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Research Article

Wet Cupping Therapy Improves the Parameters of Ventricular Repolarization

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A B S T R A C T

Background: Cupping therapy (CT) is an ancient medical treatment since antiquity and is used for the treatment of such various disease states as contagious diseases, chronic or acute inflammatory disease, and autoimmune disorders. Ventricular repolarization is represented by QT and corrected-QT (QTc) intervals from surface electrocardiography.
Objectives: As novel repolarization parameters, Tpeak-toTend (Tp-Te) interval, and Tp-Te/QT and Tp-Te/QTc ratios are suggested to correlate better with ventricular arrhythmia risk in various clinical conditions than sole QT and QTc intervals. In this study, we aimed to determine whether these parameters changed significantly after CT in healthy individuals.
Methods: One hundred and twenty participants (57 women and 63 men; mean age: 49.0 ± 13.0 years) participated in this study. ECGs strips were recorded 1 hour before and 1 hour after CT from each participant, and relevant ECG parameters were compared.
Results: Tp-Te interval [69.51 ± 11.54 msec vs 63.15 ± 10.89 msec, p = 0.001], Tp-Te/QT ratio [0.191 ± 0.030 vs 0.174 ± 0.031, $p = 0.002$] and Tp-Te/QTc ratio [0.175 ± 0.030 vs 0.159 ± 0.026, $p = 0.001$] were found to be significantly decreased 1 hour after the procedure compared with the pre-procedure values. However, no statistically significant change was observed in mean heart rate, QT and QTc intervals, QT/QRS and cQT/QRS, and frontal QRS/T angle after the procedure compared with the same parameters before the procedure ($p > 0.05$).
Conclusions: In accordance with the results of our study, it is plausible to conclude that CT may exert cardioprotective effect. However, larger scale prospective studies are needed to support our findings.

1. Introduction

Cupping Therapy (CT) is an ancient medical treatment since antiquity. Its application has been continued in the Far East both by physicians practicing Western medicine and the physicians practicing traditional medicine. Although wet cupping is the most frequently used therapy, there are also various application methods such as needle cupping, dry or moving cupping, retained cupping and medicinal (herbal) cupping.

As an acupuncture method first mentioned in The Yellow Emperor's Internal Classic (Huang Di Nei Jing), wet CT (WCT) uses a three-edged needle to prick certain acupoints of a participants' body or superficial vessels, thereby releasing a small amount of blood to treat diseases. Accordingly, the main scope of this method revolves around local treatment of lesions and improvement of microcirculation at affected areas [1].

The primary mechanism with which WCT becomes effective is precipitation of blood circulation, thus improving blood stasis and getting rid of the waste from the body. Moreover, local harm to the skin and capillaries by the implementation of this therapy serves as nociceptive stimuli which initiate the release of certain bodily substances through activation of nervous system [2].

Ventricular repolarization is represented by QT interval from an electrocardiographic aspect. It has been suggested that QT interval is associated with high ventricular arrhythmia risk in various clinical conditions [3-5]. Moreover, QT interval can also be separated in

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three parts: QRS width; JTpeak (JTp) interval, the time frame between end of QRS and T-wave peak; and, Tpeak-Tend (Tp-Te) interval, the time frame from the peak to the end of T-wave. JTp comprises the largest part of whole QT interval and can roughly be recognized as an early phase of ventricular repolarization, whereas Tp-Te interval represents the late phase of ventricular repolarization. Repolarization in cardiac ventricles starts immediately after the start of ventricular activation. For this reason, QT interval gives an idea about the general repolarization state of the ventricles. On the other hand, Tp-Te interval is recognized as a surrogate of transmural dispersion of ventricular repolarization, and is associated with the varying periods of potentials affecting endocardium, myocardium, and epicardium [6]. As in QT interval, there is evidence showing that prolonged Tp-Te interval is associated with varying degrees of ventricular arrhythmogenic potential [7, 8].

