

Comparison of sympathetic nervous system activity in pre and post-menopausal Women

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Abstract

Background: Menopause is the permanent cessation of menstruation. After menopause, primordial follicles become atretic, and the ovaries stop producing oestrogen. The presence of oestrogen receptors in the heart, vascular smooth muscles, and autonomic brain stem centers indicates that they play a role in cardiovascular regulation.

Aim of the study: This study aims to compare the sympathetic autonomic nervous system activity in pre and post-menopausal women.

Methods: This study was a cross-sectional analytical study conducted in Department of Physiology, Rangpur Medical College, Rangpur, Bangladesh, from July 2019 to June 2020. The study included 80 women aged 40 to 55 years. All of the data was gathered, recorded into a Microsoft Excel work sheet, and then descriptive statistics were used in SPSS 23.0 for analysis.

Results: Pre-menopausal and post-menopausal groups had comparable average ages. Pre menopausal women had lower pre-test values for heart rate, SBP, and DBP compared to the post-menopausal group ($P < 0.05$). Group B had a significantly higher mean rise in SBP in response to CPT compared to Group A. Group B ($P < 0.01$). Standing caused a higher drop in SBP in Group A compared to Group B ($P < 0.01$).

Conclusion: Sympathetic nervous system examination revealed sympathetic hyperactivity in the postmenopausal group when compared to the premenopausal group.

Keywords: Sympathetic, Oestrogen, pre-menopausal women, post-menopausal women.

I. INTRODUCTION

Menopause is characterized by a year-long cessation of menstruation and a decrease in oestrogen release due to follicular function loss [1]. As women age, they naturally shift from reproductive to non-reproductive phases of life [2]. Menopause typically occurs between 45 and 52 years old [1]. During the climacteric phase, which lasts 1-5 years, the genital organs involute due to the cessation of gonadal activity [1]. Premenopause is characterized by irregular menstrual cycles, lower levels of oestrogen and progesterone, and variable ovulation [2]. Common premenopausal symptoms include cramps, mood swings, nausea, anxiety, sadness, bloating, and sore breasts [3]. "Post menopause" refers to the period of life following menopause [4]. Postmenopausal women face increased risk of cardiovascular disease, anxiety, and depression. Postmenopausal women require effective health management [5]. According to the Framingham study, postmenopausal women had a two-fold higher age-adjusted risk of coronary heart disease than premenopausal women [6]. Young women who have bilateral oophorectomy are at higher risk of developing coronary heart disease if not treated with oestrogen [7]. Ovarian hormones, particularly oestrogens, are thought to protect women from coronary heart disease, as evidenced by their positive impact on cardiovascular morbidity and death in post-menopausal women receiving hormonal replacement treatment [8]. Aging has been linked to changes in cardiovascular regulation through autonomic mechanisms. Aging and post-menopausal hormonal changes in women can alter the autonomic control of their cardiovascular system. Menopause disrupts autonomic nerve control of the cardiovascular system, leading to a shift towards sympathetic hyperactivity. This trend may contribute to the higher prevalence of cardiovascular illnesses among post-menopausal women [9]. Cardiovascular function is constantly regulated by the sympathetic and parasympathetic nerve systems. Changes in autonomic activity

increase the risk of cardiovascular illness, which is also influenced by estrogen [10]. Replacement estrogen therapy has been shown to improve cardiovascular disease morbidity and mortality by 50% after menopause [10]. Menopausal alterations in ANS may lead to higher cardiovascular morbidity in women. Evaluating these alterations in post-menopausal females can inform preventive interventions for cardiovascular morbidity and mortality. We investigated the alterations in sympathetic activity of the autonomic nervous system (ANS) during menopause.

II. METHODOLOGY

This study was a cross-sectional analytical study conducted in Department of Physiology, Rangpur Medical College, Rangpur, Bangladesh, from July 2019 to June 2020. The study involved two groups of 40 women each. Group A included 40 pre menopausal women aged 40-45 years. Group B included 40 postmenopausal women aged 45 to 55.

The sympathetic nervous system was assessed using the following tests [11].

1. Cold Pressor Test (CPT)
2. Handgrip Test (HGT).
3. Blood pressure response to standing.

We used one-way ANOVA (post-hoc) testing to compare premenopausal and postmenopausal women. Results were considered significant at p-values < 0.05. All collected data was entered into a Microsoft Excel Work Sheet and analyzed in SPSS 23.0 using descriptive statistics.

