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Maternal Left Ventricular Performance in First Trimester of Pregnancy with and Without Anaemia In Pregnancy.

T Padmaja[1]*, Sumangala M patil[1], Neerja Shastri[2], and Manjunath Aithala[1].

[1]Department of Physiology, B.L.D.E.U Shri BM Patil Medical College, Bijapur, Karnataka, India.
[2]Department of Physiology, Prathima Institute Of medical Sciences, Nagunur, Karimnagar, Telangana, India.

ABSTRACT

To evaluate & Compare the effect of anaemia on left ventricular function in normal pregnant women & pregnant women with anaemia in first trimester. 50 pregnant women were selected for this study & divided in to 2 groups.25 normal pregnant women (control group)in Ist trimester (10-14 weeks of gestation) were compared with equal number of pregnant women with anaemia(study group) in Ist trimester, aged between 20-30 years . Doppler echocardiography was performed using MEGAS CVX & MEGAS GPX equipped machine in both control & study groups to evaluate left ventricular systolic and diastolic function. Stroke volume (SV), cardiac put (CO) and total peripheral resistance were calculated from the measured dimensions according to the American society of Echocardiography (ASE) guidelines. Haematological parameters were analysed by SYSMEX auto analyser. Analysis of Variance (One way ANOVA) was used for comparison between study and control groups & the data was analysed by t test. $P< 0.05$ was considered statistically significant. In this study mean values of haemoglobin concentration and serum ferritin levels were significantly lower in study group. Whereas mean values of left ventricular parameters like were increased significantly in study groups when compared to the control groups. Reduction of Hb% in study group as compared to control group significantly & negatively correlates with the left ventricular cardiac function. Anaemia and volume overload in pregnancy is a risk factor that may lead to other cardiac problems.

Keywords: Anaemia; Pregnancy; Echocardiography; Left ventricular function.

Corresponding author

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INTRODUCTION

Pregnancy causes dramatic, usually reversible changes in a woman's cardiovascular system. These remarkable changes begin soon after fertilization & continue throughout gestation. These changes help to maintain healthy environment for the fetus without compromising mother's health, although sometimes, these alterations determine small discomfort to the mother. The first hemodynamic change during pregnancy seems to be a rise in heart rate[1]

Cardiac output rises 30%to 50% above baseline during pregnancy. The increase in cardiac output is achieved by 3 factors: (1) an increase in preload because of greater blood volume; (2) reduced after load because of a decrease in systemic vascular resistance; and (3) a rise in the maternal heart rate by 10-15 beats/min. Stroke volume increases during the first and second trimesters. Blood pressure typically falls about 10mm Hg below baseline by the end of the second trimester because of reduction in systemic vascular resistance and the addition of new blood vessels in the uterus and placenta [2]. These changes begin to take place during the first 5-8 weeks of pregnancy and reach their peak in the second trimester. Loading conditions (preload & afterload) change significantly during pregnancy [3].Also changes occur in blood volume.

Blood volume increases 40% to 50% during normal pregnancy. The marked increase in plasma volume associated with normal pregnancy causes dilution of many circulatory factors. This increase may tend to decrease red cell count & its content haemoglobin due to hemodilution (i.e., the anaemia of pregnancy). Thus during the pregnancy the mother is under risk of developing nutritional deficiency anaemia.

In normal pregnancies, there is an increase in the left ventricular end diastolic volume and also increase in the left atria, right atrial and right ventricular diastolic dimensions [4].These marked hemodynamic changes during pregnancy occur as a result of increased metabolic demand of the fetus.

These changes during pregnancy account for the development of several signs and symptoms during normal pregnancy that can mimic the signs and symptoms of heart disease. Maternal heart disease is the most important non obstetric cause of death in pregnant women[2].

A working knowledge of the normal Physiology of pregnancy is often useful in the management of subjects with heart disease. Echocardiography was used to evaluate left ventricular (LV) function in pregnant women [3].Structural changes within the heart, assessment of total vascular resistance, maternal hemodynamics can predict maternal fetal complications [5]. Among all these the iron requirement also increases during pregnancy for fetal blood formation & iron is required for mothers own blood and cell mass. The degree of iron requirement depends on iron stores & the amount of dietary iron that can be absorbed during pregnancy. Iron depletion & the amount of stored iron is reduced in iron deficiency anaemia which limits reduced red cell production [6]. Serum ferritin can be used to estimate the amount of stored iron [7].

