

Research Article**Evaluation of Echocardiographic Systolic Parameters in Pre Eclamptics and Normotensives****Jain Neha^{*1}, Verma Asha², Shikha Jain³**¹Final year resident, Department of Obstetrics and gynaecology, S.M.S Medical College, Jaipur, Rajasthan²Professor, Department of obstetrics and gynaecology, S.M.S Medical College, Jaipur, Rajasthan³Department of obstetrics and gynaecology, S.M.S Medical College, Jaipur, Rajasthan***Corresponding author**

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Abstract: Early detection of changes in cardiovascular echocardiographic systolic parameters and their comparison with normotensives women. This method was a hospital based prospective case control study carried out in department of obstetrics and gynaecology in S.M.S Medical College, Jaipur during the period from February 2013 to December 2014. 100 women were enrolled in the study after applying inclusion and exclusion criteria. All women underwent two dimensional echocardiography at rest. Cardiac systolic parameters were recorded and studied. The results were Mean LVEDV in PIH group was 75.71 ± 4.8 ml v/s 71.08 ± 5.6 ml in control group and the difference was statistically significant. Mean stroke volume was higher in PIH group as compared to the control group and the difference was statistically significant (59.83 ± 7.4 ml/min v/s 52.48 ± 6.4 ml/min). Mean Aortic Root Diameter in PIH group was 2.188 ± 1.04 cm as compared to the 1.866 ± 1.06 cm in the control group which was statistically significant. Mean Left Ventricular outflow Tract diameter was slightly higher in the PIH group as compared to the controls although the P-value was not significant (2.37 ± 1.06 cm and 1.99 ± 1.08 cm). Mean Total Vascular Resistance in PIH group was found to be higher in PIH group as compared to the controls and the difference was statistically significant (1389 ± 57.04 dynes/sec/cm⁻⁵ v/s 1286 ± 45.01 dynes/sec/cm⁻⁵). In conclusion Systolic parameters get worsened in pre eclamptics. Early detection of change in these parameters could help to identify high risk women who are prone to develop cardiovascular morbidity in later life.**Keywords:** Echocardiographic, LVEDV, LV ESV, pre eclamptics.

INTRODUCTION

Preeclampsia is a multisystem disorder that occurs after 20 wks of pregnancy. The incidence of preeclampsia in nulliparous women ranges from 3-10% [1]. Acute preeclampsia is associated with significantly higher prevalence of asymptomatic abnormal global left ventricular (LV) abnormal function/geometry and myocardial injury [1]. It is also associated with significantly higher risk of subsequent heart failure, ischemic and hypertensive heart diseases, and related mortality compared with uneventful pregnancy in later life [2, 3]. Invasive monitoring devices such as the pulmonary artery catheter have significant risks and are currently rarely used as research tools. Their use in clinical practice is limited to the intensive care setting in extremely unwell women thus restricting their clinical applicability.

Trans thoracic echocardiography, however, is routinely used in cardiovascular system research in other areas of medicine. It is frequently considered the

reference standard for cardiovascular system monitoring. It is a non-invasive, precise device and is validated in pregnancy. It is an ideal device for measuring the cardiac function in women with pre-eclampsia however is currently rarely used. BP monitoring alone is insufficient to identify efficiently the risk of cardiovascular complication in these subjects. Maternal echocardiography if introduced into routine management protocol could help to identify women who are at high risk to develop complication.

METHODS

This hospital based prospective type of case control study was conducted in Department of Obstetrics and Gynaecology, SMS Medical College, Jaipur from February 2013 to December 2014. 100 women were recruited in the study including 50 pre eclamptics and 50 controls. An Inclusion and exclusion criteria were applied.

INCLUSION CRITERIA

- Singleton pregnancy
- Gestational age > 34 weeks
- Pre-eclamptic women

EXCLUSION CRITERIA

- Gestational age < 34 weeks
- Heart disease
- Medical problems
 - ✓ Severe anaemia
 - ✓ Twin pregnancy
 - ✓ Alcohol and tobacco use
 - ✓ Chronic hypertension
 - ✓ Angina pectoris
 - ✓ Previous myocardial infarction
 - ✓ Heart failure
 - ✓ Chronic obstructive pulmonary disease
 - ✓ Diabetes mellitus

Normotensive healthy, non smoking pregnant women with normal foetal growth, matched for maternal age and gestation was recruited as controls from routine antenatal clinic. All subjects were studied by standard two dimensional and Doppler trans thoracic echocardiography at rest. Patients were studied in left lateral decubitus position and data was acquired at end expiration from standard para sternal / apical views using scanner. M mode studied was performed at the level of aorta, left atrium and left ventricle at a mid position between the tips of the mitral valve and papillary muscles. Pulsed Doppler flow across the mitral valve was recorded to obtain the LV diastolic filling pattern.

