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Echocardiographic evaluation of pregnant women at 28-32 weeks of gestation with signs and symptoms related to cardiovascular disease

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Abstract
Physiological changes occur in pregnancy leading to hyperkinetic circulation with volume overload which represents an adaptation of the cardiovascular system of the mother. This prospective study was carried out in 80 pregnant women at 28-32 weeks of gestation with signs and symptoms related to cardiovascular disease to assess the impact of echocardiography on early detection and treatment of cardiovascular diseases. The mean cardiac output, mean ejection fraction, mean left ventricular end diastolic and end systolic dimension observed was 5.39±1.19 L/min, 60.72±6.71%, 44.68±6.01 mm and 28.6±5.07 mm respectively. 32 patients had tricuspid regurgitation which resolved in 6 patients on 6 weeks postpartum. 21 had mitral regurgitation, resolved in 8 patients. Other abnormalities seen were Mitral valve proplapse, Pulmonary artery hypertension, pericardial effusion, and Diastolic dysfunction and Perpartum cardiomyopathy in some patients. Echocardiography can help in evaluating valvular lesions, hemodynamic stages, and chamber size in different stages of pregnancy.

Keywords: Echocardiography, pregnancy, circulation, cardiomyopathy

Introduction
Pregnancy is a state of hyperkinetic circulation with physiological volume overload which represents an adaptation of the cardiovascular system of the mother induced by increased metabolic demands of the fetus. This circulatory burden is well tolerated by normal pregnant women. The maternal cardiovascular system undergoes significant changes throughout pregnancy, which impose considerable stress on the pregnant woman's heart. Many obstetric complications are associated with maternal cardiac dysfunction, such as thromboembolism, hypertensive disease of pregnancy, HELLP syndrome (Hemolysis, Elevated Liver enzymes, and Low Platelets) and amniotic fluid embolism. Cardiac disease remains the leading non-obstetric cause of maternal death in developed countries [1].

Evaluation of cardiac diseases in pregnancy may be complicated by normal anatomical and functional changes of cardiovascular system due to pregnancy. These changes may result in signs and symptoms that can either simulate or obscure heart diseases; therefore it is imperative to use additional diagnostic tools to obtain objective and reliable information about the cardiac status of pregnant woman.

Many of the normal symptoms of pregnancy, such as dyspnea on exertion, orthopnea, ankle edema, and palpitations, are also symptoms of cardiac decompensation. However angina, resting dyspnea, paroxysmal nocturnal dyspnea, or a sustained arrhythmia are not expected with pregnancy and warrant a further diagnostic workup [2]. Physical signs commonly seen with pregnancy are jugular venous distension, an apical S_3, basal crackles, prominent left and right ventricular apical impulses, exaggerated heart sounds, and peripheral edema. Diastolic murmurs are rare with pregnancy despite the increased blood flow through the atrioventricular valves [3]. Their presence should prompt further diagnostic evaluation[4]. Systolic murmurs more than 2/6 in intensity, continuous murmurs, and murmurs that are associated with symptoms or electrocardiographic changes should also prompt further investigation such as echocardiography. Physiologic changes occurring during pregnancy can stress a compromised cardiovascular system, resulting in maternal morbidity, mortality and compromised fetal outcomes.

Therefore diagnosis of cardiovascular disease during pregnancy is of pivotal importance for safe and proper management of pregnancy, labor, delivery and postpartum surveillance.

Echocardiography is the technique that can be used with complete safety, repeated frequently and entirely without discomfort. The use of Echocardiography permits us to estimate myocardial performance, systolic and diastolic functions, valvular lesions, hemodynamic changes, chamber size in basal state and in different stages of pregnancy and in the puerperium. Hence Echocardiography has become the preferred screening method to assess cardiac function. Increasing cases of silent valvular heart diseases and cardiomyopathies are being picked up due to more frequent use of this modality.

In this prospective study we did an echocardiographic evaluation of pregnant patients between 28 to 32 weeks of gestation with sign and symptoms related to the cardiovascular disease to assess the impact of this modality on early detection and treatment of cardiovascular diseases in pregnancy. We also re-evaluate the women in postpartum period by Echocardiography with positive Echo findings at 28-32 weeks of gestation.

Materials and Methods

This Prospective observational study was carried out in the department of gynecology and obstetrics-holy family hospital, New Delhi. This study was carried out in 80 pregnant women between age group of 20-40 years at 28-32 weeks of gestation with signs and symptoms related to cardiovascular disease during the period from June 2012 to May 2014. The study was approved by the ethics committee of our hospital. Written informed consents had taken from all participants.

