EFFECT OF COLD HIP BATH ON AUTONOMIC VARIABLES IN HEALTHY INDIVIDUALS - A RANDOMIZED CONTROL TRIAL

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Abstract: Introduction: Cold hip bath is clinically used in the treatment of gastrointestinal, gynecological and urogenital dysfunction but its physiological effects are not understood fully. This study aims to study the physiological changes following the cold hip bath. Aims and Objectives: To evaluate the changes in the autonomic variables such as Pulse rate, Heart rate variability, Respiratory rate, and blood pressure following the cold hip bath. Material and Methods: Sixty healthy individuals (18 female and 42 male) of mean age 20.65±0.54 were randomly recruited for study group (n=30) and control group (n=30). The study group was made to sit in a hip bath tub filled with cold water of 60°F (15.55°C) for fifteen minutes and the control group was made to sit in an empty tub for the same duration. The pulse rate, blood pressure and heart rate variability were assessed before the intervention (baseline) and after the intervention. Results: There was a significant reduction in Systolic blood pressure (p<0.000) and Diastolic blood pressure (p<0.007), low frequency component (LF, p<0.006) and significant increase in high frequency component (HF, P<0.006) of Heart rate variability in cold hip bath. Conclusion: Cold hip bath shifts the sympatoh-vagal balance to parasympathetic dominance.

Keywords: Autonomic variables; cold hip bath; heart rate variability; parasympathetic dominance

INTRODUCTION

Hip bath is a hydrotherapeutic measures in which lower abdomen i.e. pelvis, including genitals and upper portion of thigh is immersed in water of various temperatures depending upon desired therapeutic effects[1]. It is clinically employed in constipation, indigestion, sub-involution of uterus, hemorrhoids, chronic uterine infections, chronic congestion of prostate, impotency, and sterility[2]. It decongests the brain and spinal cord and ensures better sleep and rest. It is believed to increase the intestinal enzymatic secretions and peristaltic movement[3]. The probable mechanism for improving the gastrointestinal functions could be due to activation of vagus nerve, the nerve responsible for sensory, secretory and peristaltic movement of the gastro-intestinal tract[4]. Yet, the physiological basis of these claimed benefits has not been established. Hence to understand the physiological basis of the cold hip bath and to correlate its use in clinical practice, this study has been carried out.

MATERIAL AND METHODS

Participants

Sixty students from our college in Dakshina Kannada, aged between 18-24 years (20.65 ± 0.54) were recruited for the study. The inclusion criteria; age group of 18-24 years; BMI (body mass index) of 18.5kg/m²-24.99 kg/m²; healthy and not having any medical condition and willingness to participate voluntarily. Exclusion criteria; Weak and debilitating individuals, individuals having systemic illness, smoking, and taking recreational alcohol. A written informed consent was taken from the participants after explaining them the detail procedure and ill effect of the treatment i.e related to cold intolerance. The ethical clearance was taken from the ethical committee of the college.

Study designs

Sixty participants were randomly assigned to two groups, study group (n=30, male=21 and female=9) and control group (n=30, male=21 and female=9) by using the online random number generating tool at the website-www.random.org. The study group included healthy participants of average age 20.27±2.43 years with average BMI 20.95±2.1 kg/m². The control group included healthy participants of average age 21.03±2.63 years with average BMI of 20.09±1.71 kg/m². All the participants of both the group completed the study successfully.

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Interventions

Participants of both the groups reported in empty stomach for the intervention. The study group was given a cold hip bath for fifteen minutes. For this procedure, hip bath tub (model No. 0273M, Indian Fibre Company), made up of fibre, and was filled to its two-thirds with water of temperature 60°F (15.55°C). The participants were instructed to sit in the water filled tub in such that the area between umbilicus and mid-thigh falls in the water. They were instructed to rest their foot on the foot rest and hands to be kept outside the water. They were allowed to lean back in the tub[5].

The control group participants were instructed to sit in the empty hip bath tub in the same position and for an equal duration as for intervention group.

Assessments

Following Autonomic and respiratory variables were assessed using a four-channel polygraph MP-36, BIOPAC system Inc., U.S.A.[6].

Heart rate variability (HRV)

HRV analysis was done using HRV analysis software version 2.2 developed by the Biomedical Signal Analysis Group (University of Kuopio, Finland)[7]. The pre-gelled Ag/Agcl electrodes were placed in standard bipolar limb lead II configuration for the measurement of electrocardiogram[EKG]. The data were analyzed offline[6].

