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Comparison of Hemodynamics in Normal Antenatal and Preeclamptic women

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Abstract

Background: Preeclampsia is associated with higher prevalence of abnormal left ventricular function. So, present study was designed to compare these changes in normal and pre-eclamptic pregnancies using echocardiography. **Methods**: In present study, 60 patients with pre-eclampsia with singleton pregnancy between 20-30 years (study group) were compared with 60 age matched healthy pregnant women (control group). They were non-invasively analyzed for cardiovascular hemodynamics using echocardiography. The data was analyzed using student's t- test. p value <0.05 was considered to be significant. **Results**: Mean stroke volume in pre-eclampsia group was 55.2±5.2 ml v/s 72.74±5.6 ml in control group and the difference was statistically significant. Mean cardiac output in preeclampsia group was 5.69±0.47 lit/min v/s 6.42±3.4 lit/min in control group which was statistically significant. Mean systemic vascular resistance (dyne.sec cm-5) in pre-eclampsia group was 1468.22±5.7 v/s 957.7±131 in control group which was statistically significant. Mean ejection fraction (%) in pre-eclampsia group was 68.31±5.1 v/s 66.54±4.7 in control group which was statistically significant. **Conclusions**: Doppler echocardiography provides an excellent non-invasive method for evaluation of hemodynamic changes during pregnancy. Therefore if it is introduced into antenatal protocol, could help to identify subset of pre-eclamptic women who are at high risk to developing complications and thereby can do early intervention.

Key words: Echocardiography, Hemodynamics, Hypertension, Pregnancy.

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Introduction

Pregnancy is a physiological phenomenon. It produces both anatomical and physiological changes in all the organs including reproductive organs, cardiovascular system, hemopoietic system, respiratory system and excretory system etc. It is associated with volume overload producing significant vascular and hemodynamic adaptations in cardiovascular physiology [1].They are necessary for successful pregnancy, but they impose further load on the heart. Preeclampsia is a multisystem disorder that occurs after 20 wks of pregnancy. Acute preeclampsia is associated with significantly higher prevalence of asymptomatic abnormal

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global left ventricular (LV) abnormal function [2]. It is also associated with higher risk of heart failure, ischemic and hypertensive heart diseases and related mortality in later life [3,4]. Many studies of women with preeclampsia have revealed diverse hemodynamic findings such as elevated cardiac output (CO), high vascular resistance, and reduced CO and myocardial contractility [5]. Impairment of LV diastolic function as well as systolic function appear very early in the course of heart disease [6]. Early detection and its treatment at an asymptomatic phase can help in improving the prognosis. In earlier days, gas exchange techniques were used to determine cardiac output. With development of cardiac catheterization, it was used to study right heart hemodynamics. The advent of echocardiography enabled serial noninvasive cardiovascular monitoring throughout pregnancy. Initially, investigators used M-mode but perhaps due to its limitations, results were not uniform [7]. Recently, Doppler echocardiography has been used which is reproducible and noninvasive technique suitable for pregnant women [8]. Therefore echocardiography if introduced into the routine antenatal protocol, could help to identify women who are at high risk to develop cardiovascular complications and there by early intervention.

Methods

It was a case control study conducted in 120 subjects. 60 patients with pre-eclampsia with singleton pregnancy between 20-30 years (study group) were compared with 60 age matched healthy pregnant women (control group) during September 2018 to August 2021 after obtaining institutional ethical clearance. Patients who refused to participate; those suffering from cardiovascular disease, diabetes mellitus, thyroid disorder, anaemia and multiple gestations were excluded. All subjects were informed in detail about aim and procedure of study and written consent was taken for conduct of study.

A detailed obstetric history and thorough examination was done in all subjects. Age, height, weight were noted. Blood pressure was measured by sphygmomanometer in right arm in left lateral position after 10 minutes of rest by auscultatory method. Onset of tapping sound was taken as systolic and muffling of Korotkoff sound was taken as diastolic blood pressure. An obstetric ultrasound along with doppler was performed to confirm fetal growth. All subjects were subjected to echocardiography. Standard parasternal two dimensional long axis images were recorded and left ventricular diameters were measured in M mode (American Society of Echocardiography guidelines) [9]. Doppler Echocardiography was used to calculate stroke volume [10]. Simultaneously heart rate per minute was recorded. Cardiac output, Systemic vascular resistance and ejection fraction were calculated.

