

SHORT COMMUNICATION

EVALUATION OF LEFT VENTRICULAR PERFORMANCE
IN MENOPAUSAL WOMEN

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(Received on October 10, 2009)

Abstract : The incidence of ischemic heart disease is well documented in the literature in post menopausal women but the degree of deterioration of left ventricular performance in estrogen deficient state in women is not very clear. The present study was conducted to find the left ventricular performance by recording systolic time intervals (STIs) in 50 post menopausal women having either natural or surgical menopause and that was compared with 25 premenopausal controls. There was significant (P<0.01) increase in QS₂-I, PEP-I and PEP/LVET ratio but significant (P<0.01) decrease in LVET-I in surgical menopause group whereas the natural menopause group showed less increase in QS₂-I (P<0.05), PEP/LVET ratio (P<0.01) and decrease (P<0.01) in LVET-1. Thus, the performance of left ventricle is more affected in surgical menopause group as compared to natural menopause group. The ventricular dysfunction was observed by STIs prior to the appearance of clinical signs and symptoms.

Key words : systolic time intervals (STIs)
left ventricular functions

STI indices
menopause

INTRODUCTION

The cessation of menstruation (menopause) occurs in women at around the age of 45-50 years due to the waxing and waning of

ovarian activity which leads to the estrogen deficient state, producing certain specific clinical and metabolic changes. Estrogen deficiency causes changes in the lipid and lipoprotein profiles (1). In the pre

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menopausal women, the existing level of estrogen decreases LDL level in blood by increasing the LDL receptors in the liver and accelerating the metabolism of LDL cholesterol. Estrogen also stimulates the endothelium to produce nitric oxide (endothelium derived relaxing factor) and hence causes the vasodilatation. Whereas in the postmenopausal, estrogen deficient state, this protective shield of estrogen is lost and the levels of LDL start rising, thus distorting the HDL/LDL ratio & rendering post menopausal women more vulnerable to coronary artery disease due to atherosclerotic changes.

Gordon et al (2) reported that both surgical and natural menopause are associated with increased risk of coronary artery disease. The present study was conducted to evaluate the ventricular performance in women with natural menopause and in those with surgical menopause, in comparison to pre menopausal women, by measurement of systolic time intervals which is a noninvasive method of assessing the cardiac function (3).

MATERIALS AND METHODS

The study was conducted on a total of 75 volunteers who were taken from the outdoor patients of the Department of Obstetrics and Gynaecology at Dayanand Medical College and Hospital, Ludhiana and from some other institutions in Ludhiana. 25 healthy women of age group 30–40 years, without any cardio respiratory problem, were taken as controls (Group A). Group B consisted of 25 healthy postmenopausal women with natural menopause of 2 years or more duration and Group C consisted of 25 healthy

postmenopausal women with artificial menopause (total abdominal hysterectomy with bilateral salpingo-oophorectomy) of 6 months duration or more, but without any other ailment. The procedure followed was in accordance with the ethical standards on human experimentation approved by the ethical committee of Dayanand Medical College and Hospital, Ludhiana.

The systolic time intervals were calculated by taking simultaneous recording of electrocardiogram (in lead II by using AC amplifier (Model 206)), phonocardiogram (by a piezoelectric microphone attached to the versatile cardiac amplifier (Model 204)) and external carotid pulse tracings (by T-303 Volume transducer Vt-1635, connected to universal bioamplifier (Model 201)) on polygraph, at a speed of 50 mm/sec with time marker of 1 second, (4, 5, 6, 7). The systolic time intervals (STI) recorded with this method are comparable to the more expensive and invasive intracardiac measurements (8).

QS_2 and LVET were measured from the ECG, Heart sounds and Carotid artery pulse tracings. QS_2 (Total electro mechanical systole) begins from the onset of QRS complex and ends with the first high pitched vibration of second heart sound recorded by phonocardiography (4). LVET (Left ventricular ejection time) is the time interval between the opening and closing of the aortic valves. It is measured from the carotid artery pulse tracing, by the interval between the upstroke and the dicrotic notch. PEP (Pre ejection period) is calculated by subtracting LVET from QS_2 . It denotes the period of systole before the ejection phase. It gives evidence of rate of rise of

ventricular pressure and contractility of cardiac muscle.

The PEP/LVET ratio gives the diagnostic value of left ventricular functions. When the cardiac performance is diminished, there occurs increase in PEP/LVET ratio. This ratio is inversely correlated with the ejection fraction as determined by the invasive techniques (9). PEP/LVET ratio correlates well with internally recorded parameters (8, 10) and inversely correlates with the ejection fraction (3). The Systolic time interval indices (STI-I) were calculated by applying correction for heart rate according to the Weissler's linear regression equation (11) as:

$$QS_2-I = 2.0 \times HR + QS_2$$

$$LVET-I = 1.6 \times HR + LVET$$

$$PEP-I = 0.4 \times HR + PEP$$

This is still considered a standard equation for clinical application. In case the heart rate is below 110 beats/mm, PEP/LVET ratio is unrelated to heart rate.

Statistical Analysis was done by using Students paired t-test.