Studies in regard of the effect of WCT on cardiac repolarization parameters are scanty. Arslan et al. demonstrated an improvement in syphato-vagal imbalance through WCT and proposed that WCT was likely to possess cardioprotetive utility [9]. In their ischemic reperfusion injury model study performed on rats, Shekarforoush et al. [10] have suggested that wet cupping does not change basal heart rate and mean arterial blood pressure; however, rates of arrhythmia with ischemic origin were significantly lower in rats receiving wet cupping, and that wet cupping treatment may have a cardioprotective effect. In this study, we aimed to determine whether ventricular repolarization parameters could be improved soon after WCT in healthy individuals.

2. Materials and methods

2.1. Participant recruitment

Our study is a prospective and single-center study. Between January and June 2019, 120 patients presenting with fibromyalgia and migraine (57 women and 63 men; mean age: 49.0 $\pm$ 13.0 years) participated in this study. The exclusion criteria were defined as follows: history of any malignancy, renal, gastrointestinal or liver dysfunction, alcoholism, psychiatric disease, severe respiratory illnesses, severe metabolic disorders, severe cardiac disease, and autonomic nervous system diseases. All of the participants enrolled provided a written informed consent.

2.2. Cupping therapy

Routine physical examinations were performed for the patients before the procedure. Laboratory findings (complete blood count, sedimentation, C-reactive protein, fasting glucose, cholesterol levels, kidney, liver function tests, coagulation parameters, and viral markers) have been evaluated. The medications used, history of any chronic disease or any complains indicative of a probable chronic disease were interrogated and recorded in each of the participants.

Cupping application areas were disinfected with antiseptic products, and it was adjusted in proportion with the weight of the patient, providing 1 cup for each 15 kilograms. Again, in proportion with body mass index, cups with diameters of 5 to 7 cm were used. Application areas were on 7th cervical, 2nd and 4th thoracic vertebrae, one for each to the right and left through horizontal line of xiphoid process, and on 2nd and 4th lumbar vertebrae. After determining anatomic areas, cups were placed on the area and negative vacuum was applied with cupping pump. It was held for an average of 3 minutes. Afterward, the cups were pulled out. With number 11 sterile scalpels, superficial incisions were performed that were no more than 1 mm in length and 0.5 mm in depth. Mean number of incisions were between 10 and 15. The cup was placed on the incision area again and held for about 3 minutes by applying negative vacuum again. The blood filled in the cup was collected with the help of cotton pads and disposed of. Centaury oil was applied and procedure areas were closed with wound pads both for accelerating the healing of the wound and to prevent scarring. Mean amount of blood taken from a patient was between 40 and 100 ml. All cupping procedures were applied by physicians certified by the Turkish Ministry of Health.

2.3. Electrocardiography recording and parameters

In each participant, a MAC 2000 device (GE Medical Systems Information Technologies, Inc., 8200 W, Tower Avenue, Milwaukee, WI, USA) was used to record an 12-lead electrocardiography (ECG) strip at 50 mm/s paper speed and 10 mm/mV amplitude. The ECG strips were then transferred to digital media in a personal computer and analyzed under $\times$ 400% magnification. Recording ECG was applied 1 hour before and 1 hour after CT. Three consecutive complexes in V5 were averaged to end up with the ultimate measurement for each parameter. The time interval from Q-wave onset to T-wave end was defined as QT interval [8, 11, 12]. We measured the Tp-Te interval by using the tangent method, which refers to the time interval between the T-peak and the point of intersection of the tangent of the steepest down-slope of the T-wave and the isoelectric line [13]. QRS duration and QT interval were measured. Then, QT interval was corrected for heart rate using the Bazett's formula. Finally, Tp-Te/QT, Tp-Te/QTc, QT/QRS (index of cardiac electrophysiological balance), and QTc/QRS (corrected index of cardiac electrophysiological balance) ratios were calculated. Two different cardiologists blinded to the study participants calculated the ECG parameters of interest. The interobserver and intraobserver coefficients of variation were 2.9% and 3.3%, respectively.

