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Effects of Chin-Don Therapy on Variations in Blood Levels of Adrenalin, Noradrenalin, and Dopamine: Relationships with Emotion and Behavior of the Elderly

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Full Paper

Effects of Chin-Don Therapy on Variations in Blood Levels of Adrenalin, Noradrenalin, and Dopamine: Relationships with Emotion and Behavior of the Elderly

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Abstract

We have recently demonstrated that Chin-Don therapy (CDT) improves quality-of-life (QoL) of elderly patients; however, our studies were not totally objective. In the present study, we employed an objective method monitoring changes of the mood- and movement-related neurotransmitters such as adrenalin (AD), noradrenalin (NA), and dopamine (DP) levels in the blood before and after CDT as well as comparing results of CDT and non-CDT groups. Elderly subjects (n=30) commuting to a Daycare Community Service Center participated in the study: 18 were subjected to CDT, while 12 served as controls. Blood was sampled from both CDT (before and after CDT) and non-CDT controls. Biochemical findings showed that AD and NA but not DP levels in blood of CDT group were significantly elevated after CDT (Fig. 1); however, those in blood of the non-CDT group were not markedly affected. The CDT group was in a significantly joyful mood after CDT; they showed sweating, heavy breathing, dilated pupils with smiles/laughter and all appeared satisfied without complaints; signs apparent after a physical exercise. No significant changes in behavioral signs and emotions were observed in the non-CDT group. CDT may favorably influence moods and emotion without changing DP-related behavior. Patients participated in the CDT could have been influenced by the 'fright-fight-flight' response induced by AD and NA. Significant increases in these neurotransmitters (AD, NA) induced the adrenergic and noradrenergic responses to provide global physiological responses to meet the needs of patients in CDT, although marked increases in DP were not observed.

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1. Introduction

Recent approaches to adopting complementary alternative medicine have been focused on improving the health of the elderly to achieve a higher quality of life (QoL).[1-11] We have recently demonstrated that Chin-

Don therapy (CDT) improves QoL of elderly patients in a multiple-case study.[8,9] However, our studies were not totally objective, and subjective itemized results require objective observations to confirm the actual effects demonstrated. In an objective study,[10] rheumatism-arthritis (RA) patients who were allowed to enjoy comic stories told by professional storytellers indicate attenuated interleukin-6 (IL-6) levels with significant decrease in pain scores (Yoshino et al, 1996).[10] We have also attempted to objectively confirm the effects of CDT using salivary monitoring of cortisol and immunoglobulin-A in cognitively impaired elderly.[11] In the present study, we employed another objective method, monitoring certain blood indexes related to changes of the mood- and movement-related neurotransmitters such as adrenalin (AD), noradrenalin (NA), and dopamine (DP) levels in the blood before and after CDT, beside comparing the groups treated with CDT and without CDT (non-CDT). The indexes were selected based on their relationships with mental and physical diseases affecting the QoL of humans, especially the elderly.

2. Methods and Subjects

2.1 Subjects

The CDT methods basically resembled those of previous investigations.[8,9] Briefly, a total of 30 elderly subjects commuting to a Daycare Community Service Center (DCSC) in Prefecture A participated in the study: 18 (age range: 70 - 89 yr; male: 1, female: 17) were subjected to CDT, while 12 (age range: 60-89 yr; male: 3, female 9) served as controls. The moral and ethical codes in the treatment of participants were approved by the Ethics Committee of the Faculty of Medicine, Shiga University.

