

Cardiac Diastolic Function by Echocardiography in Normotensive Pregnancies vs Pregnancies Complicated by Hypertensive Disorders

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ABSTRACT

Aim: To assess cardiac diastolic function by echocardiography in pregnancies complicated by hypertensive disorders and in normotensive pregnant women, correlate the severity of hypertensive disorders in pregnancy with the severity of cardiac diastolic dysfunction, and determine if cardiac diastolic dysfunction assessed by echocardiography can be used as a prognostic tool for the severity of hypertensive disorders in pregnancy with regard to heart failure.

Methodology: This is an observational comparative study conducted on 160 singleton pregnant women between 20 and 40 weeks of gestation over a period of 6 months and 160 subjects are placed in two groups—80 in hypertensive group and 80 in normotensive group. Transthoracic Doppler echocardiography is carried out on these patients and cardiac diastolic dysfunction grading is done per echocardiographic guidelines of the American Society.

Results: In this study, all the normotensives had normal diastolic function (100%) whereas a significant percentage (32%) of the subjects in the hypertensive group had diastolic dysfunction (p -value < 0.0000001). There is no significant association between the severity of hypertensive disorders with the severity of diastolic dysfunction of p -value 0.2.

Conclusion: A significant percentage of subjects in the hypertensive group had diastolic dysfunction when compared to the normotensive group. Thus, diastolic function by Doppler echocardiography may be a good prognostic tool in hypertensive disorders of pregnancy so that early admission, continuous monitoring, and planned delivery can be instituted to prevent cardiac complications like heart failure.

Keywords: Diastolic dysfunction, Hypertension, Normotension.

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INTRODUCTION

Hypertensive disorders is one of the most common medical disorders in pregnancy with incidence being 2–7%.¹ Hypertensive disorders are associated with significant changes to the cardiovascular system during pregnancy. During pregnancy, various physiological changes occur related to the cardiovascular system including structural remodeling of the heart like spherical, eccentric, and concentric hypertrophy, rise in cardiac output, and decrease in systemic vascular resistance. However, left ventricular contractile function is maintained.²

In contrast, vascular remodeling occurs in hypertensive disorders leading to vasoconstriction, an increase in vascular resistance, and a decrease in cardiac output. Typical cardiac changes that are seen with hypertensive disorders include afterload-mediated left ventricular concentric hypertrophy with segmental impaired myocardial relaxation and cardiac dysfunction leading to heart failure and pulmonary edema.³ Usually diastolic dysfunction precedes systolic dysfunction.⁴

Identification of cardiac dysfunction early in hypertensive disorders complicating pregnancies can help in preventing disease progression and may also decrease morbidity and mortality due to heart failure.

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MATERIALS AND METHODS

Inclusion Criteria

Singleton pregnant women between 20 and 40 weeks of gestation.

Table 1: Age distribution

Age	Hypertensive n (%)	Normotensive n (%)	p-value
Up to 20 years	6 (7.5)	13 (16.2)	0.393
21–25	30 (37.5)	28 (35.0)	
26–30	25 (31.2)	23 (28.7)	
>30	19 (23.7)	16 (20.0)	

Exclusion Criteria

- Multiple pregnancy.
- Known case of renal disease.
- Active labor.
- Chronic hypertension.
- Diabetes mellitus.
- Known case of connective tissue disorders.
- Pheochromocytoma.
- Preexisting cardiac disease.
- Pulmonary embolus.

METHODOLOGY

In this study, 160 subjects are selected from the antenatal OPD of Gandhi Hospital. The detailed history of each subject is taken, a clinical examination is performed, and blood pressure is measured in a semi-recumbent position; 160 subjects are divided into two groups—80 in the hypertensive and 80 in the normotensive group.

Patients with hypertensive disorders are classified according to ACOG guidelines 2021 as follows:

- Gestational hypertension (GHTN).
- Preeclampsia without severe features.
- Preeclampsia with severe features.

