

Original article

A CROSS-SECTIONAL STUDY TO EVALUATE CARDIAC PERFORMANCE IN POSTMENOPAUSAL WOMEN BY ECHOCARDIOGRAPHY IN HEALTHY WOMEN AGED BETWEEN 45-85 YEARS.

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ABSTRACT:

Aim of the study:

To evaluate cardiac performance in postmenopausal women by 2D echocardiography.

Material and Methods:

356 healthy women between the age 45-85 years were included in the study after conducting a baseline study to measure height, weight, blood pressure and excluding pregnant, hypertensive, diabetic, smokers and females with coronary artery disease by taking a detail history.

The subjects were divided in to two groups:

Group I = < 44 years (Premenopausal)

Group II = > 44 years (Postmenopausal)

Transthoracic echocardiogram was performed on the all the study participants and End Systolic Diameter (ESD), End Diastolic Diameter(EDD),Ejection Fraction(EF) were measured.

Results:

The end diastolic diameter (cm) has a mean of 4.28 ± 0.65 cm in premenopausal women and 4.5 ± 0.7 cm in post-menopausal women

The end systolic diameter (cm) has a mean of 2.79 ± 0.53 cm in premenopausal women and 3.09 ± 0.86 cm in post-menopausal women

The ejection fraction has a mean of 64.72 ± 7.98 in premenopausal women and 61.65 ± 9.09 in postmenopausal women.

Conclusion:

The end diastolic diameter, end systolic diameter were increased in postmenopausal women with fractional shortening of the ejection fraction as compared to premenopausal women indicating left ventricular wall thickness and impaired left ventricular diastolic function in postmenopausal women.

Keywords: Postmenopausal, 2D Echocardiography, End diastolic diameter

Introduction:

Menopause is the transition period in a woman's life where there is cessation of ovarian function due to the changes of their hormonal status. Cardio-vascular diseases happen to be the foremost amongst non-communicable diseases affecting the health of postmenopausal women and are at a higher risk of developing them as compared to premenopausal women^[1].

The risks related to menopause are mainly due to the abrupt interruption of oestrogen.

Oestrogen regulates the LDL receptors in the liver, leading to a decrease in the levels of LDL in the blood. Oestrogen also influences the release of endothelium derived releasing factor (EDRF), that causes vasodilatation. These factors prevent the deposition of Atherosclerotic plaques in the blood vessels. Henceforth, The absence of protective effect of oestrogen plays a role in the increased atherosclerotic process leading to stiffness of arterial walls. This in turn predisposes them to a greater risk of developing hypertension and hence increased afterload on the heart^[2].

The objective of the study is to evaluate cardiovascular performance among postmenopausal women in Hyderabad, Telangana as very few studies are carried out among Indian population.

In India, the awareness and management of menopause is limited due to multiple factors such as inadequate understanding of menopause and its consequences by laypersons, primary care physicians and medical specialities.

This study is carried out to assess the effect of menopause on the cardiac function by 2-Dimensional Echocardiography in healthy women between the ages of 45-85 years^[3]. If the cardiac performance is found to be significantly affected by menopause, precautionary advises to postmenopausal women and change in their lifestyle is advised to prevent the cardiovascular catastrophes.

MATERIALS AND METHODS:

The study was conducted at Department of physiology, Deccan college of medical sciences, Hyderabad & Department of Cardiology & Radiology, Owaisi hospital and research center & princess esra hospital, hyderabad, Telangana.

Sample size was calculated using the formula $n = \frac{Z^2 \times P(1-P)}{d^2}$

Assuming a confidence level of 95% (Z=1.96), a margin of error of 5% (d=0.05), and an estimated prevalence of 33% (P=0.33), the sample size is 348.48^[3].

356 healthy women between the age 45-85 years were included in the study after conducting a baseline study to measure height, weight, blood pressure and excluding pregnant, hypertensive, diabetic, smokers and females with coronary artery disease by taking a detail history.

The subjects were divided in to two groups^[4]:

Group I = < 44 years

Group II = > 44 years

Echocardiogram, often referred to cardiac ECHO or simply an 2D-ECHO is sonogram of the heart also known as a cardiac ultrasound, it uses standard ultrasound techniques to image two-dimensional slices of the heart.

Transthoracic echocardiogram was performed on the all the study participants. The echocardiography transducer (or probe) is placed on the chest wall (or thorax) of the subject, and images are taken through the chest wall. This is a non-invasive, highly accurate and quick assessment of the overall health of the heart. M-mode analysis of the left ventricle allows for measurement of the myocardial thickness and also the diameter of the cardiac chambers in systole and diastole

End Systolic Diameter (ESD), End Diastolic Diameter(EDD),Ejection Fraction(EF) were measured.

Statistical analysis was done using unpaired t test.

RESULTS:

A total of 356 subjects were included in the study, the premenopausal women that were evaluated were were 166 and the postmenopausal women were 190 in number.

