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COMPARISON BETWEEN TAICHI CHUAN AND JACOBSON'S PROGRESSIVE MUSCULAR RELAXATION IN DECREASING CORTISOL CONCENTRATION ON PRE-HYPERTENSION PATIENTS

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Abstract

Nowadays, the prevalence of hypertension and its concomitant risk of cardiovascular and kidney disease development is increasing as the disability evidence in the society also rises. One of the potential risk factors of prehypertension is anxiety and it has already well-known that cortisol is a marker of anxiety. There are some nonpharmacologic methods to relieve anxiety: exercise and relaxation. Taichi Chuan is a low intensity aerobic exercise that also gives a relaxation effect.This study is organised to find out the effect of Taichi Chuan (TCC) and Jacobson's Progressive Muscular Relaxation (JPMR) on cortisol level in pre hypertension patients. This is a pre and post-test design study with a total of 26 pre hypertension patients included. They were randomly divided into 2 groups. Group I performed Taichi Chuan exercise, while group II performed JPMR for 18 times. The intervention frequency was 3x/week for 6 weeks with 30 minutes duration for each session. In the study, which was held in April-June 2015, there was a decrease but no significant difference of cortisol concentration in both group.The comparison between groups also did not show statistical difference. However there were significant difference noted on the blood pressure before and after intervention in both groups.

Introduction

Hypertension is a major challenge in the field of public health throughout the world. This is because the high frequency of occurrence and the concomitant risk of developing cardiovascular disease and kidney (Kerney PM et al, 2005).

Previously, the blood pressure of 120/80mmHg is considered normal, but the classification of hypertension according to the results of Hypertension Association Consensus Indonesia which is adapted to the classification of JNC VII mentions that the category of normal blood pressure is when the systolic is below 120 and diastolic is below 80 mmHg. The systolic condition of 120-139 mmHg or diastolic condition of 80-89 mmHg is classified as prehypertension. Prehypertension condition is a warning sign of someone to likely have high blood pressure (hypertension) in the future (Poth PT, 2005).

The possibility of prehypertension patients to become hypertension is twice bigger than those who have normal blood pressure and are at greater risk for cardiovascular disease. Therefore, it is important for people with prehypertension to anticipate not becoming hypertensive given the risks that come with hypertensive morbidity.

One significant comorbidity on prehypertension is anxiety. The general response of the body when under stress is controlled by the hypothalamus. Through activation of the sympathetic nervous system

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and the axis of hypothalamic-pituitary-adrenal (HPA), they will produce tremor, tachycardia, increased blood pressure, changes in blood flow and metabolic changes that lead to changes in energy production. The mechanism of the HPA axis starting from the stress response in the amygdala causes the hypothalamus to secrete the hormone CRH and will stimulate the secretion of ACTH and cortisol (Figure 1). (Künzel HE, 2003). Therefore, cortisol levels have been widely used to assess psychological stress and / or stress reactivity.

Various studies on the positive effects of exercise and relaxation toward hypertension and one of the risk factors which is stress have been done. Jacobson's progressive Muscular Relaxation (JPMR) is one of pure relaxation technique which is being developed to reduce the tension both physically and emotionally through contraction and relaxation muscle groups throughout the body. *Taichi Chuan* is a form of aerobic exercise of mild to moderate intensity which also has a relaxing effect. The uniqueness of this exercise is, in addition to exercise, will give relaxation effect. This combination is beneficial for individuals with anxiety who have the risk of hypertension.

The purpose of this study is to determine the effect of *Taichi Chuan* exercise in terms in decreasing cortisol levels as compared with Jacobson relaxation method in patients with prehypertension.

Method

This research used pre-test and post-test design study. The samples were pre-hypertension patients who visited Dr. Kariadi Semarang Hospital starting in April-June 2015 who met the criteria for inclusion and exclusion. Subjects included in the study were pre-hypertension patients between 25-45 years old, were able to follow instructions, with BMI of 18.5 to 29.9 kg / m2, MMSE> 23, and Hamilton anxiety scale <17. The exclusion criteria was if they had a history of neuromuscular disorder, cardiopulmonary and metabolic diseases, had suffered fractures of the lower extremity ≤ 6 months, smoking and drinking alcohol, taking drugs as follows: class of synthetic glucocorticoid (prednisone, hydrocortisone), hormonal therapy, KB hormonal, anti-depressants and undergoing and aerobic exercise or relaxation regularly (3x / week). The subjects would be excluded if the attendance was less than 75% or if they were not present exercise 3 times in a row or they did not come during the evaluation.