Anaemia in pregnancy in developing countries continues to be a public health of significant proportion. At least 50% of the anaemia has been noticed due to iron deficiency. However the changes in the left ventricular function during pregnancy with anaemia studies are few in India.

The aim of this study is to evaluate the effect of anaemia on left ventricular function in first trimester of pregnancy & to compare the relationship between left ventricular function & hematological parameters in both anaemic pregnant and normal pregnant women.

MATERIAL AND METHODS

The study was conducted at antenatal OPD, departments of Physiology and Cardiology of Prathima Institute of Medical sciences hospital between Feb 2012 to Oct 2013.Fifty pregnant women were selected for this study & divided in to 2 groups.25 normal pregnant women (control group) in Ist trimester (10-14 weeks of gestation) were compared with equal number of pregnant women with iron deficiency anaemia(Haemoglobin% is 7-9.9gm%---Moderate anaemia) (study group) in Ist trimester, aged between 20-30 years .Selected pregnant women were informed about the course and aim of the study and signed consent was obtained. The study protocol was approved by ethical committee of Prathima Institute of medical

sciences(Ref number: IEC/PIMS/2013/001). Pregnant women with normal clinical cardiovascular history and normal physical, ECG and 2D echocardiographic findings will be included in the study.

Predetermined exclusion criteria for the selection of the study population were pregnant women with diabetes, maternal cardiovascular disease and preeclampsia.

A detailed history was taken from all the women and a complete physical and obstetric examination was performed at the time of recruitment. Gestation was confirmed by last menstrual period and ultra sound measurement of the fetal crown-rump-length in selected pregnant women.

Height was measured in cm; weight was measured to the nearest Kg by using standard methods. All observations were done by single person. Body surface area was calculated by using the Dubois Formula [8].

$$BSA = (WEIGHT)\ 0.425(Kg) \times (HEIGHT)\ 0.725\ (cm) \times 0.007184$$

Doppler echocardiography was performed using MEGAS CVX & MEGAS GPX equipped with Phillips – HD7 machine in both control & study groups to evaluate left ventricular systolic and diastolic function. Two-dimensional Doppler echocardiographic examinations were performed using 3.5 MHZ. M–mode studies were performed at the level of aorta, left atrium and LV at midposition between the tips of the mitral value and papillary muscles. Systolic parameters studied were left ventricle end systolic diameter (LV ESD), stroke volume (SV), cardiac output (CO), left ventricular mass(LVM), posterior wall thickness (PWT) in long axis parasternal view. Diastolic parameters studied were E wave, A wave, E/A ratio, fractional shortening (FS %) and percentage ejection fraction (%EF).

Stroke volume (SV), cardiac put (CO) and total peripheral resistance were calculated from the measured dimensions according to the American society of Echocardiography (ASE) guidelines [9].

$$SV = (EDD)^3 - (ESD)^3$$

$$CO\ (L/min) = SV \times HR$$

$$EF\% = \frac{(EDD)^3 - (ESD)^3}{(EDD)^3} \times 100$$

$$FS\% = \frac{(EDD) - (ESD)}{(EDD)} \times 100$$

$$LVM\ (ASE) = 0.8[1.04\ (IVS + EDD + PWT)\ 3 - (EDD)\ 3] + 0.6\ g$$

TVR was calculated using the formula:

$$TPR\ (dyn \times sec \times cm\text{-}5) = mean\ Bp \times 80 / CO$$

Blood pressure was measured using standard auscultatory method with help of pneumatically operated mercurial type random zero sphygmomanometer. Blood pressure was measured in left arm in sitting position with arm at the level of heart. While recording BP appearance of sound (Phase I Korotkoff) and disappearance of sound (Phase V) was recorded as systolic and diastolic BP respectively.
Mean arterial pressure was calculated using the formula:

$$MAP = \frac{2(\text{Diastolic blood pressure}) + (\text{Systolic blood pressure})}{3}$$

To evaluate iron deficiency anaemia haematological parameters like Haemoglobin percentage, red blood cells were analysed by SYSMEX auto analyser. Serum Ferritin was quantitatively determined by Chemiluminscence Microparticulate Immuno Assay (CMIA).

Statistical Analysis:

Data was expressed as Mean±SD. Analysis of Variance (One way ANOVA) was used for comparison between anaemic pregnant women and normal pregnant women. The data was analysed by t tests (MINITAB 14 SOFTWARE).

