Role of Echocardiographic Systolic Parameters in Pre Eclamptics and Normotensive Women

Gattu Neha[1], E. Ramadevi[2], K. Himabindu[3], R. Padamalatha[4], S. Kavitha[5]

ABSTRACT

Introduction: Preeclampsia is a disease unique to pregnancy and it is characterized by progressive hypertension, pathological edema and proteinuria. But till now the hemodynamics of preeclampsia is not properly understood and is debated. Study aimed to assess maternal cardiovascular function using echocardiography in normal and preeclamptic women.

Material and Methods: Our study was a prospective study on 200 women admitted in the Department of Obstetrics and Gynaecology, Chalmeda Anand Rao Institute of Medical Sciences, Bommakal, Karimnagar, Telangana state, India. All women underwent two-dimensional echocardiography at rest. Cardiac systolic parameters were recorded and studied.

Results: The studied parameters like Mean Left ventricular end-diastolic volume (LVEDV), Mean stroke volume, Mean aortic root diameter and Mean total vascular resistance were higher in the Pregnancy Induced Hypertension (PIH) group than the controls and the difference was statistically significant. The Mean left ventricular outflow tract diameter in the Pregnancy Induced Hypertension (PIH) group was also higher than the control group, with the difference being insignificant.

Conclusion: Women with preeclampsia have significant systolic dysfunction compared to normotensive controls. Blood pressure monitoring alone is insufficient to identify effectively, risk of cardiovascular complications in these subjects.

Keywords: Echocardiography, Normotensive, Preeclampsia, Systolic Parameters.

INTRODUCTION

Preeclampsia, a human-pregnancy-specific disease defined as the occurrence of hypertension and significant proteinuria in a previously healthy woman on or after the 20th week of gestation, occurs in about 2–8% of pregnancies.[1]

It is the most common medical complication of pregnancy whose incidence has continued to increase worldwide, and It is associated with significant maternal morbidity and mortality, accounting for about 50,000 deaths worldwide annually.[2] Thus reducing maternal mortality by 75% between 1990 and 2015 has been considered as part of the millennium development goals of the World Health Organization (WHO) Nations.[3]

Risk factors for preeclampsia include nulliparity, multifetal gestations, previous history of preeclampsia, obesity, diabetes mellitus, vascular and connective tissue disorders like systemic lupus erythematosus and antiphospholipid antibodies, age >35 years at first pregnancy, smoking, and African American race. Cross-sectional studies of women with preeclampsia have revealed diverse hemodynamic findings such as elevated cardiac output, high vascular resistance and reduced cardiac output and reduced myocardial contractility.[4-6]

The data on changes in left ventricular diastolic function is scarce. In addition, there is conflicting information about left ventricular performance both during normotensive and hypertensive pregnancy. Normal, increased and depressed function have all been reported at various stages of gestation. and fetal outcome.[7-9]

We carried this study to assess maternal cardiovascular function using echocardiography in normal and preeclamptic women.

MATERIAL AND METHODS

Our study is a prospective study on 200 women admitted in the Department of Obstetrics and Gynaecology, Chalmeda Anand Rao Institute of Medical Sciences, Bommakal, Karimnagar, Telangana state, India from December 2016 to June 2018. All women underwent two-dimensional echocardiography at rest. Cardiac systolic parameters were recorded and studied. Our study including 100 pre-eclamptics and 100 controls.

Inclusion Criteria

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

[1]Junior Resident, Department Obstetric & Gynecology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, [2]Professor & HOD, Department Obstetric & Gynecology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, [3]Associate Professor, Department Obstetric & Gynecology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, [4]Associate Professor, Department Obstetric & Gynecology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, [5]Senior Resident, Department Obstetric & Gynecology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India

Corresponding author: Gattu Neha, Junior Resident, Department Obstetric & Gynecology, Chalmeda Anand Rao Institute of Medical Sciences, Karimnagar, Telangana, India

How to cite this article: Gattu Neha, E. Ramadevi, K. Himabindu, R. Padamalatha, S. Kavitha. Role of echocardiographic systolic parameters in pre eclamptics and normotensive women. International Journal of Contemporary Medical Research 2019;6(8):H15-H18.