The parameters evaluated between these groups were age, age of onset of menopause in years, pulse rate, systolic blood pressure and diastolic blood pressure, the mean arterial blood pressure, temperature, respiratory rate, end-diastolic diameter, end systolic diameter and ejection fraction.

Statistical analysis shows that the mean age between the groups. In premenopausal women, the mean is 37 ± 3 years and the postmenopausal women the mean is 57 ± 10 years.

The age of onset of menopause in years in the postmenopausal women has a mean of 45 ± 2 years.

The pulse rate (beats /minute) has a mean of 68 ± 7 beats per minute in premenopausal women. In postmenopausal women the mean is 70 ± 8 beats per minute.

The systolic blood pressure (mm of Hg) has a mean 124 ± 13 mm of Hg in premenopausal women. In postmenopausal women the mean is 123 ± 13 mm of Hg.

The diastolic blood pressure mm of Hg has a mean of 76 ± 8 mm of Hg in premenopausal women. The mean in postmenopausal women is 75 ± 8 mm of Hg.

The mean arterial blood pressure (mm of Hg) is 91.85 ± 8 in premenopausal women and postmenopausal women, it is 91.00 ± 7 mm of Hg.

The temperature mean in premenopausal women is 36.8 ± 0 and postmenopausal women the mean is 36.8 ± 0 .

The respiratory rate has a mean of 17 ± 3 in premenopausal women and 17 ± 2 in postmenopausal women.

The end diastolic diameter (cm) has a mean of 4.28 ± 0.65 cm in pre-menopausal women .in post-menopausal women the end diastolic diameter is 4.5 ± 0.7 cm.

The end systolic diameter cm has a mean of 2.79 ± 0.53 cm has a mean of 2.79 ± 0.53 cm in pre-menopausal women .in post-menopausal women the end systolic diameter is 3.09 ± 0.86 cm. The ejection fraction has a mean of 64.72 ± 7.98 in premenopausal women. the mean of ejection fraction is 61.65 ± 9.09 in postmenopausal women.

Table 1:

		Menopausal status	
		Pre-menopausal women	Post-menopausal women
Age (Years)	Mean	37	57
	Std Deviation	3	10
Age of Onset of Menopause (Years)	Mean	.	45
	Std Deviation	.	2
Pulse rate (Beats/Minute)	Mean	68	70
	Std Deviation	7	8
Systolic BP (mm Hg)	Mean	124	123
	Std Deviation	13	13
Diastolic BP (mm Hg)	Mean	76	75
	Std Deviation	8	8
Mean arterial BP (mm Hg)	Mean	91.85	91.00
	Std Deviation	8.14	7.57
Temperature (C)	Mean	36.80	36.80
	Std Deviation	.00	.00
Respiratory rate (Breaths/Minute)	Mean	17	17
	Std Deviation	3	2
End diastolic diameter (cm)	Mean	4.28	4.57
	Std Deviation	.65	.74
End systolic diameter (cm)	Mean	2.79	3.09
	Std Deviation	.53	.86
Ejection fraction (%)	Mean	64.72	61.65
	Std Deviation	7.98	9.09

Discussion:

The development of left ventricular diastolic dysfunction (LVDD) has been shown to put patients at an increased risk of experiencing diastolic heart failure (DHF) in the future, which is linked to ageing even in the healthy population^[5]. There is substantial correlation between a high prevalence of DHF and an accelerated progression of LVDD in older women, which can be attributed to decline in oestrogen release among postmenopausal women and the cardioprotective benefits of oestrogen has been well documented in the literature^{[6][7]}. henceforth the risk of cardiovascular disease in postmenopausal women may be escalated.

This implies that postmenopausal women must be regularly monitored^[8] with non-invasive tools like echocardiography and advised accordingly to prevent progression to diastolic heart failure.

This study included the physical parameter like height in meters, weight in kg, body temperature, respiratory rate in breaths per minute. It also includes parameters related to cardiac functioning like pulse rate in beats per min., blood pressure and others like end systolic diameter, diastolic diameter of the heart and ejection fraction measured by 2D echocardiography.

The present study focuses on effect of decreased oestrogen levels on structure and function of heart in postmenopausal women population presented to secondary care hospital in Hyderabad.

Analysis of our results showed that among the postmenopausal women the parameters depicting ventricular remodelling (viz., the EDD and ESD) had marginal increased statistically. The variable of heart's contractility^[9], ejection fraction shows fractional shortening in the post-menopausal women.

Pulse rate of has varied from 68 beats per minute to 70 beats per minute but the S.B.P., D.B.P. and MAP shows no statistical significance in both groups.

According to study by Schillazi et al^[10] it was reported that menopause is associated with reduced left ventricular systolic performance evaluated with help of mid wall fractional shortening, A maintenance of wall thickness could represent a possible component in cardio protection by oestrogen and thereafter increase in thickness maybe due to oestrogen deficiency. however, it was done in Italian population and it did not evaluate ejection fraction. In this study ejection fraction a well-documented parameter of cardiac contractility was studied and found to be significantly reduced which is well correlated by study done by Zhao et al^[11].

