ISSN: 0975-3583,0976-2833 VOL15, ISSUE 12, 2024

ORIGINAL RESEARCH

To determine lying to standing test, cold pressor test, and hand grip tests in different phases of menstruation in young healthy females

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Received: 15 October, 2024 Accepted: 17 November, 2024

Abstract

Background: Hormonal changes that occur at regular intervals throughout a woman's menstrual cycle affect many different parts of her body, including the autonomic nervous system (ANS). The ANS, comprising parasympathetic and sympathetic components, regulates important physiological processes such as heart rate, blood pressure, and vascular tone.

Aim: To determine lying to standing test, cold pressor test, and hand grip tests in different phases of menstruation in young healthy females.

Materials & methods: Researchers from the Index Medical College & Research Center conducted a study in Indore, Madhya Pradesh, involving 100 participants aged 18-25. The participants were required to provide written informed consent and be between 18-25. Eligible participants were not pregnant, nursing, residents of the study area, or those with a history of autonomic dysfunction. The study included cardiac autonomic testing, dietary habits, and a comprehensive medical, family, and medication history. The hand grip test involved taking blood pressure readings at rest, while the cold pressor test involved submerging the hand in cool water at 100ºC. The study also included a 10-minute lying down period to help the participant transition to a standing position, and recording vitals at various intervals. The study aimed to understand the effects of various medications on cardiac function.

Results: The study reveals that during the luteal phase, resting systolic and diastolic blood pressure increases, indicating sympathetic dominance. Postural challenge tests and cold pressor tests also increase these pressures. However, both systolic and diastolic blood pressure decrease with these tests, and without them. Handgrip exercise also increases these pressures during the luteal phase, while handgrip exercise decreases them in the follicular phase. These findings highlight the importance of balancing exercise and stress in maintaining blood pressure.

Conclusion: The study utilized lying-to-standing, cold pressor, and handgrip tests to assess young healthy women's autonomic function. Results showed changes based on phase, with parasympathetic activity in the follicular phase and sympathetic dominance in the luteal phase.

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Key words: Lying posture; standing posture; cold pressor; hand grip; menstruation; follicular phase; luteal phase.

Introduction

Hormonal changes that occur at regular intervals throughout a woman's menstrual cycle affect many different parts of her body, including the autonomic nervous system (ANS). The ANS, comprising parasympathetic and sympathetic components, regulates important physiological processes such as heart rate, blood pressure, and vascular tone. Hormonal changes during the menstrual cycle, specifically during the follicular, ovulatory, and luteal phases, may alter autonomic responses, according to emerging data. However, the exact nature of this association is still not fully known [1-3].

There are non-invasive ways to measure the balance of the sympathetic and parasympathetic nervous systems [4]. Some examples of these procedures are the lying-to-standing test, the cold pressor test, and the handgrip test [5]. A measure of autonomic reactivity and baroreceptor sensitivity, the lying-to-standing test compares the subjects' heart rates and blood pressures as a function of postural changes [6,7]. One measure of prolonged sympathetic activation during isometric exertion is the handgrip test, while the other is the cold pressor test, which looks at the sympathetic response to cold-induced stress [8-11].

Using these tests, this study intends to examine how young, healthy girls' autonomic responses change during their menstrual cycles. Improving clinical evaluations and making sense of autonomic dysfunction in women depend on our ability to comprehend such differences. In order to better understand female physiology and its effects on health and illness management, this study aims to shed light on phase-specific autonomic regulation.

Materials & methods

In Indore, Madhya Pradesh, researchers from the Index Medical College & Research Center's Department of Physiology made observations in a clinical setting. Using simple random sampling, one hundred participants from Indore city, ranging in age from eighteen to twenty-five, made up the study population. To be eligible to participate, individuals had to have provided their written informed consent and be between the ages of 18 and 25. Individuals who did not meet the following criteria were not eligible to participate: they were not pregnant or nursing, they did not reside in the study area, they had a history of systemic hypertension, dyslipidemia, coronary heart disease, autonomic disease, polyneuropathy, or any condition that could lead to autonomic dysfunction; they were also not willing to provide written informed consent for the study; they were smokers, alcoholics, or patients taking oral contraceptives, hormone replacement therapy, or medications that alter the heart's electrical conduction system. The research included cardiac autonomic testing, dietary habits, and a comprehensive medical, family, and medication history.

