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Original Research Article

Significance of 2 dimensional-echocardiography in hypertensive disorders of pregnancy: a study in tertiary care centre, Ahmedabad, Western India

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ABSTRACT

Background: Echocardiography is a safe, non-invasive technique to assess cardiac structure and function in pregnancy. Understanding the structure and function of the heart in hypertensive women is important in terms of timely diagnosis, better management and good prognosis. This study will focus on the importance and feasibility of Echocardiography as a routine investigation tool in hypertensive disorders of pregnancy.
Methods: This is a retrospective study of 150 cases of hypertension in pregnancy conducted at the Obstetrics and Gynaecology department of a tertiary care centre in the year June 2019-July 2020. Data was analysed in terms of complications seen in women who had structural and functional abnormalities in the echocardiographic scan in comparison to those hypertensive women who had a normal scan. The important Echocardiographic parameters were compared amongst cases of hypertension and their impact on fetomaternal outcome was discussed.
Results: In this study conducted amongst 150 pregnant women suffering from different forms of hypertensive disorders presenting in our institute for routine workup in the year 2019-2020, 12(8%) had chronic hypertension, 75(50%) had gestational hypertension, whereas 63(42%) had pre- eclampsia. The incidence of structural valvular lesions in these categories as 2%, 3.34% and 4% respectively. Deranged echocardiographic parameters like decreased Left Ventricular Ejection Fraction in 10%, decreased stroke volume in 28.6% and increased Left Ventricular mass in 26.6% are seen more in cases of pre-eclampsia compared to gestational hypertension and chronic hypertension.
Conclusions: Echocardiography is a valuable tool to stratify risk and can guide management in gestational hypertension, chronic hypertension and preeclampsia. Changes in cardiac function and morphology are recognizable at an asymptomatic early stage and correlate with disease severity and adverse outcomes. Preeclampsia has a greater impact on the heart than gestational hypertension, and changes are most pronounced in early onset, severe disease. Studying the cardiac structure and function in early trimesters can bring about better maternal and fetal outcome.

Keywords: Echocardiography, Hypertension, Left ventricular mass, Preeclampsia, Pregnancy

INTRODUCTION

Hypertensive disorders of pregnancy are one of the major contributors of maternal morbidity and mortality. It complicates 7.8% of all the pregnant women in India.[1] Hypertensive disorders cause 10-15 % of maternal deaths especially in the developing countries.[2] It is the 2nd most common cause of maternal mortality worldwide.[3]

Depending upon the gestational age of onset and presence of proteinuria, the hypertensive disorders are classified as gestational hypertension (BP>=140/90 MM HG),

preeclampsia (gestational hypertension and >300 mg/24 hrs proteinuria or signs of end organ damage), eclampsia (pre-eclampsia + seizures), chronic hypertension (gestational age of onset <20 weeks gestation) and Pre-eclampsia superimposed on chronic hypertension.[4]

Preeclampsia has a greater impact on the heart than Gestational Hypertension, and changes are most pronounced in early onset, severe disease.[5] Studying the cardiac structure and function in early trimesters can bring about better maternal and fetal outcome.

Echocardiography is a safe, non-invasive technique to assess cardiac structure and function in pregnancy.[6] Although operator dependent and requiring training to provide reproducible measurements, the temporal variability of echocardiography is small.[7,8] Echocardiography in pregnancy with hypertension shows an increased left ventricular mass and remodelling causing diastolic dysfunction in some women. Several techniques have been used: two dimensional and M – Mode Echocardiography, pulse Doppler analysis (PDA), tissue Doppler analysis and other newer techniques for better evaluation of chamber deformation.[8]

Pregnant women have an increased cardiac output accompanied with a decreased systemic vascular resistance.[9,10] Hypertension causes generalized vasospasm and increased peripheral vascular resistance further leading to increased afterload and reduced left ventricular ejection fraction.[9,10] This leads to cardiac remodelling and increased left ventricular mass index. left ventricular ejection fraction (LVEF) in normal pregnancy is 55-70%.[11] Less than 50% is considered as decreased LVEF. Stroke Volume (SV) normally increases in pregnancy up till the end of the second trimester after which it decreases. Stroke Volume in normotensives is 73.3±14.19 ml, whereas it is 70.8±3.22 ml in patients with hypertension.[12] Left Ventricular mass (LV Mass) in normotensive is 90.6±19.8 whereas it is 106±29.4 in hypertensive pregnant women.[13]

