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ROLE OF ECHOCARDIOGRAPHY (2D) IN HYPERTENSIVE DISORDERS OF PREGNANCY

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ABSTRACT

AIM: To study and evaluate echocardiography changes in women with hypertensivedisorders of pregnancy and to compare with normotensive pregnant women

MATERIALS AND METHODS: This research was conducted at the Department of Obstetrics and Gynecology, with clearance from the institute's ethical committee. This prospective observational study included 110 women. 2D echo changes of 55 patients with hypertensive disorder of pregnancy and 55 normotensive patients were compared and prognosis was evaluated depending on echocardiographic changes

RESULTS: Comparison of SBP, DBP, MAP and HR showed that the P values were <0.05 indicating that mean SBP, DBP, MAP and HR of pregnant women with hypertensive disorder was significantly higher compared to normotensive pregnant women. The P value for LVESV was <0.05 indicating that mean LVESV of pregnant women with hypertensive disorder was significantly higher. However, there was no significant difference in mean LVEDV of pregnant women with hypertensive disorder and without hypertensive disorder. On comparison of EF, the p value was <0.05 indicating that EF of pregnant women with hypertensive disorder was significantly less compared to normotensive pregnant women. On comparing mean CO, the P value was <0.05 indicating that mean CO of pregnant women with hypertensive disorder was significantly higher compared to normotensive pregnant women. However, there was no significant difference in mean SV of pregnant women with hypertensive disorder and normotensive pregnant women (p >0.05). Comparison of mean LMV S and LMV D showed, P values were <0.05 indicating that mean LMV S and LMV D of pregnant women with hypertensive disorder was significantly higher compared to Normotensive pregnant women. Comparison of mean velocity of E wave and A wave showedP values were <0.05 indicating that mean velocity of E wave and A wave among pregnant women with hypertensive disorder was significantly higher compared to normotensive pregnant women. However, there was no significant difference in E/A ratio among pregnant women with hypertensive disorder and without hypertensive disorder (p >0.05). On comparison of E Dec time, IVRT, IVCT and ET, the p values were <0.05 indicating that meanE Dec time, IVRT, IVCT and ET of pregnant women with hypertensive disorder were significantly higher compared to normotensive pregnant women. This difference in MPI statistically significant (p<0.05) indicating that MPI was significantly higher in hypertensive pregnant women compared to normotensive pregnant women. In hypertensive group, IVSd and LVPWd were significantly higher compared to normotensive pregnant women. Two patients who developed cardiac complications, namely CCF and Pulmonary edema belonged to the subclass of Severe Preeclampsia. Out of the 21 cases categorised under this subclass, two patients developed a cardiac complication.

CONCLUSION: When hypertensive pregnant cases are compared to normotensive pregnant women, the research demonstrates that there are considerable circulatory dynamic alterations, including systolic and diastolic dysfunction. This research demonstrates the importance of echocardiographic assessments of cardiac function in hypertensive pregnant women in determining the long-term clinical significance of the illness process. Two cases were identified as left ventricular Hypertrophy in echocardiography and one in them developed CCF. It is recommended to include 2D echo in routine practice for early identification of any cardiac changes in Hypertensive or Normotensive patients and thereby prevent or reduce maternal morbidity or mortality

INTRODUCTION

Pregnancy-related hypertensive disorders are one of the leading causes of maternal morbidityand mortality. 7.8% of all pregnant women in India have complications as a result.
Particularly in developing nations, hypertensive diseases account for 10-15% of maternal fatalities. In the entire world, it is the second most typical cause of maternal death. Because itmay be able to identify minor changes in cardiovascular function before hypertension worsens or other clinical consequences, echocardiography, particularly strain imaging, is crucial in the assessment of HDP-related cardiac remodeling. Concentric hypertrophy and increased LV mass associated with HDP are particularly prevalent in preeclamptic women.
Echo can detect these abnormal hypertrophies and separate them from the usual eccentric LV hypertrophy associated with normal pregnancy. Echo can also spot HDP-related chamber enlargement, which is particularly noticeable in the left atrium. The purpose of the study is to evaluate echocardiography changes in women with hypertensive disorders of pregnancy and to compare with normotensive pregnant women.