For the hand grip test, we took the subject's blood pressure readings at rest. For a short period of time, we had the subject hold with his dominant hand as firmly as possible. We carried out this process three times. Maximum voluntary contraction (MVC) was defined as the highest of the three measurements. The dynamometer marked a third of the subject's maximum voluntary contraction (MVC). The investigator instructed the subject to maintain a steady grip on the dynamometer for four minutes, until they reached the mark. If the participant feels unable to maintain his balance for the entire four minutes, he should signal to the researcher. The investigator noted how long the person could keep their grasp. While taking the test, the participant should remain still. We took the blood pressure on the opposite arm at 1, 2, and 4 minutes after the patient began contracting, or immediately before the grip if the contraction was shorter than 4 minutes. We remeasured two minutes following the release of the grip. We took the subject's blood pressure at rest as part of the cold pressor test. We took a 30-second

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 12, 2024

baseline electrocardiogram. Cool water at 100ºC was prepared. We instructed the participant to submerge their hand for one minute, ensuring the water reached their wrist. We measured the blood pressure before removing the hand from the water. Remove the hand from the water and cover it with a towel. We then took blood pressure 1.5 and 4 minutes after the hand withdrawal, respectively. As part of the exam, we instructed the individual to lie down for 10 minutes to help them transition to a standing position. Starting point data includes BP, HR, and electrocardiogram. We then instructed the patient to stand up in three seconds, and recorded their vitals at half-hour, one-, two-, three-and-a-half, and five-minute intervals. We recorded the subject's electrocardiogram for 2 minutes after they stood up.

Statistical analysis

The statistical studies were carried out using SPSS software, and a significance level of $p < 0.05$ was used to evaluate the data distribution parameters by standard normality tests and ANOVA for comparison.

Results

Table 1: Comparison of lying to standing test parameters in the different phases of menstruation.

Parameters	Menstrual (n=100)	Proliferative (n=100)	Secretory (n=100)	ANOVA P value
Resting SBP (mmHg)	117.22± 3.12	124.34 ± 5.57	120.2 ± 4.42	**<0.0001**
Resting DBP (mmHg)	83.24±4.55	70.24±4.24	76.54±5.37	**< 0.05**
Postural SBP (mmHg)	106.18±4.18	101.24±4.42	108.22±4.62	**< 0.001**
Postural DBP (mmHg)	63.41±3.21	61.15±3.32	66.13±3.23	**< 0.05**

Data presented in Table 1 shows that during the luteal phase, there was significant increase in the resting systolic and diastolic blood pressure showing the sympathetic dominance. Both systolic and diastolic blood pressure also showed significant increase ($p<0.05$) with the application of the stimulus of postural challenge test during the luteal phase. In the follicular phase, both the systolic and diastolic blood pressure decreased with the application of the stimulus challenge test and without the stimulus, the decrease is statistically significant ($p<0.05$).

Table 2: Comparison of cold pressor test (CPT) parameters in the different phases of menstruation.

Parameters	Menstrual (n=100)	Proliferative (n=100)	Secretory (n=100)	ANOVA P value
CPT SBP (mmHg)	126.18±3.30	122.42±3.38	130.22±3.13	**<0.0001**
CPT DBP (mmHg)	87.23±4.17	81.44±4.13	91.24±4.47	**< 0.05**

Data presented in Table 2 shows that during the luteal phase, there was significant increase in the resting systolic and diastolic blood pressure showing the sympathetic dominance. Both systolic and diastolic blood pressure also showed significant increase ($p<0.05$) with the application of the stimulus of cold pressor tests during the luteal phase. In the follicular phase, both the systolic and diastolic blood pressure decreased with the application of the stimulus cold pressor tests and without the stimulus, the decrease is statistically significant ($p<0.05$).

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Table 3: Comparison of hand grip test (HGT) parameters in the different phases of menstruation.

Parameters	Menstrual (n=100)	Proliferative (n=100)	Secretory (n=100)	ANOVA P value
HGT SBP (mmHg)	121.16±3.12	113.17±3.13	125.13±2.22	**<0.0001**
HGT DBP (mmHg)	75.25±2.15	71.17±1.19	79.13±3.24	**< 0.05**

Data presented in Table 3 shows that during the luteal phase, there was significant increase in the resting systolic and diastolic blood pressure showing the sympathetic dominance. Both systolic and diastolic blood pressure also showed significant increase ($p<0.05$) with the application of the stimulus of handgrip exercise during the luteal phase. In the follicular phase, both the systolic and diastolic blood pressure decreased with the application of the stimulus of handgrip and without the stimulus, the decrease is statistically significant ($p<0.05$).