The selection criteria for study were Singleton pregnancies and Normal pregnant women at 28-32 weeks of gestation with symptoms and signs related to cardiovascular disease like Breathlessness, Palpitation, Headache, Dyspnea on exertion, Orthopnea, Syncope, Blackouts, Swelling of body, Cardiac murmur, Gallop rhythm, pericardial rub, Tachy arrhythmias, Brady arrhythmias, Pallor, Hypertension. The exclusion criteria of this study were Multiple pregnancies, Pregnancy with diabetes, Pregnancy with essential hypertension, Pregnancy with known case of rheumatic heart diseases, Elderly gravida (age> 40 years)

Detailed history, general and systemic examination was done during pregnancy. The relevant investigations including echocardiography for patients with cardiac signs and symptoms, was done. In all participants echocardiography was done at 28-32 weeks of gestation. All pregnant women with positive Echo repeat, echocardiography at 6 weeks following delivery was done. In this study we used VIVID 7 dimension WIPRO-GE Colour Doppler echocardiography machine.

The Primary outcomes evaluated were echocardiographic evaluation of pregnant women at 28-32 weeks of gestation with signs and symptoms related to cardiovascular disease. The Secondary outcomes were any intervention surgical or medical (if required) in patients with positive echo findings.

Results

In the present study, majority of females were in age group of 26-30 years (50%). 57.5% (46) of the pregnant subjects were primigravida and 42.5% were multigravida in this study.

Table 1: Demographic characteristics of the study populations according to age and parity

Age group (years)	No. of patients	Percentage
20-25	19	23.75%
26-30	40	50%
31-35	21	26.25%
Parity		
N=0	46	57.5%
N=1	19	23.75%
N=2	8	10%
N=3	3	3.75%
N=4	4	5%

The Most common cardiovascular symptom and signs observed in the present study was dyspnea (Table 2). The next common cardiovascular symptom was palpitations and seen in 18 (22.5%) patients.

Table 2: Signs and symptoms related to cardiovascular disease.

Symptoms	No. of Patients	Percentage (%)
Dyspnea	28	35
Palpitations	18	22.5
Pregnancy induced HTN	17	21.25
Anemia	10	12.5
Tachycardia	4	5
Cardiac murmur	2	2.5
Bradycardia	1	1.25

The mean cardiac output in this study was 5.39±1.19 L/min, the mean ejection fraction was 60.72±6.71%. The Mean left ventricular end diastolic and end systolic dimension was 44.68±6.01 mm and 28.6±5.07 mm respectively. The mean E: A ratio was 1.27±0.35 in present study. Majority of the patients had left ventricular end diastolic dimension in range 41-45 mm (38.75%). Majority of the patients who had Left Ventricular End Diastolic Dimension between 51 to 55 mm had dyspnea (66.66%). In the present study majority of patients had an ejection fraction > 60%. 4 patients (5%) had an ejection fraction < 50%. One patient had EF < 40% which was associated with peripartum cardiomyopathy. Majority of patients had cardiac output between 4L/min to 6 L/min. 23.75% of patients had hyperdynamic circulation with a cardiac output of > 6 L/min.

In our study, out of 80 patients, 32 had tricuspid regurgitation. Out of these 32 patients, 12 patients were lost to follow up, 6 patients had no tricuspid regurgitation 6 weeks postpartum.14 patients had trace/mild low pressure (physiological) Tricuspid regurgitation on follow up. Out of 80 patients, 21 had mitral regurgitation out of which 6 had trace MR, 14 had mild MR and one patient had severe MR.MR resolved in 8 patients after 6 weeks postpartum while 6 patients were lost to follow up.

MVP was seen in 5 patients in this study. In some patients postpartum MVP was not visualized possibly it was physiological due to pregnancy.

In our study 4 patients had diastolic dysfunction. 3 patients had grade 1 and one patient had grade 3 diastolic function. Diastolic dysfunction resolved in 2 cases.

In our study 2 patients had pulmonary artery hypertension; one had associated mild pericardial effusion. Pulmonary hypertension resolved 6 weeks postpartum.

In our study one patient had Peripartum cardiomyopathy which was associated with tachycardia. Patient was under treatment of the physician and being followed up in the department of medicine.

