Section: Cardiology

Original Research Article

ASSESSMENT OF LEFT VENTRICULAR MYOCARDIAL PERFUSION INDEX (TEI INDEX) IN PATIENTS WITH PREGNANCY-INDUCED HYPERTENSION (PIH) BEFORE AND AFTER DELIVERY IN TERTIARY CARE CENTRE

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Abstract

Background: Pregnancy-induced hypertension (PIH) occurs after 20 weeks of gestation in women with previously normal blood pressure. The present study aimed to assess the left ventricular myocardial perfusion index (Tei index) in patients with pregnancy-induced hypertension (PIH) before and after delivery and compare it with that in controls. **Materials and Methods:** This prospective case-control study was conducted in Govt. Chengalpattu Medical College Hospital on 100 antenatal patients with PIH aged between 24 and 33 years for six months. Echocardiography assessed and compared 50 cases and 50 controls (age- and gestational age-matched). ET, IVRT, and the Tei index were calculated in cases and controls three times: before delivery in the third trimester, twice after delivery, 2-4 days and six weeks postpartum. **Result:** Significant differences existed between the means of the two groups in the following parameters. Average IVRT in cases vs controls in 3rd trimester, PP (2-4 days), and PP (6 weeks) were 101.5 vs 81.1 ($p<0.001$), 95.8 vs 80.2 ($p<0.001$), 83.6 vs 79.2 ($p<0.001$). The mean Myocardial perfusion index (TEI) was 0.52 vs 0.35 ($p<0.001$), 0.49 vs 0.34 ($p<0.001$), and 0.42 vs 0.32 ($p<0.001$). Six of the 50 patients went into PPCM. Tei index 0.58 had good sensitivity (83.3%) and high specificity (95.5%) for PPCM. **Conclusion:** In patients with PIH (cases), the calculated ejection time (ET) was smaller, and IVRT and MPI (Tei index) were larger in all corresponding groups than in cases compared to controls. The TEI index is useful for assessing left ventricular systolic and diastolic dysfunction in pregnant patients with PIH.

INTRODUCTION

Hypertensive disorders are the most common medical complications of pregnancy, with a reported incidence of 5–10%.[1,2] Pregnancy-induced hypertension (PIH) occurs after 20 weeks of gestation in women with previously normal blood pressure. The broad classification of pregnancy-induced hypertension during pregnancy is gestational hypertension, pre-eclampsia and eclampsia.[3] The secondary morphologic and functional left ventricular changes induced by chronic hypertension are well known.[4,5] A new Doppler index was introduced recently by Tei, which includes the duration of systolic and diastolic time intervals to evaluate myocardial performance globally.[6] Systolic time intervals have been found to correlate with other systolic function parameters such as stroke volume, cardiac output, ejection fraction, and the positive dP/dt of the left ventricle.[7,8]

Only a few studies have revealed the effects of changes induced by transient hypertension on cardiac structure and function. The myocardial perfusion index (MPI), or Tei index, is an index of combined systolic and diastolic dysfunction. Hence, this study aimed to compare the left ventricular myocardial perfusion index (Tei index) in patients with pregnancy-induced hypertension (PIH) before and after delivery with that in controls.

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MATERIALS AND METHODS

This prospective case-control study was conducted in Govt. Chengalpattu Medical College Hospital on 100 antenatal patients with PIH aged between 24 and 33 years for six months.

Inclusion Criteria

Cases of antenatal women brought to the hospital with pregnancy-induced hypertension (PIH) in the third trimester were included and assessed thrice.

Exclusion Criteria

Patients with hypertensive disorders of pregnancy, Known Heart disease, or other aetiologies such as congenital, rheumatic, ischaemic, anaemia complicating pregnancy, and renal disease complicating pregnancy were excluded.

In 50 cases and 50 controls, none of the patients had a previous history of PIH or hypertension. The cases and controls were prospectively followed. Specifically, gestational hypertension is defined as the new onset of hypertension (SBP ≥ 140 mmHg or DBP ≥ 90 mmHg) at ≥20 weeks of gestation in the absence of proteinuria or new signs of end-organ dysfunction.[9]

Patients were diagnosed with hypertension (BP of 140/90 mmHg or more) that developed for the first time after 20 weeks of gestation, documented on two occasions at least 4 hours apart in a previously normotensive woman. Controls were selected by matching them with cases by age and gestational age. Once before delivery (during the third trimester) and twice after delivery (2-4 days postpartum & six weeks). Controls were Antenatal patients (Age and Gestational age-matched with cases) brought to the hospital in the third trimester without PIH. Once before delivery (during the third trimester) and twice after delivery (2–4 days postpartum & at six weeks).

