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Original Research Article

A Comparative Study of Serum Lipid Profile in Pre-Eclamptic and Healthy Pregnant Women

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Abstract

Background: Pre-eclampsia is a multisystem disorder that complicates 3%–8% of pregnancies in Western countries and constitutes a major source of morbidity and mortality worldwide. This study aims to evaluate and compare serum lipid profile in pre- eclamptic and healthy pregnant women.

Methods: A prospective study was conducted, collecting data on lipid profile in 35 pre- eclamptic and 35 healthy females. Student's t-test and chi-square test were used for analysis and comparison. The study was conducted from Mar 2021 to Oct 2022.

Results: The mean Triglyceride (TG) and Total Cholesterol (TC) levels in Pre- eclampsia cases were higher as compared to controls and this difference is statistically significant ($p < 0.001$). Importantly, HDL level is significantly less in women who had Pre-eclampsia compared with healthy controls ($p< 0.001$). The positive linear correlation observed between TG, TC and Systolic & Diastolic Blood Pressure further strengthens the potential interplay of these parameters.

Conclusion: Considering the results, of this study correlating with the various other studies, it can be concluded that dyslipidemia is significantly evident in preeclampsia and plays an important role in its pathogenesis. The preventive measures taken to avoid dyslipidemia like dietary control, weight reduction and physical activity and its positive effect on pregnancy need to be further studied.

Keywords: Triglyceride, Cholesterol, Pre-eclampsia, Dyslipidemia.

Introduction

Pregnancy is characterized by significant metabolic and hemodynamic changes that begin early in the gestational period. Major hemodynamic changes include an increase in the cardiac output during the first trimester, sodium and water retention leading to plasma volume expansion with a peak around 30 weeks, and reduction in systemic vascular resistance and systemic blood pressure. [1] The diastolic blood pressure begins to decrease from the 7th week of gestation, with a 10 mm of Hg decline between the 24th–26th gestation weeks, returning to normal values during the third trimester. [2,3] These are some of the changes that can occur during pregnancy.

Pre-eclampsia is a multisystem disorder that complicates 3%–8% of pregnancies in Western countries and constitutes a major source of morbidity and mortality worldwide. [4, 5] Overall, 10%–15% of maternal deaths are directly associated with preeclampsia and eclampsia. Pre-eclampsia may be life-threatening for both mother and child, increasing both fetal and maternal morbidity and mortality. [6]

The parameters for initial identification of preeclampsia are specifically defined as, systolic blood pressure > 140 mm Hg or diastolic blood pressure > 90 mm Hg on two occasions at least 4 hours apart; or shorter interval timing of systolic blood pressure > 160 mm Hg or diastolic blood pressure > 110 mm Hg, all of which must be identified after 20 weeks of gestation. Preeclampsia is a pregnancy-specific disease with a unique pathogenesis. It remains unclear what triggers the occurrence in any particular individual, but various risk factors have been identified. [7]

Evidence seems to suggest the pathology of preeclampsia originates early in pregnancy in the placenta, but its manifestation as a clinical entity, which remains largely unpredictable, is seen later in the course of pregnancy. Various agents have been implicated in the pathogenesis of

preeclampsia. Abnormal lipid metabolism and deranged total antioxidant status are some of the observed pathophysiologic abnormalities seen in patients with preeclampsia. [8-10] Several studies have shown that oxidative stress is predominant in preeclampsia and as such the attempt to overcome this allows the body to overwhelm its antioxidant capacity. [11,12] Endothelial dysfunction, which is central to the pathology of preeclampsia, has also been linked to dyslipidemia; and abnormal lipid peroxidation in preeclampsia, especially concerning triglycerides, has been consistently reported in the literature. [13,14] It is likely that an imbalance between lipid peroxidation and antioxidant mechanisms may impair endothelial function leading to the manifestation of preeclampsia. In the present study, we aimed to determine the lipid profile in patients presenting with preeclampsia.

Methodology

After necessary permissions & counselling the study was conducted at SMS Medical College and attached hospitals.

Study Design: Cross-sectional observational study.

Study Type: Hospital-based comparative study

Study Period: The study was conducted from Mar 2021 to Oct 2022.

Case Eligibility Criteria Inclusion Criteria:

1. **Cases:** Pre-eclamptic women in 3rd trimester of gestation.
2. **Controls:** Healthy Pregnant women in 3rd trimester of gestation.
3. **Age:** All pregnant women would be of reproductive age between 19 and 35 years

Exclusion Criteria:

1. Patients with twin pregnancy, gestational diabetes, PCOD and any other chronic disease.
2. Patients with medical disorders like diabetes mellitus, chronic hypertension, hepatitis, renal disease, thyroid disease, and collagen vascular disease.
3. Patients who have haemoglobin < 8 gm%
4. Patients with BMI > 30 kg/m^2.
5. Patients with a period of Gestational age below 3rd trimester.

