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Immediate Effect of Cold Chest Pack on Autonomic Functions in Healthy Individuals – A Randomised Controlled Trial

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Abstract :
Background And Objective: *Cold chest pack is used as the first line of treatment in the management of cardiovascular and respiratory lifestyle disorders. Though cold chest pack is used for both rejuvenation as well as therapy its physiological effect is less understood. Hence this study aims to evaluate the physiological effect of cold chest pack on HRV.*
Materials And Methodology*: 60 male and female healthy volunteers of mean age 22.2 were recruited for the study. Subjects were randomly allocated into two groups, group1cold chest pack for 30 min, group 2 sham chest pack for 30min. Assessments will be done 5min before and 5 min immediately after the intervention.*
Results*: Results of the present study shows a significant reduction in mean HR (p=0.0309) and mean RR (p=0.0141) in the cold chest pack group. In control group, significant reduction in RR (p=0.0141).*
Conclusion: *To conclude, cold chest pack enhances the parasympathetic activity than the sham (dry) chest pack.*
Keywords*: Cold chest pack, Heart rate variability, Heart rate, Naturopathy, Sham chest pack*

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I. Introduction

Cold chest pack along with hot foot and arm bath for bronchial asthma is clinically used in naturopathy to relieve pulmonary congestion, decrease pulmonary mucous membrane irritation and increase the depth of respiration.Cold chest pack increased peak expiratory flow rate as an immediate effect in bronchial asthma patients. Cold chest pack along with hot foot and arm bath in bronchial asthma patients is believed to reduce pulmonary congestion, decrease pulmonary mucous membrane irritation and increase depth of respiration [1]. Naturopathy along with other treatment modalities uses cold chest pack as the first line of treatment in the management of various disorders. The chest pack is used in pulmonary congestion, pulmonary tuberculosis, chronic bronchitis, chronic pneumonia, chronic pleuritis, pulmonary hemorrhage and threatened cardiac failure [2]. Another study showed spa therapy improved ventilator function in steroid dependent intractable asthma[3]. Another study by sathyaprabha et al on naturopathic intervention (included massage, hydrotherapy, colour therapy, fasting and diet therapy, mud and yoga therapy) in bronchial asthma patients showed significant improvement PEFR, vital capacity, forced vital capacity, forced expiratory volume1, FEV/FEC%, Maximum voluntary ventilation and absolute eosinophil count [4].

Though cold chest pack has been extensively used in clinical scenario both for rejuvenation as well as therapy, its underlying mechanisms are less understood.There are no previous studies on the effect of cold chest pack on heart rate variability specifically as such. It is essential to understand the underlying mechanisms of cold chest pack on autonomic nervous system before applying them as therapeutic agents.

II. Methodology

2.1. Subjects

Sixty healthy volunteers of ages ranging between 18 to 30years were recruited.

2.1.1. Study Group

Students from Sri Dharmasthala Manjunatheshwara (SDM) College of Naturopathy and YogicSciences, Ujire, Dakshina Kannada were recruited for the study.

2.1.2. Inclusion criteria

- The subjects who were found to be healthy based on routine medical examination conducted by a primary care physician.
- Age: 18 to 30 years. Average age 22. 2
- Both males and females were selected.
- Those who gave written informed consent.

2.1.3. Exclusion criteria

The following criteria were used to exclude the volunteers:

- Volunteers with any disease condition.
- Females during menstrual cycle because autonomic variables vary during this period [5].
- Those who are under any medications which has an influence on autonomic variables e.g.: phenylpropanolamine.
- Those who consume alcohol and nicotine.
- Weak and debilitated individuals.

2.1.4. Consent form

The subjects were instructed about the study. A signed informed consent was obtained from eachindividual willing for the study. Institutional Ethical Committeeapproved the study.