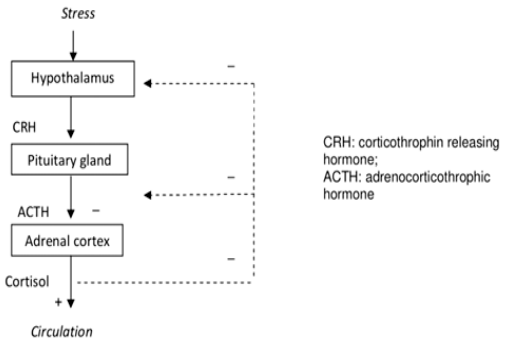

Figure 1. Axis of hypothalamic-pituarity-adrenal

Based on the inclusion and exclusion criteria, 26 people were included in this study and all subjects could complete the research process until the end. The subjects were randomly divided into 2 groups. Each individual group of 13 subjects consisted of Group I who did *Taichi Chuan* (TCC) exercise, while group II who did Jacobson's progressive Muscular Relaxation (JPMR). Intervention was conducted 18 times in 6 weeks. The frequency of treatment was 3x / week with duration of 30 minutes per session.

TCC exercise was guided by instructors of *Taichi Chuan*. The type used was 13 TCC Yang style form. Each session consisted of warm up (5 minutes), the core exercises (20 minutes), cooling (5 minutes). Jacobson's progressive Muscular Relaxation (JPMR) was guided by one occupational therapist who had been given training. The technique of JPMR system used muscle contraction and relaxation voluntarily from proximal to distal. This procedure consisted of tense a muscle group and then was followed by relaxing them. They were done to all the muscles of the proximal to distal. When doing this, the subject could feel the difference when the muscles contracted and relaxed.

Measurements of blood pressure and blood sampling were done 3 times: before the intervention, 30 minutes after the first and last intervention. Blood pressure data was

taken from an average of measurements using 3x digital sphygmomanometer while blood samples were taken from the cubital vein as 5cc. Blood sampling was performed on 09:00 to 12:00 WIB. Cortisol concentration was measured by proportional *luminometer* with ELISA reader and was expressed in units of ng / mL.

Possible fluctuations in anxiety that could occur due to influence events in the daily lives of the subjects were monitored through questionnaires anxiety Hamilton once a week.

Statistical analysis was performed using the computer program SPSS for Windows version 17. Descriptive statistics described the baseline characteristics by univariate. The bivariate analysis was obtained by performing different tests between variables. Data with normal distribution was tested by paired t-test and independent t-test, while data with abnormal distribution was tested by the Mann-Whitney and Wilcoxon test. The p-value was considered significant when $p < 0.05$.

Results and Discussion

From the characteristic statistical test, both subject groups do not have significant difference in terms of gender, age, BMI, Hamilton anxiety scale, blood pressure (systolic and diastolic) and cortisol levels before treatment. From education variable and coffee consumption, there is a significant difference where TCC group have a subject of high school graduates and consume more coffee than JPMR group who are dominated by graduates of S1. (Table 1).

Table 1. Characteristics of Subjects

Variables	Group		p
	Taichi	Jacobson	
Sex			
Male	5 (38,5%)	4(36,4%)	1,000#
Female	8(61,5%)	9(60%)	
Education			
SMA	7(87,5%)	1(12,5%)	0,030#
S1	6(33,3%)	12 (66,7%)	
Age	33 ± 4,564	30,69 ± 4,131	0,189§
BMI	24,01 ± 3,625	24,65 ± 2,728	0,612§
Hamilton Scale	6,38 ± 5,378	4,23 ± 2,833	0,364£
Coffee Consumption			
≥ 1 x per day	5 (38,5)	0 (0)	0,017*
1 – 6 x per week	5 (38,5)	4 (30,8)	
≤ 3 x per month	3 (23,1)	9 (69,2)	
Sistolikpre	127,58 ± 6,137	127,65 ± 5,599	0,758€
Diastolikpre	81,58 ± 4,173	80,96 ± 5,109	0,857€
Kortisol pre	84,51 ± 33,391	86,37 ± 38,010	0,817€

Description: € Mann Whitney test; ¥ Independent t-test, chi square #, * $p < 0.05$

The results obtained from the comparison of the data distribution of group sex at TCC and JPMR shows that there is no significant difference as well as for age and BMI of both groups. This result shows that there is no differences gender distribution of data means and there is no difference in the effect of gonadotropin hormone which can give the effect on cortisol levels. As for the age difference of factors that may affect the mindset can be eliminated.