Control Group: 35 healthy pregnant women appropriately matched for age, BMI, parity and period of gestation.

Sample Size & Statistical Analysis: The required sample size was 35 in each group. The sample size was calculated at the 80% study power and alpha error of 0.05. Qualitative data was expressed as rate and proportions while quantitative data were expressed as mean and Standard Deviation (SD). Appropriate statistical tests were applied as per data yield. A P-value of less than 0.05 was taken as statistically significant.

Sample Collection and Evaluation

After written Informed consent, 5 ml venous blood was withdrawn under all aseptic precautions. Then the sample was allowed to clot for 10 minutes and the serum was separated by centrifugation at 3000 rpm for 10 min. Each serum sample was evaluated using a diagnostic kit on a fully automated analyzer.

Principle of Assays

1. Estimation of total cholesterol by CHOD-PAP method
2. Estimation of Serum HDL-Cholesterol by CliniQuant-FSR method
3. Estimation of serum triglycerides by GPO-PAP method
4. Estimation of Serum VLDL- cholesterol and LDL-cholesterol:
5. VLDL was estimated by TG/5 based on the average ratio to cholesterol in VLDL
6. Serum LDL was estimated from Freidwald and Fredrickson's (1972) formula, which is LDL=Total Cholesterol-[HDL+VLDL]

Observations and Results

The age group of subjects is b/w 19-35 years. As shown in Table-1 Systolic & Diastolic BP are more in cases as compared to controls & this difference is statistically significant ($p < 0.01$).

The mean TG level in Pre-eclampsia cases (178.69 ± 33.92 mg/dl) was more as compared to controls (84.97 ± 18.00 mg/dl) and this difference was statistically significant ($p< 0.01$).

The mean Total Cholesterol level in Pre-eclampsia cases (236.37 ± 24.77 mg/dl) was more as compared to controls (171.03 ± 17.69 mg/dl) & this difference was statistically significant ($p< 0.01$).

Table 1: Comparison of various parameters between the Control group and Pre-eclampsia patients

Test/ Parameters	Controls (n=35)	CASES (n=35)	P-value
Age(Years)	27.14 ± 4.27	26.69 ± 4.84	0.3382 (NS)
FBS (mg/dl)	92.09 ± 11.34	95.89 ± 11.01	0.0798 (NS)
BMI (kg/m^2)	24.88 ± 1.69	24.33 ± 1.85	0.0965 (NS)
SBP (mm of Hg)	120.20 ± 4.04	161.69 ± 10.35	< 0.01 (S)
DBP (mm of Hg)	79.14 ± 3.19	95.20 ± 3.95	< 0.01 (S)
Serum Triglycerides (mg/dl)	84.97 ± 18.00	178.69 ± 33.92	< 0.01 (S)
S. Total Cholesterol (mg/dl)	171.03 ± 17.69	236.37 ± 24.77	< 0.01 (S)
Serum HDL (mg/dl)	45.54 ± 6.09	34.09 ± 6.27	< 0.01 (S)
Serum LDL (mg/dl)	108.49 ± 19.37	166.55 ± 32.08	< 0.01 (S)
Serum VLDL (mg/dl)	16.99 ± 3.60	35.74 ± 6.78	< 0.01 (S)

*P-value as obtained on applying students' t-test

The mean Serum HDL level in Pre-eclampsia cases (34.09 ± 6.27 mg/dl) was less as compared to controls (45.54 ± 6.09 mg/dl) and this difference was statistically significant (p< 0.01).

The mean LDL level in Pre-eclampsia cases (166.55 ± 32.08 mg/dl) was more as compared to controls (108.49 ± 19.37 mg/dl) & this difference was statistically significant (p< 0.01).

The mean VLDL level in Pre-eclampsia cases (35.74 ± 6.78 mg/dl) was more as compared to controls (16.99 ± 3.60 mg/dl) & this difference was statistically significant (p<0.01).

