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Role of speckle tracking echocardiography in term pregnancy with preeclampsia

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Abstract
Objectives: To study the role of speckle tracking echocardiography in term pregnancy with preeclampsia**.**
Methods: This was a hospital based cross sectional comparative analytical study carried out over 2 years from May 2019 in the Department of Obstetrics and Gynecology, SMS Medical College and attached hospitals, Jaipur. The study included two groups consisting of 45 women in each group match with age and gestational age. Inclusion and exclusion criteria were applied. All women underwent speckle tracking echocardiography and strain and strain rate indices were recorded and studied.
Results The Mean LV global longitudinal strain was significantly lower in the pre-eclamptic group as compared to control group (-13.32 ± 2.37 v/s -17.61 ± 1.89) and the difference was stastically significant. The mean left ventricular radial strain was also lesser in preeclampsia group than control group (-20.66±1.22% v/s -20.67±1.14%), although there was no statistical significant difference between the two groups.
The mean left ventricular circumferential strain was also lesser in preeclampsia group than control group (-19.24±1.49% v/s -19.84±0.99%), although there was no statistical significant difference between the cases and controls
Conclusion: Speckle tracking echocardiography is very sensitive method of measuring myocardial function and can detect even subclinical myocardial impairement in hypertensive disorder of pregnancy. Speckle tracking echocardiography should be introduced in routine management protocol to identify women at high risk of developing complications.

Keywords: speckle tracking echocardiography, left ventricular global longitudinal strain rate, left ventricular radial strain rate, left ventricular circumferential strain rate

Introduction

Pre-eclampsia is a complex multisystem condition. It affects 3-5% of all pregnancies [1]. It is defined as new onset hypertension after twenty weeks of pregnancy plus involvement of at least one organ system-renal, hepatic, neurological, hematological, pulmonary or cardiac system or as utero-placental dysfunction. It not only increase the risk for maternal and perinatal morbidity and mortality, but also represents a risk factor for further hypertension, ischemic heart disease, stroke and premature cardiovascular death in women. In pregnancy, the cardiovascular system has to adapt to a state of chronic volume overload. It is now well established that pre-eclampsia is an independent risk factor for subsequent cardiovascular disease [2, 3]. One of the principal manifestation of this progress is the change in geometry and function of left ventricle. Therapeutic intervention during asymptomatic phase of cardiac derangement can improve the long term prognosis more effectively. Newer diagnostic strategies such as speckle tracking echocardiography are more sensitive in detecting subclinical cardiac changes than conventional technique [4, 5]. It provides an objective quantification of myocardial deformation evaluated in all spatial directions independently from the angle of insonation and from cardiac translational movements. Speckle tracking echocardiography measures strain by tracking the two-dimensional motion of characteristic speckles (defined as spots generated by the interaction between the ultrasound beam and myocardial fibers) on B-mode images. Speckle tracking echocardiography promises to reduce inter and intra observer regional left ventricular function and to improve healthcare cost-effectiveness through the early identification of subclinical disease [6]. Compared to the 2D echocardiography, speckle tracking echocardiography operates with a large amount of volume data, which makes speckles in the myocardium that can be treated in 3D space, and thereby has an advantage to overcome out-of-plane motion. Thus parameters obtained by speckle tracking echocardiography has good reproducibility and therefore appear sufficiently reliable to be used in early detection of pregnancy associated disorders in the myometrium.

Material and Methods

This was a hospital based comparative analytical cross sectional study carried out over 2 Years period from May 2019 in the Department of Obstetrics and Gynecology, SMS Medical College and attached hospitals, Jaipur.

The study included two groups consisting of 45 women in each group match with age and gestational age.

Group-A: 45 women with singleton pregnancy with gestational period of ≥34 weeks with preeclampsia.

Group-B: 45 normotensive women with singleton pregnancy with gestational period of ≥34 weeks.

Women with singleton pregnancy, ≥34 Weeks gestation normotensive pregnant, ≥34 Weeks gestation with preeclampsia and women willing to Participate Were included in the study. Subjects with any renal disease, chronic hypertension, cardiovascular disease, congenital cardiac disorder of pregnancy and obesity were excluded from the study. After applying inclusion and exclusion criteria informed written consent were taken and women willing to participate in this study were recruited from routine antenatal clinic. Approval from Institutional Research, Review Board and Ethical Committee was taken. Speckle tracking echocardiography was done in left lateral position and strain and strain rate indices were calculated. LV global longitudinal strain was calculated as the average longitudinal strain of all six segments of each of the three view (two chamber, four chamber and long-axis i.e. as the mean strain of all 18 segments). Longitudinal strain assess apex-base deformation.