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RESULTS

Table 1 shown demographic characteristic of the study population. Age and body surface area (BSA) were almost similar in the two groups.

Table 1: The anthropometric data of the two study groups

Parameter	Group –I (Control group) (n=25)	Group-II (Study group) (n=25)	P Value.
Maternal age (years)	22±1.9	23± 3.4	0.28 (NS)
Gestational age at the Time of echo (week)	10 ± 4	10 ± 4	0. 7 (NS)
Weight (kg)	42.03±3.40	43.05±4.02	0.6 (NS)
Height (cm)	140.3±3.5	141.2±4.0	0.5 (NS)
Body surface area	20.33±0.04	21.35±0.06	0.5 (NS)
P value of ≤ 0.05 were considered significant; NS-non significant. p>0.05: Not Significant, *p: <0.05: Significant(S), **p: <0.01: Highly significant(HS), *** p: <0.001: Very highly significant.			

Table 2 shown comparison of hemodynamic parameters between two groups. It shown that SBP was increased & DBP was decreased in study group. This observation was statistically significant. Stroke volume was significantly increased in study group. Cardiac output in the study group was 6314 ±1152 ml/min as compared to 5764±890 ml/min in the control group. This observation was statistically significant at $P < 0.05$.Total peripheral resistance in control was higher at 1423.6 ± 157 dyne, sec cm5 as compared to 1405 ± 130 dyne, sec cm5 in the study group. This observation was statistically significant at $P<0.05$.

Table 2: Comparison of hemodynamic data between two groups

Parameter	Group –I (Control group) (n=25)	Group-II (study group) (n=25)	P Value.
SBP(millimitres of mercury)	101.6±6.62	102.3± 5.19	0.01 (S)
DBP(millimitres of mercury)	68.5± 7.92	66.6±7.48	0.001 (HS)
MAP(millimiters of mercury)	77.1±5.89	78.5±6.70	1.00 (NS)
End systolic diameter(cm)	2.47±0.17	2.63±0.08	0.01(S)
End diastolic diameter(cm)	4.25±0.21	4.40±0.90	0.05 (S)
Stroke volume(ml)	61.83±14.22	67.73±8.22	0.01 (S)
Pulse rate(beats/min)	81.09±6.82	87.23±9.93	0.04 (S)
Cardiac output(ml/min)	5764±890	6314±1152	0.04 (S)
Total peripheral resistance (dyn.sec.cm-5)	1423.6±157	1405±130	0.05 (S)
P value of ≤ 0.05 were considered significant; NS-non significant. p>0.05: Not Significant, *p: <0.05: Significant(S), **p: <0.01: Highly significant(HS), ***p: <0.001: Very highly significant. SBP: Systolic Blood Pressure;DBP: Diastolic Blood Pressure; MAP: Mean Arterial Pressure			

Table 3 shown comparison of left ventricular contractile parameters between normal and anaemic pregnant women. Isovolumertic relaxation time was increased in study group. This observation was not significant whereas %Ejection fraction & %Fractional shortening were significantly higher in anaemic group.

Table 4 shown comparison of haemoglobin concentration, RBC count & serum ferritin between control & study groups. Haemoglobin concentration showed a statistically significant decrease in study group when compared to control group ($P<0.001$). RBC showed a statistically significant decrease in study group