2.2 Methods

a) Timing of blood sampling and use of CDT

Elderly non-residential subjects (n=30) participated in our study, which lasted from June 20 to September 28, 2008. Subjects arrived at about 09:00 hr on every visit, and engaged in daily chores and activities designated for the day at the DCSC. On the day of investigation, subjects were divided into 2 groups: 18 patients were given CDT (CDT group) and 12 were without CDT (non-CDT group). Before 30-min CDT was given to patients (10:00–10:30 hr), blood was sampled from each of 18 patients in an orderly serial manner. Blood sampling for controls were similarly repeated. While the CDT group was given CDT, controls spent a similar time-interval leisurely/comfortably doing nothing in a room layered with Japanese mattresses (tatamis) at a site away from CDT-treated participants, and where rhythmic sounds from CDT were not audible (given free access to the washroom and non-alcoholic beverages without CDT). After 30-min CDT, blood from each patient in the CDT group were again sampled in an orderly serial manner duplicating pre-CDT order. As for the non-CDT group, blood sampling was similarly repeated in the serial order and manner similar to pre-control conditions. The rhythm and dance incorporated in the CDT used were similar to that used in a previous study.[8,9,11] Briefly, the 'chin' and 'don' are sounded respectively by beating a gong-like instrument and a drum with a stick to produce a rhythmic musical flow of 3 (don x 3) + 7 (chin x 7) beats, these being executedby colorfully dressed performers who move and dance in circles.[8,9] In the study, we measured the blood levels of AD, NA, and DA before and after CDT exposure in both CDT and non-CDT groups, and the results were statistically compared before and after CDT for those in the CDT group. Similar comparisons were performed for those in the non-CDT group.

b) Statistical analysis

Mean scores of both methods for CDT subjects and controls were compared before and after CDT using the Wilcoxon rank-sum test. Differences where $p<0.05$ were considered significant. All calculations were done using statistical analysis software Windows SPSS-15.0.

3. 3. Results

3.1 Personal particulars, physical data, and health status

The personal particulars, physical data, and health status of subjects were similar to those in a previous study.[9] Briefly, the percentage (tested/total number) of participants required nursing care level 1, 2 and 1+2 were 66.6% (12/18), 11.1% (2/18), and 5.6% (1/18) in the CDT group as well as 58.4% (7/12), 8.3%

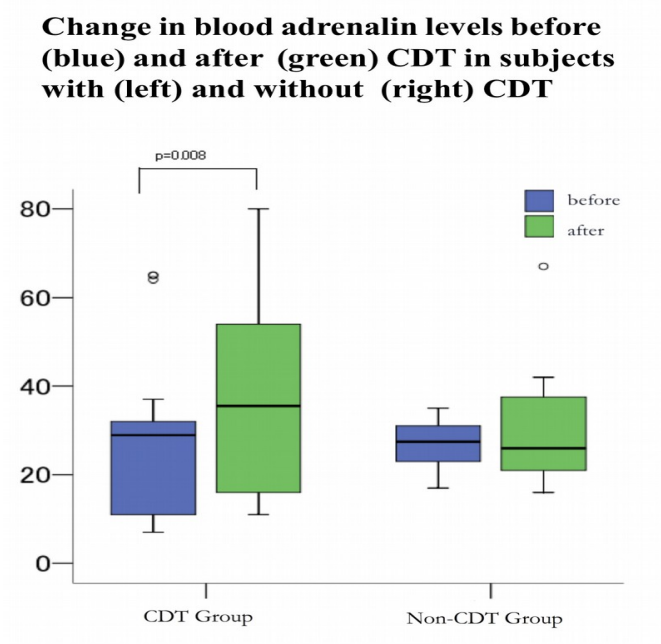

Fig. 1. AD levels before and after CDT. AD (p<0.008) and NA (Fig. 2; p<0.002) but not DP (Fig. 3) levels in blood of CDT group were significantly elevated after CDT; however, those in blood of the non-CDT group were not markedly affected.