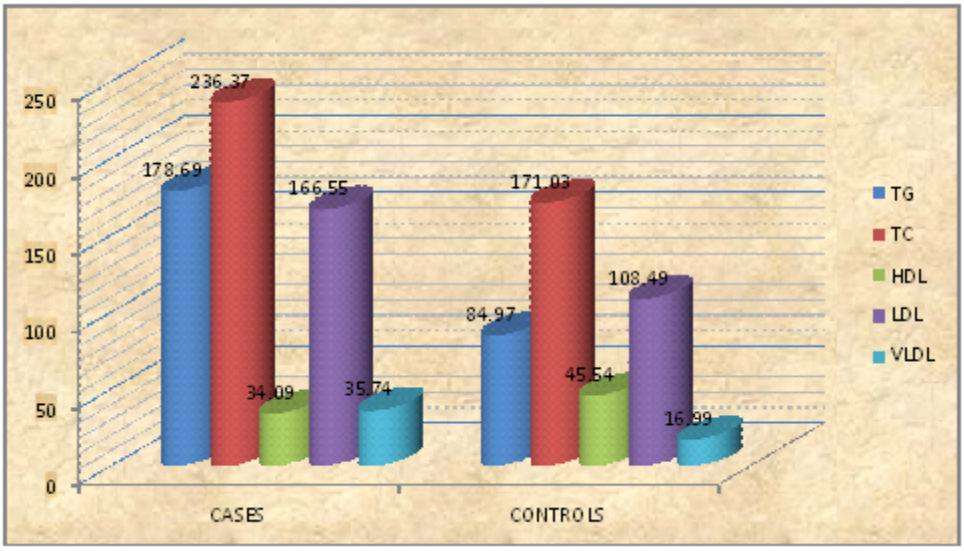

Figure 1: Comparison of various parameters b/w Pre-eclampsia Patients and controls

Table 2: Correlation b/w various parameters in Pre-eclampsia patients

Parameter	P value	R Score	R^2	Significance
SBP vs TG	< 0.001	0.7767	0.6033	S
SBP vs TC	< 0.001	0.8144	0.6632	S
DBP vs TG	< 0.001	0.6392	0.4086	S
DBP vs TC	< 0.001	0.7473	0.5585	S

*Data analysis using Pearson correlation analysis

When Pearson correlation was applied to compare Systolic BP and Diastolic BP with Serum TG & TC in Preeclampsia cases (Table-2, Figure-2), there was a positive linear correlation between them and it was statistically significant (p < 0.001).