Discussion

The Incidence of heart disease noted in pregnancy is <1% of all pregnancies [5]. Current estimated prevalence of clinically significant cardiac disease during pregnancy is 0.1 – 1.4% [6, 7, 8], however the maternal mortality rate for these patients during pregnancy has decreased to 0.5% [6-9]. Nevertheless, cardiac disease still account for 15% pregnancy related mortality [10].

Pregnancy is associated with substantial physiological changes that require adaptation of the cardiovascular system. Symptoms such as breathlessness, fatigue, palpitations or signs such as ejection systolic murmur that are suggestive of heart disease, may be present in up to 90% of pregnant women as a consequence of the physiological changes induced by pregnancy itself [11]. The increased circulatory burden of pregnancy can unmask previously unrecognized heart disorders and can worsen heart disease.

Mishra *et al*. [4] (1992) used echocardiography to examine the significance of a heart murmur in 103 pregnant women. The echocardiogram and Doppler were normal in all 79 women who had soft or short ejection systolic murmur. Three of 15 women who had long or loud ejection systolic murmur had abnormalities. One had MVP with MR; second had nonobstructive hypertrophic cardiomyopathy; the third, mild aortic stenosis due to bicuspid aortic valve.

In our study out of 80 patients, 2 had a cardiac murmur, one had MVP and other one had trace Mitral regurgitation on echocardiography.

Jyotsana R. Bharshankar *et al*. [12] in 2010 did a prospective study in 30 primigravid women who were evaluated 4 times at early (14-17 weeks), mid (24-27 weeks) and late gestation (30-33 weeks) and at 6 weeks postpartum. At each visit, echocardiography was performed in the left lateral decubitus position to assess the hemodynamic changes. Considering values of 6 weeks postpartum as baseline, the mean values of cardiac output (COP) increased in early gestational period (from 3.75±0.39 to 4.41±0.43 L/min, $p< 0.01$). It continued to increase further in mid (4.95±0.5, $p< 0.001$) and later gestational periods (5.57±0.56, $p< 0.001$).

In our study we included 80 patients with cardiovascular symptoms at 28-32 weeks of gestation and the mean cardiac output was 5.39 L/min. 37.5% patients in our study had CO between 5.1 to 6 L/min and 23.75% patients had cardiac output >6 L/min.

Andres Mesa *et al*. [13] studied the Left Ventricular Diastolic Function by Echocardiography in 37 healthy pregnant women at the end of each trimester.

The mean cardiac output, as determined by the pulsed wave Doppler method, increased throughout pregnancy, from4.6±0.8 L/min in the control subjects to 6.0±1.3 L/min at 34 weeks gestation. The cardiac output underwent a significant increase throughout gestation. The LV end-diastolic and end-systolic dimensions did not change significantly during or after pregnancy. LV end diastolic dimension (in cm) and LV end systolic dimension (in cm) in their study was 4.3±0.4 and 2.80 ±.3 respectively. LV ejection fraction was 60 ±3% at 34 weeks with no significant change in comparison to early trimesters. In our study mean cardiac output of 80 pregnant women with cardiovascular symptoms was 5.39±1.19 L/min. Mean LV end diastolic diameter (in cm) and LV end systolic diameter(in cm) in our study was 4.46± .6 cm and 2.860± .5 mm respectively. Mean Ejection fraction in our study was 60.72± 6.71%. The results were almost same as above study concluding that cardiovascular symptoms may be because of physiological changes of pregnancy.

In our study, 18.75% patient had left ventricular end diastolic dimension in between 5.1 to 5.5 cm, which is higher than normal pregnant female without symptoms. Among these, 35.7% dyspneic patients had increased left ventricular end diastolic dimension.

Campos O (1996) [14] measured the Cardiac chamber dimensions by echocardiography during pregnancy. Left ventricular end diastolic volume at 30-34 weeks in their study was 43.0±1.7.mm, LV end diastolic diameter (in cm) in our study was 44.69±6.01 mm at 28-32 weeks.

Kuzinar *et al*. (1983) [15] did a study on 42 PIH patient and they found average left ventricular end diastolic dimension of 49.2 mm and end systolic dimension of 32.3 mm. In our study we had we had PIH in 17 out of 81 patients and left ventricular End diastolic dimension was 46.11±6.6 mm and LV End systolic dimension was 28.5± 5 mm in the patients with PIH.