From the preliminary data on the characteristics of the study subjects, significant differences between the two groups in terms

of education and consumption of coffee are revealed. This can happen because the group division is from randomization technique from a relatively small sample size, and therefore, correlation test is conducted to determine the level of significance of the correlation between education and consumption of coffee and cortisol levels. The result of correlation test finds no significant correlations between these factors.

The concerns in doing JPMR and TCC exercises exist because besides serving as a standard procedure in addition to exercise, heart rate (HR) and blood pressure are measured before and after treatment. From the average of several samples of HR in the early weeks 1, 3 and 6, an increase in HR in the TCC group is seen. The increase in the average HR is within the scope of the 40-60% HR maximum so that it can be concluded that the practice of TCC is included in the category of mild intensity exercise. Whereas in the JPMR group, a decline in the average HR before and after treatment demonstrates that JPMR gives a relaxing effect which causes a reduction in HR.

Paired statistical test results of cortisol levels before treatment, after the first practice and after practice last two groups do not show any significant difference in any comparison of measurement results. From the measurement results either in cortisol levels and JPMR TCC group, a decrease in the ratio of pre-post 1 is found, but the difference is not significant. (Table 2).

Table 2. Difference Cortisol Levels Pre, Post 1 and Post 2 Based on Treatment Group

Groups	Cortisol			p (pre-post1)	p (post1-post2)	p (pre-post2)
	Pre	Post 1	Post 2			
TCC	84,51 ± 33,391	76,24 ± 27,250	86,70 ± 33,062	0,499§	0,396§	0,769§
JPMR	86,37 ± 38,010	65,15 ± 21,416	66,94 ± 18,925	0,117‡	0,809§	0,136‡
p	0,817€	0,260¥	0,074¥			

Description: Tested with € Mann Whitney test; ¥ Independent t-test, § Paired t-test; ‡ Wilcoxon test; pre: before treatment; post 1: after the first exercise; post 2: after the last training

Cortisol levels before treatment (pre cortisol) is compared with after the first training (cortisol post 1) to determine the effects of acute (immediate) exercise on levels of cortisol. Comparison of cortisol levels after the first training (cortisol post 1) and after the last exercise (cortisol post 2) is intended to determine the long-term effects of exercise on cortisol levels; likewise for the comparison of results of blood pressure measurement.

Comparison of cortisol levels in TCC group, both comparisons to determine the effects of immediate and long-term effects indicate a decline but the difference is not significant. Similarly, the comparison of the difference between the cortisol levels before treatments and after the first practice, after the first practice and last practice, and before the treatment and after the last practice shows no significant difference.

Several previous studies demonstrate that exercise causes increased levels of cortisol because exercise is one of stressors. A study comparing the increase in salivary cortisol levels after exercise in athletes and individuals states that the rising cortisol in sedentary population of nearly 3 times higher as compared with the athlete (Mathur, et al., 1986). Some previous studies have also reported that elevated levels cortisol occurs in the training load of more than 60% VO2 max, while other studies have reported a reduction in cortisol levels actually occur on the training load below 50% VO2 ma. This study provides TCC exercise intensity which is lightweight and has a load below 50% VO2 max, but cortisol levels after exercise is decreased.

Such results in this study is likely due to all subjects who are not athletes and categorized as sedentary group so that the effect of exercise

is not in line with the subjects of athlete. The evidence shows that cortisol levels after exercise TCC is decreased but not significantly, and it is also not increased. This suggests that the practice of TCC is not a stressor for the subject.

The comparison from the difference between cortisol levels of TCC and JPMR group does not show any significant difference from each measurement results (Table 3).

From the paired test results of systolic and diastolic blood pressure from both groups, there is a significant decrease for comparison in each measure except in the TCC group. In the TCC group, the comparison between the TDS after the first practice and last, but it is not significant (Table 4).

