

Comparative study of sympathetic function tests in premenopausal and postmenopausal Women

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Abstract

Introduction: Menopause is permanent cessation of menstruation. After menopause primordial follicles become atretic, hence ovaries fail to produce estrogen. The presence of estrogen receptors in the heart, vascular smooth muscles and autonomic brain stem centers denotes role in regulation of cardiovascular system.

Aims and Objectives: To compare the sympathetic function tests in premenopausal and postmenopausal women.

Materials and Method: The autonomic function tests in 60 premenopausal and 60 postmenopausal women were compared. Parameters under study were Height, Weight, BMI, Sympathetic function test: Orthostatic tolerance test and Sustained isometric hand grip test.

Result: We found significant increase in BMI ($P < 0.05$) and blood pressure during Sustained isometric hand grip test ($P < 0.05$) while there was significant change in Orthostatic tolerance test when compared between premenopausal and postmenopausal.

Discussion: Estrogen acts on pro-opiomelanocortin (POMC) neurons, regulate their cellular activity through estrogen receptor, and suppress food intake. Also decline in the estrogen levels shifts the autonomic balance toward the sympathetic dominance in the postmenopausal women.

Conclusion: We conclude that there is increased tendency of obesity, autonomic imbalance with sympathetic over activity in postmenopausal women as compared to premenopausal women.

Keywords: Sympathetic function, Premenopausal women, Postmenopausal women, Body Mass Index

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Introduction

The menopause is the point in a women's life when permanent cessation of menstruation occurs. Premenopausal is a term that encompasses the entire reproductive period up to final menstrual period.⁽¹⁾ By the year 2025, 23% of the population will be aged 60 or above.⁽²⁾ The average age of menopause in Indian women is 47.5 years compared to 51 years in developing countries.⁽³⁾ Though the age of onset of menopause has remained constant, the life expectancy in women has increased substantially. Currently a woman can expect to live a third of her life after attaining menopause in a state of estrogen deficiency.⁽²⁾

After menopause, the primordial follicles become atretic, hence the ovaries fail completely to produce estrogen, Plasma level of estrogen decreases and level of luteinizing hormone and follicular stimulating hormone increases. This change in neuroendocrine system due to loss of ovarian function cause change in mood, memory cognition, behavior, immune function, loco motor system and cardiovascular functions.⁽³⁾ Premenopausal women have lower incidence of cardiovascular diseases than age matched men. But, after menopause, the incidence of cardiovascular diseases in women is similar to that in men.⁽⁴⁾ Autonomic control of heart plays an important role in the cardiac mortality.⁽⁴⁾

The changed sympathovagal activity poses an unfavorable effect on health. Hence, there is a need to

understand the autonomic changes that take place after the cessation of estrogen secretion, i.e., menopause.⁽²⁾ So the objective of this study was to compare the autonomic function tests in premenopausal women in the age group of 25–45 years and postmenopausal women in the age group of 45–60 years. Early detection of subclinical autonomic dysfunction in postmenopausal women, therefore, will improve the quality of life by proper medication and lifestyle modification.

Materials and Method

The present study was carried out in 60 premenopausal and 60 postmenopausal women. Subjects were selected by simple random sampling method. The subjects were selected from office workers of Dr. Shankarrao Chavan Government Medical College, Nanded and from their relatives.

Selection criteria

A. Premenopausal women:

1. Age group 25-35 years. With regular menstrual cycle with an average length of 28 days.
2. They were in the follicular phase of their menstrual cycle.

B. Postmenopausal women:

1. Age group 45- 60 years.
2. They had completed a period of at least 12 months since their last menstrual period.

Exclusion criteria

The following women were excluded from study:

1. Those on oral contraceptive pills or hormonal therapy in any form.
2. Those consuming drugs that alter the cardiovascular functions.
3. Those having any history of diabetes, cardiovascular disease, surgical menopause or history of addiction to tobacco, alcohol, smoking.
4. Those suffering from any other disease or complication.

All the subjects were explained the procedure to alleviate any fear or apprehension. Before starting the procedure, the physical examination of all the subjects was done with the help of proforma and the consent form was signed by the subjects.

The subjects were asked to abstain from tea or coffee for 12 hours before the procedure.⁽⁵⁾ All observations were made between 8.30 a.m. and 9.30 am in quiet and comfortable atmosphere.

