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Original Research Article

An observational study on level of serum lipid profile in early second trimester as a predictor of pre-eclampsia and relation of different dyslipidemias with pre-eclampsia

Sarita Kapuria*, Ruma Sarkar, Ankita

Department of Obstetrics and Gynecology, BRD Medical College, Gorakhpur, Uttar Pradesh, India

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***Correspondence:**
Dr. Sarita Kapuria,
E-mail: saritakapuria008@gmail.com

ABSTRACT

Background: Preeclampsia (PE) is a pregnancy condition that affects 2–8% of pregnant women worldwide and significantly increase the incidence of morbidity and mortality for both mother and newborns. Dyslipidemia has been implicated as a predictor of PE due to its role in endothelial dysfunction and vascular damage. This study aimed to evaluate the serum lipid profile in the early second trimester (14–20 weeks) as a predictor of Preeclampsia and to investigate the relationship between PE risk and dyslipidemia.
Methods: This descriptive observational study was conducted at BRD Medical College, Gorakhpur, from May 2023 to April 2024. A total of 171 pregnant women (14–20 weeks gestation) were included, with exclusion criteria such as preexisting hypertension, diabetes, and multiple pregnancies. Fasting blood samples were analyzed for lipid profiles, and participants were categorized based on National Cholesterol Education Program (NCEP) guidelines into normal or abnormal lipid profile groups. Blood pressure was monitored, and participants were followed until 48 hours postpartum to confirm PE diagnoses.
Results: Among the participants, 21.6% developed PE, with dyslipidemia observed in 71.3% of the total sample. Key lipid profile parameters (triglycerides, total cholesterol, LDL, and VLDL) were significantly elevated in those with PE, while HDL was reduced. The most accurate lipid predictor of PE was total cholesterol, with an accuracy of 68.2%, sensitivity of 81.1%, and specificity of 55.3%.
Conclusion: The study emphasizes how early second-trimester lipid profile can be used to predict PE. Increased PE risk was linked to elevated levels of LDL, VLDL, total cholesterol, and triglycerides. Early identification and management of dyslipidemia could reduce maternal and neonatal complications, underscoring its importance in antenatal care.

Keywords: Preeclampsia, Dyslipidemia, High density lipoprotein, Low density lipoprotein

INTRODUCTION

Preeclampsia is a multifactorial illness of pregnancy that affects 2% to 8% of pregnancies in the world and in severe forms can lead to placental and other organ injury.[1] A previously defined multisystemic disorder, preeclampsia ismarked by the development of proteinuria (>300 mg/24 hours) and hypertension (systolic blood pressure (SBP)≥140 mmHg and/or diastolic blood pressure (DBP)≥90 mmHg) in a woman who was previously normotensive after 20 weeks of pregnancy. According to a recent statement from the American College of Obstetricians and Gynecologists, proteinuria is no longer necessary to diagnose preeclampsia. This complication of pregnancy remains a leading cause of maternal morbidity and mortality.[2] In 1996, Ness and Roberts suggested dividing preeclampsia into two major groups: maternal and placental. Others have categorized into early onset (<34 weeks of gestation) versus late onset (>34 weeks of gestation).[3]

So, many markers have been proposed as predictors of pre-eclampsia such as Roll over test, angiotensin sensitivity test, mean arterial pressure (MAP), raised uric acid, raised serum beta hCG at 14-20 weeks of gestation, alpha fetoprotein (AFP), estriol levels, pregnancy associated protein A (PAPP A), inhibin A levels, activin A, placental protein 13, corticotrophin releasing hormone, uterine artery Doppler, platelet count, fms- like tyrosine kinase receptor-1 (sFlt-1), endoglin plasminogen activator inhibitor (PAI), neurokinin B, p-selectin, decreased levels of pro-angiogenic factors that includes vascular endothelial growth factors (VEGF), placental growth factor (PLGF), endothelial adhesion molecules, C-reactive proteins.[4-7]

Women with PE have biologically exaggerated lipid secretion. A recent meta-analysis of 74 studies found that PE is associated with elevated total cholesterol (TC) and non-HDL-c in the third trimester.[8] Some studies suggest that dyslipidemia with increased serum triglycerides (TGs) in early pregnancy before 20 weeks of gestation and elevated oxidized low-density lipoproteins (LDLs) are associated with an increased risk of PE.[9,10]