Understanding the structure and function of the heart in hypertensive mothers is important in terms of timely diagnosis, better management and good prognosis. This study will discuss the importance and feasibility of echocardiography as a routine investigation tool in hypertensive disorders of pregnancy.

Aims and objectives of the study were to study the echocardiographic alterations in pregnant women with hypertension, to study the correlation between Echocardiographic abnormalities and outcome of pregnancy in patients of hypertensive disorders of pregnancy, to study the advantages of early diagnosis and early echocardiography in preventing adverse outcomes in patients of hypertensive disorders, and to analyse the fetomaternal outcome in hypertensive women with a normal echocardiographic finding compared to those with impaired echocardiographic findings.

METHODS

This is a retrospective study of 150 cases of hypertension in pregnancy conducted at the Obstetrics and Gynaecology department of a tertiary care centre in the year June 2019-July 2020. We have included patients suffering from chronic hypertension, gestational hypertension, pre-eclampsia. All OPD patients were screened out for hypertension. The patients who showed BP>140/90mmHg on 2 occasions 4 hours apart were considered as hypertensive and as a routine protocol, they were admitted and all basic investigations and a departmental ECHO was done. In the patients who were detected in early pregnancy, repeat 2D ECHO was done near term.

Data was compared with terms of complications seen in hypertensive patients with structural and functional abnormal echocardiographic findings with those hypertensive patients in whom echocardiogram was normal. Changes in left ventricular ejection fraction, stroke volume and left ventricular mass in all the classes were studied. Cardiologist opinion was taken in patients showing abnormal echocardiographic findings and a decision regarding the mode of delivery was taken after consultation with the cardiologist.

Inclusion criteria

Pregnant women admitted in our institute in the year 2019-2020 suffering from gestational hypertension (BP>140/90mmHg after 20 weeks of pregnancy and which normalizes after 3 months of postpartum). Pre-eclampsia (gestation hypertension + proteinuria > 300 mgs in 24 hrs urine sample or dipstick proteinuria >-+1 or signs of end organ damage which include renal impairment, thrombocytopenia, epigastric pain, liver dysfunction, visual disturbances, headache). Chronic hypertension (BP> 140/90 before 20 weeks of pregnancy or which remains raised even after 3 months postpartum.

Exclusion criteria

Patients who came to our institute for the first time with eclampsia and required urgent management and in whom getting an Echocardiogram was not feasible. Women with previously known congenital cardiac conditions. Women who underwent abortion.

Data analysis

Comparison of fetomaternal outcome amongst patients with positive abnormal echocardiographic findings with those with a normal echocardiogram was done and comparison of outcome with the time of echocardiographic scan was performed using Chi Square test and Fisher Exact test using the ChiSquare calculator available on social science statistics website. Statistical significance was accepted at 95% confidence level ($p<0.05$).

RESULTS

In this study, 150 pregnant female suffering from different forms of hypertensive disorders presented at our institute for routine antenatal checkup. Out of them, 12 (8%) had chronic hypertension, 75 (50%) had gestational hypertension, whereas 63 (42%) had pre-eclampsia.

Table 1: Echocardiographic changes in hypertensive women.

	LVEF N=150 (% of N)		Stroke volume N=150 (% of N)		LV mass N=150 (% of N)	
	Decrease	No change	Decrease	No change	Increase	No change
Chronic hypertension	2(1.34)	10(6.67)	10(6.67)	2(1.33)	3(2)	9(6)
Gestational hypertensior	12(8)	63(42)	50(33.33)	25(16.67)	30(20)	45(30)
Pre eclampsia	15(10)	48(32)	43(28.6)	20(13.33)	40(26.67)	23(15.34)
	29(19.3)	121(80.6)	103(67.3)	47(31.11)	73(48.6)	77(51.33)

Table 2: Incidence of structural Echocardiographic findings in patients suffering from hypertensive disorders in pregnancy.