DOI: http://dx.doi.org/10.21276/ijcmr.2019.6.8.53

Parameter	Control group	Pih group	P value
Age	25.8±1.9	26.3±2.75	0.44
Body mass index	23.98±3.48	27.32±2.08	0.12
Systolic blood pressure	108.6±22.86	156±18.53	0.01
Diastolic blood pressure	72.4±5.97	96.8±9.16	0.01

Table-1: Baseline characteristics of two study groups

LVEDV (ML)	PIH Group	Control group	P value
65-70	28	66	0.001
70-75	44	24	
75-80	8	4	
80-85	14	4	
>85	6	2	
Total	100	100	

Table-2: Distribution of patients according to left ventricular enddiastolic volume (LVEDV)

LVESV (ML)	Control group	PIH Group	P value
20-25	5	4	0.08
25-30	45	26	
30-35	30	46	
35-40	16	20	
>40	4	4	
Total	100	100	

Table-3: Distribution of patients according to left ventricular endsystolic volume (LVESV)

SV (ML)	Control group	PIH group	P value
<40	24	10	0.06
40-50	38	18	
50-60	14	26	
60-70	16	34	
>70	8	12	
Total	100	100	

Table-4: Distribution of patients according to stroke volume (SV)

Cardiac output (L/min)	Control group	PIH group	P value
4.5-5	14		0.01
5.1-5.5	30		
5.6-6	36	52	
6.1-6.5	4		
6.6-7	8		
7.1-7.5	8		
Total	100	100	

Table-5: Distribution of patients according to cardiac output (CO)

Cardiac output (L/min)	Control group	PIH group	P value
1-1.5	14	12	0.02
1.5-2	62	20	
2-2.5	16	58	
>2.5	8	10	
Total	100	100	

Table-6: Distribution of patients according to aortic root diameter (ARD)

Exclusion Criteria

1. Gestational age <34 weeks
2. Heart disease
3. Medical problems, like chronic hypertension, severe anaemia, twin pregnancy, alcohol and tobacco use, previous myocardial infarction, chronic obstructive pulmonary disease and diabetes mellitus

Normotensive healthy, non-smoking pregnant women with normal foetal growth matched for maternal age and gestation were 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 were acquired at end expiration from standard parasternal/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 studied were:

1. Left ventricular end-diastolic volume (LVEDV)
2. Left ventricular end-systolic volume (LVESV)
3. Stroke volume (SV)
4. Cardiac output (CO)
5. Aortic root diameter (ARD) and
6. Left ventricular outflow tract (LVOT)

RESULTS

Baseline details of both the groups were recorded (Table 1 and Graph 1). Mean LVEDV was higher in the PIH group as compared to the control group. Mean LVEDV in the PIH group was 73.62 ± 4.6 versus 69.86 ± 5.9 ml in the control group, and the difference was statistically significant (Table 2 and Graph 2).

In the PIH group, maximum number of patients, i.e. 46 had LVESV between 35 and 40 ml, 26 between 25 and 30 ml, 20 between 35-40 ml, 4 between 20 and 25 ml and other 4 patients >40 ml. In the control group, majority, i.e. 45 of the patients had LVESV between 25 and 30 ml and 30 had LVESV between 30 and 35 ml. The mean was higher in the PIH group as compared to the control group, and the difference was statistically significant (Table 3).