Discussion

In the current study, we observed a significant rise in the resting systolic and diastolic blood pressure during the luteal period, in contrast to the menstrual phase. In the follicular phase, estrogen causes vasoconstrictors like angiotensinogen II and endothelins to not be made. Instead, it encourages the release of prostacyclin and nitric oxide. [6,7]. It lowers the release of noradrenaline a lot during the follicular phase, but estrogen increases the density and function of presynaptic α2 adrenoreceptors [8]. Estrogen stimulates the opening of calcium-activated potassium channels via the nitric oxide and cyclic guanosine monophosphate routes, therefore inducing smooth muscle relaxation and hence vasodilation. [9] A rise in acetylcholine concentration may be associated with estradiol. This could potentially explain why the follicular phase experiences lower sympathetic activity compared to the luteal phase [10].

By countering actions of estrogen, progesterone may raise cardiac excitability during the luteal phase.[11] On the cardiovagal baroreflex responses, progesterone also causes inhibition. [12] Luteal phase estradiol peaks serve to boost progesterone receptors. Progesterone hormone's enhanced action during the luteal phase may explain the enhanced sympathetic activity. Studies have demonstrated that ovarian steroids during the normal menstrual cycle alter the autonomic nervous system's activity, with parasympathetic dominance in the follicular phase and sympathetic dominance in the luteal phase, thereby influencing the resting blood pressure. [13,14] In all three periods of the menstrual cycle, our study revealed a statistically significant variation in postural change in systolic and diastolic blood pressure. When someone abruptly shifts from a supine to a standing position, there is a peripheral pooling of blood in the dependent areas of the body; this reduces venous return and cardiac output, thereby lowering the systolic blood pressure. The sinoaortic reflex, which works in seconds, helps steady the blood pressure. [15] The follicular phase dominates parasympathetic activity, which reduces baroreflexes brought on by postural alterations. Moreover, in the premenstrual phase, baroreflex regulation of the sympathetic component rises. Thus, we determined that postural variation throughout the menstrual cycle alters baroreflex control of autonomic activities. [16] Our investigation revealed statistically significant ($p < 0.05$) differences in the systolic and diastolic blood pressure response to the cold pressor test between the luteal phase and the menstrual and follicular phases. Cold water stress's increased sympathetic activity results in norepinephrine release and blood pressure raising. The release of endothelins, prostaglandins, and angiotensin II could potentially explain blood pressure increases. [17] The second part of the menstrual cycle marked a much higher pain threshold for women, suggesting higher ovarian steroid and endorphin levels. [18-20] During isometric handgrip activity, nerve endings that are sensitive to metabolites in the interstitium of skeletal muscle usually pick up on rising levels of metabolites such as adenosine and lactic

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 12, 2024

acid. These medicines increase the discharge of group IV (metaboreceptor) afferent fibers. This sets off a strong reflex that makes the sympathetic nerves work harder. This causes vasoconstriction, which fuels the increase in blood pressure.[19] Oestrogen clearly affects the blood flow via the hand and forearm, particularly on the venous tone, although the effects of progesterone on peripheral blood flow are dubious. [20-22]

Conclusion

This study used the lying-to-standing, cold pressor, and handgrip tests to test the autonomic function of young, healthy women at various points throughout their menstrual cycles. The results showed that there were changes based on phase, with parasympathetic activity being more prevalent in the follicular phase and sympathetic dominance during the luteal phase. These results highlight the significant role of the menstrual cycle in autonomic regulation, which is important for both physiological evaluations and therapeutic uses. Menstrual phase consideration enhances the precision of autonomic function studies in women.

Conflict of interest

There is no conflict of interest among the present study authors.