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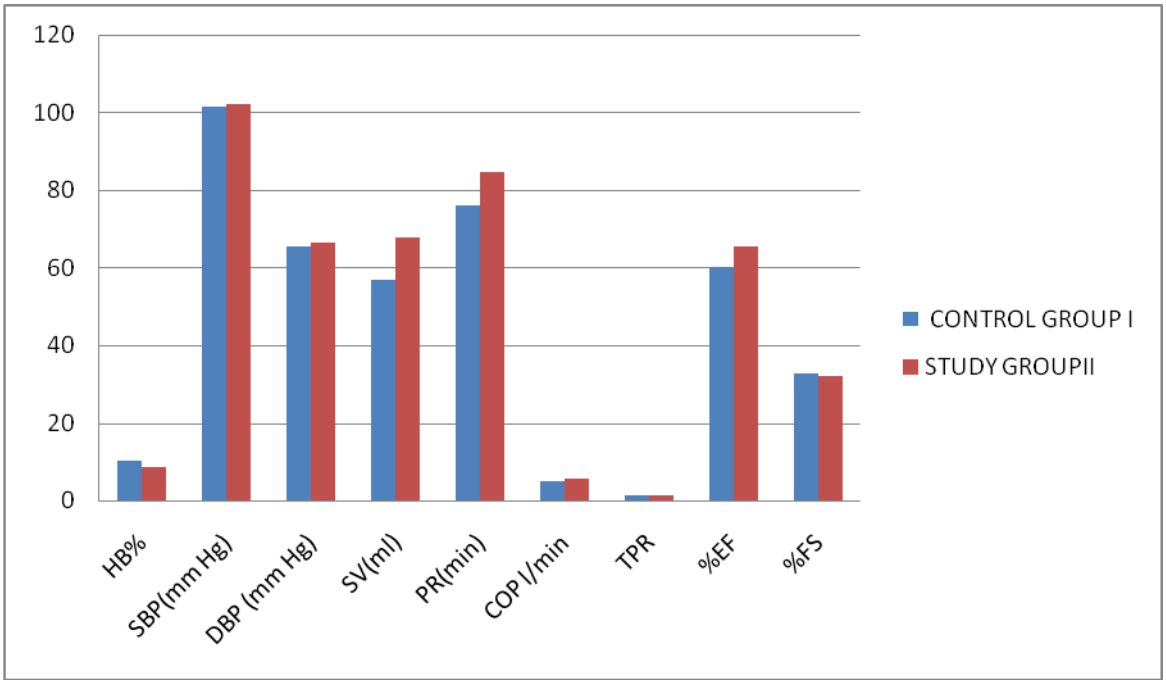
when compared to control group (P<0.1). Serum ferritin showed a statistically significant decrease in study group when compared to control group(p<0.01).

Table 3: Comparison of left ventricular contractile parameters between two groups

Parameter	Group –I (Control group) (n=25)	Group-II (Study group) (n=25)	P Value.
%Ejection fraction	62.42±2.74	64.42±3.17	0.02 (S)
%fractional shortening	31.14±1.31	32.14 ±1.55	0.02 (S)
Isovolumetric relaxation Time	0.89±0.10	0.95±0.08	0.07 (NS)
P value of ≤ 0.05 were considered significant; NS-non significant. p>0.05: Not Significant, *p: <0.05: Significant (S), **p: <0.01: Highly significant(HS), ***p: <0.001: Very highly significant.			

Table 4: Comparison of haematological parameters between two groups

Parameter	Group –I (Control group) (n=25)	Group-II (study group) (n=25)	P Value.
Hb%	11.51±1.11	8.06±0.71	0.000 (HS)
RBC (millons/cumm)	4.16±0.41	3.89±0.40	0.1 (S)
Serum ferritin	35.57±29.59	5.48±1.9	0.000 (HS)
P value of ≤ 0.05 were considered significant; NS-non significant. p>0.05: Not Significant, *p: <0.05: Significant(S), **p: <0.01: Highly significant(HS), ***p: <0.001: Very highly significant.			



DISCUSSION

Normal pregnancy is associated with adaptive changes in the maternal hemodynamics to fulfil the needs of enlarged uterus and to protect mother. Initially marked increase in circulatory blood volume is met

with an increase in stroke volume and a 15%-20% increase in heart rate. The net effect is a 30-50% increase in cardiac output by the end of first trimester[10]. In this study there was significant increase in cardiac output, stroke volume & heart rate in study group. This confirms the earlier studies [11] (Mabie et al.,) and is due to increased circulating volume, reduced systemic vascular resistance & increase in heart rate.

These changes in overall hemodynamic function, allowing the cardiovascular system to adjust to the physiological demands of the fetus while maintaining maternal cardiovascular integrity. Similar reports were given by Stuart Campbell et al., [12]

In this study MAP was not significantly increased and TPR decreased significantly in study group suggesting these changes might have started in the earlier weeks of pregnancy. Thus it supports the cardiac changes suggested by previous studies [13]. In present study a significant increase in left ventricular internal dimensions (ESD &EDD) were observed in study group which in turn showed changes in stroke volume and cardiac output.