LV radial strain and circumferential strain were evaluated by using short axis views at the level of the papillary muscles (endocardial borders). Three consecutive end expiratory cycles, in gray scale stored for each view and subsequently transferred to an Echo PAC.

Statistical analysis was performed by calculating the average of each strain parameters.p-value <0.05 was taken as significant. Medcalc 16.4 version software was used for all statistical calculations.

Results

A total of 45 women with pre eclampsia and 45 normotensive women were recruited during the study period. Speckle tracking echocardiography was done and strain rate indices were obtained. Compared with the healthy term normotensive pregnant women, preeclamptic women showed a significantly lower mean left ventricular global strain rate.

The mean left ventricular radial strain was also lesser in preeclampsia group than control group (-20.66±1.22% v/s -20.67±1.14%), although there was no statistical significant difference between the two groups.

The mean left ventricular circumferential strain was also lesser in preeclampsia group than control group (-19.24±1.49% v/s -19.84±0.99%), although there was no statistical significant difference between the cases and controls.

Table 1: Distribution of subjects according to Mean Left Ventricular Global Strain (%)

Group	Cases	Controls	p-value
Mean LVGLS (%)	-13.23±4.51	-20.03±2.27	0.001

*: statistically significant

Table 2: Distribution of subjects according to Mean left ventricular Radial Strain (%)

Group	Cases	Controls	p-value
Mean LVRS (%)	-20.66±1.22	-20.67±1.14	0.968

Table 3: Distribution of subjects according to left ventricular Mean circumferential Strain (%)

Group	Cases	Controls	p-value
Mean LVCS (%)	-19.24±1.49	-19.84±0.99	0.09

Discussion

Pre-eclampsia is associated with significant haemodynamic changes that leads to higher prevalence of global left ventricular abnormal function and myocardial injury. Speckle tracking echocardiography is a newer diagnostic tool that possess potential benefits over 2D-tissue doppler imaging by better delineation of cardiac performance status. It allows non-invasive measurement of overall LV strain independently from the angle of insonation. This newer technology is more sensitive in detecting subclinical cardiac changes than conventional techniques. Our results were comparable to the study done by Buddeberg BS *et al* (2018) [7] in which they studied the cardiac maladaptation in term pregnancies with pre-eclampsia. The LV global longitudinal strain was significantly lower in the pre-eclamptic group as compared to control group (-13.32 ± 2.37 v/s -17.61 ± 1.89).

Similar study was done by Shahul S *et al* (2012) [8] in which they studied 11 pre-eclamptic women and 17 women without pre-eclampsia. They concluded that global longitudinal strain significantly worsened in women with pre-eclampsia compared to women without pre-eclampsia (p=0.0001). They also found pre-eclampsia group had worsened radial strain compared to normotensive women (p = 0.007).

Our results were also supported by Orabona R *et al* (2016) [9] in which they found that there was reduction in LV global longitudinal strain in women with late onset pre-eclampsia as compared to healthy control.

Similar results were obtained by the study done by Mostafavi A *et al* (2019) [10] on comparison of left ventricular systolic function by 2D specikle-tracking echocardiography between normal pregnant women and pregnant women with pre-eclampsia. They found lesser mean circumferential strain in pre-eclamptic women than control group (-20.40 ± 4.12 v/s -22.68 ± 5.50). Similar results were obtained by study done by Zaman N *et al* (2019) [11] on maternal cardiovascular haemodynamics in pre-eclampsia. Global circumferential strain was lesser in pre-eclamptic group than normotensive pregnant women (-16.93 ± 1.11% v/s -21.76 ± 1.25%).

Conclusion

Preeclamptic women are at higher risk of developing cardiovascular complications later in life. Speckle tracking echocardiography is very sensitive method of measuring myocardial function and can detect even subclinical myocardial impairement in hypertensive disorder of pregnancy. Speckle tracking echocardiography should be introduced in routine management protocol to identify women at high risk of developing complications.

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