A study from Nedeljkovic M, et al (2012) states that TCC practice decreases stress reactivity in healthy individuals by looking at the decrease in salivary cortisol levels. Carek PJ (2011) states that exercise can be used as a therapy for patients with anxiety and depression. Another study by Jin (1989) who studies the cortisol levels in subjects with treatment of TCC exercise, by comparing the changes in heart rate, non-adrenalin levels, cortisol and mood at beginners and practitioners of TCC reports that TCC practitioner cortisol levels is lower than the beginners.

The study involves subjects who are beginners in TCC practices. In every training session, the coach who is the practitioner TCC, teaches not only the movements TCC ad breath control, but also the principles of TCC that refers to the self-control and calmness as a lifestyle. Within a period of 6 weeks and 18 times practice sessions, the subjects have not understood and applied basic principles of the TCC in their daily life. They consider TCC as a merely physical exercise. It can also be one of the driving factors cortisol levels to drop significantly.

In JPMR groups, cortisol level is also decreased but the change is not statistically significant. JPMR is shown to provide relaxation influence directly, so that not a few subjects feel asleep at this session, but the relaxation effect is not statistically significant in lowering cortisol levels. This is not in line

Table 3. Difference of Cortisol Levels from Pre, Post 1 and Post 2 Based on Treatment Group

Differences	Treatment Groups		p
	Taichi	Jacobson	
Cortisol pre – post 1	-8,27 ± 42,780	-21,22 ± 48,090	0,778€
Cortisol post 1 – post 2	10,46 ± 42,883	1,79 ± 26,114	0,539¥
Cortisol pre – post 2	2,19 ± 26,361	-19,43 ± 42,455	0,132¥

Description: € Mann Whitney test; ¥ Independent t-test

Table 4. Differences in Blood Pressure from Test Pre, Post 1 & Post 2 based on Treatment Group

Groups	Pre	Post 1	Post 2	p (pre-post1)	p (post1-post2)	p (pre-post2)
TDS						
TCC	127,58 ± 6,137	120,62 ± 8,422	116,85 ± 8,707	0,000*¶	0,216¶	0,001*¶
JPMR	127,65 ± 5,599	117,85 ± 5,031	111,31 ± 6,775	0,001*¥	0,006*¥	0,001*¥
P	0,758£	0,321§	0,063§			
TDD						
TCC	81'58 ±4,173	76,69 ± 5,574	69,46 ±5,925	0,009*¶	0,002*¶	0,000*¶
JPMR	80,96 ± 5,109	76,62 ± 4, 369	70,31 ± 3,521	0,004*¥	0,003*¥	0,002*¥
P	0,857£	0,938£	0,562§			

Description: * Significant p <0.05; £ Mann Whitney; §Uji Independent t, ¥ Wilcoxon; Paired ¶test; TDS: systolic blood pressure; TDD: diastolic blood pressure

with a research report by Pawlow & Gary (2005) and Najafian J & Hashemi SMG (2006). Their research shows a significant decrease in cortisol levels immediately after JPMR. Research by Maghfirah S, et al (2015) also states that the progressive muscle relaxation can reduce psychological stress in patients Diabtes mellitus type 2. It can be concluded that both TCC and JPMR although exercise has an effect on cortisol levels both acute and long-term effects, but the decline does not have significant difference. This is probably because the cortisol levels are already in the normal background concentrations and tends to be low in the beginning. Normal plasma cortisol concentration in adults is at 09.00 is 171-536 nmol / L (Roche Elecsys) or in units of nm / mL is 53.77 to 168.55 ng / mL and in this study, baseline cortisol levels of the subjects are in the range of 83-84 ng / mL. Anxiety scores which are lower in subjects with anxiety Hamilton score of less than 14 and are included in the criteria "not worry" can also be one factors contributing to this result.

The comparison of the difference between systolic and diastolic blood pressure between the TCC and JPMR shows no significant difference (Table 5).