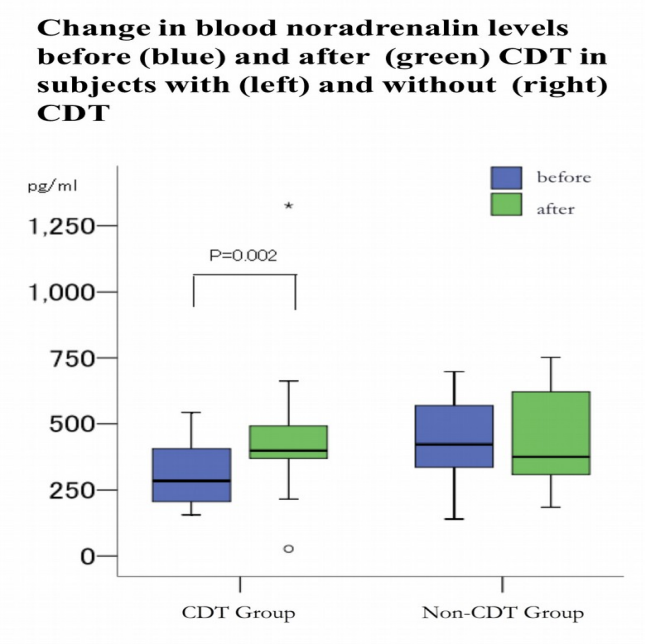

Fig. 2. NA levels before and after CDT. AD (Fig. 1; p<0.008) and NA (p<0.002) but not DP (Fig. 3) levels in blood of CDT group were significantly elevated after CDT; however, those in blood of the non-CDT group were not markedly affected.

(1/12), and 25.0% (3/12) in controls, respectively. Except for the gender factor (1 male vs 17 female subjects), there were no significant differences in personal particulars and other relevant items between the two groups.

Based on facial scores reported in the previous study,[9] the CDT group was in a significantly joyful mood after CDT. They showed sweating, heavy breathing, dilated pupils with smiles/laughter and satisfaction after CDT; signs apparent after a physical exercise. No significant changes in behavioral signs and emotions were observed in the non-CDT group.

3.2 Changes in AD, NA, and DP levels in the blood

Patients in the CDT group participated actively in the CD performance. They appeared to have sweated, breathed heavily and felt relieved and joyful signs of smiles/laughter after CDT. According to the blood indexes, AD (Fig. 1; p<0.008) and NA (Fig. 2; p<0.002) but not DP (Fig. 3, next page) levels in blood of CDT group were significantly elevated after CDT; however, those in blood of the non-CDT group were not markedly affected.

4. Discussion

Humor is a specific defense mechanism where positive emotions can overcome the undesirable negative emotions involved in a stressful situation.[12] Previous findings have demonstrated that humor and laughter can improve depression and dementia[13] and therefore QoL as well as attenuating stress[14,15] in psychologically affected patients,

In our previous study,[8] we have shown that Chin-Don therapy (CDT) can evoke smiles/laughter and improve mood to yield useful effects with positive psychological and neurological outcomes via retrieval of fond memories of past events and experiences of three elderly Japanese cases.

In another study,[9] a significant difference in mood improvement using the face-scale has been established. It has therefore reconfirmed that CDT works effectively in improving mood (emotional and psychological states) in the elderly. As all the elderly subjects had prior exposure to CD performance in their childhood, CDT may work effectively for elderly participants: viz., CD performance using 'musical' sound evoked from traditional instruments. It is thought that CDT may work for only those who had prior exposure to CD performance/music,[9] as participants in this study were all exposed to CD performance when young or during their childhood. However, an objective study has shown that the projection was otherwise: viz., young subjects (25 – 45 yr) have exhibited emotionally favorable results with

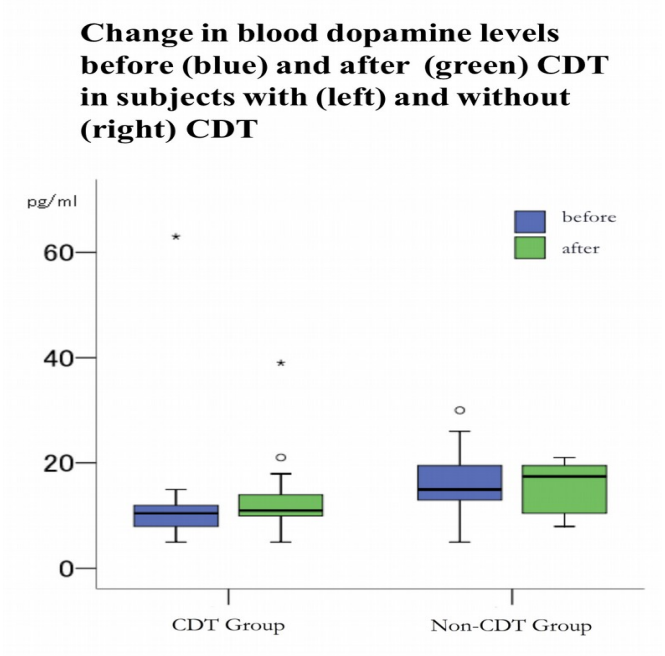

Fig. 3. DP levels before and after CDT. AD (Fig. 1; p<0.008) and NA (Fig. 2; p<0.002) but not DP levels in blood of CDT group were significantly elevated after CDT; however, those in blood of the non-CDT group were not markedly affected.