Left ventricular contractility was assessed with the use of percentage ejection fraction (EF %) and percentage fractional shortening (FS %). In current study a significant increase in EF% and an increase in FS% were observed in anaemic pregnant women as compared to normal pregnant women. This can be best explained by Franks Starlings law. These observations suggest that volume over load during pregnancy is a risk factor for left ventricular contractility functions. This observation was supported by D. V. Thakker et al [14].,

The mean haemoglobin concentration was significantly decreased in study group than in control group .In anaemia due to low RBC count blood viscosity falls. This decreases resistance to blood flow in the blood vessels. So greater amount of blood passes to the tissues and returns to the heart. So stroke volume, cardiac output and left ventricular contractility functions of the heart increase. Similar reports were given by F Gay Cunningham et al.,[15]

However present results might be influenced by our small sample size, socioeconomic status of the study population, maternal characteristics & methodology. The population size was small. Follow up was not there in this study because the study participants came from small city & rural population.

CONCLUSION

Pregnant women in Ist trimester with low haemoglobin concentration showed greater changes in heart rate, left ventricular dimensions& decrease in total peripheral resistance than in normal pregnant women in Ist trimester.

Increase in left ventricular functions shows hyperkinetic heart. Reduction of Hb in study group as compared to control group significantly & negatively correlates with the left ventricular cardiac function. Anaemia and volume overload in pregnancy is a risk factor that may lead to adverse effects in both mother and fetus. This study clinically helps in assessment of condition of the heart.

REFERENCES

[1] Campos o, Doppler echocardiography during pregnancy: physiological & abnormal findings. Echocardiography 1996; 13:135-46.
[2] Desai, D.K.J. Moodley and D.P.Naidoo, 2004. Echocardiographic assessment of cardiovascular hemodynamic in normal pregnancy. Obstetrics Gynecology 104:20- 29.
[3] Fok, W.Y., L.Y.Chan, J.T.Wong, C.M.Yu and T.K.Lau, 2006. Left ventricular function during normal pregnancy; assessment by spectral tissue Doppler imaging. Ultrasound Obstet.Gynecol.28:789-793.
[4] Chesnutt AN. Physiology of normal pregnancy crit care clin 2004 Oct, 2004:69-15.
[5] Thomas H Bothwell, Iron requirements in pregnancy and strategies to meet them 1,2,3 Am J Clin Nutr July 2000 vol.72 no.1257s-264s.
[6] Puolakka J,Janne O,Pakarinen A.vihko R ,Serum ferritin in the diagnosis of anaemia during pregnancy. Acta Obstet Gynecol Scand Suppl. 1980; 95:57-63.
[7] Barbara. V., G.p.novelli and V.Herbert, Total vascular resistance and left ventricular morphology as screening tools for complications in pregnancy. Hypertension, 2008, 51:1020-1026.

[8] Du Bois D, Du Bois EF. A formula to estimate the approximate surface area if height and weight be known. Arch Intern Med 1916; 17: 863-71.
[9] Devereux, R.B., D.R.Alonso, E.M.Lutas, G.L.Gottlieb, E.Campo, I.Sachs and N.Reichek, Echocardiographic assessment of left ventricular hypertrophy: comparision to necropsy findings.am.J.Cardiology1986,57: 450-458.
[10] Robson SC, Hunter S, Boys RJ and Dunlop W. Serial study of factors influencing changes in cardiac output during human pregnancy. Am J Physiol 1989; 256: H1060-6D5.
[11] Mabie,W.C., T.G. Di Sessa,L.G.Crocker, B.M.Sibai and K.L. Arheart, 1994. Alongitudinal study of cardiac output in normal human pregnancy. Am.J.Obstet.Gynecol. 170:849-856.
[12] Stuart Campbell, Christoph Lees "Obstetrics by ten teachers" 17th Edition, 2000.
[13] Schrier RW, Brier VA. Peripheral arterial vasodilation hypothesis of sodium and Water retention; Implication for pathogenesis of preeclampsisa-eclampsisa. Obstet Gynecol. 1991; 77: 632-39.
[14] Assessment of Left Ventricular Structural and Functional Indices By Echocardiography In Relation To the Haemoglobin Levels in Second Trimester Of Pregnancy Dr. D. V. Thakker*, Dr. V. B. Kariya** NJIRM 2012; Vol. 3(3):7-10
[15] F Gay Cunningham, Kenneth J Leveno, Steven L Bloom, John C Hauth, Larry C Gilstray III, Katharine D Wenstrom "Williams Obstetrics" – 22nd edition, 2005(11).