

Comparative Study of Sympathetic Nervous System Activity in Normotensive Premenopausal and Postmenopausal Women Using Bedside Autonomic Function Tests

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Abstract: ***Background & Introduction:** Menopause marks the period of many changes in women. The term menopause comprises as the stage of aging process which marks the transition from the reproductive phase of life to the post – reproductive phase. **Aim & Objective:** to compare the sympathetic nervous system activity using autonomic function tests in normotensive premenopausal women and postmenopausal women (had natural menopause). **Materials & Method:** The autonomic function tests in 30 premenopausal and 30 postmenopausal women were compared. Parameters under study were Height, Weight, BMI, Sympathetic function test like the blood pressure response to Orthostatic tolerance test, Sustained isometric hand grip test and Cold pressor test. **Result:** We found significant difference in BMI ($P < 0.05$) and blood pressure during Orthostatic test, sustained isometric hand grip test and cold pressor test when compared between premenopausal and postmenopausal.*

Keywords: Sympathetic function, Premenopausal women, Postmenopausal women, Body Mass Index (BMI), Orthostatic Tolerance test (OTT), Isometric Hand Grip Test (IHG), Cold Pressor Test (CPT)

1. Introduction

The term Menopause is derived from Greek language where pausis means to stop and mens refers to menstrual cycle. The WHO defines menopause as the cessation of menses for a period of one year (natural menopause) or the surgical removal of the uterus along with or without ovaries (surgical menopause).^[1]

Menopause, a normal aging phenomenon in women, consists of gradual transition from the reproductive to the non - reproductive phase of life. The median age of menopause is currently around 50 years. As a result of increasing life expectancy in the first and second worlds, many women will be post - menopausal for over one third of their lives^[2]

Menopause in humans is characterized by reduced circulating oestradiol level which is due to falling numbers of functional follicles as the age advances. Menopause predisposes women to many diseases and changes their quality of life. Alteration in autonomic nervous system (ANS) functions primarily due to changes in oestrogen level is responsible for symptoms associated with menopause.^[3]

The Phases of menopause typically referred as pre - menopause & post - menopause, mark a significant transition time in a woman's life & overall health. menopause is the permanent cessation of menstruation^[4]

The Autonomic Nervous System is one of the parts of the nervous system. It is responsible for maintaining constant

internal environment or homeostasis along with the help of Endocrine and Immunological systems. The ANS is very important in daily life.^[23, 24] Which act as a major coordination center for different systems in human body.^[25] The autonomic nervous system regulates blood pressure, temperature, respiration, heart rate, gastrointestinal, bladder, sexual function in the body.^[26]

Both sympathetic and parasympathetic disorders assessed by using the autonomic function tests.^[27] Isometric handgrip test, cold pressor test, supine to standing position test are used to assess the autonomic function.^[28] Isometric hand grip exercise increases sympathetic outflow and increases blood pressure.^[30] cold pressor test is a standard parameter to assess sympathetic Nervous System activity.^[29, 30]

The changed sympathovagal activity poses an unfavourable effect on health.^[16] Hence, there is a need to understand the autonomic changes that take place after the cessation of menopause. So, the objective of this study was to compare the autonomic function tests in premenopausal women in the age group of 30–40 years and postmenopausal women in the age group of 40–60 years.

Early detection of subclinical autonomic dysfunction in postmenopausal women, therefore, will improve the quality of life by proper medication and lifestyle modification.

2. Materials & Method

The comparative cross – sectional study was done in 30 premenopausal women and 30 postmenopausal women. The subject was selected by the general population was divided into two strata: premenopausal and postmenopausal women. The sample were recruited randomly from the strata considering the inclusion and exclusion criteria.

Group I – Premenopausal women

The inclusion criteria were women of age 30 –40 years with regular menstrual cycle were selected. The exclusion criteria were women on oral contraceptive pills or any medication that alters cardiovascular function or endocrine function; lactating and pregnant women; women within 2 years of postpartum; trained athlete, or women performing any kind of strenuous exercise, yoga, or meditation.

Group II – Postmenopausal women

The inclusion criteria were postmenopausal women of age 40–60 years with natural cessation of menstruation for 2 years. The exclusion criteria were women on hormone replacement therapy or any other drug that alters cardiovascular function or endocrine function; women with history of hypertension, diabetes, or any systemic or metabolic disorder; women with any history of addiction; trained athlete, or women performing any kind of strenuous exercise, yoga, or meditation.