With regard to the QRS and T-wave axes, they were obtained through the intrinsically presented reports by the ECG device itself [14-16]. The frontal QRS-T angle can be computed as follows: absolute difference was taken between the QRS and T-wave axes to end up with the values between 0 and 180°. If the value exceeds 180°, it was subtracted from 360°.

2.4. Statistics

The statistical analyses were performed using SPSS software (version 20.0, SPSS Inc., Chicago, IL, USA). Normality of the parameters was assessed by the Kolmogorov–Smirnov test. Continuous variables were presented as mean $\pm$ standard deviation or median (25-75 interquartile range) where appropriate. On the other hand, categorical variables were expressed as numbers and percentages. Paired t-test was used for the comparison of the relevant ECG parameters before and after the WCT. p valueS <0.05 were considered as statistically significant.

3. Results

Table 1 represents the basal demographic and laboratory characteristics of the participants receiving WCT. Mean age of the participants was 49 $\pm$ 13 years. Of 120 total participants included in the study, 63 (52%) was male. Changes in the ECG parameters before and after WCT were depicted in Table 2. No statistically significant difference was observed in mean heart rate, QT and QTc intervals, QRS duration, QT/QRS (index of cardiac electrophysiological balance) and cQT/QRS (corrected index of cardiac electrophysiological balance) ratios, and frontal QRS/T angle 1 after WCT compared with the same values recorded 1 hour before the procedure ($p > 0.05$). However, Tp-Te interval [69.51 $\pm$ 11.54 msec vs 63.15 $\pm$ 10.89 msec, $p = 0.001$], Tp-Te/QT ratio [0.191 $\pm$ 0.030 vs 0.174 $\pm$ 0.031, $p = 0.002$] and Tp-Te/QTc ratio [0.175 $\pm$ 0.030 vs 0.159 $\pm$ 0.026, $p = 0.001$] were

Table 1
Demographic characteristics of the study population.

Demographic parameters	
Age, years	49.0 ± 13.0
Gender, male, n (%)	63 (52%)
BMI, (kg/m2)	30.19 ± 4.73
DM, n (%)	18 (15%)
HT, n (%)	33 (27%)
CAD, n (%)	3 (2.5%)
COPD, n (%)	7 (5.8%)
Smoking, n (%)	25 (20%)
HL, n (%)	23 (19.1%)
Biochemical parameters	
Glucose (mg/dL)	108.87 ± 40.07
GFR (mL/min/1.73-m2)	92.74 ± 14.64
Uric acid (mg/dL)	5.59 ± 1.68
AST U/L	24.46 ± 10.73
TG (mg/dL)	182.81 (40-823)
Total cholesterol (mg/dL)	188.16 ± 38.17
LDL-C (mg/dL)	106.89 ± 33.45
HDL-C (mg/dL)	47.72 ± 15.00
TSH mU/L	2.93 ± 2.81
Vitamin D pg/mL	18.38 ± 11.95
Vitamin B12 pg/mL	339.71 (135-669)
WBC (10^9/L)	8.03 ± 1.88
Hgb (g/dL)	15.27 ± 1.28
Platelet (10^9/L)	254.76 ± 52.84
PDW (%)	12.36 ± 1.59

BMI, body mass index; DM, diabetes mellitus; HT, hypertension; CAD, coronary artery disease; COPD, chronic obstructive pulmonary disease; HL, hyperlipidemia; GFR, glomerular filtration rate; AST, aspartat transaminase; TG, trigliseride; LDL-C, low-density lipoprotein cholesterol; HDL-C, high-density lipoprotein cholesterol; TSH, thyroid-stimulating hormone; WBC, white blood cell count; Hgb, hemoglobin; PDW, platelet distribution width.

Table 2
Changes in the ECG parameters after wet cupping therapy.