A cardiologist performed transthoracic Doppler echocardiography. The following parameters of echocardiography are assessed:

- E/A ratio across mitral valve (Peak early filling velocity/Peak filling velocity during atrial systole).
- S/D of pulmonary venous flow patterns (Systolic to Diastolic ratio).
- Isovolumetric relaxation times in milliseconds (IVRT).
- e/e'.
- Left atrial volume index in mL/m² (LA volume index).
- Left ventricular ejection fraction (LVEF).

Cardiac diastolic function grading is done according to the American Society of Echocardiography’s guidelines.⁵

Data Analysis and Interpretation

Data is entered in Microsoft Excel and analysis is performed using the SPSS software. Descriptive statistics like mean and standard deviation (SD) for continuous variables are determined while frequencies and percentages were calculated for categorical variables. ANOVA test was used for comparing echocardiography parameters among the study subjects while the Chi-square test for comparing the diastolic dysfunction in the study subjects (Tables 1 to 7). The level of significance was set at <0.05.

RESULTS AND ANALYSIS

The majority of both hypertensive group (37.5%) and normotensive group (35%) are in the age-group of 21–25 years. There is no significant difference in age distribution between the hypertensive and normotensive groups with p-value being 0.393.

Table 2: Parity distribution

Parity	Hypertensive n (%)	Normotensive n (%)	p-value
Primi	30 (37.5)	30 (37.5)	1
Multi	50 (62.5)	50 (62.5)	

Table 3: Distribution of gestational age (GA) and BMI

Parameters	Hypertensive mean (SD)	Normotensive mean (SD)	p-value
GA	33.1 (6.8)	33.5 (6.1)	0.749
BMI	21.4 (2.3)	21.4 (1.9)	0.976

Parity-wise distribution among participants, categorized by hypertensive and normotensive status shows equal distribution of primigravida and multigravida with no statistical difference between the two groups with p-value being 1.

The mean gestational age (GA) of the hypertensive group is 33.1 and of the normotensive group is 33.5 with a p-value of 0.749 indicating no significant difference in GA between the two groups.

The mean BMI of both groups is 21.4 with a nonsignificant p-value of 0.976.

Distribution of systolic blood pressure (SBP) and diastolic blood pressure (DBP) among normotensive and hypertensive groups as per their mean values showed a p-value < 0.0001 which is statistically significant.

The S/D ratio of pulmonary venous flow patterns showed a p-value of 0.47 indicating no significant difference between the groups in this parameter. The LA volume index demonstrated significant differences between the hypertensive and normotensive groups, with p-value < 0.0001 with the LA volume index being higher in the hypertensive group. LVEF with p-value = 0.02 indicates a significant difference in the two groups. The E/E' ratio, indicative of left ventricular diastolic function, showed a notable difference between the hypertensive and normotensive groups with a p-value < 0.001 and E/A across mitral valve showed a p-value of 0.11 indicating no significant difference among both groups.

All the individuals in the normotensive group had normal diastolic function (100%), whereas a significant proportion of the hypertensive group (32.4%) had diastolic dysfunction. A clear association is observed between diastolic dysfunction severity and hypertension status, as indicated by the significant p-value (<0.001).

Among individuals with grade I diastolic dysfunction, 2 are gestational hypertension (GHTN), 2 are nonsevere preeclampsia (NSPE), and 9 are severe preeclampsia (SPE). Among individuals with grade II diastolic dysfunction, 3 are NSPE and 10 are SPE indicating an association of severity of hypertension with that of diastolic dysfunction even though the p-value is 0.2 which is not statistically significant.

DISCUSSION

This observational comparative study was conducted on 160 singleton pregnant women between 20 and 40 weeks of gestation over 6 months. In this study, 160 subjects were placed into two groups—80 in the preeclampsia group and 80 in the normotensive group. Transthoracic Doppler echocardiography was carried out on these patients and cardiac diastolic dysfunction grading was done according to echocardiography guidelines of the American Society.

In this study age, parity, and BMI showed no significant difference between the hypertensive and normotensive group.