3. Procedure

Anthropometric Parameters

Various anthropometric parameters studied were

- **Height:** We had measured height of patients using standard measuring technique, using measuring tape or scale. Patient standing erect across wall, with bare feet, legs are straight, arms at sides, and shoulders relaxed, the back of the body touches/has contact with the wall at some point, preferably with heels, buttocks, upper back and head touching the wall by Stadiometer.
- **Weight:** We had measured weight of patients using MCP BR2020 Deluxe analogue personal weighing Scale and recorded in kilograms.
- **Body Mass Index (BMI) (Quetelet's Index):** Calculation of BMI was done by using formula

$$BMI = \frac{\text{weight (Kg)}}{\text{Height}^2(\text{m})}$$

Determination of Resting blood pressure (mmHg):

Systemic arterial blood pressure - Systolic blood pressure and Diastolic blood pressure. All subjects BP were measured by the help of Elka Digital Blood Pressure monitor. Before recording the blood pressure, the subjects were allowed to rest in a quiet room to reduce anxiety

Table 2: Distribution of anthropometric measurements in group 1 (Premenopausal women) and group 2 (Postmenopausal women)

Anthropometric Measurement	Group1		Group2		P Value
	Range	Mean±SD	Range	Mean±SD	
Height (cm)	152 - 167	158.63±3.62	149 - 165	156.57±3.88	0.037
Weight (cm)	46 - 65	57.30±4.46	50 - 78	66.07±5.91	<0.0001
BMI (Kg/m ²)	18.90 - 26.37	22.65±1.49	20.82 - 31.20	26.96±2.46	<0.0001

Autonomic function tests. The subjects were made to rest for 15 min in the supine position. The resting time given to subjects in between the two tests was 5 to 10 min.

Assessment of autonomic function:

- Orthostatic tolerance Test
- Isometric Hand grip test
- Cold pressor Test

Orthostatic Tolerance Test: After recording the BP in supine position, the subject is asked to sit down immediately and record the BP after standing 1 minute and 3minutes after standing. The postural change in BP is taken as the difference between the systolic blood pressure while supine and standing. A fall in systolic blood pressure more than 20mmHg and diastolic blood pressure by more than 10 mmHg or the presence of certain symptoms like nausea, fatigue, dizziness etc. are considered to be abnormal

Isometric Handgrip Test: The subject is asked to perform maximum grip of the handgrip dynamometer with their dominant hand and the maximum capacity was noted. After 5mts in the sitting position, the subject is asked to hold their grip with 1/3rd or 1/4th of the maximum capacity for 5mt & the bp was recorded just after release of the grip.

Normal: 16 mmHg or more, **Borderline:** 11–15 mm, **Abnormal:** 10 mmHg or less

Cold Pressor Test: After recording the resting blood pressure subjects were asked to dip left arm in the cold water (temp at 2^oC - 4^oC) for 1 minutes and blood pressure will be recorded from right arm

Result: Normally both systolic and diastolic blood pressure should increase at least by 10mm of Hg at the end of 1 minute of immersion.

Statistical Analysis

Descriptive statistics will be used to present all outcomes; normally distributed data presented by mean and standard deviation (SD) and median. For the comparison of blood pressure variation within study groups were assessed by either Paired T Test or Mann Whitney U Test, and between group assessed by Independent T Test of Mann Whitney U Test. A p value less than 0.05 shows statistical significance. Data entered in Microsoft excel and analysed using SPSS version 28.00.

4. Result

Table 1: Distribution of age among the study population

Age	Range	Mean±SD
Group 1	30 - 42	36.3±3.79
Group 2	53 - 67	59.5±3.72

Table 3: Comparison of Resting Systolic and Diastolic Blood Pressure between Premenopausal & Postmenopausal group

Parameters	Premenopausal women	Postmenopausal women	Z value	P value
Resting Systolic blood pressure (mmHg) Mean±SD	116.83±6.28	124.07±6.92	3.722	<0.0001
Resting Diastolic blood pressure (mmHg) Mean±SD	75.4±3.3	78.37±7.2	2.419	0.016

Table 12: Comparison of SBP and DBP assessed by using autonomic function tests between the study groups