Statistical Analysis

The data was expressed as Mean±S.D and was analyzed using student's t-test P-value <0.05 was considered to be significant.

Result

Table 1: Comparison of mean age, mean height and mean weight of control and study groups (N =120).

Parameter	Control group (n=60)	Study group (n=60)	p value
Mean age (years ± SD)	25.4 ± 4.19	29.51 ± 3.24	>0.05
Mean height (cm ± SD)	157.33± 2.87	152.07 ± 4.29	>0.05
Mean weight(Kg ± SD)	54.5 ± 3.04	59.34 ± 4.54	<0.05

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p value: <0.05 - significant; Mean age and height in control and study groups were comparable. Mean weight was more in study group which was statistically significant.

Table 2: Comparison of heart rate and blood pressure between study and control group (N=120) (Mean ±SD).

Parameter	Control group (n=60)	Study group(n=60)	p value
Heart rate (Beats/min)	97.6±4.1	106±8.05	<0.05
Systolic blood pressure (mm Hg)	107.32±6.9	114±8.4	<0.05
Diastolic blood pressure (mm Hg)	71.5±5.1	82±7.2	<0.05

Table 3: Comparison of echocardiographic parameters between study and control group (N=120) (Mean ±SD).

Parameter	Control group (n=60)	Study group(n=60)	p value
Stroke volume (ml)	72.74±5.6	55.2±5.2	<0.05
Cardiac output (lit/min)	6.42±3.4	5.69±0.47	<0.05
Systemic vascular resistance (dyne. sec cm-5)	957.7±131	1468.22±5.7	<0.05
Ejection fraction (%)	66.54±4.7	68.31±5.1	<0.05

Hemodynamic parameters are more in study group then control group and are statistically significant.

Out of 60 patients, 17 patients with severe preeclampsia had associated Intrauterine growth restriction (IUGR).

Discussion

Pregnancy is associated with hyperdynamic circulation with high CO and low systemic vascular resistance (SVR) [11]. In normal pregnancy, there is an early rise in CO, peaking with a 40–50% increase at around 32 weeks. The initial stimulus, a reduction in peripheral resistance, triggers tachycardia, upregulation of the renin–angiotensin system and erythropoietin production with a lowering of the osmotic threshold for the secretion of antidiuretic hormone. Plasma volume thereby increases, giving increased CO. The drop in peripheral resistance is potentially placental in origin.

Preeclampsia is associated with increased vascular resistance and hypertension and contributes substantially to maternal and fetal morbidity and mortality. [12]. Hypertension produces structural changes in the left ventricle usually accompanied by functional alterations and in majority of cases; these precede clinical manifestations [13]. In normal pregnancy, an increased preload and a decreased after load favor an improved emptying of the left ventricle during systole and a reduction of the end-systolic pressure [14]. In preeclamptic women, the elevated after load is linked with a reduced emptying of the left ventricle and elevated end-systolic pressure. Rizwana Solanki et al[4] found a statistically significant difference in mean SVR between pre eclamptics and normotensive women [5]. In present study, low cardiac

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output & increase systemic vascular resistance was more in pre eclimptic patients. This is in accordance with study done by [5,15-18].
It is important to note that the cardiovascular profile had a stronger impact on the clinical onset of preeclampsia.

Conclusion
Doppler echocardiography is an excellent non-invasive method for the evaluation and serial analysis of hemodynamic changes during pregnancy. They help in distinguishing abnormal changes from maternal physiologic changes. Preeclampsia still contributes to maternal mortality and morbidity. Therefore echocardiography if introduced into the antenatal protocol, could help to identify subset of preeclamptic women who are at high risk to develop cardiovascular complications and thereby can do early intervention.

Limitation
It was performed in a small sample size. Therefore sample may not be representative of all Indian women. Therefore cross-sectional multicentric study is recommend.

Future
Further studies can be made by 3D echocardiography which is based on direct volumetric quantification, which is independent of geometric assumption of Left Ventricle.