RESULTS AND DISCUSSION

There is non significant increase in pre ejection period indices (PEP-I) and highly significant decrease in left ventricular ejection time indices (LVET-I) along with prolongation of PEP/LVET ratio (Table II) in natural menopause women as compared to controls. Total electromechanical systolic period indices (QS_2-I) is showing significant decrease. The decrease of QS_2-I in this could possibly be due to greater decrease of Left Ventricular Ejection Time and less increase of Pre Ejection Period. In Surgical menopause group, there is significant increase in QS_2-I , PEP-I and PEP/LVET ratio along with significant decrease in LVET-I. Lengthening of QS_2 can be explained due to greater increase in PEP than the decrease of LVET. On comparing the groups B and C, it is observed that there is highly significant increase in QS_2-I , PEP-I and PEP/LVET ratio in Group C cases.

TABLE I: Age and number of subjects.

	<i>Pre menopause women</i> <i>n=25</i> <i>(Group A)</i>	<i>Natural menopause</i> <i>n=25</i> <i>(Group B)</i>	<i>Surgical menopause</i> <i>n=25</i> <i>(Group C)</i>
Mean age (in years)	35.24±2.77	58.96±6.95	48.28±9.50

Data are shown as means±SD.

TABLE II: Mean STIs and STI indices for all groups.

<i>STI (milliseconds)</i>	<i>Pre menopause (A) (n=25)</i>	<i>Natural menopause (B) (n=25)</i>	<i>Surgical menopause (C) (n=25)</i>	<i>t-value A & B</i>	<i>t-value A & C</i>	<i>t-value B & C</i>
Mean QS_2	353.76±14.3	350.64±17.32	372.44±19.68	0.68 ^{NS}	3.76**	4.07**
Mean LVET	263.6±9.24	247.92±17.72	245.16±15.05	3.84**	5.11**	0.58 ^{NS}
Mean PEP	90.16±10.18	102.7±14.88	127.3±20.27	3.40**	8.02**	4.79**
Mean QS_2-I	510.64±15.68	502.64±11.65	535.24±19.95	2.00*	4.74**	6.92**
Mean LVET-I	389.10±13.58	369.52±12.61	375.4±14.42	5.18**	3.38**	1.44 ^{NS}
Mean PEP-I	121.53±25.23	133.12±15.08	159.84±20.43	1.91 ^{NS}	5.73**	5.15**
PEP/LVET ratio	0.34±0.04	0.42±0.08	0.52±0.10	4.38**	8.18**	3.82**

Values are shown as means ± SD. NS – not significant, *P<0.05, **P<0.01.

Decrease in LVET-I indicates poor pumping ability of left ventricle and increase in PEP provides an indirect measurement of maximum rate of rise in pressure (dp/dt) which is directly related to the isovolumetric contraction phase. The PEP/LVET ratio correlates well with the ejection fraction and is an important measure of the left ventricular function (9).

In our study, systolic dysfunction is significantly more in Group C (PEP/LVET ratio is 0.52 ± 0.10) as compared to Group B (PEP/LVET ratio 0.42 ± 0.08). This could be attributed to sudden withdrawal of estrogen levels in surgical menopause as compared to the gradual decline of hormone levels in natural menopause (12). The age factor does not appear to contribute in systolic dysfunction, as mean age of group B (58.96 ± 6.95 years) is more as compared to Group C (48.28 ± 9.50 years) (Table I).

The fall in the estrogen level in the post menopausal women cause decrease in myocardial efficiency, probably due to atherosclerosis caused by the change in lipid profile and less responsive estrogen dependent receptors present in smooth muscle of coronary blood vessels, endothelium and cardiomyocytes. The other effect could be attributed to the decrease in estrogen mediated production of NO, and hence decrease in vasodilatation (1, 13, 14, 15, 16).

The observed increase in PEP in post menopausal subjects (in Group B and C) is due to increased forward resistance due to

above factors and decrease in LVET due to decreased myocardial perfusion, which decreases the ability of the myocardium to sustain contraction. In mild left ventricular failure, the PEP lengthens in proportion to the shortening of LVET and the QS_2 remains same; but with the progress of dysfunction, there is more increase in PEP than the shortening of LVET and this causes lengthening of QS_2 . Hence the period of systole encroaches over the diastolic period causing decrease the myocardial perfusion.

PEP/LVET ratio is 0.52 ± 0.10 in surgical menopausal group and 0.42 ± 0.08 in natural menopausal group, indicating mild left ventricular dysfunction in both the groups, but this systolic dysfunction is more in women with Group C. An increased ratio indicates the fall in ejection fraction and hence decreases the stroke volume, which leads to increases the end diastolic volume and stretching of myocardial fiber which, if occurs beyond the physiological limits, leads to further fall in the ejection fraction and the stroke volume. This may decrease the coronary blood flow and myocardial perfusion and further accentuate the cardiac dysfunction, thus leading to clinically evident left heart failure. The increase in ratio can determine a preclinical or compensated stage of cardiac disorder which may lead to clinical phase of cardiac decompensation (17). STIs and STI indices detect the left heart dysfunction before the appearance of clinical signs and symptoms and can be useful in the detection and prevention of coronary artery disease in post menopausal women.

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