References

1. Rodrigues GD, Gurgel JL, Gonçalves TR, da Silva Soares PP. Inspiratory muscle training improves physical performance and cardiac autonomic modulation in older women. European journal of applied physiology. 2018 Jun;118:1143-52. Masroor S, Bhati P, Verma S, Khan M, Hussain ME. Heart rate variability following combined aerobic and resistance training in sedentary hypertensive women: a randomised control trial. Indian heart journal. 2018 Dec 1;70:S28-35.
2. Zlibinaite L, Skurvydas A, Kilikeviciene S, Solianik R. Two months of using global recommendations for physical activity had No impact on cognitive or motor functions in overweight and obese middle-aged women. Journal of Physical Activity and Health. 2020 Dec 22;18(1):52-60.
3. Deschodt-Arsac V, Lalanne R, Spiluttini B, Bertin C, Arsac LM. Effects of heart rate variability biofeedback training in athletes exposed to stress of university examinations. PloS one. 2018 Jul 26;13(7):e0201388
4. Grimaldi D, Carter JR, Van Cauter E, Leproult R. Adverse impact of sleep restriction and circadian misalignment on autonomic function in healthy young adults. Hypertension. 2016 Jul;68(1):243-50.
5. Vannuccini S, Fondelli F, Clemenza S, Galanti G, Petraglia F. Dysmenorrhea and heavy menstrual bleeding in elite female athletes: quality of life and perceived stress. Reproductive Sciences. 2020 Mar;27:888-94.
6. Stults-Kolehmainen MA, Sinha R. The effects of stress on physical activity and exercise. Sports medicine. 2014 Jan;44:81-121.
7. Karayigit R, Naderi A, Akca F, Cruz CJ, Sarshin A, Yasli BC, Ersoz G, Kaviani M. Effects of different doses of caffeinated coffee on muscular endurance, cognitive performance, and cardiac autonomic modulation in caffeine naive female athletes. Nutrients. 2020 Dec 22;13(1):2.
8. Strahler J, Skoluda N, Kappert MB, Nater UM. Simultaneous measurement of salivary cortisol and alpha-amylase: application and recommendations. Neuroscience & Biobehavioral Reviews. 2017 Dec 1;83:657-77.
9. Wunsch K, Kasten N, Fuchs R. The effect of physical activity on sleep quality, well-being, and affect in academic stress periods. Nature and science of sleep. 2017 Apr 26:117-26.

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10. Charkoudian N, Stachenfeld N. Sex hormone effects on autonomic mechanisms of thermoregulation in humans. Autonomic Neuroscience. 2016 Apr 1;196:75-80.
11. Turan V, Mutlu EK, Solmaz U, Ekin A, Tosun O, Tosun G, Mat E, Gezer C, Malkoc M. Benefits of short-term structured exercise in non-overweight women with polycystic ovary syndrome: a prospective randomized controlled study. Journal of physical therapy science. 2015;27(7):2293-7.
12. Altenburg TM, Rotteveel J, Serné EH, Chinapaw MJ. Standing is not enough: A randomized crossover study on the acute cardiometabolic effects of variations in sitting in healthy young men. Journal of science and medicine in sport. 2019 Jul 1;22(7):790-6.
13. Joyner MJ, Barnes JN, Hart EC, Wallin BG, Charkoudian N. Neural control of the circulation: how sex and age differences interact in humans. Comprehensive Physiology. 2015 Jan;5(1):193.
14. Williams JS, Dunford EC, MacDonald MJ. Impact of the menstrual cycle on peripheral vascular function in premenopausal women: systematic review and meta-analysis. American Journal of Physiology-Heart and Circulatory Physiology. 2020 Dec 1;319(6):H1327-37.
15. Gordan R, Gwathmey JK, Xie LH. Autonomic and endocrine control of cardiovascular function. World journal of cardiology. 2015 Apr 4;7(4):204.
16. Yazar Ş, Yazıcı M. Impact of menstrual cycle on cardiac autonomic function assessed by heart rate variability and heart rate recovery. Medical Principles and Practice. 2016 Feb 1;25(4):374-7.
17. Pal R, Singh SN, Chatterjee A, Saha M. Age-related changes in cardiovascular system, autonomic functions, and levels of BDNF of healthy active males: role of yogic practice. Age. 2014 Aug;36:1-7.
18. Rodrigues B, Lira FS, Consolim-Colombo FM, Rocha JA, Caperuto EC, De Angelis K, Irigoyen MC. Role of exercise training on autonomic changes and inflammatory profile induced by myocardial infarction. Mediators of inflammation. 2014;2014(1):702473.
19. Machi JF, Dias DD, Freitas SC, de Moraes OA, da Silva MB, Cruz PL, Mostarda C, Salemi VM, Morris M, De Angelis K, Irigoyen MC. Impact of aging on cardiac function in a female rat model of menopause: role of autonomic control, inflammation, and oxidative stress. Clinical Interventions in Aging. 2016 Mar 22:341-50.
20. Miller AJ, Arnold AC. The renin–angiotensin system in cardiovascular autonomic control: recent developments and clinical implications. Clinical Autonomic Research. 2019 Apr 1;29:231-43.
21. Kisan R, Sujan MU, Adoor M, Rao R, Nalini A, Kutty BM, Murthy BC, Raju TR, Sathyaprabha TN. Effect of Yoga on migraine: A comprehensive study using clinical profile and cardiac autonomic functions. International journal of yoga. 2014 Jul 1;7(2):126-32. *DOI:* 10.4103/0973-6131.133891