CDT even without prior exposure to CD music.[11] However, because CD music/beat is a unique form of Japanese rhythm found in Japanese entertainment, this finding may be applicable only for the Japanese populace.

In the present study, we purposely focused on endogenous factors closely related with humor, laughter, stress, emotion, depression, joy, movement, and apparent physiological responses such as adrenalin (AD), adrenalin (NA), and dopamine (DP), although more would be gained in understanding the underlying physiological changes in the body system with the various remaining neurotransmitter and hormonal factors (other than AD, NA, DP) involved in aforesaid mental and physical states of the mind and body. In this study, we purposely limited ourselves to the aforesaid 3 endogenous catecholamines, and hope the results would guide us in future studies by investigating the relevant factors not studied in the present investigation to complement understanding of CDT effects on elderly patients with mental disturbances such as depression, dementia, immunosuppression, and other relevant disorders.

Based on our findings (Figs. 1-3), blood level increases in AD and NA are associated with the respective numerous adrenergic and noradrenergic activities in the living system. As a hormone/neurotransmitter, AD acts on nearly all body tissues. Its actions vary by tissue type and tissue expression of adrenergic receptors: e.g. high levels of AD cause smooth muscle relaxation in the airways but causes contraction of the smooth muscle that lines most arterioles. Additionally, AD increases heart rate, myocardiac contractility, respiratory rate, bronchodilation, vasodilation/vasoconstriction, glycogenolysis, and muscle contraction, although monitoring of these parameters was not done as they were outside the scope of the present study (http://enwikipedia.org/wiki/Epinephrin).

Therefore, apart from inducing the 'fear-fight-flight' (triple-F) response,[16] AD and NA increased blood flow to muscles, cardiac output, pupil dilation, and blood sugar were probably increased[17,18] to cope with patients dancing to the CD beats. A mood uplift due to positive facial expression scores[9] was most likely induced by elevated NA in blood levels in the present study. Although studies have found a definite relation between AD and fear (e.g. patients feared of not coping well with others, etc.), augmentation in other emotions were probably not affected.[19] A general increase in sympathetic nervous system (SNS) activity is usually accompanied by increased AD secretion as well.

AD is a nonselective agonist that binds to all adrenergic receptors, including the major subtypes α_1, α_2, β_1, β_2, and β_3.[20] Binding of AD to these receptors triggers a number of metabolic changes: e.g. binding to α-adrenergic receptors inhibits insulin secretion by the pancreas, stimulates glycogenolysis in the liver and muscle,[21] and stimulates glycolysis and inhibits insulin-mediated glycogenesis in muscle.[22,23] β-adrenergic receptor binding triggers glucagon secretion in the pancreas, increased adrenocorticotropic hormone (ACTH) secretion by the pituitary gland, and increased lipolysis by adipose tissue. Together, these effects lead to increased blood glucose and fatty acids, providing substrates for energy production within cells throughout the body in patients joining in the CD performance during CDT. Although not monitored in the present study, AD increases peripheral resistance via α_1 receptor-dependent vasoconstriction, and increase cardiac output via its binding to β_1 receptors. The goal of reducing peripheral circulation is to increase coronary and cerebral perfusion pressures and therefore increase oxygen exchange at the cellular level[24] to facilitate patients in CDT group joining in the CD performance in this study. While AD does increase aortic, cerebral, and carotid circulation pressure by improving macrocirculation at the expense of the capillary beds where actual perfusion is taking place.[25] Intriguingly, ele-

vated AD increases alertness[26] and improves augmentation of memory consolidation:[27] a useful effect for the present CDT patients.

Elevated NA releases trigger AD-like multifaceted noradrenergic activities such as increased hear rate, blood pressure, and release glucose from glycogen in the living system. However, our present study focused more on mental/emotional effects using facial expression scores. Patients were elated probably due to enhanced NA-related SNS excitation. As CDT patients joined in the CD performance, increased blood flow to skeletal muscles with reduced blood flow to the gastrointestinal system occured.