2.2. Study setting

Condition of recordings: The subjects were seated on a chair recording leads were connected to thefour-channel polygraph equipment (BIOPAC, Montana, USA; model No: BSL 4.0 MP 36) and monitored on aclosed circuit TV. Instructions were given to the subjects to remain relatively undisturbed during the session

2.3. Design

The study adopted was Randomized Control Trial. 60 healthy volunteers were divided in to twogroups. Subjects were randomly allocated into two groups using computerized generated random number table.Group 1 received cold chest pack, group 2 received sham chest pack

2.4. Assessments

All the subjects of both cold chest pack and sham chest pack group were assessed beforeand after the treatment.Assessments were done 5minutes before and 5 minutes immediately after the intervention.Condition of recordings: The subjects were seated on a chair recording leads were connected to thefour-channel polygraph equipment (BIOPAC, Montana, USA; model No: BSL 4.0 MP 36) and monitored on aclosed circuit TV. Instructions were given to the subjects to remain relatively undisturbed during the session.

2.4.1. Variables Studied

Hence in the present thesis the assessments measures have been described as variables.

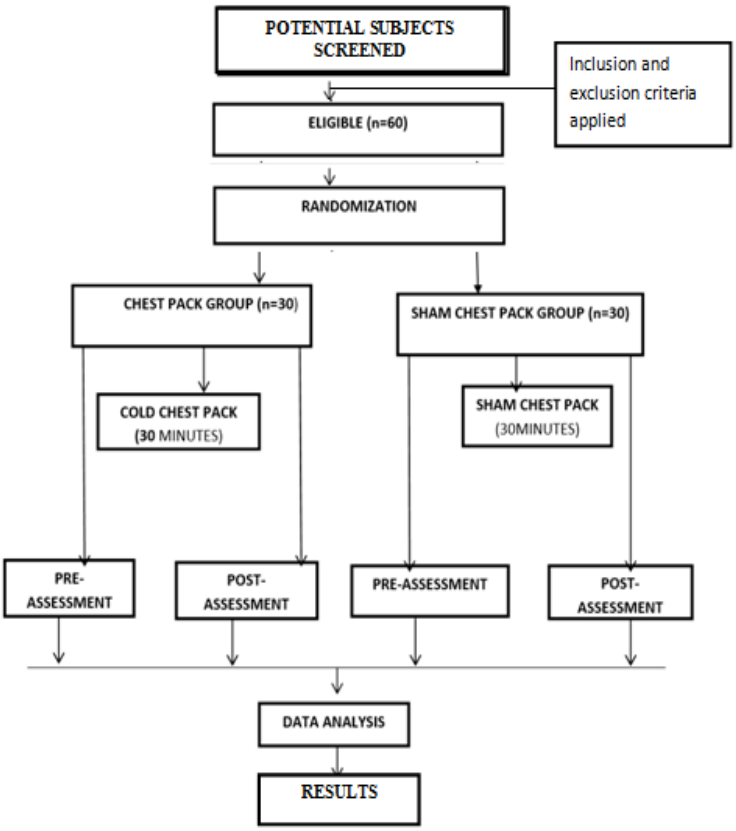
Autonomic and respiratory variables.

- Heart rate and Heart rate variability spectrum (HRV)
- Respirogram
- Digital Pulse Volume
- Blood Pressure
- Body temperature

2.5. Intervention.

The cold chest pack, consists of a cotton cloth, approximately 2.5m long and 0.5m wide, soaked in water at room temperature and wrung out completely. It will be applied over the chest, covering both front and back, followed by a wrapping of woolen flannel of the same dimensions of the cotton cloth [1]. The sham chest pack consists of a dry cotton cloth, approximately 2.5m long and 0.5m wide. It will be applied over the chest covering both front and back. The subjects will be assessed five minutes before and five minutes after the intervention. The subjects were asked to drink one glass of cold water for before going for cold chest pack and one glass of warm water, before going for sham chest pack intervention in respective groups. Intervention will be done in sitting position.