The respiratory rate

The respiratory rate was recorded by fixing volumetric pressure transducer around the trunk at the level of the lower costal margin. Care was taken to make subjects sit erect and adjustment of the strap was not limiting the full inspiration. Breath rate was calculated in cycles per minute by counting the breath cycles in 60 sec epochs, continuously[6].

Pulse digital volume

The photo-electric transducer was used to measure the pulse digital volume. It was placed on the volar surface of the distal phalanx of the right index finger. The light emitting diode faced the volar surface. Pulse rate was calculated in beats per minute by counting the number of peaks in 60 second epochs, continuously[6].

Blood pressure

Before measuring the blood pressure the subjects were made to rest for 5 minutes on a chair with feet on the floor and arm properly supported at heart level. The cuff was tied to subject’s arm placing the lower edge about 3 cm above the elbow crease[8]. The cuff pressure was inflated 30 mm Hg above the level at which the radial pulse disappeared and then deflated slowly at the rate of about 2mm per sec[8].

The mercury sphygmomanometer was used for measuring blood pressure and recording was made in both arms. After comparing the inter arm recording, the highest value was considered for interpretation. The post intervention blood pressure was measured in same arm of which baseline blood pressure was considered[8].

Statistical analysis

Data were checked for the normality using Kolmogorov-Smirnov. The statistical analysis of within group was performed using paired samples-t-test and Wilcoxon signed ranks test and between group analysis was performed using independent samples-t-test and Mann-Whitney U test with the use of Statistical Package for Social Sciences (SPSS), version 16 (2007, USA). p value < .05 was considered as significant.

RESULTS AND DISCUSSION

Result

The recruited sixty participants were randomized into two group, study group (n=30) and control group (n=30). Baseline and post intervention assessment of each intervention were taken before and after the respective intervention. To compare baseline and post-intervention assessments between the group independent samples-t-test and Mann-Whitney U test were performed and to compare within the group paired samples-t-test and Wilcoxon signed ranks were performed.

There were no significant differences in demographic variables of the subjects of both the
groups participated in this study (Table-1)

Table-1: Demographic variables of study group (n=30) and control group (n=30).

<table>
<thead>
<tr>
<th>Variables</th>
<th>Study Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>20.27±2.45</td>
<td>21.03±2.63</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>165.4±8.604</td>
<td>165.2±8.852</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>57.53±3.390</td>
<td>56.66±7.321</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>20.95±2.1</td>
<td>20.69±1.77</td>
</tr>
</tbody>
</table>

*All values are in mean ± standard deviation

The result of our study showed statistically significant reduction in Systolic blood pressure (SBP, P<0.000), Diastolic blood pressure (DBP, P<0.007), mean Heart rate (HR, P<0.03) and Low frequency (LF, P<0.006) and significant increase in High frequency (HF, P<0.006) variables in the study group. There was a statistically significant increase in Mean RR (Respiratory rate) in both the group. There was no significant difference observed either in study group or control group in RMSSD (the square root of the mean of the sum of the squares of differences between adjacent NN intervals), NN50 (the number of interval differences of successive NN intervals greater than 50 milliseconds), pNN50% (Proportion derived by dividing NN50 by the total number of NN intervals) and VLF (Very low frequency band of the HRV) variables (Table-2).

Table-2: Baseline and post-test assessments of study group and control group.

