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Research Article

EFFECT OF SLOW AND FAST PRANAYAMS ON GENDER SPECIFIC DIFFERENCE IN QTC INTERVAL OF HEALTHY YOUNG ADULTS

Rajajeyakumar M*[1], Bhattacharjee M[2], , Madanmohan [3] Balachander J [4]
[1]Assistant Professor Department of Physiology [1], Chennai Medical College Hospital & Research Centre, Trichy, 621105.
[2]Assistant Professor Department of Physiology [2], Vardhman Mahavir Medical College and Safdarjung Hospital, Delhi
[3]Professor & Head, Department of Physiology, Mahatma Gandhi Medical College & Research Centre, Pondicherry.
[4]Professor & Head, Department of Cardiology[3,] JIPMER, Pondicherry.

Corresponding Author: Dr.M.Rajajeyakumar; Email: rajakumar60@ gmail.com

Abstract: Background& objective: Women physiologically have a longer QTc interval and are more likely to suffer from drug induced torsades de pointes and other forms of arrhythmia. The current treatment for fatal arrhythmia is mainly invasive. Hence, there is a need for some non-invasive preventive measure which can be advised to persons with long QTc. In the present study, we assessed the effect of slow and fast pranayams on QTc. **Methods**: 90 volunteers were recruited and informed consent was obtained from them. They were randomly divided into three groups: control group (n=30), kapalabhati group (n=30) and savitri pranayam group (n=30). At the beginning of the study period QTc was recorded during rest, deep breathing (DB) and isometric handgrip (IHG) at 30% of maximum voluntary contraction (MVC). Fast yogic breathing group were practiced kapalabhati whereas slow yogic breathing group were practiced Savitri pranayam for three months, after which QTc was recorded again during the same experimental conditions. One way ANOVA was used for baseline inter-group comparison. An unpaired't' test was done to compare the values between male and female subjects. Results: Female subjects had a longer QTc which was uniformly observed in all the groups. In general, Practice of pranayam shortened the QT in both sexes. However, females responded better to both kapalabhati and savitri pranayam, whereas males were more responsive to the former. **Interpretation & conclusion**: From our study, both fast and slow pranayam were beneficial to both sexes. Therefore, pranayam can be advised in conditions with prolonged QTc. The results of this study therefore have strong clinical implications.
Key word*:* Kapalabhathi pranayam, QTc interval, Savitri pranayam

Introduction

QT interval reflects the time between the initial fast depolarization of the ventricle and its subsequent repolarization. This interval is an easily accessible non-invasive marker of repolarization[1]. Since the duration of depolarization is dependent on heart rate, QT intervals need to be corrected for heart rate. Haverkamp et al have reported that the Bazett equation ($QTc = QT / \sqrt{RR}$) has been most frequently applied for heart rate correction[2]. The QT interval has gained clinical importance, primarily because prolongation of this interval can predispose to a potentially fatal ventricular arrhythmia known as *torsades de pointes*[3]. Multiple factors such as older age, female sex and slower heart rate have been implicated in QT prolongation and *torsades de pointes.*

QT interval is prolonged at slower heart rates and shortened at faster heart rates[4]. A prolonged heart rate–adjusted QT is considered as a marker of ventricular instability and is usually associated with an increased sympathetic drive and is a risk factor for ventricular arrhythmias and sudden death in patients with myocardial infarction and hypertension[5]. Women have slower cardiac repolarization than men, which manifests as longer heart rate corrected QT intervals on the ECG[6] . This sex difference is apparent after puberty. A heart rate corrected QT interval of more than 440 ms in males and 460 ms in females is of considerable concern[7]. Furthermore, women are more prone than men to develop *torsades de pointes* ventricular arrhythmias after administration of drugs that prolong cardiac repolarization[8]. This sex difference might be due to down regulation of expression of cardiac potassium channel genes by female sex hormones which has been shown to prolong the QT interval[9].

The current treatment for fatal arrhythmia is mainly invasive. Hence, there is a need for some non - invasive preventive measure which can be advised to persons with long QTc interval such as females, post myocardial infarction patients and patients suffering from hypertension. In an earlier work, we have reported that pranayam (yoga breathing technique) is of value in patients with benign ventricular ectopics[10]. In view of this, the present study, we planned to determine

1. The effect of kapalabhati and savitri pranayam pranayam training on QTc (a marker of ventricular instability).
2. Effect of Deep breathing and isometric handgrip on QTc.

