International Journal of Reproduction, Contraception, Obstetrics and Gynecology
Jain N et al. Int J Reprod Contracept Obstet Gynecol. 2015 Oct;4(5):1517-1521
www.ijrcog.org

pISSN 2320-1770 | eISSN 2320-1789

DOI: http://dx.doi.org/10.18203/2320-1770.ijrcog20150739

Research Article

Evaluation of echocardiographic systolic parameters in pre eclamptics and normotensives women

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Received: 25 August 2015
Accepted: 09 September 2015

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ABSTRACT

Background: Early detection of changes in cardiovascular echocardiographic systolic parameters and their comparison with normotensives women.
Methods: This 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.
Results: 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 ± 7.4ml/min v/s 52.48 ± 6.4ml/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}).
Conclusions: 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: Eclampsia, Echocardiography, Hypertension

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.

Transthoracic 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 criterion was applied.

Inclusion criteria

1. Singleton pregnancy
2. Gestational age > 34 weeks
3. Pre-eclamptic women

Exclusion criteria

1. Gestational age < 34 weeks
2. Heart disease
3. Medical problems

- Severe anemia
- 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 transthoracic 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 midposition 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

1. Left ventricular end diastolic volume (LV EDV)
2. Left ventricular end systolic volume (LV ESV)
3. Stroke volume (SV)
4. Cardiac output (CO)
5. Aortic root diameter (ARD)
6. Left ventricular outflow tract (LVOT)

RESULTS

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				

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 ± 4.2ml v/s 30.1 ± 3.7ml). 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.

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				

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).

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				

DISCUSSION

Solanki et al and Doha et al 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 ± 16ml v/s 94 ± 7 ml).[4,5]

Doha et al 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 ± 16ml v/s 94 ± 7 ml) highlighting the importance of this variable in early detection of cardiovascular morbidity.[5]

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 et al to assess LVESV in pre eclamptics and normotensives by two dimensional

echocardiography.[5] 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 (2012) who studied left ventricular systolic and diastolic function and structure using transthoracic echocardiography in women with 40 untreated pre eclampsia and 40 normotensive women and found a higher mean LVESV in the pre eclampsia group.[6] In a study done by AT Dennis et al (2012) to observe the haemodynamics in women with 40 untreated pre eclampsia and 40 matched healthy pregnant controls by using transthoracic echocardiography, they calculated an increased stroke volume in untreated pre eclamptic group i.e. (58.9 ± 12.8 ml v/s 56.9 ± 7.2ml).[6]

Rizwana Solanki et al 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.[5] 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 Dennis et al who studied systolic parameters in pre-eclamptics and healthy pregnant women.[6] 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.

Solanki et al 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.[5] Our results were comparable to the study done by Solanki Rizwana et al (2011) in which they assessed the echocardiographic changes in pre eclamptic women.[5] Women with pre-eclampsia had higher aortic root diameter as compared to normotensive control (2.48 cm v/s 2.02 cm).

Naidoo et al also reported a higher mean ARD in pre-eclamptics as compared to the controls (24 mm v/s 23 mm).[7] They studied haemodynamics in 36 pre-eclamptics and 41 normotensive women using tissue Doppler imaging studies. Li Jun Yuan et al (2014) who studied the impact of pre eclampsia on left ventricular outflow tract in 40 normal and 23 pre-eclamptic pregnancies by two dimensional transthoracic echocardiography and LVOT diameter was calculated which was found to be higher in PIH group.[8]

Solanki 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}.[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.

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

AT Dennis et al (2012) 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.[6]

CONCLUSIONS

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.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Jain N, Verma A, Jain S. Evaluation of echocardiographic systolic parameters in pre eclamptics and normotensives women. Int J Reprod Contracept Obstet Gynecol 2015;4:1517-21.