	Chronic Hypertension N=150 (% of N)	Gestational Hypertension N=150 (% of N)	Preeclampsia N=150 (% of N)	Total N=150 (% of N)
No. of patient who had structural anomalies in Echocardiography	5 (3.3)	15 (10)	12 (8)	32 (21.3)

Table 3: Complications seen amongst hypertensive patients with structural abnormalities with those who had only functional abnormality and those who had a structurally and functionally normal cardiac condition.

Complications	Women with normal structural and functional heart N=29 (n=%)	Women with abnormal structure and function of heart N=32 (n=%)	Women with normal structure and abnormal function N=89 (n=%)	p value
Maternal complications				
CCF	3 (10.34)	12 (37.5)	12 (13.48)	<0.05
Atrial fibrillation	1 (3.34)	5 (15.62)	1 (1.12)	<0.05
Hypertensive crisis	1 (3.34)	25 (78.1)	12 (13.48)	<0.05
Cardiomyopathy	1 (3.34)	6 (18.7)	1 (1.12)	<0.05
ICU Admissions	1 (3.34)	27 (84.3)	28 (31.46)	<0.05
Maternal mortality	1 (3.34)	5 (15.62)	1 (1.12)	<0.05
Fetal complications				
IUGR	2 (6.89)	17 (53.1)	14 (15.7)	<0.05
Preterm	2 (6.89)	20 (62.5)	12 (13.8)	<0.05
IUD	1 (3.34)	6 (18.7)	5 (5.61)	<0.05

Amongst these classes, the changes in the echocardiographic variables were studied. LVEF <55% is considered as decreased LVEF. Stroke volume <73ml is considered as decreased stroke volume. Left ventricular mass index includes cases with both eccentric and concentric hypertrophy.

In order to see the severity of these findings, we have compared the complications seen amongst these 32 patients with those 89 who had only functional abnormalities without any anatomical structural defect and 29 hypertensive women who had a structurally and functionally normal heart. There were no patients found who had structural lesions without any functional abnormality.

Incidence of complications like CCF, atrial fibrillation and hypertensive crisis were more in those with structural lesions (37.5%, 15.6%, and 78% respectively) compared to the other 2 groups. Women with normal structural and functional Echocardiogram have least ICU admissions-3.34% only. We have compared the fetomaternal outcome with the time of scan. The outcome of patients who underwent their first echocardiographic scan in 1st

trimester were compared to those who underwent the scan in 2nd and 3rd trimesters. Out of the 150 women, 80 underwent echocardiography is 1st trimester and 70 in the second and third trimester. We have compared the outcome of those who underwent their first scan in 1st trimester to those who underwent the first scan in later trimesters. 81% full term deliveries were seen in patients who underwent echocardiography in 1st trimester.

Table 4: Comparison regarding outcome amongst patients who underwent Echocardiography in 1st trimester to those who underwent the procedure in 2nd or 3rd trimester.

Outcome	1st Trimester scan N=80 (n=%)	2nd and 3rd Trimester scan N=70 (n=%)	P value
Maternal ICU admissions	15 (18.75)	41(58.5)	P<0.05
Full term deliveries	65 (81.2)	39 (55.7)	P<0.05
Preterm deliveries	12 (15)	22 (31.4)	P<0.05
IUD	3 (3.75)	9 (12.8)	p<0.05
IUGR babies	12 (15)	21 (30)	P<0.05
Live babies at 3 months postpartum	72 (90)	52 (64.28)	P<0.05

DISCUSSION

Hypertensive disorders in pregnancy are associated with high maternal mortality and morbidity. The study showed a decrease in LVEF and Stroke Volume with an increased left ventricular mass suggestive of diastolic dysfunction. These changes were more pronounced in pre-eclamptics compare to chronic hypertension. In our study, 19.3% of the 150 hypertensive women taken presented with decreased LVEF, 68.6% had decreased stroke volume and 73% had increased LV mass. These findings were consistent with the study conducted by Kathryn et al, which showed decreased LVEF in 17 pre-eclamptics out of 57 patients.[14]

