was about 30 minutes, and this included the warming-up (5 minutes), the Qigong (20 minutes) and the cool-down exercise (5 minutes). The exercise was performed around 3 to 5 pm with a Qigong expert and experimenter while watching a recorded videotape at a quiet place of temperature 18[degrees]C-22[degrees]C.

Experimental Procedures: This study is a quasi experiment; non-synchronized control group Pre-Post test. All testing was conducted at the Department of Nursing in Mokpo Catholic University. A week prior to the beginning of the experiment, all subjects visited the laboratory room in order to become familiar with the experimental conditions and to become accustomed to the basic experimental procedures. Also, they were given their experimental date. Subjects were asked to refrain from food, coffee, tea and smoking for at least 4 hours before the assessment and to refrain from alcohol for at least 24 hours prior to the experiment. The measurements were done before the experiment to measure baseline values and after 10 weeks to see the effects of intervention.

Statistical Analysis:

The results obtained were statistically treated with SAS. Unpaired t-test and [chi square] was used to evaluate statistical differences of demographic data and comparison of group differences between control and Qigong groups. If there was a statistical difference in baseline value, we also used the repeated measured ANCOVA for those variables. And a paired t-test was used to analyze the differences between baseline and after 10 week values.

Results:

Changes in BP and PR are presented in Table 2. Mean basal values of SBP and DBP were not different between the two groups. The levels of SBP and DBP at Post decreased significantly compared to the levels at Pre (SBP: $p < 0.001$; DBP: $p < 0.001$) in Qigong group, but increased slightly in the control. There were significant group differences in the levels of SBP and DBP at Post between Qigong and control group (SBP: $p < 0.001$; DBP: $p < 0.001$). There was a significant increase after 10 weeks compared to the levels of Pre in the control group PR but not in the Qigong group.

Table 3 displays the baseline levels and changes after 10 weeks of intervention on urinary catecholamine levels. The levels of catecholamines had a tendency to decrease after 10 weeks of intervention compared to baseline in the Qigong group but slightly increased in the control group. There were significant group differences of norephinephrine (NE) ($p < 0.05$) and ME at the baseline ($p < 0.005$), but not in ephinephrine (E) level. The levels ore at Post decreased significantly compared to Pre ($p < 0.05$) in Qigong group, but increased slightly in control. Also, there was a significant reduction of NE and ME compared to baseline values in the Qigong group. Because there were differences in baseline values of NE and ME, ANCOVA were done with baseline values as covariants. ANCOVA for NE reveals a significant difference between Qigong and control group ($F = 6.24$, $p = 0.0001$). However, there was no significant effect in ME levels ($p > 0.1$) by ANCOVA.

Ventilatory functions of the Qigong group increased significantly after 10 weeks of Qigong compared to baseline (FVC, $p < 0.001$; FE[V.sub.1], $p < 0.001$) and there were significant group differences in values at 10 weeks between Qigong and control groups (FVC, $p < 0.001$; FE[V.sub.1], $p < 0.001$) (Table 4). But, there was a slight decrease in the control group with no significance.

Discussion:

The aim of this study was to examine the clinical utility of self-training Qigong on essential hypertensive patients. We found that SBP and DBP were reduced by 10 weeks of Qigong as well as levels of catecholamines, but not in the control group. Furthermore, there was significant improvement in ventilation functions.

BP (SBP and DBP) decreased after 10 weeks of Qigong but remained the same in the control. These phenomena are similar to other reports of Qigong studies. Many groups have assessed the effect of Qigong on hypertensive patients and they reported that receiving Qi positively affects BP, levels of catecholamines and cholesterol, heart rate, and other aspects of health (Agishi, 1998; Bornoroni et al., 1993; Hong, 1996; Lee et al., 2000; Li et al., 1993; Xing et al., 1993; Youshan et al., 1993). BP has been shown to be directly linked to sympathetic nervous system (SNS) activity, and the urinary catecholamine assay has been used as an integrated measure for sympathoadrenal system activity (SSA), a unique neuroendocrine unit comprising the sympathetic nervous system and the adrenal glands (Macdonald, 1995). Hence, lower BP levels after Qigong is compatible with stabilization of SNS activity since BP has been shown to be directly linked to SNS activity.