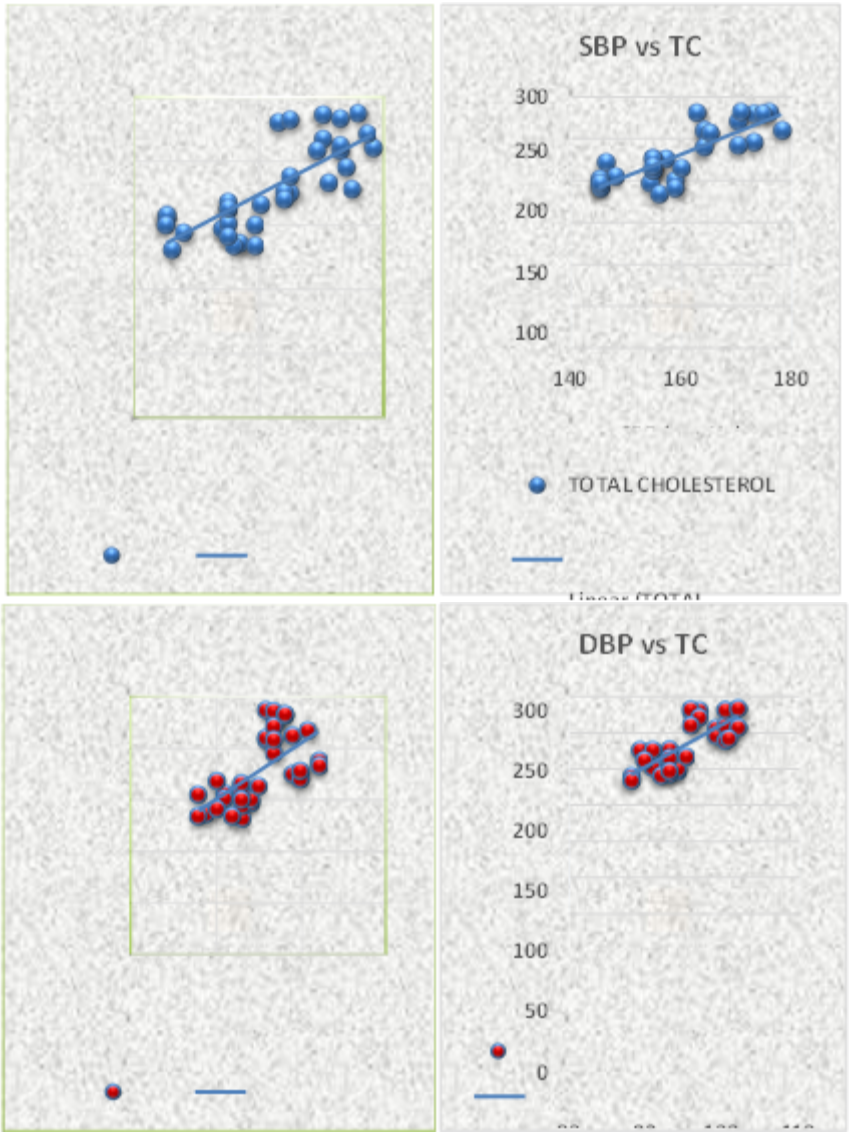

Figure 2: Correlation b/w various parameters in Pre-eclampsia patients

Discussion

Hypertension during pregnancy is a major health problem. It is one of the leading causes of perinatal morbidity and mortality. [15] Pre-eclampsia (PE) is a theoretical disease with a pathogenesis that is not clearly understood yet.

Pregnancy not only demands more metabolic fuels but also causes an alteration in hormonal levels, which may cause few changes in the lipid profile during pregnancy. [16] Pregnancies complicated with pre- eclampsia have the potential to lead to future CVD and metabolic syndrome. [17-19] Hence; it is of utmost importance that these complications should be prevented in the pregnancy itself. So the present study was planned to estimate serum lipid profile in pre-eclamptic & healthy pregnant women.

A total of 35 cases of pre-eclampsia were included and the lipid profile was compared with 35 normal healthy pregnant women.

Systolic & Diastolic BP are more in cases as compared to controls and this difference is statistically significant ($p < 0.01$). This difference in systolic and diastolic BP between cases & controls was according to the definition of pre-eclampsia which states "blood pressure readings include systolic pressure of > 160 mm of Hg or diastolic pressure >110 mmHg."

In the present study, the mean TG in pre-eclamptic women was significantly higher than in controls ($p< 0.01$). There was a statistically significant ($p< 0.001$) positive correlation ($R= 0.7767$) found between Systolic BP and Serum TG levels in patients with pre-eclampsia. Statistically significant ($p< 0.001$) positive correlation ($R= 0.6392$) was also found between Diastolic BP and Serum TG levels in patients with Pre- eclampsia. It shows Serum TG levels increase with the increased systolic and diastolic BP.

The results of the present study correlate with the

study conducted by Madhuri Sushil Gawande et al [20] in 2016 which showed P value for both the groups is <0.05 which is significant and shows that the triglyceride concentration was found higher in pre-eclamptic subjects than subjects with pregnancy without pre- eclampsia. Results of the present study were in concordance with a study conducted by Gohil J. T et al [21] in 2011 which showed that Triglyceride concentration in all four groups and comparing, it was found significantly more in pregnant females as compared to non-pregnant females. In pre-eclampsia, there is a further significant increase than the normal pregnant females. Similar results showed by a study conducted by Kashinakunti et al [23] in 2010 concluded that there is a positive correlation between serum triglycerides and systolic blood pressure & diastolic blood pressure in pre-eclampsia cases.

The probable mechanism behind this may be that Pre- eclampsia is a complex pathophysiological process where regulatory systems of inflammation and endothelial function are stimulated beyond the physiological limits of normal pregnancy. [24] Women with pre-eclampsia have higher levels of circulating serum triglycerides which is an essential step in lipid mediated endothelial dysfunction. The mechanisms driving the abnormal elevation of triglycerides leading to pre-eclampsia are unclear. During pregnancy, there is an increase in hepatic lipase activity and a decrease in lipoprotein lipase activity. Hepatic lipase is responsible for the increased synthesis of triglycerides at the hepatic level, and the decreased activity of lipoprotein lipase is responsible for the decreased catabolism at the adipose tissue level, whereas placental VLDL receptors are up-regulated. This results in the re-routing of TG rich lipoproteins to the feto-placental unit. [25]

In the present study, the mean Cholesterol level in pre-eclamptic women was significantly higher than controls ($p< 0.01$). There was a statistically significant ($p< 0.001$) positive correlation ($R= 0.8144$) found between Systolic BP and Serum TC levels in patients with Pre-eclampsia. Statistically significant ($p< 0.001$) positive correlation ($R= 0.7473$) was also found between Diastolic BP and Serum TC levels in patients with Pre- eclampsia. It shows Serum TC levels increases with the increased systolic and diastolic BP.