Materials and methods

The present study was conducted in department of physiology, JIPMER, Pondicherry. Ninty young healthy volunteers were recruited after obtaining ethical clearance from the institutional Human Ethics Committee. Their age

ranged between 17- 20 years (17.65 ± 0.15), body weight between 46 - 65 kg (53.72 ± 2.28) and height between 146 – 173 cm (168.5 ± 1.12). All volunteers underwent a routine clinical examination at the beginning of the study to rule out presence of any major health problem. The subjects were randomly divided into control group, kapalabhati group and savitri pranayam group.

The study did not involve intravascular instrumentation or administration of drugs at any stage. The participants were explained in detail about the study protocol and informed consent was obtained from them. They were advised to refrain from smoking, drinking alcohol and any other exercise other than those prescribed during the study period.

***Study design*:**
ECG was acquired using Biopac MP 100 hardware, BIOPAC Inc., USA and instantaneous heart rate and RR intervals were continuously plotted using the MP 100 BIOPAC AcqKnowledge *3.7.1* software and a Microsoft Windows-based PC. QT & QTc intervals were analyzed by lab chart pro 6 software, (AD Instruments, Australia).Blood pressure (BP) was measured using an automated non-invasive BP monitor (Colin Press-Mate, Model BP 8800, Colin Corporation Inc., Japan). This measures BP by the oscillometric method. A standard adult-size cuff measuring 23 cm by 12 cm was used for all subjects. The record was obtained under the following experimental conditions:

1. Rest
2. Deep breathing
3. Isometric handgrip at 30% of maximum voluntary contraction (MVC)

1. Rest: Each volunteer was instructed to rest for five minutes followed by base line parameters like HR, SBP and DBP were recorded. ECG was recorded in the sitting posture for at least 330 seconds to determine resting RR and QTc intervals.

2. Deep breathing: This is a test used to assess the parasympathetic limb of the autonomic nervous system. With the subject comfortably seated in a chair, the procedure for deep breathing was demonstrated. The subject was instructed to inspire for five seconds and expire for five seconds so as to have a cycle of six breaths per minute. It was ensured that the volunteer has understood the procedure and the chest excursions during the maneuver were monitored. During this condition the ECG was recorded. The RR, QT, and QTc intervals were computed.

3. Isometric handgrip at 30% of maximum voluntary contraction: This test assesses the sympathetic reactivity of an individual. Using a handgrip dynamometer, the volunteer was asked to do maximum voluntary contraction (MVC) for a few seconds. After five minutes rest, they were asked to maintain 30% of MVC for one minute. ECG was recorded during the entire procedure.

Following these recordings, the volunteers were trained for three months either in kapalabhathi or savitri pranayam or instructed to refrain from any yogic practice or exercise depending on whether they belonged to kapalabhati group, savitri pranayam group or control group. Pranayam was taught to both groups separately by a trained yoga instructor. After the pre test, the volunteers of both pranayam groups will be given 1 hour session of instructions about diet, life style modification and pranayam practices. Supervised pranayam practices will be given thrice per week (Monday, Wednesday, and Friday) for kapalabhathi pranayam group and (Tuesday, Thursday, Saturday) for Savitri pranayam group. Each pranayam session consists of three cycles in 30 min between 4.30 pm to 5.00 pm and each cycle consists of 5 min practice of pranayam followed by 5 min rest. All the volunteers will be motivated to perform the same at home also. All the parameters will be recorded after 12 weeks and obtained data will be analyzed statistically.

Procedure for kapalabhathi: Kapalabhathi was practiced in the sitting posture (with erect spine) in a well ventilated room. Sharp contractions of abdominal muscles produce active and quick expiration while inspiration was relatively passive. The subject performs 30 cycles in 1 minute. Stancak had described that the kapalabhati consists of fast shallow abdominal respiratory movements at about 2 Hz. Stancak et al have described the technique to perform kapalabhati step by step[11].

Procedure for savitri pranayam: Savitri pranayam was also practiced in sitting posture (with erect spine) in a well ventilated room. The subjects were asked to breathe slowly, uniformly and deeply with a ratio of 2:1:2:1 between inspiration (purak), held-in (kumbhak), expiration (rechak) and held-out (shunyak) phases[12]. Parameters recording were repeated after three months of training.

Calculation of R- R interval: A detailed account of techniques of R- R interval analysis is given in the Task Force Report of the European Society of Cardiology [13].