Table 4: Distribution of SBP and DBP

Parameter	GHTN	NSPE	SPE	Normotensive	p-value
SBP	136.7 (9)	150.5 (6.0)	155.78 (13.57)	107.54 (21.14)	<0.0001
DBP	86.67 (6.1)	96.5 (7.4)	98.22 (15.56)	73 (7.01)	<0.0001

DBP, diastolic blood pressure; GHTN, gestational hypertension; NSPE, nonsevere preeclampsia; SBP, systolic blood pressure; SPE, severe preeclampsia

Table 5: Distribution of S/D ratio of pulmonary venous flow patterns, DT (deceleration time), LA volume index, LVEF, E/E' ratio, and E/A

Parameter	Hypertensive			Normotensive	p-value
	GHTN	NSPE	SPE		
S/D ratio of pulmonary venous flow patterns	0.81 (0.05)	0.97 (0.24)	0.86 (0.12)	0.95 (0.58)	0.47
Left atrial (LA) volume index	2.78 (0.22)	12.34 (12.41)	12.28 (14.17)	2.94 (0.61)	<0.0001
Left ventricular ejection fraction (LVEF)	62.67 (4.86)	58.4 (7.91)	62.11 (5.06)	61.78 (3.65)	0.02
E/E'	1.51 (0.12)	4.29 (3.65)	3.13 (3.01)	1.43 (0.21)	<0.001
E/A across mitral valve	1.06 (0.08)	1.16 (0.27)	1.09 (0.20)	1.06 (0.12)	0.11

GHTN, gestational hypertension; NSPE, nonsevere preeclampsia; SPE, severe preeclampsia

Table 6: Association of hypertension with diastolic dysfunction

Diastolic dysfunction	Hypertensive	Normotensive	p-value
	n (%)	n (%)	
Normal	54 (67.6)	80 (100)	<0.0000001
Grade I	13 (16.2)	0	
Grade II	13 (16.2)	0	
Grade III	0	0	
Grade IV	0	0	

Table 7: Association of severity of hypertension with severity of diastolic dysfunction

Diastolic function	GHTN (15)	NSPE (20)	SPE (45)
Normal	13 (86.7)	15 (75)	26 (57.8)
Grade I diastolic dysfunction	2 (13.3)	2 (10)	9 (20)
Grade II diastolic dysfunction	0	3 (15)	10 (22.2)
Grade III diastolic dysfunction	0	0	0
Grade IV diastolic dysfunction	0	0	0

GHTN, gestational hypertension; NSPE, nonsevere preeclampsia; SPE, severe preeclampsia

In this study, notable differences were observed in blood pressure parameters. The mean SBP and DBP in the hypertensive group were 152.2 and 96.5 mm Hg, respectively, and that in the normotensive group were 112.0 and 75.4 mm Hg, respectively, with a highly significant *p*-value of less than 0.001.

The S/D ratio of pulmonary venous flow patterns showed a *p*-value of 0.47 indicating no significant difference between the groups in this parameter. The LA volume index demonstrated a significant difference between the hypertensive and normotensive groups, with a *p*-value < 0.0001 with the LA volume index being higher in the hypertensive group. With regard to LVEF, *p*-value = 0.02 indicates a significant difference between the two groups. The E/E' ratio, indicative of left ventricular diastolic function, showed a notable difference between the hypertensive and normotensive groups with a *p*-value < 0.001; E/A across mitral valve showed a *p*-value of 0.11 indicating no significant difference among both groups.

In this study, all the normotensives had normal diastolic function (100%) whereas a significant percentage (32%) of the subjects in the hypertensive group had diastolic dysfunction (*p*-value < 0.0000001). There is no statistical significance between the severity of hypertensive disorders with the severity of diastolic dysfunction as the *p*-value is 0.2.

A similar study by Muthyala et al. revealed that 1/5th of women with preeclampsia had cardiac diastolic dysfunction. There is a correlation between diastolic dysfunction grading and the severity of preeclampsia.⁶

Archana et al. revealed in their study that women with a history of early or preterm preeclampsia have an increased prevalence of diastolic dysfunction.⁷

CONCLUSION

A significant percentage of subjects in the hypertensive group had diastolic dysfunction when compared to the normotensive group. Thus, diastolic function by Doppler echocardiography may be a good prognostic tool in hypertensive disorders of pregnancy so that early admission, continuous monitoring, and planned delivery can be instituted to prevent cardiac complications like heart failure.

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