Our results correlate with the study conducted by Madhuri Sushil Gawande et al [20] in 2016, the P value for both groups is less than 0.05 which is significant. However contrast results found in the study conducted by Valmir Jose de Lima et al [22] in 2011 showed no significant differences in the total serum cholesterol levels between the pre-eclampsia cases and the healthy women.

A probable mechanism for this may be that plasma cholesterol levels increase during pregnancy in response to an increase estrogen- induced hepatic synthesis or failure of lipoprotein lipase to clear the plasma lipids. Higher plasma cholesterol level is used for placental steroid, and placental membrane synthesis and stored as maternal fat stores which serve as fuel for the mother as well as for the growing fetus in later pregnancy or during lactation. [26,27]

In our study, mean HDL levels in pre-eclamptic women was 34.09 ± 6.27 mg/dl and in controls, it was 45.54 ± 6.09 mg/dl. This shows significantly low levels of HDL in cases in comparison to controls ($p<0.01$).

Our results were in concordance with a study conducted by Gohil J. T et al [21] in 2011 which showed that there is a significant increase in HDL levels in normal pregnancy compared to the non-pregnant state. But its level falls in Pre-eclampsia which is highly significant and it may be a reason for atherosclerosis-like features mentioned in Pre-eclampsia in some studies as compared to normal pregnant females. Contrast results were found in the study conducted by Madhuri Sushil Gawande et al [20] in 2016. The P value for both the groups is > 0.05, hence not significant. Another study by Valmir Jose de Lima et al [22] in 2011 showed contrasting results according to which no significant differences in the HDL levels between the preeclampsia cases and the healthy women.

Reports showed that reduced levels of HDL-c are associated with an increased risk of coronary disease and myocardial infarction. [28] HDL carries cholesterol from peripheral tissues to the liver, where it is broken down for excretion and used for the synthesis of biomolecules. Higher levels of HDL lipoprotein have a protective effect against hypertension and cardiovascular diseases. [29]

In this study, mean LDL levels in pre-eclamptic women was 166.55 ± 32.08 mg/dl and in controls it was 108.49 ± 19.37 mg/dl. This shows a significantly high LDL level in cases in comparison to controls ($p<0.01$).

Our results correlate with a study conducted by Madhuri Sushil Gawande et al.[20] in 2016 P value is < 0.05 which is significant. Our results were in concordance with study conducted by Gohil J. T et al [21] in 2011 which showed that LDL concentration increased significantly during pregnancy compared to non-pregnant females. It increased further significantly in preeclamptic females as compared to normal pregnant females. Contrast results were found in the study conducted by Valmir Jose de Lima et al [22] in 2011 which showed no significant differences in LDL levels between the preeclampsia cases and the healthy

women.

LDL-c transports cholesterol to the peripheral tissue and plays a significant role in the development of atherosclerosis and cardiovascular disease. [30] The oxidized LDL products modify the lysine residues of Apo- lipoprotein B (apo B) which is recognized by the receptors of macrophages. The modified product of LDL is engulfed by macrophages and converted into foam cells which induce the production of different inflammatory mediators resulting in plaque formation and atherosclerosis. [31]

In this study, mean VLDL levels in pre-eclamptic women was 35.74 ± 6.78 mg/dl and in controls it was 16.99 ± 3.60 mg/dl. This shows a significantly high VLDL level in cases in comparison to controls ($p<0.01$).

Our results correlate with the study conducted by Madhuri Sushil Gawande et al [20] in 2016, the P value is <0.05 which is significant. Our results were in concordance with a study conducted by Gohil J. T et al [21] in 2011 which showed that VLDL concentration follows the same pattern as LDL. It increases during pregnancy compared to non-pregnant females. In preeclampsia, there is a further significant increase. Similar results found in the study conducted by Valmir Jose de Lima et al [22] in 2011 showed that pre-eclamptic patients presented significantly higher concentrations of VLDL than healthy women.

VLDL cholesterol carries the highest amount of triglycerides from the liver to the blood vessels which have been linked to atherosclerosis and subsequent risk of heart diseases and stroke. VLDL cholesterol remnants are associated with the risk of pre-eclampsia and high blood pressure. [29]

Conclusion

In our study serum triglyceride, cholesterol, LDL and VLDL levels were significantly higher in pregnant women with pre-eclampsia, while serum HDL-cholesterol levels were significantly lower. Considering the results in this study correlate with the various other studies, it can be concluded that dyslipidemia is significantly evident in pre-eclampsia and plays an important role in its pathogenesis. The preventive measures taken to avoid dyslipidemia like dietary control, weight reduction and physical activity and its positive effect on pregnancy need to be further studied.

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