III. RESULT

Table-1 shows that the pre-menopausal and post-menopausal groups had comparable average ages. Pre-menopausal women had lower pre-test values for heart rate, SBP, and DBP compared to the post-menopausal group (P < 0.05) (Table-2). Group B had a significantly higher mean rise in SBP in response to CPT compared to Group A (P < 0.001). Group B showed a higher mean rise in DBP in response to HGT than Group A (P < 0.01). Standing caused a higher drop in SBP in Group A compared to Group B (P < 0.01) (Table-3).

Table-1: Comparison of age in pre-menopausal and post-menopausal groups

Groups	Number(n)	Age (mean ± SD)	P value
Pre-menopausal (Group A)	n=40	42.18±1.66	0.00***
Post-menopausal (Group B)	n=40	51.43±2.60	0.00***

Table -2: Comparison of pre-test values of heart rate, SBP, and DBP in pre-menopausal and post-menopausal groups

Parameters	Pre-menopausal(Group A) (mean ± SD)	Post-menopausal (Group B) (mean ± SD)
Heart rate (beats/min)	77.95±3.34	86.53±2.51*
SBP (mmHg)	122.75±3.39	130.00±3.92*
DBP (mmHg)	80.00±2.77	84.28±7.40*

Table-3: Comparison of sympathetic functions in pre-menopausal and post-menopausal groups

Parameters	Pre-menopausal(Group A) (mean ± SD)	Post-menopausal (Group B) (mean ± SD)
CPT (rise in SBP) (mmHg)	14.56±0.75	15.98±2.08**
HGT (rise in DBP) (mmHg)	14.78±0.80	15.64±1.29**
SBP fall on standing (mmHg)	8.19±1.19	7.49±0.49**

IV. DISCUSSION

Pre-menopausal (Group A) and post-menopausal (Group B) women had comparable average ages. Menopause often begins between ages 40 and 50 [12]. Women in Group B have an average age that is similar to the general population. The pre-menopausal group was made up of females aged 40-45 to avoid age-related variations in sympathetic nervous system function testing. Statistical analysis revealed that the post-menopausal group had greater mean heart rates than the pre-menopausal group (P < 0.05). This finding supports a previous study that assessed autonomic systems in 24 post-menopausal women [13]. Other research support our findings on tachycardia in postmenopausal women [14]. The post-menopausal group had greater mean pre-test SBP than the pre-menopausal group. Similarly, the post-menopausal group had higher mean pre-test DBP recordings than the pre-menopausal group. Our findings are consistent with a study of 38 pre-menopausal and 28 post-menopausal women, which found that post-menopausal women had considerably greater basal SBP and DBP

than pre-menopausal women [15]. Post-menopausal women had considerably higher mean SBP rise in response to CPT. These findings are consistent with those of a research on 24 post-menopausal women for ANS assessment [13]. A population-based study of 9864 men and women aged 18-70 years followed for 18 years found that menopausal women had a stronger pressure response to cold than fertile women [16]. HGT, which evaluates blood pressure response to continuous isometric exercise, found that post-menopausal women had higher DBP levels than pre-menopausal women. A study found that oestrogen therapy can reverse increased sympathetic vasoconstriction in postmenopausal women's forearms after exercise [17]. Another study found similar results when measuring ANS functions in 24 post-menopausal women [13]. Postmenopausal women had a lower drop in SBP after standing compared to pre-menopausal women. Our findings are consistent with previous research on post-menopausal female autonomic function [13]. Post-menopausal women exhibit more sympathetic activity in the autonomic nervous system compared to pre-menopausal women. Sympathetic activity was assessed using many procedures, including resting heart rate, blood pressure, CPT, HGT, and BP response to standing. Post-menopausal women exhibit more sympathetic activity than pre-menopausal women due to alterations in catecholamine and 5-hydroxytryptamine levels in the hypothalamus and extra hypothalamic regions of the brain [18]. After menopause, circulating oestrogen levels decline and the number of estrogenic receptors in the brain changes [19]. Increased sympathetic activity causes vasomotor symptoms, including hot flushes and sweating.

Limitation of the study: This study had a single focal point and small sample sizes. Therefore, it's possible that the study's findings don't accurately capture the overall situation.