Parameters	SBP			DBP		
	Pre menopause (Mean±SD)	Post menopause (Mean±SD)	Sig.	Pre menopause (Mean±SD)	Post menopause (Mean±SD)	Sig.
Resting Blood pressure	116.83±6.28	124.07±6.92	<0.0001	75.4±3.3	78.37±7.2	0.016
OTT Supine	112.03±5.62	121.57±7.18	<0.0001	68.7±4.24	76.23±5.54	<0.0001
OTT - Standing	105.2±5.52	114.73±8.30	<0.0001	73.37±3.93	77.27±6.36	0.002
Isometric Hand grip test	124.93±6.33	138.84±6.08	<0.0001	92.3±3.57	100.9±6.46	<0.0001
Cold pressor	130.3±6.47	142.37±8.80	<0.0001	88.6±5.29	95.47±6.88	<0.0001

We found significant increase in BMI, resting blood pressure, Blood pressure response to standing from supine position, blood pressure response to sustained handgrip test and blood pressure response to cold pressor test in postmenopausal women when compared between premenopausal and postmenopausal women.

5. Discussion

The present study we compared the blood pressure changes during autonomic function using bed side autonomic function tests in 30 normotensive premenopausal women (age between 30 to 40 years) and postmenopausal women (age between 40 to 60 years).

In our study we compared BMI, resting blood pressure, Blood pressure response to Standing from supine position (Orthostatic tolerance test), Blood pressure response to Sustained hand grip test (IHG), blood pressure response to Cold pressor test (CPT) between normotensive premenopausal and normotensive postmenopausal women. (Table 4)

Menopause in humans is characterized by reduced circulating estradiol level which is due to falling numbers of functional follicles as the age advances. Menopause predisposes women to many diseases and changes their quality of life. Alteration in autonomic nervous system (ANS) functions primarily due to changes in oestrogen level is responsible for symptoms associated with menopause.^[3]

Mean resting SBP recordings in the post - menopausal group were higher as compared to the pre - menopausal group. Similarly, mean resting DBP recordings in the post - menopausal group were more as compared to the pre - menopausal group (Table 3). Our finding matches with the study conducted by SS Moodithaya et al on 38 pre - menopausal and 28 post - menopausal women which showed that basal SBP and DBP were significantly higher in post - menopausal women as compared to pre - menopausal women.^[33]

Increased body fat has been associated with increased sympathetic nervous activity and decreased parasympathetic activity^[34]. In the present study, percent body fat was significantly higher among postmenopausal women, compared to that of young women. We found significant difference in BMI (P<0.05) (Table 1).

Menopause may result in endothelial dysfunction and increase in body weight and type II diabetes that cause increased sympathetic activation.^[35] Decreased Sympathovagal activity was found in postmenopausal women by Chaudhuri et al.^[16]

Mercuro g et al found a role of endogenous oestrogen in the modulation of autonomic nervous system in their study, they observed autonomic changes before and after oophorectomy in premenopausal women which indicates that oestrogen has a role in increasing vagal function and reducing sympathetic action.^[36] Saab et al. studied the cardiovascular and neuroendocrine responses to behavioral stressors in the pre - and postmenopausal women. Their result showed exaggerated cardiovascular and neuroendocrine responses in the postmenopausal women and they also linked the mechanism of these influences to estrogen and their hemodynamic effects.^[39] The physiological levels of estrogen account for an increased vagal and lower sympathetic modulation. The decline in the estrogen levels shifts the autonomic balance toward the sympathetic dominance in the postmenopausal women.^[4]

Autonomic modifications of cardiovascular control have also been observed with aging. In women, both aging and postmenopausal hormonal changes contribute to modifications of the autonomic control of the cardiovascular system. Menopause causes an imbalance of the autonomic nervous control of the cardiovascular system with a shift toward sympathetic hyperactivity. This shift explains, in part, the increased incidence of cardiovascular diseases observed in post - menopausal women.^[38] Cardiovascular function is under constant control by the sympathetic and parasympathetic nervous systems and any change in autonomic activity enhances the risk of cardiovascular disease and this aspect of cardiovascular function is also modulated by estrogen.^[3]

6. Conclusion

The Blood pressure variation were assessed using different bedside autonomic function test in this study shows there is an increase in BMI and the sympathetic function in the postmenopausal women when compared with the premenopausal women. The autonomic nervous system is a component of peripheral nervous system that regulates involuntary physiologic processes includes heart rate, Blood pressure, respiration, digestion and sexual arousal. This

study suggests that the increased tendency of obesity and decrease in the level of oestrogen from premenopausal to postmenopausal stage results shifting of autonomic balance toward sympathetic ascendancy.

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