Anthropometric Parameters

Various anthropometric parameters studied were

- **Height:** We had measured height of patients using standard measuring technique, using Indosurgical height measuring 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 health Sense PS126 ultra litSe weighing scale and recorded in kilograms.
- **Body Mass Index (BMI) (Quetelet's Index):** Calculation of BMI was done by using formula

$$BMI = \frac{Wt(kg)}{Ht^2(m)}$$

The following parameters of cardiovascular sympathetic function tests were recorded in all the subjects:

1. **Resting blood pressure (mmHg):** Systemic arterial blood pressure- Systolic blood pressure and Diastolic blood pressure.
 - The subject was asked to rest for 5 to 10 minutes the sphygmomanometer (Acussure i.e. Clinical mercury manometer was kept at heart level and blood pressure was recorded from right arm.
 - First the systolic pressure was measured by the palpatory method.

- The systolic and diastolic blood pressures were then recorded by auscultatory method. Similarly, one more reading was taken at an interval of 1 minute. Therefore the mean of the two readings was considered as the resting blood pressure.
- 2. **Blood pressure response to standing from supine position:⁽⁶⁾**
 - The subject was asked to lie supine on the examination table for 5 minutes.
 - The baseline systolic and diastolic blood pressure was recorded with the help of sphygmomanometer by the auscultatory method. Then the cuff was deflated completely and the subject was asked to stand up and lean against the wall for support.
 - Immediately within 2 to 5 minutes after standing up. The systolic and diastolic blood pressures were measured again from same arm. The differences between the blood pressures (systolic and diastolic) at baseline and the blood pressures (systolic and diastolic) in standing position were noted.
 - Blood pressure response to sustained handgrip test.^(6,7) The subject was asked to seat comfortably in a chair.
 - The baseline systolic and diastolic blood pressures were measured from the non-exercising arm with the help of sphygmomanometer by the auscultatory method. Then the cuff was deflated completely. The subject was then asked to hold the baseline Smedley Spring dynamometer in the dominant hand and compress it with maximum effort. The tension developed was measured. After 1 minute, the whole procedure was repeated and a second reading obtained. Likewise, third reading was obtained. The mean of these three readings was taken as the maximum isometric tension.
 - Then the subject was asked to maintain a handgrip steadily at 30% of the maximum isometric tension for 1 minute. Before the subject released the handgrip, the systolic and diastolic blood pressures were measured on the non-exercising arm.

The difference between systolic blood pressure in premenopausal women at the baseline and the difference between systolic blood pressure in premenopausal women at the baseline and the blood pressures (systolic and diastolic) at the end of 1 minute of sustained handgrip were noted in both the study groups.

Results

Table 1: Shows comparison of resting systolic blood pressure and diastolic blood pressure between premenopausal and postmenopausal women

| Parameters | Premenopausal women (n=60) | Postmenopausal (n=60) | Z value | P value |
|--|----------------------------|-----------------------|---------|---------|
| Resting systolic blood pressure (mmHg) Mean \pm S.D. | 114 \pm 7.4 | 120 \pm 7.3 | 4.68 | <0.0001 |
| Resting diastolic blood pressure (mmHg) Mean \pm S.D. | 75.77 \pm 4.94 | 79.07 \pm 5.11 | 1.611 | <0.0004 |

Table 2: Shows comparison of change in systolic blood pressure and diastolic blood pressure in response to standing from supine position between premenopausal and postmenopausal women

| Parameters | Premenopausal women (n=60) | Postmenopausal (n=60) | Z value | P value |
|--|----------------------------|-----------------------|---------|---------|
| Systolic Blood Pressure (mmHg) Mean \pm S.D. | 106 \pm 6.1 | 112 \pm 7.75 | 0.244 | 0.808 |
| Change in S.B.P. (mmHg) Mean \pm S.D. | 8.1 \pm 3.024 | 8.22 \pm 3.4 | | |
| Diastolic Blood Pressure (mmHg) Mean \pm S.D. | 78 \pm 4.5 | 80.3 \pm 4.43 | 0.176 | 0.7283 |
| Change in D.B.P. (mmHg) Mean \pm S.D. | 2.67 \pm 1.829 | 2.8 \pm 2.335 | | |