Figure1: Illustration of trial profile



2.7. Stastical analysis.

The raw data obtained from each subject in each recording session were tabulated separately. Thedistribution of the data and normality assumption were estimated, then the group's mean, standard deviation calculated for all the variables. Independent T test was used to compare cold chest pack and control group pretest and posttest for each variable separately. Statistical analysis was done using Statistical Package for Social Sciences (SPSS 21.0).

III. Results

The independent t- test for paired data: Mean RR shows significant reduction (p=0.0309) in cold chest pack or experimental group.Mean HR shows significant reduction (P=0.0144) in cold chest pack or experimental group.There is a significant reduction (P=0.0144) in RR of the control group. Hence compared with the control group cold chest pack shows significant parasympathetic activity.Frequency variables like VLF, LF, HF and LF/HF did not show any significant change both in experimental as well as control group.

The main observed results were

1. Mean HR significant reduction in chest pack group (p=0.0144)
2. Mean RR significant reduction in cold chest pack group (p=0.0309)
3. RR significant reduction in control or sham chest pack group (p=0.0141)
4. All indices were very likely lowered compared with control but there is no significance value.

On comparing the 2 groups the results suggest parasympathetic dominance following cold chest pack which is reflected by significant reduction in Mean HR (p=0.0144) and Mean RR (p=0.0309)

Table 1:independent t test of all variables control and ccpk with respect to pre and post test.

	PRE MEAN (SD)		POST MEAN (SD)		p-VALVE	
VARIABLES	CCPK	SCPK	CCPK	SCPK	CCPK	SCPK
SBP	105.93 ± 9.49	105.33±12.2	106.2 ± 9.16	106.27 ±9.91	0.8473	0.4219
DBP	64.73± 8.87	65.93 ± 6.27	65.93 ± 8.69	67.27 ± 4.88	0.2539	0.1270
RR	16.10 ± 1.48	16.22 ± 1.26	15.87 ± 1.19	15.55 ± 1.18	0.3416	0.0141*
BT	36.13 ± 0.64	35.62 ± 0.6	36.16 ± 0.73	35.74 ± 0.74	0.7664	0.1603
Mean RR	778.73± 104.63	747.33 ± 82.81	799.06± 99.37	752.02± 90.66	0.0309*	0.7064
SDNN	61.93± 29.21	61.27 ±35.57	65.80 ±27.72	58.72±18.75	0.0670	0.6255
Mean HR	78.87± 10.82	82.62 ± 9.36	76.77 ± 9.41	81.50 ± 10.43	0.0144*	0.4163

RMSSD	53.7 ± 31.84	50.83 ± 33.33	56.89 ±30.70	48.78 ± 24.95	0.2203	0.5576
NN50	106.5±71.46	91.93 ±69.73	106.92±69.72	92.43 ±76.34	0.9376	0.9301
pNN50	29.35± 21.32	24.28 ± 19.72	29.96 ± 21.01	24.77 ± 21.8	7091	0.7772
VLF	28.88± 16.73	36.13 ± 17.13	29.91 ± 14.93	36.31 ± 17.47	6349	0.9627
LF	47.15± 22.33	54.56 ± 24.17	47.35 ± 24.51	53.91 ± 18.41	9429	0.8299
HF	52.83± 22.33	46.63 ± 22.78	52.66 ± 24.49	47.42 ± 16.78	9448	0.7941
LF/HF	1.69 ± 2.59	2.06 ± 2.26	2.42 ± 4.43	1.61 ± 1.62	1681	0.1811

<0.05 Considered has a significant.

SD=Standard deviation, HR=Heart rate, RR=Respiratory rate, PR=Pulse rate, MEANRR= Mean of RR interval, RMSSD=The square root of the mean squared difference between adjacent N-N intervals,NN50=Consecutive normal sinus (NN) intervals exceeds 50 ms, pNN50=The fraction of consecutive NNintervals that differ by more than 50 ms, VLF=Very low frequency power, LF=Low frequency Power, HF=Highfrequency power, LF/HF=Low frequency/High frequency ratio, SBP=Systolic blood pressure, DBP=Diastolicblood pressure and TEMP=Temperature.