Mohammed S.M. Nouth *et al*. (2001) [16] studied 104 symptomatic healthy pregnant who women were examined clinically and subjected to echocardiography, Doppler color studies, resting echocardiogram. These were performed at 24th and 34th weeks of gestation and 8 weeks after delivery. The findings were compared with those of 50 young age - matched non pregnant women without heart disease. Twenty-four cases showed pericardial effusion of different severity. Doppler color flow studies detected seven cases with trivial mitral regurgitation and seven cases with combined mild mitral and tricuspid regurgitation. While 24 cases had mild TR. Mitral valve prolapsed was recorded in 23 cases of which 15 have no mitral insufficiency. Aortic valve dysfunction was not detected in any stage of pregnancy or in the puerperium. 19 pregnant participants had normal color Doppler echocardiographic findings. 8 weeks after delivery, mitral regurgitation was not detected but tricuspid insufficiency resolved in 4 cases.

In our study we studied 80 pregnant women with signs and symptoms related to cardiovascular symptoms. 32 patients had Mild TR, 21 patients had MR. MVP was noted in 5 patients. Pericardial effusion in one patient and pulmonary regurgitation was noted in one patient. TR resolved in 6 patients, MR resolved in 8 patients after 6 weeks of delivery. MVP was seen in 3 patients after 6 weeks postpartum. Pulmonary regurgitation and pericardial effusion was not detected in postpartum period.

Melchiorre K *et al*. [17] (2011) designed a study to evaluate cardiac function and remodeling in preeclampsia occurring at term. This was a prospective case-control study of 50 term preeclampsia and 50 normal pregnancies assessed by echocardiography and tissue Doppler analysis. Global diastolic dysfunction was observed more frequently in preeclampsia versus control pregnancies (40% versus 14%, P = 0.007).

In our study 4 out of 81 patient had diastolic dysfunction, out of them one patient had severe preeclampsia with grade 3 diastolic dysfuntion, 2 had dyspnea with grade 1 diastolic dysfunction and one patient had tachycardia which was associated with grade 1 diastolic function. On repeat Echo 6 weeks postpartum, diastolic dysfunction was resolved in two cases in our study which were associated with tachycardia and dyspnea.

Sustained or non-sustained ventricular tachycardia may be the initial manifestation of peripartum cardiomyopathy therefore a thorough evaluation of the third trimester pregnant woman with

otherwise unexplained new onset ventricular tachycardia is necessary [18].

In our study we had a patient at 32 weeks with unexplained tachycardia which was diagnosed as peripartum cardiomyopathy on echocardiography.

Hibbard JU *et al*. [19] (1999) gave a modified definition for peripartum cardiomyopathy and prognosis based on echocardiography. This article argues for uniform criteria that define peripartum cardiomyopathy, similar to the criteria for idiopathic dilated cardiomyopathy set forth by a National Heart, Lung, and Blood Institute-sponsored workshop and proposes that the new definition include heart failure within the last month of pregnancy or 5 months postpartum; absence of preexisting heart disease; no determinable etiology, the traditional definition; and strict echocardiographic criteria of left ventricular dysfunction: ejection fraction less than 45%, or M-mode fractional shortening less than 30%, or both, and end-diastolic dimension more than 2.7 cm/m2. Mortality from peripartum cardiomyopathy remains high, 25-50%, and a recent review related long-term prognosis to echocardiographic measures of left ventricular chamber dimension and function at diagnosis and recovery.

In our study we had one patient with tachycardia who was diagnosed as peripartum cardiomyopathy had ejection fraction of 35%, fractional shortening of 16%, left ventricular end diastolic dimension of 57 mm, severe MR with grade 1 diastolic dysfunction and generalized hypokinesia. Repeat Echo at 6 weeks postpartum was suggestive of EF of 37%, end diastolic dimension of 50 mm with mild MR, mild to moderate global hypokinesia and improved diastolic dysfunction.

Conclusion

There is definite role of cardiological assessment in patients with Persistent cardiovascular signs and symptoms in late pregnancy. Symptoms and signs such as such as dyspnea, palpitations, fatigability persisting in late pregnancy need to be thoroughly evaluated. Echocardiography is the technique that can be used with complete safety, repeated frequently and entirely without discomfort. It is a non-invasive procedure which allows the cardiovascular evaluation of pregnant women with no maternal or fetal risks, and is sensitive enough to detect minor structural and functional cardiac changes. Echocardiography can help in evaluating valvular lesions, hemodynamic stages, and chamber size in different stages of pregnancy and in distinguishing the normal physiological changes of pregnancy from pathological changes. It is a useful non-invasive tool which can help in correct diagnosis and management of cardiovascular problems in pregnancies. It can help in improving the outcome, with early medical and surgical intervention, for patients with subclinical heart disease complicating pregnancy.

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