SYSTOLIC PARAMETERS STUDIED WERE

- Left ventricular end diastolic volume(LV EDV)
- Left ventricular end systolic volume(LV ESV)
- Stroke volume(SV)
- Cardiac output(CO)
- Aortic root diameter(ARD)
- Left ventricular outflow tract(LVOT)

RESULTS

Mean LVEDV was higher in PIH group as compared to the control group. Mean LVEDV in PIH group was 75.71 ± 4.8 ml v/s 71.08 ± 5.6 ml in control group and the difference was statistically significant. In the PIH Group, maximum number of patients i.e. 22 (44%) had LVESV between 35-40 ml, 14 (28%) between 25-30 ml, 4 (8%) patients had LVESV between 20-25 ml and other 4 (8%) patients > 40 ml. In the Control Group, majority i.e. 20 (40%) of the patients had LVESV between 25-30 ml and 12 (24%) of the patients had LVESV between 30-35 ml.

The mean was higher in the PIH group as compared to the control group and the difference was statistically significant (33.75 ± 4.2 ml v/s 30.1 ± 3.7 ml).

Mean stroke volume was higher in PIH group as compared to the control group and the difference was statistically significant. 44% of the patients in PIH group had CO between 5.6-6 L/min whereas only 20% patients in the control group had CO in this range indicating a statistically significant difference.

Mean ARD in PIH group was 2.188 ± 1.04 cm as compared to the 1.866 ± 1.06 cm in the control group which was statistically significant. Mean LVOT diameter was slightly higher in the PIH group as compared to the controls although the P-value was not significant (2.37 ± 1.06 cm and 1.99 ± 1.08 cm).

DISCUSSION

Rizwana Solanki *et al.*; [4] and Chahinda Ghossein Doha *et al.*; [5] studied the same parameter in pre eclamptics and normotensives and found a significant difference in LVEDV between the two groups (108.23 ± 27.95 ml v/s 107.73 ± 5.66 ml 100 ± 16 ml v/s 94 ± 7 ml).

Chahinda Ghossein, Doha *et al.*; [5] studied systolic parameters in 40 pre eclamptic women and 40 normotensive women and concluded that the mean LVEDV was higher in pre-eclamptic group i.e. (100 ± 16 ml v/s 94 ± 7 ml) highlighting the importance of this variable in early detection of cardiovascular morbidity.

Although the results of our study was similar to all above studies but there was a difference in the values of mean LVEDV (75.71 ml v/s 100 ml). It could be because of the difference in the body surface area of the patients. Indian women have smaller habitus as compared to western women.. They concluded that preeclampsia is characterized by a significant increase in left ventricular end systolic volume.

In a study done by Solanki Rizwana *et al.*; [5] to assess LVESV in pre eclamptics and normotensives by two dimensional echocardiography. Mean LVESV was found to be higher in PIH group as compared to the controls (36.04 ± 13.32 ml v/s 27.2 ± 3.5 ml).

Our results were comparable with the study done by Alicia Dennis *et al.*; [6] who studied left ventricular systolic and diastolic function and structure using trans thoracic echocardiography in women with 40 untreated pre eclampsia and 40 normotensive women and found a higher mean LVESV in the pre eclampsia group. In a study done by AT Dennis *et al.*; [6] to observe the haemodynamics in women with 40 untreated pre eclampsia and 40 matched healthy pregnant controls by using trans thoracic echocardiography, they calculated a increased stroke volume in untreated pre eclamptic group i.e. (58.9 ± 12.8 ml v/s 56.9 ± 7.2 ml).

Rizwana Solanki *et al.*; [5] did a similar study to evaluate various systolic parameters in pre eclamptics and normotensive women and they found a statistically

significant difference in mean SV between two groups studied. Stroke volume in women with pre eclampsia and normotensives was 73.3 ± 14.19 ml v/s 70.8 ± 3.22 ml respectively.