Similarly decreased Stroke Volume (SV) is also seen in study of Rizwana et al who found average SV to be 70.8±3.22ml.[15] The study of Manuel et al showed 90% subjects to have SV <70ml compared to our study where SV<70ml was seen in 68.6% subjects.[13] Our study demonstrated that 73% women had increased Left Ventricular mass in comparison to Manuel et al who showed 47.3% cases to present with left ventricular mass thickness in form of eccentric or concentric hypertrophy.[13]

The study showed poor feto-maternal outcome in patients with abnormal structural echocardiographic findings. Such women had an increased rate of deterioration and increased morbid events during pregnancy. Increased incidence of IUGR and fetal demise which was 53.1% and 18.7% respectively is attributed to the decreased uterine artery blood flow as a result of increased peripheral vascular resistance during pregnancy. In women with only deranged cardiac function, fetomaternal outcome was better in comparison to women with both structural and functional abormality. Those who have a normal echocardiographic report have best prognosis amongst the 3 classes.

Preeclampsia and cardio-vascular disorders also tend to share common risk factors like obesity, smoking, increased cholesterol levels, stress, sedentary lifestyle as well as some genetic factors.[17] This is the reason that preeclampsia is more associated with abnormal functional echocardiographic changes. The present study has observed that early diagnosis of cardiac lesions and its appropriate management is associated with better pregnancy outcome, similarly observed by James et al study. James et al showed that LV remodelling was seen in 33% patients at 20- 23 weeks of pregnancy.[5] Patients with increased LV mass are more likely to have complications. Time of scan is also important as abnormal placentation occurs by 20 weeks of pregnancy. Hence early Echocardiogram helps decrease the incidence of IUD and preterm deliveries due to IUGR and abnormal doppler.

Echocardiography can reveal cardiac impairment in gestational hypertension and preeclampsia, which changes antenatal management (medication, frequency of monitoring, and timing of delivery) and can indicate when postnatal follow-up is warranted. In our study, 27 out of the 32(84.3%) subjects with abnormal structural Echocardiogram findings had poor outcome in terms of hypertensive crisis or CCF or ICU admissions. Out of the 89 with only functional impairment, rate of ICU admissions was 31.46%. Total 62.5% out of the 32 with structural abnomalities and 13.8% out of the 89 with only functional abnormality had preterm deliveries. Incidence of such poor outcome was found to be less in the control group of 29 hypertensive women who had a normal heart structurally and functionally. Thus Echocardiogram if performed can identify the high risk patients who need better monitoring and can improve prognosis in such patients.

This study also showed that if the abnormal Echocardiographic findings were identified during early pregnancy and proper care was taken, prognosis

improved and the rate of complications decreased. Early onset preeclampsia can have more changes especially near term and so a repeat Echocardiography should always be done in such cases when the patient reaches near term pregnancy.

Echocardiogram if done early in pregnancy can thus improve both the maternal and the fetal outcome. Cardiac MRI and trans-oesophageal Echocardiography are newer modalities. Cardiac MRI gives better soft tissue contrast without any ionizing radiation.[18] Echocardiography has an interobserver varaiation of 10-15% which is overcomed by cardiac MRI.[18]

Also, the limitation by poor acoustic window can be overcomed by cardiac MRI.[18]

CONCLUSION

The cardiac structure and function are altered in pregnant women suffering from hypertensive disorders in different forms. Recognition of this impairment in cardiac function is important in management of gestational hypertension and pre-eclampsia and in improving the fetomaternal outcome. Early recognition and management can bring better prognosis. 2-dimensional echocardiography is an important non-invasive technique to understand the cardiac structure and function and should be done as early as possible in hypertensive women. The cardiac structure should be re-evaluated near term in patients who present with hypertension since early pregnancy. Combined Obstetrician and Cardiologist care results into good fetomaternal outcome.

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