MATERIALS AND METHODS: This research was conducted at the Department of Obstetrics and Gynecology, with clearance from the institute's ethical committee. This prospective observational study included 110 women. 2D echo changes of 55 patients with hypertensive disorder of pregnancy and 55 normotensive patients were compared and prognosis was evaluated depending on echocardiographic changes

METHODOLOGY: A well informed written consent was taken. A detailed history was taken and general physical examination was done.
This was a prospective observational study where echocardiography changes in women with hypertensive disorders of pregnancy and normotensive pregnant women were observed and they were followed up prospectively for outcome till delivery.

Sample size of 55 was taken for the study in each group. Pregnant women with Primi gravida having hypertensive disorder of pregnancy and gestational age > 20 weeks till term were included and Patients with pre-existing hypertension, known cardiorespiratory disease, renal disease, connective tissue disorders and in labour were excluded.

All patients were examined by a cardiologist using echo machine with 2.5 mHz transducer. Echocardiography of left ventricle obtained under standard conditions during quiet expiration with patients in the left lateral recumbent positions after the patients remained undisturbed in this position for 15 minutes. Initial 2D studies helped to evaluate cardiac structure and visual assessment of Left Ventricle contractile function.

STATISTICAL ANALYSIS:

Student t test (two tailed, independent) was be used to find the significance of study parameters on continuous scale between two groups (Inter group analysis) on metric parameters. Chi-square/ Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups. The following assumptions on data was made for the statistical analysis: Assumptions: 1. Dependent variables should be normally distributed, Samples drawn from the population should be random, Cases of the samples should be independent.

RESULTS:

Table 1: Demographic data

Parameters	Variables	Hypertensive	Normotensive	P value
Age (years)	18-20	1	2	0.3024
	21-25	19	17	
	25-30	22	23	

	31-35	9	10	
	>35	4	3	
BMI (kg/m2)	<18.5	3	7	0.0013
	18.5-25	11	16	
	25.1-30	31	24	
	>30	10	8	

Table 1, Maximum Hypertensive patients fell in the age group of 25-30 years. On comparing the mean age, P value was >0.05 indicating that there was no significant difference in age distribution of pregnant women with hypertensive disorder and without hypertensive disorder.
Maximum hypertensive patients fell in the criteria of 25.1-30 kg/m2. On comparison of mean BMI, the p value was <0.05 indicating that mean BMI of pregnant women with hypertensive disorder was significantly higher comparted to pregnant women without hypertensive disorder.

Table 2: Comparison of 2D Echo changes

Variables	**pertensive(Mean)**	**rmotensive(Mean)**	**P value**
Systolic BP (SBP)	155	110.1	<0.001
Diastolic BP (DBP)	98.4	68.4	<0.001
Mean arterial pressure (MAP)	116.8	84.7	<0.001
Heart rate (beats/min)	91.4	78.1	<0.001
Left ventricular end systolic volume (LVESV) (ml)	35.32	27.74	<0.001
Left ventricular end diastolic volume (LVEDV) (ml)	110.39	105.58	0.222
Stroke Volume (SV) (ml)	71.83	72.22	0.840
Cardiac Output (CO) (L/min)	6.81	5.49	<0.001
Left Ventricle Mass (LVM) – Diastolic (g)	128.53	107.00	<0.001
Left Ventricle Mass (LVM) – Systolic (g)	90.27	81.66	0.011
E wave, m/s	1.00	0.69	<0.001
A Wave, m/s	0.79	0.49	<0.001
E/A ratio	1.47	1.38	0.213
Interventricular Septum Thickness in Diastole (IVSd) (cm)	1.19	0.92	<0.001
Left Ventricle Posterior Wall Dimension (LVPWD) (cm)	1.00	0.90	0.008
E deceleration time (ms)	172.79	123.48	<0.001
Isovolumetric Relaxation Time (IVRT) (ms)	94.21	84.97	<0.001
Isovolumetric Contraction Time (IVCT) (ms)	39.14	34.02	0.025
Ejection Time (ET) (ms)	279.03	287.93	0.034
Myocardial Performance Index (MPI)	0.48	0.41	<0.001