In the brain, NA (similar to the monoamine AD; belongs to the family catecholamines). increases arousal and alertness, promotes vigilance, enhances formation and retrieval of memory, and focuses attention; elements most needed in CDT patients joining the CD performance in this study. Additionally, NA could have been increased emotion thresholds - such as those of restlessness and anxiety - required in joining the CD dance (not monitored). These events contrasted the acetylcholine-mediated effects of the parasympathetic system (PNS), where most of the NA-regulated organs are modified into a state more inclined to rest, recovery, and food digestion with lower energy output.[28] Additionally, PNS activity coupled with the reduced digestive activity in stomach and intestines (due to the inhibitory effect of NA on the enteric nervous system) further cause decreases in gastrointestinal mobility, blood flow, and secretion-related digestion.[34]

The SNS effects of NA include: moistening of eyes,[29] pupil dilation, elevated cardiac output,[30] increased body heat by stimulating calorie-burning of brown adipose tissue,[31] vascular constriction of arteries,[32] release of renin to retain sodium in the bloodstream,[33] increased glucose production in liver via releasing glucagon in the pancreas,[33] as glucose was required for energy output of patients joining in the CD performance in this study, which in turn prompted increased glucose uptake in skeletal muscles.[34] Furthermore, NA elicits multiple effects on the immune system. The SNS is the primary interactive pathway between the immune system and brain, albeit complex without clear explanation, immunity-related organs/tissues such as the thymus, spleen, and lymph nodes received SNS innervations.[35]

Dopamine (DP) is the simplest possible catecholamine: a family that includes neurotransmitters such as AD and NA. DP is the precursor of AD and NA in the synthetic processes.[36] As a neurotransmitter, apart from executive functions, motor control, motivation, arousal, reinforcement, and in the reward system, DP plays important roles in lactation, sexual activity, gratification, and nausea. The dopaminergic system is neuromodulatory. Additionally, DP functions as a chemical messenger: it inhibits NA release and induces vasodilation. In the present observation, DP was not significantly affected, although significant NA increases were observed. Since DP regulates the threshold for initiating movements,[37] higher DP levels lead to higher levels of motor activity and impulsive behavior. However, significant increases in DP were not established in the present study, prompting a possibility of age-related factors, as many studies have demonstrated age-related decline DP synthesis and DP receptor density in the brain.[38] Other factors such as mental factors and attention-regulatory and memory mechanisms,[39] etc. Further evaluations in corporation with other neural systems may be warranted to have a better understanding of the role of DP in CDT.

Physiologically, stress is defined as a situation where the living system is disturbed to threaten the stability and functions of the body.[40] Stress consistently influences the body system as follows: i) the hypothalamus-pituitary-adrenal system, and ii) the NA-associated - including the SNS and the locus coeruleus – systems.[36] Changes in immunosystem- and closely related stress-associated factors should be pursued to gain better understanding of NA release in this investigation as NA is related to stress.[36]

Our present study was limited by the number of endogenous indexes observed. Observable signs and responses as well as endogenous AD, NA and DP were focused emphatically in this study. Other relevant endogenous factors should be taken into consideration in future studies. All in all, CDT may favorably influence moods and emotion with joy and other SNS responses without changing DP-related behavior. Patients participated in the CDT could have been influenced by the 'fright-fight-flight' response induced by AD and NA. Significant increases in these neutrotransmitters (AD and NA) induced the SNS responses to provide global physiological responses for challenges required by the patients in performing the dances, although marked increases in DP were not observed. As the 'triple-F' response is a form of stress, which influences immunity, our follow-up investigations should focus more on stress, stress-in-

duced immunosuppression, and joy and euphoria associated with CDT.

5. Conclusion

CDT may favorably influence moods and emotion without changing DP-related behavior. Patients participated in the CDT could have been influenced by the 'fright-fight-flight' response induced by AD and NA. Significant increases in these neutrotransmitters induced the adrenergic and noradrenergic responses to provide global physiological responses to meet the needs of patients in CDT, although marked increases in DP were not observed.

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