<table>
<thead>
<tr>
<th>Sr. No.</th>
<th>Variables</th>
<th>Study Group</th>
<th>Control Group</th>
<th>Between Group analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Pre-test</td>
<td>Post test</td>
<td>Pre-test</td>
</tr>
<tr>
<td>1.</td>
<td>SBP(mmHg)</td>
<td>105.53±21.24</td>
<td>95.13±13.12**</td>
<td>103.33±11.26</td>
</tr>
<tr>
<td>2.</td>
<td>DBP(mmHg)</td>
<td>68.53±13.75</td>
<td>62.73±9.34**</td>
<td>65.07±9.08</td>
</tr>
<tr>
<td>3.</td>
<td>PPG(beats/min)</td>
<td>95.15±4.00</td>
<td>94.68±3.84</td>
<td>92.72±3.10</td>
</tr>
<tr>
<td>4.</td>
<td>RR (cycle/ min)</td>
<td>15.61±1.13</td>
<td>15.53±1.26</td>
<td>15.50±1.54</td>
</tr>
<tr>
<td>5.</td>
<td>Mean RR</td>
<td>810.81±122.90</td>
<td>856.24±123.48**</td>
<td>820.49±113.06</td>
</tr>
<tr>
<td>6.</td>
<td>STD RR</td>
<td>64.56±27.13</td>
<td>63.80±28.82</td>
<td>59.75±29.99</td>
</tr>
<tr>
<td>7.</td>
<td>Mean HR</td>
<td>74.21±9.93</td>
<td>71.86±9.86*</td>
<td>74.93±10.40</td>
</tr>
<tr>
<td>8.</td>
<td>STD HR</td>
<td>12.15±34.02</td>
<td>5.25±1.87**</td>
<td>5.20±2.07</td>
</tr>
<tr>
<td>9.</td>
<td>RMSSD</td>
<td>58.67±33.63</td>
<td>62.22±37.92</td>
<td>52.29±27.81</td>
</tr>
<tr>
<td>10.</td>
<td>NN50</td>
<td>94.84±44.44</td>
<td>101.63±68.37</td>
<td>50.73±54.48</td>
</tr>
<tr>
<td>11.</td>
<td>pNN50</td>
<td>35.44±24.76</td>
<td>33.17±24.75</td>
<td>28.33±20.18</td>
</tr>
<tr>
<td>12.</td>
<td>LF</td>
<td>53.23±21.59</td>
<td>45.02±21.79**</td>
<td>51.56±23.44</td>
</tr>
<tr>
<td>13.</td>
<td>HF</td>
<td>46.77±21.59</td>
<td>54.98±21.79**</td>
<td>48.24±23.56</td>
</tr>
<tr>
<td>14.</td>
<td>LF/HF</td>
<td>1.91±1.94</td>
<td>1.43±1.86</td>
<td>4.92±1.073</td>
</tr>
</tbody>
</table>

Note: All values are in mean ± standard deviation. * P value < 0.05. ** P value < 0.01

SBP = Systolic blood pressure; DBP = Diastolic blood pressure; RR = Intervals between consecutive R-waves; PPG = Pulse plethysmogram; RR = Respiratory rate; HR = Heart rate; STD RR = Standard deviation of RR; RMSSD = the square root of the mean of the sum of the squares of differences between adjacent NN intervals; NN50 = the number of interval differences of successive NN intervals greater than 50 milliseconds; pNN50 = Proportion derived by dividing NN50 by the total number of NN intervals; VLF = Very low frequency band of the HRV; LF = Low frequency band of the HRV; HF = High frequency band of the HRV; LF/HF ratio = Ratio of low frequency to high frequency

Discussion

This study examined the effects of cold hip bath and empty hip bath on autonomic variables. In this study within the group analysis showed the statistically significant reduction in SBP, DBP, HR, and LF and a significant increase in HF in cold hip bath group.

The reduction in SBP in study group might be due to baroreceptor reflex[9]. Cold water application initially accelerates the cardiovascular system function and increases the pulse rate but after three minute of application this stimulating effect diminishes[5]. This effect may be due to adaptation of the cold receptors thus decreasing their firing rate[4].

Cold water immersion increases the plasma beta endorphin level[10]. And Beta endorphins have shown to decrease the arterial blood pressure[11]. Cold hip bath might also increase the plasma
endorphin level and thus contributes to decrease in arterial blood pressure.

The reduction of DBP in study group might be due to the reduction in centrally mediated peripheral resistance or due to vasodilatation through local mechanisms like Nitric Oxide[9]. Peripheral vasocostriction effect of general cold water immersion last lesser than ten minutes and withdrawing of cold water application produces the marked cutaneous vasodilation[5].

In our study, there is partial immersion of the body part i.e. only pelvic part and the physiological effects are measured after five minute of withdrawal of the intervention. So, the increase peripheral resistance by cold hip bath might have lasted lesser than five minutes followed by peripheral vasodilation. Thus, might have contributed to decrease diastolic blood pressure.

The decrease in LF and increase in HF in study group suggest the influence of cold hip bath in the shifting of sympatho-vagal balance towards the vagal dominance[12][13]. Decrease in LF component may be due to inhibition of the sympathetic area in posterior nucleus of the hypothalamus[14] and increase in HF may be due to subsequent activation of the parasympathetic area in the pre-optic nucleus of the hypothalamus[4].

The strengths of the study are; effective randomization; and, no any adverse effects during the study. Limitations of the study are; a smaller sample size; study of immediate effect only; no study of how long the effect lasted for; no blinding. Measurement of the gastro-intestinal motility could have been given a better understanding.

CONCLUSIONS

The result of this study showed cold hip bath has tendency to decrease the systolic and diastolic blood pressure and shift the sympatho-vagal dominance towards the vagal dominance. Large scale randomized control trials are warranted to confirm the results.

References