IV. Discussion

The main aim of the study was to evaluate the physiological effect of cold chest pack. The present study was conducted to evaluate the changes in the autonomic variables such as heart rate, heart rate variability. Respiratory rate, Body temperature and blood pressure following cold chest pack in normal healthy volunteers. There were 60 normal healthy volunteers both male and female were recruited for the study. Subjects were randomly allocated into two groups, group 1 cold chest pack and group 2 sham chest pack for 30 minutes each. Assessments were done 5 minutes before and 5 min immediately the intervention. All the 60 members had gone through the intervention without any dropouts.

A Study shows that cold water immersion induces fast post exercise parasympathetic reactivation. Cold water immersion is a better strategy to increaseparasympathetic activity. At rest, the equilibrium between the two branches of the ANS confers a cardioprotective back ground. The sympathetic accelerates HR parasympathetic acts as brake on heart rate. Cold stimulation triggers peripheral vasoconstriction, leading to a shift in blood volume towards the core. The resulting increase in central pressure in turn activates the baroreflex, responsible for reducing sympathetic nerve activity while shifting autonomic heart rate control towards a parasympathetic dominance [6].

Stanley et al reported that cold water immersion significantly aided post exercise parasympathetic reactivation. As exercise causes an intensity dependent parasympathetic withdrawal and sympathetic increase [7]. According to another study, superficial cold receptors that are innervated by the ophthalmic branch of the trigeminal nerve would enhance the cardio vagal activity [8].Hence in our study superficial cold receptors could have played a role is increasing parasympathetic activity.In another study done by Syan et al on Migraine patients there was a significant decrease in heart rate (p=0.017) following ice massage to head and hot foot and bath [9]. In another study a significant relationship between water temperature and heart rate is shown. At 25 degrees Celsius, heart rate drops approx. 12 to 15bpm, cohereas at thermoneutral the rate drop is less than 15% and in warm water the rate generally rises significantly. Cold water temperature plays a large role in the increased peripheral vasoconstriction with enhanced central blood volume [10].

A Significant reduction in local blood volume was found for cold gel pack in healthy ankles. This reduction was attributed to pack's temperature [11].A study on alternate hot and cold application for heel pain done by Arankalle et al showed significant effect. In this study 20 patients were randomly assigned tostandard naturopathic physiotherapy carewith two adjuvant therapy groups: a control group (therapeutic ultrasound, n= 10) and alternating compress (n= 10). The variables measured pain score (VAS) and foot functionality using foot function index (FFI)before and after treatment. Results showed FFI reduced significantlyfrom 46.97 to 31.98(p=<0.001) in alternating compress group. Average VAS pain intensity decrease from 3.53 to 2.53(p=<0.001)in naturopathy care and from 4.09 to 2.61(p=<0.001) in alternating compress group. Hence, hot and cold compress improved foot functionality and pain scores. It is a known fact that pain reduction is achieved by enhanced parasympathetic activity [12].

According to Dr. Ramesh K Khurana et al, cold face test can be effectively used in assessment of trigeminal- brainstem- vagal function in humans. Based on this we can infer that cold stimulates para sympathetic activity [13].

V. Conclusion

To conclude after investigating the physiological effect of thermic effect of water on autonomic variables, the study shows that cold chest pack enhanced parasympathetic activity. Meanwhile sham (dry) chest pack also showed parasympathetic activity to a lesser extent. Based on this finding cold chest pack for 30 minutes can be applied for those lifestyle disorders with sympathetic dominance on cardiovascular and

respiratory system like stress, insomnia, hypertension. However long term as well as large population studies is required to understand the autonomic variation to cold chest pack.

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