Original article

Cardiovascular Sympathetic Function Status by Cold Pressor Test in Lactating Mothers

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Abstract

Background:
Lactation has a significant impact on women cardiac autonomic control and various cardiometabolic changes which occurs during lactation that influence women health.

Objective:
The study was aimed to assess the cardiovascular sympathetic functions status by the cold pressor test in lactating mothers.

Methods:
This cross-sectional analytical study was conducted in the Department of Physiology, Rangpur Medical College, Rangpur from July 2022 to June 2023. After obtaining permission, a total 100 subjects who were met the inclusion criteria and enrolled in the study after briefing them objectives of the study. Among them 50 apparently healthy lactating mothers (Group A) and 50 apparently healthy non-lactating mothers (Group B) were selected through purposive sampling. The evaluation of sympathetic functions in selected individuals was done by cold pressor test. The individuals were selected from Breast Feeding or Lactating Corner, Out Patient Department of Paediatrics. For statistical analysis, unpaired 't' test was performed by computer-based software SPSS-25 version for windows.

Results:
Resting systolic and diastolic blood pressure was significantly higher ($P<0.001$) in lactating mothers. After cold pressor test the mean change of both systolic and diastolic blood pressure response by cold pressor test was significantly higher ($p<0.01$) in lactating mothers group compared to control group.

Conclusion:
Increased resting systolic and diastolic blood pressure in lactating mothers and increased diastolic blood pressure response by cold pressor test in lactating mothers indicate increased sympathetic functions.

Keywords: Lactating mothers, Non-lactating mothers, Cold pressor test.

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Introduction:

Lactation is the secretion of milk from the mammary glands and the period of time that a mother lactate her child. The pregnancy and lactation process naturally occurs with sexually mature female.[1] Lactation results in a number of physiological adaptations which exert direct effects on maternal health. It is ascertain that the association of lactation with later health derives from healthier lifestyle in mother who choose to breast feeding. The frequency of feeding also is an important factor for determining breast feeding effect of maternal sympathetic nervous system functions.[2] Various cardiometabolic changes that occurs during lactation that influence women

health.[3] Lactation have significant effects on mother and child. Lactation that affects maternal sympathetic nervous system functions.[4,5] There are many health benefits of lactation. Lactation in early postpartum period causes a more rapid return of the uterus to its prepregnant state through the actions of oxytocin. Lactation delays the return of ovulation and significantly reduces fertility during the period of lactational amenorrhoea.[6] Short term benefits of lactation include decreased blood pressure, more positive moods, pregnancy associated weight loss, and fertility control.[7,8] Long term benefits of lactation reduces risk of certain cancers, cardiovascular diseases, hypercholesterolemia, type 2 diabetes Mellitus.[9,10] The autonomic nervous system is the part of nervous system that is responsible for regulation and integration of internal organs functioning. Sympathetic activity can inhabit milk production and milk ejection on lactation.[11] Stress and anxiety can rise cortisol levels, which can negatively impact on milk production.[12,13] Sympathetic nervous system can also interfere with milk ejection reflex, which is triggered by release of oxytoc in in response to suckling.[14] Several tests are used for evaluation of cardiovascular reflexes triggered by performing specific provocative maneuvers. A commonly used technique to rapidly elicit stress reaction is cold pressor test (CPT).[15] Cold pressor response is an indicator of sympathetic activity after cold stress. Cold stress causes massive discharge of sympathetic nervous system and release of norepinephrine. The sympathetic discharge triggers response in the cardiovascular (CV) system that includes arteriolar constriction, increased HR and increased cardiac activity. These responses combine to increase BP. This is known as the pressor response and testing a subject with cold stress in this fashion as the cold pressor test.[16,17] The features of cardiovascular sympathetic functions in lactating mothers are conflicting. Moreover, there was lack of adequate information regarding sympathetic function status in lactating mothers of our country. Present study was designed to assess the changes of cardiovascular autonomic function status in lactating mothers. These tests could help in early detection and quantification of degree of autonomic function and prevent further complication.

Methods:

This is cross sectional analytic study was conducted in department of Physiology, Rangpur Medical College Rangpur from July 2022 to June 2023. A total number of 100 individuals, which are apparently healthy lactating mothers and their age ranged from 20-30 years were included in this study. Sample of lactating mothers are collected from Breast feeding or Lactating corner and Out Patient Department of Paediatrics Rangpur Medical College, Rangpur. Before performing the sympathetic nerve function test and collection of sample all the subjects are briefed about the objective of study. Informed written consent of the study subjects was taken in easy understandable Bengali phase. All information was recorded in a preformed questionnaire after taking history and through clinical examination. All the subjects were divided into two groups, among them 50 lactating mothers was considered as group-A and 50 are non-lactating mothers as group-B. They were matched with age, BMI and socioeconomic condition. Study was carried out with prior protocol approved by thesis protocol review committee and ethical committee of Rangpur Medical College. History of diabetes mellitus, History of hypertension, cardiac disease, psychiatric disorder (depression), history of taking neurotoxic drug, history of taking sympathomimetic drugs, history of taking oral contraceptive pills, obesity and overweight, renal disease, pregnancy was taken as exclusion criteria. From the previous night up to the examination, they were not undergoing any physical or mental stress and not to take any sedatives or any drugs affecting central nervous system. Then the autonomic nerve function parameters were assessed by cardiac reflex tests using sphygmomanometer and ECG machine. Blood glucose, serum creatinine level and serum alanine amino transferase were measured to exclude diabetes mellitus, chronic renal failure and liver diseases respectively. Cold pressor test was conducted in a comfortable environment in the department of physiology laboratory from 9.00am – 2.30pm.