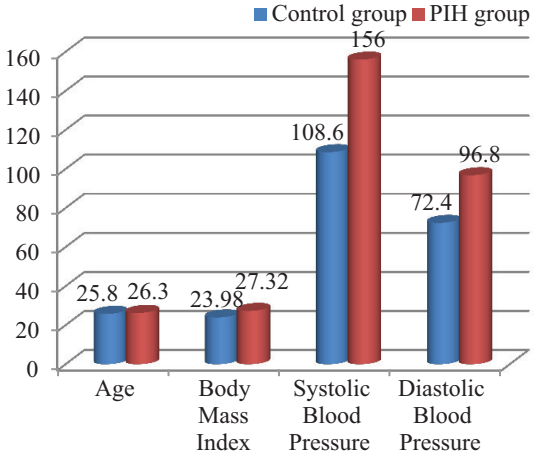
Mean stroke volume was higher in the PIH group as compared to the control group, and the difference was statistically significant (Table 4).

52 patients in the PIH group had CO between 5.6 and 6 L/min, whereas only 36 patients in the control group had CO in this range, indicating a statistically significant difference (Table 5).

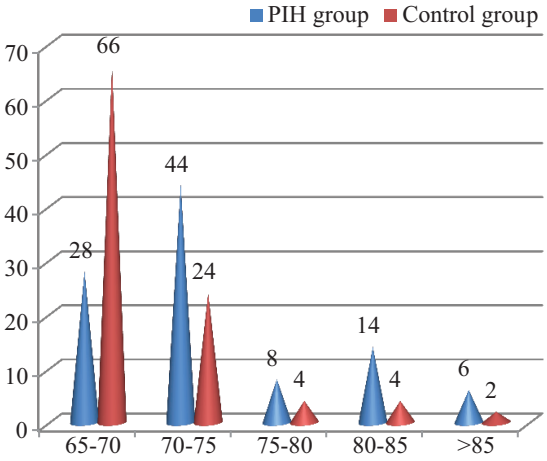
Mean ARD in the PIH group was 2.216 ± 1.02 cm as

Cardiac output (L/min)	Control group	PIH group	P value
<1	4	2	0.06
1-1.5	20	12	
1.5-2	50	34	
2-2.5	20	44	
>2.5	6	8	
Total	100	100	

Table-7: Distribution of patients according to left ventricular outflow tract (LVOT)



Graph-1: Baseline characteristics of two study groups



Graph-2: Distribution of patients according to left ventricular enddiastolic volume (LVEDV)

compared to the 1.898 ± 1.08 cm in the control group which was statistically significant (Table 6).

Mean LVOT diameter was slightly higher in the PIH group (2.39± 1.05) as compared to the controls (2.08 ± 1.07 cm), the difference being insignificant (Table 7).

DISCUSSION

Preeclampsia in women is characterized by a high CO and high vascular resistance state. There are physiological changes in left ventricular structure and function during normal pregnancy but exaggerated physiological changes are seen in preeclamptic subjects. Previous similar studies by Solanki et al and Ghossein Doha et al also found a significant difference in LVEDV between the two groups. They concluded that pre-eclampsia is characterised by a significant increase in left ventricular end-systolic volume.[10,11]

Even though the results of our study were similar to all the above studies, there was a difference in the values of parameters studied which could be because of the difference in the body surface area of the patients.

Valensise et al found that CO, LVM and TVR in preeclamptic group was higher than that of normotensive group. B.[12] Vasapollo and Bosio et al reported that the preclinical phase of preeclampsia is characterized by low TVR and high CO. Established preeclampsia is characterized by high TVR and low CO.[13,14]

The findings of our study are also comparable with the study done by Dennis et al, who found a higher mean LVESV in the pre-eclampsia group. They observed the haemodynamics in women with 40 untreated pre-eclampsia and 40 matched healthy pregnant controls by using transthoracic echocardiography, and they calculated a increased stroke volume in untreated pre-eclamptic group, i.e. (58.9 ± 12.8 vs. 56.9 ± 7.2 ml).[15]

Naidoo et al also reported a higher mean ARD in pre-eclamptics as compared to the controls (24 vs. 23 mm). They studied haemodynamics in 36 pre-eclamptics and 41 normotensive women using tissue Doppler imaging studies.[16] Yuan et al 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 calculated was found to be higher in the PIH group.[17]

Limitations of study

1. Smaller sample size
2. Lack of follow up of subjects in the postpartum period to examine whether the altered cardiovascular hemodynamic state reverts to normal after pregnancy.