Our results were also comparable to the study done by AT Dennis *et al.*; [6] who studied systolic parameters in pre-eclamptics and healthy pregnant women. 40 pre-eclamptic and 40 healthy pregnant women underwent Doppler echocardiography and observed for cardiac output which was found to be higher in PIH group as compared to the controls (4789 ± 14 ml/min v/s 4109 ± 59 ml/min). They stated that cardiac output is increased in women with untreated pre eclampsia due to an increase in stroke volume.

Rizwana Solanki *et al.*; [5] assessed cardiac output in 40 patients. Cardiac output in pre-eclamptics was 6600.85 ± 4.56 ml/min as compared to 5600.1 ± 1.77 ml/min which was significantly higher. Our results were comparable to the study done by Solanki Rizwana *et al.*; [5] in which they assessed the echocardiographic changes in pre eclamptic women. Women with pre-eclampsia had higher aortic root diameter as compared to normotensive control (2.48 cm v/s 2.02 cm).

DP Naidoo *et al.*; [7] also reported a higher mean ARD in pre-eclamptics as compared to the controls (24 mm v/s 23 mm). They studied haemodynamics in 36

pre-eclamptics and 41 normotensive women using tissue Doppler imaging studies. Li Jun Yuan *et al.*; [8] who studied the impact of pre eclampsia on left ventricular outflow tract in 40 normal and 23 pre-eclamptic pregnancies by two dimensional trans thoracic echocardiography and LVOT diameter was calculated which was found to be higher in PIH group.

Solanki Rizwana *et al.*; [5] who did a study in which they assessed various systolic and diastolic parameters and observed that mean TVR in PIH group was 1396.85 ± 156.2 dynes/sec/cm⁻⁵ as compared to the 1204.5 ± 71.18 dynes/sec/cm⁻⁵. They suggested that women with pre eclampsia had a uniform pattern of high total vascular resistance and high cardiac output. High TVR in pre-eclampsia suggests elevated after load which is linked with reduced emptying of left ventricle.

Karen Melchiorre *et al.*; [9] also found TVR to be higher in the PIH group as compared to the controls mainly due to vasoconstriction.

AT Dennis *et al.*; [6] in his study found a significant difference in mean TVR in pre-eclamptics and controls. Mean TVR was 2015.7 ± 624.7 dynes/sec/cm⁻⁵ and 1612.5 ± 315.4 dynes/sec/cm⁻⁵ in PIH group and normotensives respectively.

Table 1: Distribution of Patients According to Left Ventricular End Diastolic Volume (LVEDV)

LVEDV (in ml)	PIH Group		Control Group	
	No.	%	No.	%
65 – 70	14	28.00	32	64.00
70 – 75	6	12.00	12	24.00
75 – 80	4	8.00	3	6.00
80 – 85	20	40.00	2	4.00
>85	6	12.00	1	2.00
Total	50	100.00	50	100.00

P value 0.001

Table 2: Distribution of Patients According to Left Ventricular End Systolic Volume (LVESV)

LVESV (in ml)	PIH Group		Control Group	
	No.	%	No.	%
20 – 25	4	8.00	8	16.00
25 – 30	14	28.00	20	40.00
30 – 35	6	12.00	12	24.00
35 – 40	22	44.00	8	16.00
>40	4	8.00	2	4.00
Total	50	100.00	50	100.00

P value 0.06

Table 3: Distribution of Patients According to Stroke Volume (SV)

Stroke Volume (in ml)	PIH Group		Control Group	
	No.	%	No.	%
<40	5	10.00	10	20.00
40 – 50	8	16.00	18	36.00
50 – 60	14	28.00	5	10.00
60 – 70	18	36.00	5	10.00
>70	5	10.00	2	4.00
Total	50	100.00	50	100.00

P value 0.002

Table 4: Distribution of Patients According to Cardiac Output (CO)

Cardiac Output (in L/min)	PIH Group		Control Group	
	No.	%	No.	%
4.5 – 5	5	10.00	8	16.00
5.1– 5.5	20	40.00	22	44.00
5.6 – 6	22	44.00	10	20.00
6.1 – 6.5	2	4.00	2	4.00
6.6 – 7	1	2.00	4	8.00
7.1 – 7.5	0	0.00	4	8.00
Total	50	100.00	50	100.00