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References
1. Sonali S Somani, Sunandini R, Shashikant G Somani. Role of echocardiography for assessment of cardiovascular haemodynamics during pregnancy. Int J Reprod Contracept Obstet Gyneco 2016 ; l 5(1): 84-89.
2. Melchiorre K, Sutherland GR, Baltabaeva A, Liberati M, Thilaganathan B. Maternal cardiac dysfunction and remodeling in women with preeclampsia at term. Hypertension 2011 ; 57(1): 85-93.
3. Lykke JA, Langhoff Roos J, Sibai BM, Funai EF, Triche EW, et al. Hypertensive pregnancy disorders and subsequent cardiovascular morbidity and type 2 diabetes mellitus in the mother. Hypertension 2009; 53(6): 944-951.
4. Mongraw Chaffin ML, Cirillo PM, Cohn BA. Preeclampsia and cardiovascular disease death- prospective evidence from the child health and development studies cohort. Hypertension 2010; 56(1): 166-71.
5. Solanki R, Maitra N. Echocardiographic assessment of cardiovascular hemodynamics in preeclampsia. J Obstet Gynaecol India 2011; 61(5): 519-522.
6. Kuznetsova T, Herbots L, Jin Y, Stolarz Skrzypek K, Staessen JA. Systolic and diastolic left ventricular dysfunction-From risk factors to overt heart failure. Expert Rev Cardiovasc Ther 2010; 8(2): 251-258.
7. Vered Z, Poler SM, Gibson P, Wlody D, Wrez J. Noninvasive Detection of the morphologic and hemodynamic changes during normal pregnancy. Clin Cardiol 1991;14(4): 327-334.

ISSN: 0975-3583,0976-2833 VOL14, ISSUE 06, 2023

8. Robson SC, Hunter S, Boys RJ, Dunlop W. Serial study of factors influencing changes in cardiac output during human pregnancy. Am J Physiol 1958; 256: 1060-1065.
9. Sahn DJ, DeMaria A, Kisslo J, Weyman. A Recommendations regarding quantitation in M-mode echocardiography: results of a survey of echocardiographic measurements. Circulation 1978; 58(6): 1072-1083.
10. Van Oppen AC, Stigter RH, Bruinse HW. Cardiac output in normal pregnancy: A critical review. Obstet Gyneco 1996; l 87(2): 310-318.
11. Schrier RW. Pathogenesis of sodium and water retention in high-output and low-output cardiac failure, nephrotic syndrome and pregnancy. N Engl J Med 1989; 319(17): 1127-1134.
12. Easterling TR, Benedetti TJ, Schmucker BC, Millard SP. Maternal hemodynamics in normal and preeclamptic pregnancies: A longitudinal study. Obstet Gyneco 1990 ; l 76(6):1061-1069.
13. Escudero EM, Favaloro LE, Moreira C, Plastino JA, Pisano O. Study of the left ventricular function in pregnancy-induced hypertension. Clin Cardiol 1988; 11(5): 329-333.
14. Valensise H, Novelli GP, Vasapollo B, Di Ruzza G, Romanini ME, et al. Maternal diastolic dysfunction and left ventricular geometry in gestational hypertension. Hypertension 2001; 37(5): 1209-1215.
15. Dennis AT, Castro S, Carrc C, Simmons S, Permezel M et.al. Haemodynamics in women with untreated preeclampsia. Anaesthesia 2012; 67(10): 1105-1118.
16. Maternal hemodynamics in normal pregnancy and in pregnancy affected by pre-eclampsia. D. Stott , O. Nzelu, K. H. Nicolaides and N. A. Kametas, Ultrasound Obstet Gynecol 2018; 52: 359–364.
17. Prognostic Value of Maternal Cardiovascular Hemodynamics in Women With Gestational Hypertension and Chronic Hypertension in Pregnancy. Erkan Kalafat , Helen Perry, Sophie Bowe, Basky Thilaganathan, Asma Khalil, Hypertension 2020;76:506-513.
18. Comparison of Hemodynamic and Biochemical Factors and Pregnancy Complications in Women with/without Preeclampsia. Banafsheh MASHAK, Ramesh Baradaran ,Ghazal Noorani, Safoora Soleimani fakhr, Mina ataei. Maedica – a Journal of Clinical Medicine 2022; 17(2): 363-370.