ECG parameters	1 hour before cupping therapy	1 hour after cupping therapy	*p*
Heart rate, beat/min	78.7 ± 13.93	76.6 ± 12.97	0.137
QT, msec	363.75 ± 30.77	364.15 ± 32.26	0.921
QTc, msec	398.02 ± 21.02	396.90 ± 21.03	0.787
QRS, msec	94.1 ± 17.48	93.9 ± 14.41	0.843
Tp-Te, msec	69.51 ± 11.54	63.15 ± 10.89	**0.001**
Tp-Te/QT	0.191 ± 0.030	0.174 ± 0.031	**0.002**
Tp-Te/QTc	0.175 ± 0.030	0.159 ± 0.026	**0.001**
QT/QRS	3.75∓0.51	3.79∓0.61	0.339
QTc/QRS	4.22∓0.52	4.21∓0.67	0.885
Frontal QRS/T angle, degree	19.5 (11-24)	21 (12-26)	0.231

ECG, electrocardiography. Bold value indicates significant *p* values.

revealed to be significantly decreased 1 hour after the WCT compared with those recorded 1 hour before the procedure. Comparative ECG before and after CT is shown in Fig. 1.

4. Discussion

The present study evaluated ventricular repolarization parameters in participants receiving WCT and showed significant decrease in mean Tp-Te interval, Tp-Te/QT ratio and Tp-Te/QTc ratio 1 hour after WCT. To our knowledge, this is the first study in the literature investigating the ventricular repolarization parameters in participants undergoing WCT.

There is increasing attention on WCT by clinicians around the world because it alleviates the symptoms of various diseases. Moreover, WCT is getting greater and greater attention in the treatment of such various disease states as chronic or acute inflammatory disease, and autoimmune disorders [17]. It is also used in daily practices for the rehabilitation of stroke, treatment of hypertension, and as an alternative therapy for chronic pain. Dry and wet cupping therapies altogether were proposed to have removed excessive toxins and fluids, activated peripheral neural networks, loosened adhesions within the connective tissue, and boosted cutaneous and muscular blood flow [18]. It has been shown in clinical studies that CT poses a modulator effect on immune system by releasing b-endorphin and adrenocortical hormone into circulation with a skin puncture. Furthermore, these hormones may assist in blocking the inflammation during arthritis, thereby exerting beneficial effects on immune system through the central nervous system [19].

There is more than one theory for explaining the effects of CT. Removal of toxins, uric acid, lipoprotein, serum glutamic oxalacetic transaminase, iron and heavy metals can be clarified with blood detoxification theory. Regarding the anti-inflammatory effect of CT, immunological modulation and hormonal adjustment can be explained with immune system activation theory. Decreased pain, changes in the biomechanical characteristics of skin, and acceleration of blood circulation can be explained with pain-gate theory, diffuse noxious inhibitory controls and reflex zone theory. Relaxation of muscles, specific changes in local tissue structures, and increases in blood circulation can be explained with nitric oxide release theory [20].

