

Maternal Cardiac Diastolic Dysfunction by Doppler Echocardiography in Women with Preeclampsia

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ABSTRACT

Introduction: Preeclampsia may lead to heart failure in late pregnancy and early puerperium. Diastolic dysfunction may be the cause of heart failure in these patients. There is paucity of data on diastolic dysfunction in patients with preeclampsia.

Aim: To assess cardiac diastolic dysfunction in women with preeclampsia by Doppler echocardiography and to correlate severity of dysfunction with severity of preeclampsia.

Materials and Methods: One hundred and fifty nulliparous women in age group of 20-35 years were recruited for the study. Among these, 120 women with preeclampsia were taken as cases and 30 normotensive women as controls. Doppler echocardiography was carried out between 28-36 weeks of gestation in both groups to assess and grade severity of diastolic dysfunction.

Results: Of 120 women with preeclampsia, 61 had mild preeclampsia and 59 had severe preeclampsia. Diastolic dysfunction was seen in 25(20.8%) cases. Among these, grade I diastolic dysfunction was seen in 40% and the rest 60% had grade II diastolic dysfunction. In the mild preeclampsia group, only 2(3.3%) patients had diastolic dysfunction. Both had grade I dysfunction. Of severe preeclampsia patients, 8(13.6%) had grade I and 15(25.4%) had grade II diastolic dysfunction ($p=0.001$). None of these progressed to heart failure or pulmonary oedema. Systolic function assessed by left ventricular ejection fraction was normal in all cases. All controls had normal systolic and diastolic functions.

Conclusion: Cardiac diastolic dysfunction occurred in one-fifth of women with preeclampsia. Grade of diastolic dysfunction correlated with the severity of preeclampsia.

Keywords: Hypertension, Medical disorders, Pregnancy

INTRODUCTION

Preeclampsia is one of the most common medical disorders in pregnancy, the incidence being 2-7% [1]. Various complications associated with preeclampsia are eclampsia, cerebrovascular accidents, renal failure and pulmonary oedema. Preeclampsia can affect the maternal heart too. The physiological changes of pregnancy like tachycardia increase in cardiac output and decrease in peripheral vascular resistance can further mimic the symptoms of heart failure. Heart failure in pregnancy is most commonly due to pre-existing heart disease. In India, the important causes are valvular heart disease especially mitral stenosis and congenital heart disease. Some cases may be also due to heart diseases that develop in pregnancy, most important of which is peripartum cardiomyopathy.

Cardiac dysfunction, both systolic and diastolic is known to occur in hypertension. Diastolic dysfunction usually precedes systolic dysfunction [2,3]. We speculated that preeclampsia may be responsible for some cases of heart failure occurring in late pregnancy and early puerperium. If we can identify any form of cardiac dysfunction along with its severity during early pregnancy, it may be possible to prevent progression of the condition and save mother from severe morbidity of acute heart failure [4]. We thus aimed to determine cardiac diastolic dysfunction in both mild and severe preeclampsia and also to correlate the severity of dysfunction with severity of preeclampsia in women between 28 to 36 weeks period of gestation. These were compared with normotensive control women at similar period of gestation.

MATERIALS AND METHODS

This prospective study was conducted at the Postgraduate Institute of Medical Education and Research, Chandigarh after approval from institute's ethics committee. The duration of study was one

year, from July 2012 to June 2013. Informed written consent was obtained from all patients. One hundred and fifty nulliparous women with singleton pregnancy between 20-35 years of age and between 28 to 36 weeks period of gestation were recruited for this study. A total of 120 women with preeclampsia were enrolled as cases and 30 normotensive women were controls. Women already having signs and symptoms of imminent eclampsia, those with eclampsia and those in active labours were excluded. Women with other comorbidities including chronic hypertension, connective tissue disorders, diabetes mellitus and thyroid disorders were also excluded. A detailed physical and obstetrical examination was done in all subjects. Blood pressure was measured in a semi-recumbent position. Severity of preeclampsia was assessed using the International Society of the Study of Hypertension in Pregnancy (ISSHP) criteria [5].

Doppler echocardiography was carried out by the same cardiologist within 2 days of initiation of treatment. Hypertension was treated by standard therapy as per the discretion of the treating unit. Mothers were followed up, to look for development of heart failure till delivery. The parameters assessed were E/A (peak early filling velocity/peak filling velocity during atrial systole) ratio across mitral valve, S/D (Systolic to Diastolic ratio) of pulmonary venous flow patterns, Deceleration Time (DT) in milliseconds, Isovolumetric Relaxation Times (IVRT) in milliseconds, transmitral annular velocities on tissue Doppler (septal E' and lateral E') in cm/seconds, Left Atrial (LA) volume index in ml/m² and Left Ventricular Ejection Fraction (LVEF). Grading of diastolic function was done as per the American society of echocardiography guidelines [6]. Independent t-test was applied for comparison of two groups. Mann-Whitney U-test was used for statistical analysis of skewed continuous variables. Proportions were compared using Chi-square or Fishers-exact test whichever was applicable.