Comparison of SBP, DBP, MAP and HR showed that the P values were <0.05 indicating that mean SBP, DBP, MAP and HR of pregnant women with hypertensive disorder was significantly higher compared to normotensive pregnant women. The P value for LVESV was <0.05 indicating that mean LVESV of pregnant women with hypertensive disorder was significantly

higher. However, there was no significant difference in mean LVEDV of pregnant women with hypertensive disorder and without hypertensive disorder. On comparing mean CO, the P value was <0.05 indicating that mean CO of pregnant women with hypertensive disorder was significantly higher compared to normotensive pregnant women. However, there was no significant difference in mean SV of pregnant women with hypertensive disorder and normotensive pregnant women (p >0.05). Comparison of mean LMV S and LMVD showed, P values were <0.05 indicating that mean LMV S and LMV D of pregnant women with hypertensive disorder was significantly higher compared to Normotensive pregnant women. Comparison of mean velocity of E wave and A waveshowed P values were <0.05 indicating that mean velocity of E wave and A wave among pregnant women with hypertensive disorder was significantly higher compared to normotensive pregnant women. However, there was no significant difference in E/A ratio among pregnant women with hypertensive disorder and without hypertensive disorder (p >0.05). On comparison of E Dec time, IVRT, IVCT and ET, the p values were <0.05 indicating that mean E Dec time, IVRT, IVCT and ET of pregnant women with hypertensive disorder were significantly higher compared to normotensive pregnant women. This difference in MPI statistically significant (p<0.05) indicating that MPI was significantly higher in hypertensive pregnant women compared to normotensive pregnant women. In hypertensive group, IVSd and LVPWd were significantly higher compared to normotensive pregnant women.

Table 3: Ejection Fraction

Parameter	**Hypertensive (n = 55)**	**Normotensive (n = 55)**	**P value**
Ejection Fraction (%)	66.7%	74.8%	<0.001

On comparison of EF, the p value was <0.05 indicating that EF of pregnant women with hypertensive disorder was significantly less compared to normotensive pregnantwomen.

Table 4: Cardiac Complication

Variables	**rtensive (55)(Cases)**	**notensive (55)(Cases)**
CCF	1	0
Pulmonary Oedema	1	0
Cardiomyopathy	0	0
Left Ventricular hypertrophy	2	0

Parameter	Total Cases		Outcome		
	Cases	%	CCF	Pulmonary Edema	Cardiomyopathy
Gestational Hypertension	12	21.82%	0	0	0
Non severe Preeclampsia	16	29.09%	0	0	0
Severe Preeclampsia	21	38.18%	1	1	0
Ante partum eclampsia	6	10.91%	0	0	0
Total	55	100.00%	1	1	0

Two patients who developed cardiac complications, namely CCF and Pulmonary edema

belonged to the subclass of Severe Preeclampsia. Out of the 21 cases categorised under this subclass, two patients developed a cardiac complication.

DISCUSSION: Preeclampsia has a significant negative impact on maternal and foetal health. Preeclampsia's angiogenic imbalance, which is its defining feature, goes away after delivery, but the cardiac alterations last for a year. As preeclampsia progresses, cardiac output significantly decreases because of an increase in peripheral vascular resistance. Women whoare pregnant have higher cardiac output and decreased systemic vascular resistance.

Generalized vasospasm brought on by hypertension results in increased peripheral vascular resistance, which in turn increases afterload and lowers left ventricular ejection fraction. As a result, the left ventricular mass index rises and the heart is remodelled. In a typical pregnancy, the LVEF ranges between 57% and 70%. Reduced LVEF is defined as values below 50%. Stroke Volume (SV) typically rises throughout pregnancy and drops off at the conclusion of the second trimester. In present study, the mean LVESV in hypertensive groupwas 35.32±13.05 ml whereas in normotensive group it was 27.74±3.57 ml. The mean LVEDV in hypertensive group was 110.39±28.51 ml whereas in normotensive group it was 105.58±5.55 ml. On comparing mean LVESV, the P value was <0.05 indicating that mean LVESV of pregnant women with hypertensive disorder was significantly higher comparted to pregnant women without hypertensive disorder. However, there was no significant differencein mean LVEDV of pregnant women with hypertensive disorder and without hypertensive disorder.