Calculation of QTc: QT & QTc intervals were analyzed by lab chart pro 6 software (AD instruments, Australia). The files from the BIOPAC AcqKnowledge software 3.7.1 were imported into lab chart pro 6 software. The QTc interval was calculated using Bazett formula ($QTc = QT/\sqrt{RR}$).

Data analysis: Data was analyzed using SPSS statistical program (version 16 for Windows. SPSS Inc Chicago IL, USA). One way ANOVA was used for baseline inter-group comparison. An unpaired t test was done to compare parameters between male and female subjects and a paired t test to compare values at the beginning and end of the study period. P value less than 0.05 was considered significant.

Results

Table I: The data is expressed as Mean ± SEM .Intergroup comparison showed no statistically significant difference between the groups with respect to pre training baseline values. Post training analysis showed that significant changes in all three groups except in case of BMI which was not significant. Kapalabhathi training produced a significant increase ($p \leq 0.001$) in HR and SBP except RR interval which was decreased statistically ($p \leq 0.001$) as compared to both control and Savitri groups. It was found that Savitri

pranayam also produced a significant decreased ($p \leq 0.001$) in DBP as compared to the control group.

Table I: Comparison of baseline parameters between three groups at the beginning and end of three months.

Groups	Control	Kapalabhathi	Savitri	P value	F/df
BMI Beginning	22.42± 0.414	23.21± 0.332	22.88± 0.311	0.3	1.219/(2,87)
BMI End	22.54± 0.430	22.40± 0.309	22.49± 0.312	0.959	0.042/(2,87)
SBP Beginning	118.50±1.05	115.73±1.74	115.53±1.82	0.338	1.099/(2,87)
SBP End	122.53± 1.15	118.20± 1.68***	111.53± 1.69££	0	13.091/(2,87)
DBP Beginning	68.43± 0.813	64.63± 1.51	65.76± 1.97	0.194	1.670/(2,87)
DBP End	71.93± 1.08	65.83± 1.19***	63.03± 1.28***	0	14.645/(2,87)
HR Beginning	74.87± 1.38	74.97± 0.896	72.90± 1.08	0.357	1.042/(2,87)
HR End	75.38± 1.66	85.90± 2.19***	73.29± 1.39£££	0	14.401/(2,87)
RR Beginning	0.788±0.019	0.753±0.013	0.799±0.019	0.165	1.837/(2,87)
RR End	0.806±0.016	0.710±0.090***	0.827±0.015£££	0	14.604/(2,87)

Values are expressed as (Mean ± SEM). One way ANOVA was used for baseline inter-group comparison.
*P ≤ 0.05, **P ≤ 0.01, ***P ≤ 0.001.
* Comparison of kapalabhathi pranayam group with control group
* Comparision of Savitri pranayam group with control group
£ comparison of kapalabhathi pranayam group with Savitri pranayam group.
BMI = body mass index; HR = heart rate; SBP = systolic blood pressure; DBP = diastolic blood pressure; RR- RR interval.

Table II: QTc intervals (Mean ± SEM) in seconds in male and female subjects at the beginning and end of three months study period during conditions of supine rest, deep breathing (DB) and isometric handgrip at 30% of maximum voluntary contraction (IHG 30%).

		Supine rest		DB		IHG 30%	
Groups		**Beginning**	**End**	**Beginning**	**End**	**Beginning**	**End**
Control	**Male**	0.342± 0.006	0.334± 0.003	0.34±0.006	0.336± 0.007	0.335± 0.006	0.337± 0.006
	Female	0.368± 0.009£	0.366± 0.009*	0.333± 0.007	0.341± 0.005	0.367± 0.006£££	0.361± 0.007***
Kapalabhati	**Male**	0.338± 0.006	0.347± 0.003	0.333±0.010	0.312± 0.007	0.343± 0.006	0.365± 0.006
	Female	0.375± 0.008£	0.359± 0.007	0.366± 0.007££	0.347± 0.005**	0.361± 0.009£££	0.375± 0.007***
Savitri pranayam	**Male**	0.351± 0.007	0.327± 0.005	0.331± 0.005	0.317± 0.007	0.355± 0.008	0.345± 0.011
	Female	0.375± 0.005£	0.352 ± 0.005 *	0.328± 0.007	0.323± 0.007	0.379± 0.009	0.360± 0.006

An unpaired t test was done to compare parameters between male and female subject's values at the beginning and end of the study period. P value less than 0.05 was considered significant.
£ P< 0.05 ££ P < 0.01 £££ P < 0.001 Comparison between male and female volunteers at the beginning of the study
* P< 0.05 ** P< 0.01 *** P< 0.001 Comparison between male and female volunteers at the end of the study.
DB - Deep breathing; IHG 30%. - Isometric handgrip at 30% of maximum voluntary contraction.