RESULTS

Baseline characteristics of cases and controls were comparable [Table/Fig-1]. All patients including with diastolic dysfunction received standard treatment for preeclampsia. No specific drug therapy was given for the treatment of diastolic dysfunction. In patients with mild preeclampsia, a single antihypertensive drug was used in 44% while in the rest 56% patients no antihypertensive medications were used. In patients with severe preeclampsia a single antihypertensive agent was used in 29% patients, remaining 71% required two or more drugs and magnesium sulphate was used in 44%. Labetalol was the most commonly used antihypertensive agent.

The mean period of gestation at which echocardiography was done was 33.74 ± 2.07 weeks in cases and 34.18 ± 1.13 weeks in controls was similar ($p=0.272$). Echocardiographic parameters are shown in [Table/Fig-2]. LVEF was normal and comparable in both groups suggesting preserved systolic function in both cases and controls. Out of 120 patients with preeclampsia, diastolic dysfunction was seen in 25(20.8%) cases. All the controls had normal systolic and diastolic functions. Of 120 cases, 50.8% had mild preeclampsia and 49.2% had severe preeclampsia. Echocardiographic parameters were compared between patients with mild and severe preeclampsia [Table/Fig-3]. In severe preeclampsia group, 23 (38.9%) patients had diastolic dysfunction, of which 8 patients had grade I and 15 had grade II diastolic dysfunction. In mild preeclampsia group, only 2(3%) patients had diastolic dysfunction, all these being only grade I. None of the subjects had grade III or grade IV dysfunction. The severity of diastolic dysfunction correlated with severity of preeclampsia. Systolic function assessed by left ventricular ejection fraction was normal in all cases. None of the patients developed heart failure or pulmonary oedema.

Characteristics	Cases (N=120) Mean± standard deviation	Controls (N= 30) Mean ± standard deviation.	p-value
Age (years)	26.06±3.21	25.13±2.70	0.33
Body mass index (kg/m ²)	24.28±1.86	23.57±1.97	0.18
Body surface area (m ²)	1.71±.024	1.70±0.04	0.07

[Table/Fig-1]: Baseline characteristics of cases and controls.

Doppler parameters	Cases (N=120) Mean±standard deviation	Controls (N=30) Mean± standard deviation	p-value
E/A Ratio	1.16±0.20	1.170±.14	0.87
IVRT (milliseconds)	81.63±7.62	76.83±6.17	0.02
DT (milliseconds)	171.38±28.82	159.07±14.82	0.01
Septal e' (cm/seconds)	10.54±1.91	11.78±1.21	0.01
Lateral e' (cm/seconds)	12.40±2.44	13.86±1.11	0.01
Left atrial volume index (ml/m ²)	23.78±4.52	22.07±2.33	0.17
S/D Ratio	1.15±0.22	1.220±.11	0.04
Left ventricular ejection fraction (%)	57.55±1.75	57.80±1.75	0.53

[Table/Fig-2]: Mean values of Doppler parameters among the groups.

Diastolic dysfunction	Severity of preeclampsia				p-value
	Severe preeclampsia (n=59)		Mild preeclampsia (n=61)		
	Number	%	Number	%	
Grade I	8	13.6	2	3.3	0.001
Grade II	15	25.4	0	0	
Normal diastolic function	36	61.0	59	96.7	

[Table/Fig-3]: Correlation of severity of preeclampsia with severity of diastolic dysfunction.

DISCUSSION

Preeclampsia is a multisystem disorder that can affect almost every organ. Association between preeclampsia and cardiovascular morbidity has been highlighted in various studies [7,8]. Acute cardiovascular complications occur in around 6% of patients with severe preeclampsia [8,9]. Diastolic dysfunction usually precedes the compromise of systolic function in hypertension and can lead to heart failure or pulmonary oedema [10]. If this cardiovascular dysfunction can be picked by an echocardiography in preeclamptic women, it may be possible to reduce the risk of heart failure by early intervention.

In present study, diastolic dysfunction was present in one fifth of patients with preeclampsia. Diastolic dysfunction was uncommon in patients with mild preeclampsia, being present in only 3% patients. Even when present, the diastolic dysfunction was mild in all patients. None of the patients with mild preeclampsia had grade II or higher grade of diastolic dysfunction. Diastolic dysfunction was not seen in any of our controls. None of our study patients progressed to symptomatic disease due to management in a tertiary centre and timely termination of pregnancy based on severity of preeclampsia.