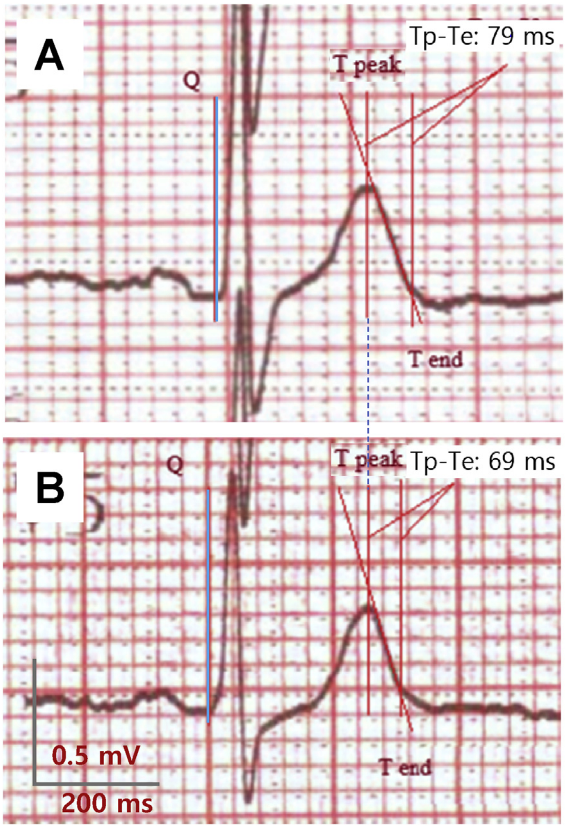

Figure 1. Typical ECG traces showing the decrease in Tp-Te duration before (A) and after the cupping therapy (B) in a subject (male, 42-years old). The ECG signals were obtained from Lead V5. Q, Q wave of ECG; Tpeak, peak of T wave; Tp-Te, duration between the peak and the end of T wave.

CT stimulates acupuncture points and restores the disruptions in the homeostasis. Tham et al. [21] showed that cupping may be capable of stimulating individual acupuncture points.

Therapeutic effectiveness of acupuncture on such disease conditions as myocardial ischemia, hypertension, and certain cardiac rhythm disturbances has been well recognized in the current literature [22]. Aleyeidi et al. [23] indicated WCT as an effective method in the reduction of systolic blood pressure without serious side effects for around 1 month in hypertensive patients.

New parameters estimating the status of ventricular repolarization, such as Tp-Te/QT and Tp-Te/QTc ratios, were reported to be more sensitive compared with the Tp-Te interval itself [24, 25]. Tp-Te interval and Tp-Te/QT ratio have been demonstrated to increase in cardiac diseases such as acute myocardial infarction accompanied with long QT syndrome, short QT syndrome, Brugada syndrome and increased malignant ventricular arrhythmia. Moreover, various other diseases such as psoriasis, obstructive sleep apnea, and autoimmune hepatitis were also suggested to associate with increase in these parameters [26, 27]. Moreover, Yayla et al. [28] reported an increase in Tp-Te interval, and Tp-Te/QT and Tp-Te/QTc ratios in patients with systemic sclerosis as compared with healthy participants.

The main power of our study is the fact that we evaluated ventricular repolarization parameters such as Tp-Te interval, Tp-Te/QT ratio and Tp-Te/QTc ratio, which are commonly used recently in various different studies, in a comparative manner before and after WCT. In this regard, it would be prudent to propose that CT is a noninvasive, safely applied and harmless treatment method that can ensure sympathovagal balance by stimulating peripheral nervous system.

As a future perspective, it is very likely that our study may provide a new frame for future studies to assess the effect of CT on cardiac electrophysiology.

4.1. Limitations

The present article should be assessed with a number of limitations. The first one is that our study was conducted in a single-center and contains limited number of participants. The second is long-term ECG and clinical follow-ups were not performed in the participating patients to evaluate the long-term persistence of the improvement obtained in the relevant parameters of ventricular repolarization. Third, we did not fulfill multimodal recordings and signal amplitude dispersions to seek for more robust heartbeat detection and more qualified ECG assessment in our study.

5. Conclusion

In our study, significant decrease was observed in such parameters of ventricular repolarization as Tp-Te interval, Tp-Te/QT ratio and Tp-Te/QTc ratio 1 hour after WCT. Our results may point out to possible cardioprotective effects of WCT and may also encourage the clinicians to use WCT as an add-on therapeutic option in cardiac arrhythmias. However, the proposed cardioprotective effects of CT need to be proven with future large-scale clinical studies.

Author contributions

M.Ç. contributed to study concept, design, data collection, analysis and interpretation of data; H.E.Y. contributed to study concept; S.S. contributed to analysis and interpretation of data; E.S. contributed to analysis and interpretation of data; C.U. contributed to drafting the manuscript and critical revision.

Declaration of Competing Interest

The authors declare there is no conflict of interests in this study.

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