In a study by Prelevic et al^[12], they found that decreased ejection fraction and peak flow velocity in post-menopausal women compared to pre-menopausal controls but marked demographic differences existed between the two groups, it is in concurrence with our research but in our work there were no such differences of demograohy.

M.kaur et al^[13] concluded in his study that there is a definitive predisposition to cardiovascular morbidity due to a decreased oestrogen levels, which may be affecting myocardial efficiency in two ways. firstly by a change in lipid profile that is a rise in LDL cholesterol and fall in HDL cholesterol, leading to increased atherosclerosis. Atherosclerosis of the systemic blood vessels increases the forward resistance and the atherosclerosis of coronary blood vessels, as a part of generalized atherosclerosis, reduces coronary blood flow and in turn myocardial efficiency with menopause. Secondly, the oestrogen receptors present on the myocardium and blood vessels become less effective with decreased levels of oestrogen with menopause and thus may be responsible for the decreased myocardial efficiency. it has also been reported that oestrogen confers cardio protection by down regulating the beta-adrenoceptor and suppressing the expression and activity of protein kinase A and also by suppressing Calcium-calmodulin dependent protein kinase II. Another estrogen receptor, ER beta also mediates oestrogen induced cardio protection through

phosphatidyl inositol 3- kinase –B and anti apoptotic signaling .hence due to declined levels of oestrogen ,this cardio protective role effect is lost and the postmenopausal women become more vulnerable to cardiovascular diseases.

Mechanism for the hypothesis:The cardiac effects of estrogen are both direct and indirect, and are mediated by estrogen receptor- α and estrogen receptor- β ^[14].The direct effects include rapid vasodilatation through increased nitric oxide production,and long term effects involving genomic-mediated changes in expression of proteins that regulate vascular tone and response to injury.Estrogen-mediated genomic effects increase vasodilatory enzymes and accelerate endothelial cell growth,but inhibit smooth-muscle proliferation, collagen, and elastin deposition.Indirect effects include actions on ventricular contractile function, endothelial calcium metabolism and coronary calcification, coagulation and fibrinolysis, insulin resistance, inflammation, oxidative alterations of lipids and changes in lipid profile.

Oestrogen increases serum levels of high-density lipoprotein-cholesterol and triglycerides,

and decreases low density lipoprotein-cholesterol (LDL-C) and LDL-C oxidation^[15].

Oestrogen also modulates cardiac myocyte sensitivity to autonomic stimuli and results in

enhanced inotropy, decreased chronotropy and reduced cardiac respiratory and energy needs.These effects support a myocardial protective role for Oestrogen which is lost after the onset of menopause.

Conclusions:

The present study's findings show that menopause, has an impact on systolic function and the evolution of Left Ventricular Dysfunction.

In conclusion, menopause is linked to early structural and functional heart disease symptoms that are unaffected by age, clinic or ambulatory blood pressure, or other confounding variables. Women with normal blood pressure exhibit similar Left Ventricular(LV) alterations linked to menopause. These results support the idea that oestrogen deprivation has a significant impact in both hypertension and normotensive women's early cardiac alterations. To further understand the prognostic value of these data, large outcome studies are required.

At the menopausal transition, women experience drastic changes in the levels of endogenous sex hormones with an abrupt decrease in oestradiol (E2) and sex hormone binding globulin (SHBG), as well as a concomitant but more gradual decrease in total Testosterone. In women, a more androgenic pattern of sex hormones after menopause has been associated with elevated blood pressure (BP), insulin resistance, and other Cardio Vascular Disease(CVD) risk factors. Thus, a more androgenic profile may lead to adverse LV remodelling in postmenopausal women^[16].

Our study supports an association of higher total testosterone levels and higher testosterone/oestradiol ratio with increased CVD and Congestive heart disease(CHD) events in postmenopausal women, as well as an association of higher estradiol levels with reduced CHD and Heart failure (HF) events, although the association between estradiol and HF did not reach statistical significance (HF events were fewer than CHD events, with therefore less power to detect associations). Among HF subtypes, we found that higher

testosterone/estradiol ratio and lower estradiol levels were associated increased risk for Heart Failure with Reduced Ejection Fraction (HFrEF), but not Heart Failure with Preserved Ejection Fraction (HFpEF), the type of HF more commonly seen in older women. It is possible that the reduction in estradiol during menopause differentially affects vascular and cardiac remodeling processes that differentially lead to a HFrEF vs. HFpEF phenotype. Lower levels of estradiol are associated with risk for hypertension, a major risk factor for HFrEF. In our study estradiol was associated with CHD, and CHD may contribute more to HFrEF than to HFpEF. As mentioned, our results contradicted the two Germany studies and Rancho Bernardo Study that showed null or reversed association between total testosterone and CVD events^[11]. The difference may be due to the selection of study participants (younger women with mean age 49, and hospital based in the German study) or ascertainment of CVD outcome (self-report in Rancho Bernardo Study). Further studies are needed to confirm these findings and to better understand the associations and mechanisms between sex hormones and subtypes of HF.

Conflict of Interest:None

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