Table-II: Control group: At the beginning of the study the females exhibited significantly longer QTc interval as compared to males during rest ($p \leq 0.05$) and during IHG ($p \leq 0.01$). The post–training values were not significantly different from the pre-training values under all experimental conditions.

Kapalabhati group: In this group a gender difference in QTc interval was observed with the females having a longer interval during all three experimental conditions both before and after the 3 month study period. However, when the initial and latter values were compared within the same sex, there was a significant reduction in the QTc interval in females during deep breathing. The males did not show any significant difference in their values at the beginning and end of the study period.

Savitri pranayam group: The female volunteers of this group had a prolonged QTc interval during rest ($p \leq 0.05$) and this difference was not abolished with three months practice of savitri pranayam. On comparing the initial values with those at the end of the study within the same sex, both the males and females exhibited a decrease in QTc interval during rest. No such decrease was observed during deep breathing or isometric hand grip.

Discussion

Effect of three months pranayam training on cardiovascular parameters:

In the present study showed that a significant fall in SBP, DBP and RR interval after 12 weeks of practice of kapalabhathi pranayam with compare to control group but HR was significantly increased. A significant increase in SBP, DBP with compare to Savitri group except RR interval which was significantly lower. This changes probably due to high sympathetic tone as reported earlier and blood pressure changes in contrast with the finding [11]. In Savitri pranayam group a significant decrease in SBP, DBP in compare to control group .HR was decreased and RR interval was increased which was significantly significant with compare to kapalabhathi group. Savitri pranayam is a slow type of breathing known to enhance parasympathetic tone. This was in accordance with the finding of Madanmohan et al 1983[12, 17].

A wide variation in QT intervals results from physiological factors, such as diurnal effects, sex difference, differences in autonomic tone; pathological factors such electrolytes, drugs; and technical factors, including environment, processing of the record, and intra and inter observer variability. Congenital long QT syndrome is a rare cardiac disorder and the affected persons present with prolongation of the QTc. These patients are at increased risk for syncope and sudden death due to life threatening ventricular arrhythmias. Females are more prone to develop cardiac arrhythmias probably owing to their longer cardiac repolarization time which is manifested as a longer QTc interval in them[14].

Deep breathing at six breaths per minute has been recently reported to be associated with a significant reduction in the frequency of premature ventricular complexes[10]. The control group showed no change at the end of the three month study period. However, a highly significant difference was observed between the male and female volunteers of the kapalabhati group both at the beginning and end of the study period. The females showed a shortening of the QTc during rest and DB after three months. This attained statistical significance only during DB. The males of this group showed an increase in QTc during rest and decrease during DB. During IHG both the sexes hand a prolongation of QTc. There are reports which indicate that kapalabhati pranayam enhances the sympathetic system. The QTc interval was prolonged with handgrip[15,]. It is difficult to explain our results solely on the basis of these reports.

The volunteers of the savitri pranayam group exhibited a gender difference during rest and not during deep breathing and isometric handgrip. Also, at the end of three months both sexes showed a significant shortening in the QTc interval during rest. There are reports in the literature which say that savitri pranayam enhances parasympathetic activity[12]. A decrease in QTc interval indicating a shift towards parasympathetic dominance may be due to decrease in cardiac sympathetic activity, which is seen after yoga.[16.] It is interesting to note however, that the QTc interval has shortened after the three months study period irrespective of the pranayam practiced and the experimental condition with the exception of isometric handgrip in the kapalabhati group. Although, this did not attain statistical significance at all times.

From our study, it appears that both fast and slow pranayam may be beneficial[18] but there may be a gender based variation in the responsiveness to these pranayam. It appears that savitri pranayam is more effective in males with regards to shortening of QTc interval, whereas both kapalabhati and savitri are effective in females. Although, it was not evident in all three experimental conditions. Therefore, practice of pranayam has positively influenced the females who physiologically exhibit a prolonged QTc[16]. Hence, this pranayam is likely to be useful even in pathological conditions of prolonged QTc and as a prophylactic measure during drug therapy known to prolong the QT interval.

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