In the study by Sengodan SS et al (2017), LVESV in normotensive group was 24-30 ml whereas in hypertensive group it was 23-49 ml. LVEDV in normotensive group was 102-112ml whereas in hypertensive group it was 81-135 ml. When compared to Left Ventricular Diastolic Volume, Left Ventricular Systolic Volume was considerably greater in preeclampsia patients.

In the study by Solanki R et al (2011), the mean LVESV in normotensive group was 27.2 ± 3.5 ml whereas in hypertensive group it was 36.04 ± 13.32 ml. LVEDV in normotensive group was 107.73 ± 5.66 ml whereas in hypertensive group it was 108.23 ± 27.95 ml.

In present study, Ejection fraction or strain rate was calculated by using formula EF=EDV-ESV/EDV×100. Ejection fraction in hypertensive group was 66.7% whereas in normotensive group it was 74.8%. On comparison of EF, the p value was <0.05 indicating that EF of pregnant women with hypertensive disorder was significantly less comparted to pregnant women without hypertensive disorder.

In present study, the mean stroke volume in hypertensive group was 71.83±13.91 ml whereas in normotensive group it was 72.22±3.28 ml. The mean cardiac output in hypertensive group was 68.19±4.65 ml/min whereas in normotensive group it was 54.98±1.73 ml/min. On comparing mean CO, the P value was <0.05 indicating that mean CO of pregnant women with hypertensive disorder was significantly higher comparted to pregnant women without hypertensive disorder. However, there was no significant difference in mean SV of pregnant women with hypertensive disorder and without hypertensive disorder (p >0.05).

In the study by Sengodan SS et al (2017), Cardiac output was between 62 and 70 in the preeclamptic group while it was between 54 and 57 in the normotensive group. It was statistically significant to make this observation.

In the study by Solanki R et al (2011), the preeclamptic group's cardiac output was 66.85± 4.56 ml/min as opposed to the normotensive group's 56.1±1.77 ml/min. With a P value of0.004, this observation was statistically significant.

In present study, the mean LVM diastolic in hypertensive group was 128.53±16.51 g whereas in normotensive group it was 107±23.63 g. The mean LVM systolic in hypertensive group was 90.27±7.49 g whereas in normotensive group it was 81.66±23.36 g. On comparing mean LMV S and LMV D, the P values were <0.05 indicating that mean LMV S and LMV D of pregnant women with hypertensive disorder was significantly higher comparted to pregnant women without hypertensive disorder.