CONCLUSION

This study shows that there are significant structural and functional changes in the cardiovascular dynamics in subjects with preeclampsia. It appears that BP monitoring alone is insufficient to identify effectively, risk of cardiovascular complications in these subjects. Maternal echocardiography if introduced into the routine management protocol, could help to identify women who are at high risk to develop complications.

REFERENCES

1. J. Moodley. Maternal deaths associated with hypertensive disorders of pregnancy: a population-based study. Hypertension in Pregnancy, 2004;23:247–256.
2. L. Duley. The global impact of pre-eclampsia and eclampsia. Seminars in Perinatology 2009;33:130–137.
3. O. K. Osungbade and O. K. Ige. Public heath perspectives of preeclampsia in developing countries: implication for health system strengthening. Journal of Pregnancy, vol. 2011, Article ID 481095, 2011.
4. Escudero EM, Favaloro LE, Moreira C, et al. Study of left ventricular function in pregnancy induced

hypertension. Clin Cardiol. 1988;11:329–33.

5. Moran AM, Colan SD, Mauer MB, et al. Adaptive mechanisms of left ventricular diastolic function to the physiologic load of pregnancy. Clin Cardiol. 2002;25:124–31.
6. Kametas NA, McAuliffe F, Cook B, et al. Maternal left ventricular transverse and long axis systolic function during pregnancy. Ultrasound Obstet Gynecol. 2001;18:467–74.
7. Desai DK, Moodley J, Naidoo DP, et al. Cardiac abnormalities in pulmonary edema associated with hypertensive crises in pregnancy. Br J Obstet Gynaecol. 1996;103:523–8.
8. Poppas A, Shroff SG, Korcarz CE, et al. Serial assessment of the cardiovascular system in normal pregnancy. Circulation. 1997;95:2407–15.
9. Simmons LA, Gillin AG, Jeremy RW. Structural and functional changes in left ventricle during normotensive and preeclamptic pregnancy. Am J Physiol Heart Circ Physiol. 2001;283:1627–33.
10. Solanki R, Maitra N. Echocardiographic assessment of cardiovascular hemodynamics in pre-eclampsia. J Obstet Gynecol India. 2011;61:519–22.
11. Ghossein Doha C, Peeters L, Van Heijster S, et al. Hypertension after preeclampsia is preceded by changes in cardiac structure and function. Hypertension. 2013;62:382–90
12. Valensise H, Novelli GP, Vasapollo B, et al. Maternal diastolic dysfunction and left ventricular geometry in gestational hypertension. Hypertension. 2001;37:1209–15.
13. Vasapollo B, Valensise H, Novelli GP, et al. Abnormal maternal cardiac function precedes the clinical manifestation of fetal growth restriction. Ultrasound Obstet Gynecol. 2004;24:23–9.
14. Bosio PM, Mckenna PJ, Conroy R, et al. Maternal central hemodynamics in hypertensive disorders of pregnancy. Obstet Gynecol. 1999;94:978–84.
15. Dennis AT, Castro S, Carrc C, et al. Haemodynamics in women with untreated preeclampsia. Anaesthesia. 2012;67:1105–18.
16. Naidoo DP, Fayers S, Moodley J. Cardiovascular haemodynamics in preeclampsia using tissue Doppler studies. Cardiovasc J Afr. 2013;24:130–6.
17. Yuan LJ, Duan YY, Xue D. Ultrasound study of carotid and cardiac remodelling and cardiac arterial coupling in normal pregnancy and preeclampsia: a case control study. BMC Pregnancy Childbirth. 2014;14:113.

Source of Support: Nil; **Conflict of Interest:** None

Submitted: 22-07-2019; **Accepted:** 08-08-2019; **Published:** 28-08-2019