Table 5. Difference between Systolic and Diastolic Blood Pressure Between Both Groups

Difference	Treatment groups		P
	Taichi	Jacobson	
TDSpre – post 1	-7,15 ± 4,688	-10,08 ± 4,387	0,114[¥]
TDS post 1-post 2	-3,77 ± 10,402	-6,54 ± 7,031	0,434[¥]
TDS pre – post 2	-10,92 ± 8,539	-16,62 ± 8,342	0,098[¥]
TDDpre – post 1	-5,08 ± 5,678	-4,54 ± 3,406	0,772[¥]
TDDpost 1-post 2	-7,23 ± 6,457	-6,31 ± 5,218	0,692[¥]
TDDpre – post 2	-12,31 ± 6,524	-10,85 ± 5,942	0,656[¥]

Description: : [§] Independent t-test

The comparison of systolic blood pressure before treatment with after the first practice in both groups shows meaningful difference which means that both TCC and JPMR have immediate effect on systolic blood pressure reduction. In the comparison of the long-term effects of systolic blood pressure in the TCC group, there is no significant difference in the JPMR group. This suggests that JPMR have better long-term effect on systolic blood pressure when compared to TCC. Comparison of diastolic blood pressure in both groups, indicating that both TCC and JPMR equally have a significant effect in lowering diastolic blood pressure both immediate and long-term effects.

Such result is caused by the pressure of the blood which is influenced by many factors. Factors that may influence and cannot be controlled in this study include: genetics, age, smoking habits, intake of sodium, saturated fat and others. Because of these factors are not restricted, the subjects in the TCC group are more likely to have risk factors as compared with JPMR group (Guyton AC, 2010).

The result of the difference in blood pressure in both systolic and diastolic which do not have significant differences in both treatment groups shows that both treatments have the same effect against the powerful blood pressure reduction. According to research by Khatri et al (2012), JPMR practice is conducted jointly by administering medication in hypertensive patients is shown to significantly lower blood pressure better than patients who are given medication.

Referring to the results of the study, although the TCC and JPMR do not have a significant effect in reducing levels of cortisol, but its influence proves significant in decreasing blood pressure. This is in line with the research by Lee EN (2004) which states TCC significantly lowers blood pressure but not significant enough in decreasing the cholesterol and blood cortisol levels. Whitworth JA (2005) concludes that increased levels of cortisol causes a rise in blood pressure. From various studies, there are no data on the magnitude of the cortisol dose

which may affect changes in blood pressure. Therefore, the difference in cortisol levels which can be attributed to the difference of change in blood pressure in this study cannot be known. The results of the study shows there is no changes in cortisol levels and JPMR TCC group, but there are significant differences to the decrease in blood pressure, likely due to the blood pressure is not only influenced by the levels of cortisol. There is multifactorial and / or substances that can affect blood pressure.

The researchers try to explain the hypotensive effects that occur in the subjects of this study. This effect is not obtained from the change in cortisol concentrations, but it is possibly due to muscle contractions performed when TCC and JPMR are performed. Active contraction of muscle mass in the beginning of the exercise helps to restore blood to the heart. Effects of 'muscle pump' will increase the venous return and stroke volume which in turn causes the systolic and diastolic blood pressure increased minimally, it is physiological. If exercise is continued with the same intensity, the blood pressure will be decreased, this is because the redistribution of blood to the peripheral and cardiac filling reduction.

However, this study has limitation because there is no mechanism to limit some factors that can influence the levels of cortisol, including caffeine and behavioral factors of the subjects. Some subjects at TCC group are beginners. Therefore, six weeks training may still not give effect to the measurement. This can be a consideration to use TCC practitioners as subjects in research that will come when the TCC will examine the effects on cortisol levels because the practitioners have regularly practice of TCC, understand and apply the principles of TCC. In addition, scores of anxiety and cortisol levels of subjects who tend to be low at the beginning of the study could also be a factor causing no change in cortisol levels.

Conclusion

In a study conducted in April-June 2015 in Medical Rehabilitation of Hospital dr. Kariadi Semarang on the subject of pre-hypertension for 6 weeks, the conclusion that Taichi Chuan and Jacobson's Progressive Muscular Relaxation are proven to reduce cortisol levels, both immediate and long-term effects, but the decline is not statistically significant. The changes in cortisol levels are not associated with changes in blood pressure after TCC and JPMR exercises.

Suggestion for future research is to determine more precise target subjects, i.e. the TCC practitioners. In order to look for TCC effects on cortisol levels, there is a need to determine criteria for the initial cortisol levels which is higher than normal quantities to look for differences or changes in levels. It is also important to conduct research on the relationship changes in the amount of cortisol dose value with changes in blood pressure.

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