In the study by Sengodan SS et al (2017), LVMS in normotensive group was 60-106 gm whereas in hypertensive group it was 81-95 gm. LVMD in normotensive group was 81-127gm whereas in hypertensive group it was 115-147 gm. When compared to left ventricular systolic mass, preeclamptic patients had significantly larger left ventricular diastolic mass.
imilar observation also found in the Solanki R et al128 study. In the study by Solanki R et al (2011), the mean LVMS in normotensive group was 83.33 ± 23.84 gm whereas in hypertensive group it was 88.5 ± 7.34 gm. The mean LVMD in normotensive group was
104.90 ± 23.17 gm whereas in hypertensive group it was 131.15 ± 16.85 gm. The result was statistically significant.
In present study, the mean E/A ratio in hypertensive group was 1.47±0.48 m/s whereas in normotensive group it was 1.38±0.23 m/s. On comparing mean velocity of E wave and A wave, the P values were <0.05 indicating that mean velocity of E wave and A wave among pregnant women with hypertensive disorder was significantly higher comparted to pregnant women without hypertensive disorder. However, there was no significant difference in E/A ratio among pregnant women with hypertensive disorder and without hypertensive disorder(p >0.05).
In the study by Sengodan SS et al (2017), the E/A ratio in normotensive group was 1.13-1.57m/s whereas in hypertensive group it was 1.005-1.989 m/s. Patients with preeclampsia had greater E and A wave velocities. This outcome was consistent with our study.
In the study by Solanki R et al (2011), the mean E/A ratio in normotensive group was 1.35 ± 0.224 m/s whereas in hypertensive group it was 1.497 ± 0.492 m/s. (p= 0.3)
On comparison of E Dec time, IVRT, IVCT and ET, the p values were <0.05 indicating thatmean E Dec time, IVRT, IVCT and ET of pregnant women with hypertensive disorder were significantly higher comparted to pregnant women without hypertensive disorder. Tei index, known as myocardial performance index (MPI), was measured from transmitral and LV outflow tract recordings. MPI was calculated according to formula: MPI = (IVRT + IVCT)/ET
In present study, the mean MPI was 0.48 (SD 0.03) among pregnant women with hypertensive disorder while it was 0.41 (SD 0.02) among pregnant women without hypertensive disorder. This difference was statistically significant (p<0.05) indicating that MPI was significantly higher in hypertensive pregnant women compared to normotensivepregnant women.
In the study by Sengodan SS et al (2017), preeclampsia patients had increased IVRT, E wave deceleration time, and A VTI values. This outcome was consistent with our study.
In the study by Solanki R et al (2011), the mean E Dec time in normotensive group was 126 ± 8.07 ms whereas in hypertensive group it was 189.4 ± 49.73 ms. (p= 0.02). The mean IVRT in normotensive group was 83.3 ± 5.9 ms whereas in hypertensive group it was 96.13 ± 9.13ms. (p= 0.03). E dec time, IVRT, IVCT, ET were higher in hypertensive group.
Biering-Sørensen T et al (2016), the mean MPI in nonhypertensive group was 0.46±0.11 whereas in hypertensive group 0.54±0.15. The MPI is significantly higher in hypertensive group compare to nonhypertensive group. E dec time, IVRT, IVCT, ET were also higher inhypertensive group.
In present study, the mean LVSd in hypertensive group was 0.92 ± 0.28 cm whereas in normotensive group it was 1.19 ± 0.31 cm. The mean LVPWd in hypertensive group was 0.90 ± 0.20 cm whereas in normotensive group it was 1.00 ± 0.19 cm. In hypertensive group,IVSd and LVPWd were significantly higher compared to normotensive pregnant women. Similar results observed in the study by Sengodan SS et al (2017) and Solanki R et al (2011). When preeclampsia and gestational hypertension are present, echocardiography can reveal cardiac impairment. This alters antenatal care (medication, frequency of monitoring, and time of birth) and can help determine when postnatal follow-up is necessary. If an echocardiogram is conducted, it can help identify high-risk patients who need better monitoring and can enhance their prognosis.
Parikh PM et al (2021), study also demonstrated that the prognosis improved and the incidence of problems decreased if the aberrant Echocardiographic findings were discoveredin the early stages of pregnancy and treated appropriately. Repeat echocardiography should always be performed in

situations of early-onset preeclampsia because it can cause further alterations, especially close to term.

Thus, an early pregnancy echocardiogram can benefit both the mother and the foetus.

CONCLUSION: This analytical investigation examined the numerous hemodynamic changes associated with hypertensive disorder during pregnancy. When hypertensive pregnant cases are compared to normotensive pregnant women, the research demonstrates that there are considerable circulatory dynamic alterations, including systolic and diastolic dysfunction.
The risk of cardiovascular complications in such cases does not seem to be properly identified by blood pressure monitoring alone. If maternal echocardiography is included into the standard management approach, it may be able to identify women at risk of cardiovascular complications. Timely identification and adequate management of these casescould avoid serious adverse effects including pulmonary oedema and heart failure.
This research demonstrates the importance of echocardiographic assessments of cardiac function in hypertensive pregnant women in determining the long-term clinical significance of the illness process. Two cases were identified as left ventricular Hypertrophy in echocardiography and one in them develop CCF. CCF is one of the rare complications in the peripartum period and can occur in a non-hypertensive patient also. Hence, we need to be cautious while concluding anything from this single case of CCF. A prospective cohort study with large sample size may help to make some concrete conclusion.