Patients with severe preeclampsia were different. Diastolic dysfunction was common being present in 38.9% of patients. What was of concern was that even the diastolic dysfunction was more severe in this group, with almost two thirds of these having grade II diastolic dysfunction. None of the patients had diastolic dysfunction more than grade II in this study. However, Hoogsteder et al., showed that most women with preeclampsia undergo adaptive responses with significant heart remodelling, but a subgroup of approximately 20% of women demonstrate more evident myocardial damage and overt global diastolic dysfunction. Global diastolic dysfunction was observed more frequently in preeclampsia versus control pregnancies being seen in 40% versus 14% respectively [11]. Another study found that women with preeclampsia had more diastolic dysfunction and higher cardiac output in the second trimester as compared to normotensive individuals. Blood pressure recordings alone did not identify patients at higher risk of cardiac complications [3]. In women with gestational hypertension haemodynamic parameters like increased peripheral vascular resistance and higher left ventricular mass predicted adverse maternal and fetal outcomes [4]. Thus assessment of diastolic dysfunction by echocardiography can potentially identify women at risk as early as the second trimester and guide therapy in these patients.

Diastolic dysfunction is known to be associated with left ventricular systolic dysfunction. Bamfo et al., found that longitudinal left ventricular systolic function tissue Doppler indices were reduced in preeclampsia and concluded that myocardial contractility was impaired in this condition [12]. Results of Melchiorre et al., showed that preeclampsia is associated with biventricular diastolic dysfunction, altered geometry and widespread myocardial impairment and only preterm but not term preeclampsia is characterized by biventricular systolic dysfunction [13]. However, none of our patients had impaired left ventricular ejection fraction. This is likely due to close follow-up and timely intervention in our patients.

LIMITATION

Our patients were closely monitored and had good maternal and fetal outcomes. This was primarily a diagnostic study looking at the prevalence of diastolic dysfunction in women with preeclampsia. Study of a larger cohort of patients is required to look at interventions that can prevent and treat diastolic dysfunction in these individuals.

CONCLUSION

Cardiac diastolic dysfunction can occur in women with preeclampsia and the severity of dysfunction correlates with severity of preeclampsia. Doppler echocardiography may be considered as one of the investigations in women with severe preeclampsia to identify patients for early intervention to prevent heart failure.

REFERENCES

- [1] Sibai BM. Diagnosis and management of gestational hypertension and preeclampsia. *Obstet Gynecol.* 2003;102:181-92.
- [2] 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.
- [3] Tangeda P, Shastri N. Maternal left ventricular systolic and diastolic function during second trimester of pregnancy with preeclampsia. *Journal of Dr. NTR University of Health Sciences.* 2015;4:224-28.
- [4] Valensise H, Vasapollo B, Novelli GP, Pasqualetti P, Galante A, Arduini D. Maternal total vascular resistance and concentric geometry: a key to identify uncomplicated gestational hypertension. *BJOG.* 2006;113:1044-52.
- [5] Report of the National High Blood Pressure Education Program Working Group on High Blood Pressure in Pregnancy. *Am J Obstet Gynecol.* 2000;183:S1-S22.
- [6] Nagueh SF, Appleton CP, Gillebert TC, Marino PN, Oh JK, Smiseth OA, et al. Recommendations for the evaluation of left ventricular diastolic function by echocardiography. *J Am Soc Echocardiogr.* 2009;22:107-33.
- [7] Melchiorre K, Thilaganathan B. Maternal cardiac function in preeclampsia. *Curr Opin Obstet Gynecol.* 2011;23:440-47.
- [8] Solanki R, Maitra N. Echocardiographic assessment of cardiovascular haemodynamics in preeclampsia. *J Obstet Gynaecol India.* 2011;61:519-22.
- [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.* 2002;283:H1627-33.
- [10] Maurer MS, Spevack D, Burkhoff D, Kronzon I. Diastolic dysfunction: can it be diagnosed by Doppler echocardiography? *J Am Coll Cardiol.* 2004;44:1543-49.
- [11] Hoogsteder PH, Krüse AJ, Sep SJ, Dassen WR, Gorgels AP, Peeters LL. Electrocardiographic findings in women with a recent history of pre-eclampsia. *Acta Obstet Gynecol Scand.* 2012;91:372-78.
- [12] Bamfo JE, Kametas NA, Chambers JB, Nicolaidis KH. Maternal cardiac function in normotensive and preeclamptic intrauterine growth restriction. *Ultrasound ObstetGynecol.* 2008;32:682-86.
- [13] Melchiorre K, Sutherland GR, Watt-Coote I, Liberati M, Thilaganathan B. Severe myocardial impairment and chamber dysfunction in preterm preeclampsia. *Hypertens Pregnancy.* 2012;31:454-71.

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