V. CONCLUSION & RECOMMENDATION

Post-menopausal women exhibit sympathetic dominance compared to pre-menopausal women. Menopausal symptoms can be caused by sympathetic over activity and hormone imbalances.

References

- [1]. Malhotra N, Kumar P, Malhotra J, Bora NM, Mittal P. Clinical aspect of menstruation and ovulation. In: Jeffcoate's Principles of Gynaecology. 8th ed. New Delhi: Jaypee brothers medical publishers (P) Ltd; 2014:80-5.
- [2]. Sudarsana U, Sheshta S, Kumar P. Comparative analysis of autonomic function tests in normotensive premenopausal and postmenopausal women. International journal of medical research professionals 2017; 3(1):234-9.
- [3]. Comparing perimenopause and perimenopause. [Online/Internet]. Available from: <https://www.medicalnewstoday.com> (accessed July 2017).
- [4]. Menopause, perimenopause and postmenopause. [Online/Internet]. Available from: <https://my.clevelandclinic.org/health/diseases> (accessed December 2019).
- [5]. Chang WD, Lai PT. Different exercise behaviours influences heart rate variability, autonomic nerve system function and menopausal symptoms in post-menopausal women. Journal of physical therapy science 2013; 25:477-81.
- [6]. Kannel WB. Metabolic risk factors for coronary heart disease in women: Perspective from the Framingham study. Am Heart J. 1987; 114(2):413-9.
- [7]. Colditz GA, Willett WC, Stampfer MJ, Rosner B, Speizer FE, Hennekens CH. Menopause and the risk of coronary heart disease in women. N Engl J Med. 1987; 316(18):1105-10.
- [8]. Schillaci G, Verdecchia P, Borgioni C, Ciucci A, Porcellati C. Early cardiac changes after menopause. Hypertension. 1998; 32(4):764-9.
- [9]. Neves VF, Silva de Sá MF, Gallo L Jr, Catai AM, Martins LE, Crescêncio JC, et al. Autonomic modulation of heart rate of young and postmenopausal women undergoing estrogen therapy. Braz J Med Biol Res. 2007; 40(4):491-9. [10]
- [10]. Du XJ, Reemersma RA, Dart AM. Cardiovascular protection by estrogen in partly mediated through modulation of ANS. Cardiovasc Res. 1995; 30(2):161-5.
- [11]. Freeman R. Assessment of cardiovascular autonomic function. Clin Neurophysiol 2006; 117(4):716-30.
- [12]. Ramaekers D, Ector H, Aubert AE, Rubens A, Van de Werf F. Heart rate variability and heart rate in healthy volunteers. Is the female autonomic nervous system cardioprotective? Eur Heart J. 1998; 19(9):1334-41.
- [13]. Bhat AN, Sadhoo AK, Yograj S, Kaur G. Autonomic functions in postmenopausal women. JK Sci. 2005; 7(3):135-9.
- [14]. Rosano GM, Leonardo F, Dicandia C, Sheiban I, Pagnotta P, Pappone C, et al. Acute electrophysiologic effect of estradiol 17b in menopausal women. Am J Cardiol. 2000; 86(12):1385-7.
- [15]. Moodithaya SS, Avadhany ST. Comparison of cardiac autonomic activity between pre and post-menopausal women using heart rate variability. Indian J Physiol Pharmacol. 2009; 53(3):227-34.
- [16]. Casiglia E, Tikhonoff V, Caffi S, Bascelli A, Schiavon L, Guidotti F, et al. Menopause does not affect blood pressure and risk profile, and menopausal women do not become similar to men. J Hypertens. 2008; 26(10):1983-92.
- [17]. Fadel PJ, Wang Z, Watanabe H, Arbiq D, Vongpatanasin W, Thomas GD. Augmented sympathetic vasoconstriction in exercising forearms of post-menopausal women is reversed by estrogen therapy. J Physiol. 2004; 561(3):893-901.
- [18]. Biegon A, Bercovitz H, Samuel D. Serotonin receptor concentration during the estrous cycle of the rat. Brain Res. 1980; 187(1):221-5.
- [19]. Morrison JH, Brinton RD, Schmidt PJ, Gore AC. Oestrogen, menopause, and the aging brain: How basic neuroscience can inform hormone therapy in women. J Neurosci. 2006; 26(41):10332-48.