Resting blood Pressure:[15] The subjects were asked to take rest for 10 minutes in supine position and resting blood pressure was recorded in supine position and expressed as mmHg. Three readings were taken and the average of three was taken as the resting blood pressure.

Cold pressor test:[15] After recording basal blood pressure, subjects were asked to immerse left hand (up to 2 inches proximal to wrist crease) in the cold water for 2 minutes and temperature was maintained at 4-6^{0}C throughout the procedure. Blood pressure measurement was made from right arm at pain threshold time, which was defined as time between immersion of hand and subjective feeling of pain. Maximum increase in systolic and diastolic pressure was recorded. A rise of diastolic pressure ≥10 mm of Hg and increase in the systolic pressure 10-20 mm of Hg was considered as normal response and less than this considered as abnormal.

All data were recorded systematically in a preformed history sheet and all statistical analysis was done by computer using the software SPSS 25.0 version for windows. Comparison between the experimental group with control group was done by unpaired 't' test. In the interpretation of result, <0.05 level of probability was accepted as significance.

Result:

The mean±SD of age was 24.04±2.35 years in group A and 23.92±2.52 in group B. The mean±SD of height was 157.64± 8.62 in group A and 162.20±7.89 in group B. The mean±SD of weight was 51.24±4.85 in group A and 52.30± 5.76 in group B. The mean±SD of BMI was 20.77±1.10 in group A and 21.25±1.14 group B. The age, height, weight and BMI were statistically non-significant between the groups (Table-I).

Table-ll showed the mean±SD of resting systolic and diastolic Blood pressure were in group A 115.08±7.37 and 71.68±7.29 and resting systolic and diastolic blood pressure were 110.32±7.87 and 65.65±8.62 in group B. The mean resting systolic and mean resting diastolic blood pressure were significantly higher (p<0.001) in group A then group B.

Table-I: Age, height, weight and body mass index of the study subjects of in group A and group B (N=100)

Variable (mean±SD)	Group A	Group B	p-value
Age	24.04±2.35	23.92±2.52	0.806
Height	157.64±8.62	162.20±7.89	0.418
Weight	51.24±4.85	52.30±5.76	0.972
BMI	20.77±1.10	21.25±1.14	0.943

Table-II: The resting blood pressure of the study subjects in Group A and Group B (N=100)

Variable (mean±SD)	Group A	Group B	p-value
Resting systolic blood pressure	115.08±7.37	110.32±7.87	0.000
Resting diastolic blood pressure	71.68±7.29	65.65±8.62	0.000

The mean±SD systolic pressure change in cold pressor test were in group A 11.833±2.4506 and in group B 12.166±5.363, The mean values were significantly (p<0.01) lower in group A than group B (Table-III).

The mean±SD diastolic pressure change in cold pressor test were in group A 16.900±7.4429 and in group B 13.7000 ±5.518, The mean values were significantly (p<0.001) higher in group A than group B (Table-III).

Table-III: The statistical analysis of systolic and diastolic blood pressure changes in cold pressor test in study subjects of different groups (n=100)

Variable (mean±SD)	Group A	Group B	p-value
Systolic blood pressure change in cold pressor test	11.833± 2.4506	12.166±5.363	0.009
Diastolic blood pressure change in cold pressor test	16.900±7.4429	13.7000±5.518	0.000

Discussion:

The present study was carried out to observe the cold pressor test and compare between apparently healthy lactating mothers and non-lactating mothers. In lactating mothers significantly higher ($p<0.01$) diastolic blood pressure was found in cold pressor tests, when compared to non-lactating mothers. This finding is consistent with that of some other investigators.[3,16,17] In contrast some other researchers did not find any significant difference in cold pressor test in lactating mothers and non-lactating mothers.[18,19]

The sympathetic nervous system is best known for its role in responding to stressful situation, the altered cold pressor test in the lactating mothers group could possibly because of hyperfunction of sympathetic nervous system. The cold pressor test elicits the pressure response to a cold stimulus and is an indicator of vasoconstrictor tone. The cold pressor test which increase sympathetic vasoconstriction and inhabit vagal control of heart rate, resulting in increased heart rate and blood pressure.[6] The sympathetic motor nerve control blood vessel tone and the degree of contraction of nipple area and adrenal catecholamine are released by suckling stimulation, which causes circulatory level of catecholamine that stimulate sympathetic overactivity.[9]

Therefore, CPT, being a reliable, non-invasive and simple screening tool in early diagnosis of autonomic dysfunction and risk of cardiovascular complication.However, the exact mechanisms involved for the impairment of sympathetic nerve function in lactating mothers of the present studies cannot be elucidated.

From this above discussion it may be concluded that significantly higher values of diastolic blood pressure in response to cold pressor test in lactating mothers, indicate increase sympathetic activity may be due to sympathetic nerve activation . This study may be helpful in early diagnosis of autonomic nerve alteration and can be used to prevent further complication.

Conclusion:

From the outcome of the present study suggested that with the help of simple, noninvasive cold pressor test, it has been shown that cardiovascular sympathetic nerve function activity was increased in lactating mothers individuals indicate sympathetic overactivity. This might provide diagnostic information about early subclinical sympathetic dysfunction and is a useful tool to monitor the efficacy of therapeutic and lifestyle modification. As our study was cross sectional and limited in sample size. We recommend studying this test in a larger population may be diagnosis of autonomic nerve alteration and can be used to prevent further complication.

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