The septal wall was first highlighted in tissue Doppler imaging mode in the apical four-chamber view. Using pulse-wave Doppler imaging, a sample volume of 5.0 mm was placed at the septal side of the mitral annulus, and the process was repeated for the lateral wall. Values were averaged to obtain the tissue Doppler imaging ET, IVCT, and IVRT means. The Tei index was obtained by subtracting ET from the interval between cessation and onset of mitral inflow velocity to obtain the sum of IVCT and IVRT: Tei index = (IVCT ± IVRT)/ET.[10] The Tei index incorporates systolic and diastolic time intervals to express global systolic and diastolic ventricular function. The corrected time of IVRT (IVRTc) was calculated as IVRT divided by the square root of the R interval time.

Echocardiography was performed, the Tei index was calculated, and the normal range of the left ventricular Tei index was 0.37±0.05.[6] Value > 0.43 was considered abnormal, and the parameters of cases were compared with their corresponding age and gestational age-matched controls and analysed.

Statistical Analysis: The data were entered into Microsoft Excel. Suitable significance tests were performed, and statistical significance was set at $p < 0.05$.

RESULTS

One hundred antenatal women (50 cases and 50 controls) were assessed as primigravid out of the 50 cases that were assessed. The mean age was 27.24±0.25, and the mean age of the controls was 27.16±0.26. The average body weight of antenatal women with PIH (cases) was higher than that of the controls (80.5 Vs 74.6). All 100 antenatal women were non-smokers. The mean gestational age of patients with PIH was 36 weeks, and that of controls was 38 weeks.

The echocardiographic assessment revealed that the average Ejection Time (ET) of cases in the third trimester was 262.6 as against controls, which was 292.4.ET at 2-4 days postpartum for cases vs. controls was 268.5 vs 295.6. ET measured six weeks after delivery for cases vs. controls was 287.3 vs 312.1, respectively. The Isovolumetric Relaxation Time (IVRT) of cases in the third trimester was 101.5 ms, IVRT measured after delivery at 2 to 4 days postpartum was 95.8 ms, and at six weeks, IVRT was 83.6 ms. In the control group, IVRT measured in the third trimester, 2 to 4 days postpartum and at six weeks were 81.1, 80.2, and 79.2, respectively.

The myocardial Performance index (Tei) in the third trimester was higher (0.52) than that of the controls (0.35). The Tei index for cases and controls 2 to 4 days after delivery were 0.49 & 0.34, respectively. The Tei index at six weeks postpartum was 0.42 for cases and 0.32 for controls. The t-test value was calculated for the mean values of the cases and their corresponding controls in the third trimester, 2–4 days, and six weeks postpartum. The mean IVRT and Tei index of cases in the third trimester, 2-4 days, and six weeks postpartum were significantly different from the corresponding controls [Table 1]. Six of 50 antenatal patients with PIH developed Peripartum Cardiomyopathy (PPCM).

The Tei Index of cases in the third trimester was plotted, and the Receiver Operator characteristics curve (ROC) for PPCM was obtained. A good area under the curve (AUC) of 96.2% with a Youden J cutoff point of -0.58 had 83.3% sensitivity and 95.5% specificity for the development of PPCM [Figure 1].