Table 3: Comparison of change in systolic blood pressure and diastolic blood pressure in response to 1minute of sustained handgrip between premenopausal and postmenopausal women

| Parameters | Premenopausal women (n=60) | Postmenopausal (n=60) | Z Value | P value |
|--|----------------------------|-----------------------|---------|---------|
| Systolic Blood Pressure (mmHg) Mean \pm S.D. | 128.2 \pm 5.9 | 138 \pm 5.42 | 10.93 | <0.0001 |
| Change in S.B.P. (mm hg) Mean \pm S.D | 14.16 \pm 5.73 | 17.8 \pm 6.1 | | |
| Diastolic Blood Pressure (mmHg) Mean \pm S.D. | 90.3 \pm 5.04 | 97.16 \pm 5.6 | 4.67 | 0.05 |
| Change in D.B.P. (mmHg) mean \pm S.D. | 14.53 \pm 3.59 | 17.8 \pm 6.1 | | |

We found significant increase in BMI, resting blood pressure response to standing from supine position, blood pressure response to sustained handgrip in post menopausal women. When compared between premenopausal and postmenopausal women.

Discussion

In the present study, a careful statistical analysis of the sympathetic function status in premenopausal and postmenopausal women was done. We compared 60 premenopausal women (age between 25- 35 years) with 60 postmenopausal women (age between 45- 60 years).

In our study we compared BMI, resting blood pressure, blood pressure response to standing from supine position, blood pressure response to sustained handgrip between premenopausal women and postmenopausal women.

During menopause the ovarian functions gradually become diminished and so, the estrogen production from the granulosa cells of the ovary also reduces.

In this study, we found that there was a statistically significant increase in BMI (P<0.05) in the postmenopausal women when compared with the premenopausal women. Similar significant increase in

BMI in the postmenopausal women has been reported by Chaudhuri et al.⁽⁷⁾ Estrogen acts on pro-opiomelanocortin (POMC) neurons, regulate their cellular activity through estrogen receptor (ER), and suppress food intake. Moreover, estrogen levels are closely associated with leptin levels. Leptin modulates energy balance in the hypothalamus by exerting an anabolic effect and exhibiting a lipolytic effect. Estrogen increases the leptin sensitivity by controlling the expression of leptin-specific receptors. In addition, resistin is a hormone that is produced by adipocytes. After menopause, the ovaries fail completely to produce estrogen, resulting into a deregulation of energy metabolism that may have induced an elevation in the total adiposity in the postmenopausal women.⁽⁸⁾ In our study there was a statistically significant increase in the resting blood pressure, blood pressure response to standing from supine position, blood pressure response to sustained handgrip in the postmenopausal women when compared with the premenopausal women. In our study there was a statistically significant increase in the sympathetic function in the postmenopausal women when compared with the premenopausal women. The physiological levels of estrogen account for an increased vagal and lower sympathetic modulation.⁽⁹⁾ As suggested by some studies, estrogen binds to the membrane receptors to stimulate the nitric oxide release from the endothelium. It facilitates calcium efflux and reduces the calcium sensitivity of contractile elements. Thus, estrogen promotes vasodilation.^(10,11) Estrogen also increases b-adrenergic receptor sensitivity to catecholamine to promote vasodilatation.

The decline in the estrogen levels shifts the autonomic balance toward the sympathetic dominance in the postmenopausal women.⁽¹²⁾

Human obesity is featured by noticeable sympathetic activation. In addition, a rise from the usual body weight of an individual is associated with a decrease in the parasympathetic activity.⁽⁷⁾ Table suggest that the postmenopausal women are obese when compared with the premenopausal women. This is a contributing factor for autonomic imbalance found in the postmenopausal women. Mercurio et al.^(13,14) showed that surgical menopause (oophorectomy) resulted in a decrease in the cardiac vagal modulation, leading to a shift toward the sympathetic activity. 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.⁽¹⁵⁾

Hence, hormone alteration (decline in estrogen level) is responsible for obesity and autonomic imbalance (sympathetic over activity) in the postmenopausal women when compared with the premenopausal women.

Conclusion

There is an increase in BMI and the sympathetic function in the postmenopausal women when compared with the premenopausal women. This study suggests that the increased tendency of obesity and decrease in the level of estrogen from premenopausal to postmenopausal status cause shifting of autonomic balance toward sympathetic dominance. Altered sympathetic nervous system, one component of autonomic nervous system, in healthy Indian post menopausal women might help physician to detect subclinical autonomic dysfunction and to give proper medication and life style modification as post menopausal women have shorter lifespan in developing country like India as compared to developed countries.

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