References:

1. Parikh, Purvi & Goswami, Vishwa & Shah, Sapana & Vyas, Rupa & Damor, Hiral. (2020). Significance of 2 dimensional-echocardiography in hypertensive disorders of pregnancy: a study in tertiary care centre, Ahmedabad, Western India. International Journal of Reproduction, Contraception, Obstetrics and Gynecology. 10. 279. 10.18203/2320-1770.ijrcog20205782.
2. Moors S, van Oostrum NHM, Rabotti C, Long X, Westerhuis MEMH, Kemps HMC, Oei SG, van Laar JOEH. Speckle Tracking Echocardiography in Hypertensive Pregnancy Disorders: A Systematic Review. Obstet Gynecol Surv. 2020 Aug;75(8):497-509. doi: 10.1097/OGX.0000000000000811. PMID: 32856716.
3. SENGODAN, Subha Sivagami; DHANAPAL, Mohana; PANDIAN, Anbarasi. Left ventricular dysfunction in preeclampsia: an echocardiographic study. International Journal of Reproduction, Contraception, Obstetrics and Gynecology, [S.l.], v. 6, n. 11, p.4895-4898, oct. 2017. ISSN 2320-1789. Available at: . Date accessed: 22 nov. 2022. doi:http://dx.doi.org/10.18203/2320-1770.ijrcog20174996.
4. Bauer TW, Moore GW, Hutchins GM. Morphologic evidence for coronary artery spasm in eclampsia. Circulation. 1982;65:255-9.
5. Sengodan SS, Dhanapal M, Pandian A. Left ventricular dysfunction in preeclampsia: an echocardiographic study. Int J Reprod Contracept Obstet Gynecol 2017;6:4895-8
6. Solanki R, Maitra N. Echocardiographic assessment of cardiovascular hemodynamics in preeclampsia. J Obstet Gynaecol India. 2011 Oct;61(5):519-22. doi: 10.1007/s13224- 011-0084-x. Epub 2011 Nov 8. PMID: 23024520; PMCID: PMC3257339.
7. Parikh PM, Goswami VM, Shah SR, Vyas RC, Damor H. Significance of 2 dimensional-echocardiography in hypertensive disorders of pregnancy: a study in tertiary care centre, Ahmedabad, Western India. Int J Reprod Contracept Obstet Gynecol 2021;10:279-84.
8. Regitz - Zagrosek V, Roos - Hesselink JW, Bauersachs J, Blomström-Lundqvist C,Cífková R, De Bonis M, et al. 2018 ESC Guidelines for the management of cardiovascular diseases during pregnancy. Eur Heart J. 2018;39(34):3165–241. [PubMed] [Google Scholar]
9. Remenyi B, Davis K, Draper A, Bayley N, Paratz E, Reeves B, Appelbe A, Wheaton G,da Silva Almeida IT, Dos Santos J, Carapetis J, Francis JR. Single Parasternal-Long- Axis-

View-Sweep Screening Echocardiographic Protocol to Detect Rheumatic Heart Disease: A Prospective Study of Diagnostic Accuracy. Heart Lung Circ. 2020 Jun;29(6):859-866. [PubMed]

10. Clevenger N, Hutchison JD, Hertz AD. Unmasking Valvular heart disease in Pregnancy [31B]. Obstet Gynecol. 2017;129:28S. [Google Scholar]
11. Narayanan M, Elkayam U, Naqvi TZ. Echocardiography in Pregnancy: Part 2. Curr Cardiol Rep. 2016 Sep;18(9):90. doi: 10.1007/s11886-016-0761-6. PMID: 27457084; PMCID: PMC4960283.
12. Denault AY, Langevin S, Lessard MR, Courval JF, Desjardins G. Transthoracic echocardiographic evaluation of the heart and great vessels. Can J Anaesth. 2018 Apr;65(4):449-472. [PubMed]