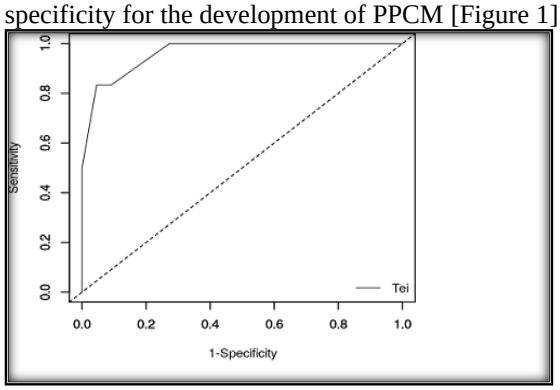

Figure 1: Receiver Operator Characteristics Curve (ROC) of cases with Tei index for predicting PPCM in the third trimester

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Table 1: Mean IVRT and Tei index of Cases and controls

Mean		Cases	Controls	P value
IVRT	Third Trimester	101.5	81.1	<0.001
	2–4 days Postpartum	95.8	80.2	<0.001
	Six weeks Postpartum	83.6	79.2	<0.001
Tei Index	Third Trimester	0.52	0.35	<0.001
	2–4 days Postpartum	0.49	0.34	<0.001
	Six weeks Postpartum	0.42	0.32	<0.001

DISCUSSION

This prospective case-control study was performed on 100 antenatal patients (50 cases and 50 controls) at the Government Chengalpattu Medical College. Antenatal women with PIH (cases) were assessed by echocardiography, compared with their corresponding controls (age and gestational age), and analysed. All 100 antenatal women were primigravidas and non-smokers. The ejection time of the patients was lower than that of the patients in the control group. The IVRT in the control group was significantly higher than in the corresponding control group. IVRT tends to increase in isolated left ventricular diastolic dysfunction since early diastolic relaxation proceeds more slowly.[11] However, its duration depends on LV relaxation velocity and the difference between LV end-systolic pressure and left atrial pressure.[12]

In this study, the Tei index increased significantly in cases in the third trimester compared to controls, indicating further impairment in global cardiac function during the third trimester of pregnancy, as seen in the study by Hieda M et al.[13] Antenatal Women who develop PIH have increased myocardial perfusion index (TEI) than women without PIH in the third trimester and continue to have increased TEI index at 2-4 days postpartum. At six weeks postpartum, mean values for cases were in the upper limit of the normal Tei index (MPI), which appears more resistant to pseudo normalisation, as increased LV filling pressures correlate with shorter ejection times.[14] However, some studies have shown that TDI-MPI is independent of heart rate, blood pressure and ventricular loading.[15,16]

In our study, the mean Tei index was maximum during the third trimester and progressively reduced postpartum to reach a mean upper limit of normal (0.42) at six weeks postpartum. There were statistically significant differences in the mean IVRT and Tei between cases and controls in all corresponding groups (third trimester, 2-4 days and six weeks postpartum), as indicated by the significant t-test scores ($p<0.001$). Six of the 50 patients developed PPCM. The ROC curve was plotted for the Tei index values in the trimester, showing that the Tei index of 0.58 had good sensitivity (83.3%) and was highly specific (95.5%) for developing PPCM.

This study has some limitations. As the number of participants was relatively small, this single-centre study included 100 antenatal patients. Drug compliance and its relationship with the Tei index have been studied. Outcomes, such as E/A, have also been studied. Only antenatal patients who underwent PPCM were present, and the cutoff points could not reveal the true sensitivity and specificity. In addition, pre-pregnancy data can be used to predict the development of PIH, and in the future, these values need to be assessed in a larger population. Despite these limitations, the present study shows that identification of early LV diastolic and systolic function by MPI (Tei index) in the high-risk group (cases) compared to controls is possible so that cases can be kept under close follow-up to prevent and address further complications early.

CONCLUSION

The echocardiographic assessment revealed that the cases' isovolumetric relaxation time (IVRT) and MPI (Tei index) were significantly higher in the third trimester, 2-4 days and six weeks postpartum than their corresponding controls. The calculated Ejection Time (ET) was lower than the corresponding controls in all groups. The TEI index is useful for assessing left ventricular systolic and diastolic dysfunction in pregnant patients with PIH. Patients with PIH have cardiac dysfunction during pregnancy and the postpartum period, which reveals an increased susceptibility to cardiovascular complications during the subsequent pregnancy. Patients with an abnormal Tei index, especially >0.58 in the third trimester, should be closely followed up for the development of peripartum cardiomyopathy. (83.3% sensitivity and 95.5% specificity for PPCM), respectively. In PIH patients with isolated diastolic dysfunction and normal LVEF, the Tei index can be used to assess and stratify which group of patients require regular follow-up so that cardiovascular complications can be prevented or intervened earlier.

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