There is agreement among investigators that urine catecholamin levels, though representing only a small portion of the total catecholamines released into the bloodstream, are a good reflection of sympathetic activity. Because NE is located mainly in the sympathetic post-ganglionic neurons and its concentration increases when the sympathetic tone is increased due to physiological or psychological stress (James et al., 1989), the finding of lower concentrations of NE and E after 10 weeks of Qigong could reflect a stabilization of sympathetic tone. A decrease in cathecholamine production might be the mechanism underlying the observed reduction of BP. This is consistent with results of other studies, which showed that Qigong reduced NE, and sympathetic nervous system activity and increased parasympathetic nervous system activity (Hong, 1996; Lee, 1993; Lee et al., 2002; Lee et al., 2000; Li et al., 1990; Yang, 1993).

From the results obtained for ventilatory function, it may be considered that 10 weeks of Qigong had beneficial effects on expiratory capacity. Similarly, 10 days of Qigong breathing increased ventilatory efficiency about 20% for oxygen uptake and carbon dioxide production (Lim et al., 1993; Zhang et al., 1992). In the study of Wannamethee et al. (1995) on middle-aged British men, lower FE[V.sub.1] was associated with an increased risk of stroke that in multivariate analysis was independent of age, smoking, physical activity, pre-existing ischemic heart disease, diabetes, antihypertensive treatment and SBP. Increased levels of FVC and FE[V.sub.1] may indicate that Qigong has potential beneficial effects for reducing the symptoms of essential hypertension. However, further study is necessary.

In summary, these results revealed that 10 weeks of Qigong reduced levels of SBP, DBP, NE, E and improved ventilatory functions in mild hypertensive middle-aged patients. These results indicate that Qigong has relaxation effects and stabilizes the sympathetic nervous systems in patients with essential hypertension. Hence, Qigong may be applicable to the improvement and prevention of symptoms of hypertension.

Table 1. The Composition of Qigong (Shuxinpingxuegong)

Stage	Step	Motions
1st	1	Raise both arms during inspiration and lower both arms with expiration.
2nd	1	Turn the body trunk to left with inspiration, and push the trunk forward with expiration
	2	Move the right foot backward with inspiration and bend the left knee with expiration.
3rd	1	Bend both knees a little bit and raise both hands with inspiration. Take hands to shoulders in horse riding posture position with expiration.
4th	1	Shake both hands up and down about 5-8 times in horse riding posture.
5th	1	Massage the face from down to up with inspiration and from up to down during expiration.
	2	Massage the inner ear with inspiration and massage the outer ear during expiration.
6th	1	Pat the left shoulder down to the back of hand with right hand and do the same manner for the right shoulder with the left hand.
	2	Pat the arm from elbow to shoulder in the same methods of 6th-1st. Pat the left calf with the top side of right foot and do the same manner in the right calf with the left
7th	1	Stretch out both arms with inspiration and turn the body trunk to the right with expiration while bending both knees.
8th	1	Massage the back with palm during the inspiration and bend both knees with expiration.
	2	Massage from the lower abdomen to the clavicle with inspiration and bend the right knee with turning body trunk to the left during expiration.

Table 2. Effect of Qigong on Blood Pressure

Variables	Group	Before
SBP (mmHg)	Qigong	146.96 [+ or -] 9.57
	Control	148.62 [+ or -] 12.16
DBP (mmHg)	Qigong	92.75 [+ or -] 5.27
	Control	95.51 [+ or -] 5.72
PR (bpm)	Qigong	73.82 [+ or -] 6.25
	Control	73.55 [+ or -] 7.87
Variables	After	
SBP (mmHg)	131.34 [+ or -] 9.05 ([dagger]),([double dagger])	
	151.72 [+ or -] 10.37	
DBP (mmHg)	86.89 [+ or -] 7.12 ([dagger]),([double dagger])	
	96.89 [+ or -] 5.41	
PR (bpm)	72.27 [+ or -] 5.11	
	76.20 [+ or -] 8.22 *	

SBP: Systolic blood pressure; DBP: diastolic blood pressure; PR: pulse rate.

* $p < 0.05$, ([dagger]) $p < 0.001$ compared to baseline, ([double dagger]) $p < 0.001$ compared to control group.

Table 3. Effect of Qigong on Urinary Catecholamine Levels

Variables	Group	Before
E (pg/l)	Qigong	6.20 [+ or -] 5.52

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