P value 0.05

Table 5: Distribution of Patients According to Aortic Root Diameter (ARD)

Aortic Root Diameter (in cm)	PIH Group		Control Group	
	No.	%	No.	%
1 - 1.5	5	10.00	8	16.00
1.5 – 2	11	22.00	30	60.00
2 - 2.5	28	56.00	8	16.00
>2.5	6	12.00	4	8.00
Total	50	100.00	50	100.00

P value 0.002

Table 6: Distribution of Patients According to Left Ventricular Outflow Tract (LVOT)

Left Ventricular Outflow Tract (in cm)	PIH Group		Control Group	
	No.	%	No.	%
<1	1	2.00	2	4.00
1 - 1.5	5	10.00	12	24.00
1.5 – 2	18	36.00	24	48.00
2 - 2.5	22	44.00	10	20.00
>2.5	4	8.00	2	4.00
Total	50	100.00	50	100.00

P value 0.06

Table 7: Distribution of Patients According to Total Vascular Resistance (TVR)

Total Vascular Resistance (in dynes/sec/cm ⁵)	PIH Group		Control Group	
	No.	%	No.	%
<1200	0	0.00	10	20.00
1200 – 1300	10	20.00	26	52.00
1300 – 1400	26	52.00	12	24.00
1400 – 1500	12	24.00	1	2.00
>1500	4	8.00	1	2.00
Total	50	100.00	50	100.00

P value 0.001

CONCLUSION

Pre-eclampsia is a multisystem disease with acute onset of cardiovascular manifestations. The cardiovascular system undergoes a host of changes which ultimately lead to classic high cardiac output – high systemic vascular resistance state. Since there are structural and functional changes in the cardiovascular dynamics in subjects with pre-eclampsia, maternal echocardiography if introduced in the routine management protocol could help to identify women who are at high risk to develop complications.

REFERENCES

1. Melchiorre K, Sutherland GR, Baltabaeva A, Liberati M, Thilaganathan B; Maternal cardiac dysfunction and remodeling in women with preeclampsia at term. *Hypertension*, 2011; 57: 85–93.
2. Lykke JA, Langhoff-Roos J, Sibai BM, Funai EF, Triche EW, Paidas MJ; Hypertensive pregnancy disorders and subsequent cardiovascular morbidity and type 2 diabetes mellitus in the mother. *Hypertension*, 2009; 53: 944–951.
3. Mongraw-Chaffin ML, Cirillo PM, Cohn BA; Preeclampsia and cardiovascular disease death: prospective evidence from the child health and development studies cohort. *Hypertension*, 2010; 56: 166–171.
4. Solanki Rizwana, Maitra Nandita; Echocardiographic assessment of cardiovascular hemodynamics in pre-eclampsia. *The Journal of Obstetrics and Gynecology of India*, 2011; 61(5): 519-522.
5. Ghossein Doha Chahinda, Peeters Louis, Van Heijster Sanne, Van Kuijk Sander, Spaan Julia, Delhaas Tammo, Spaanderman Marc; Hypertension after preeclampsia is preceded by changes in cardiac structure and function. *Hypertension*, 2013; 62(2): 382-90.
6. Dennis AT, Castro S, Carric, Simmons S, Permezel M, Royse C; Haemodynamics in women with untreated preeclampsia. *Anaesthesia*, 2012; 67(10): 1105-18.
7. DP Naidoo, S Fayers, J Moodley; Cardiovascular haemodynamics in preeclampsia using tissue doppler studies. *Cardiovas J Afr*, 2013; 24(4): 130-136.
8. Li Jun Yuan, Yun You Duan, Dan Xue, Tie- Sheng Cao, Ning Zhou; Ultrasound study of carotid and cardiac remodelling and cardiac arterial coupling in normal pregnancy and preeclampsia: a case control study. *BMC Pregnancy and Childbirth*, 2014; 14: 113.
9. Karen Melchiorre, George Ross Sutherland, Aigul Baltabaeva, Marco Liberati, Basky Thilaganathan; Maternal cardiac dysfunction and remodeling in women with preeclampsia at term. *Hypertension*, 2011; 57: 85-93.