Dysregulation of these lipid parameters has been linked to endothelial dysfunction and vascular damage, key components of pre-eclampsia pathophysiology. Lipid profile as a predictor of preeclampsia is attributed to the metabolic alterations and risk factors which are similar in pre-eclampsia and arthrosclerosis and this might suggest a common pathophysiology.[11]

Therefore, early pregnancy dyslipidemia detection may be a diagnostic tool for early pre-eclampsia prediction, reducing the lag time and preventing morbidity and mortality in both mothers and newborns. This research may contribute to the development of more effective screening protocols, ultimately enhancing our ability to identify and manage preeclampsia, thus improving outcomes for pregnant individuals and their infants.

METHODS

Study design

The obstetrics and gynecology department at BRD Medical College in Gorakhpur conducted the descriptive observational study. Duration of the study was from 01 May 2023 to 31 April 2024.

Inclusion criteria

Primigravida and multigravida women who are 14–20 weeks along in their singleton pregnancy, as assessed by LMP or scan were included.

Exclusion criteria

Individuals who have diabetes mellitus, chronic hypertension, any cardiovascular disease, a history of liver disease, kidney disease, or any previous medical conditions, thyroid issues, multiple pregnancies, or who smoke were excluded.

Sample size

Pre-eclampsia present approximately 70% of pregnant female. Sample size was calculated using the formula give, where P=70%, Q= 100-P=100-70=30%, and L=7%.

$$N = 4Pq/d^2 = (4 \times 70 \times 30 \times 7 \times 7)/8400 = 49 = 171$$

Methodology

Routine antenatal investigations, including serum lipid profiles, were conducted for all patients. Under strict aseptic conditions, and after a 12-hour fasting period, 3 ml of venous blood was collected for serum lipid profile analysis.

Patients were classified based on their serum lipid levels according to the National Cholesterol Education Program (NCEP) guidelines into two groups: normal lipid profile and abnormal lipid profile.

Blood pressure was measured in either the supine or sitting position, first by palpatory method and then by auscultatory method. The appearance of the Korotkoff sound (phase I) was recorded as the systolic BP, while the disappearance of the sound (phase V) was recorded as the diastolic BP.

Statistical analysis

Statistical package for the social sciences (SPSS) software version 24.0 (Chicago, Illinois) was used for data analysis. Continuous variables were described using measures of dispersion and central tendencies, whereas categorical variables were described using descriptive statistics. Statistical significance was defined as a $p>0.05$.

RESULTS

Distribution of study participants according age

The distribution of study participants according to age. Participants aged 25 years or younger accounted for 61.4% (105 participants) of the total. Those aged between 26 and 30 years made up 25.7% (44 participants). Participants older than 30 years constituted 12.9% (22 participants). The total number of participants was 171, representing 100% of the study population.

Distribution of lipid profile among the study participants

Table 1 presents the distribution of lipid profile values among the study participants.

Serum triglycerides

The mean value was 274.275 mg/dl with a standard deviation (SD) of 127.3540 mg/dl. The values ranged from a minimum of 51.0 mg/dl to a maximum of 609.0 mg/dl, with a median value of 264.000 mg/dl.

Serum total cholesterol

The mean value was 228.567 mg/dl with an SD of 73.1484 mg/dl. The values ranged from a minimum of 61.0 mg/dl to a maximum of 528.0 mg/dl, with a median value of 236.000 mg/dl.

Serum high-density lipoprotein (HDL)

The mean value was 44.977 mg/dl with an SD of 10.6914 mg/dl. The values ranged from a minimum of 25.0 mg/dl to a maximum of 107.0 mg/dl, with a median value of 42.000 mg/dl.

Serum low-density lipoprotein (LDL)

The mean value was 158.871 mg/dl with an SD of 58.4834 mg/dl. The values ranged from a minimum of 36.0 mg/dl to a maximum of 380.0 mg/dl, with a median value of 157.000 mg/dl.

Distribution of study participants according dyslipidaemia

Figure 1 presents the distribution of dyslipidemia among the study participants. Increased cholesterol levels were observed in 47.4% (90 participants), while increased triglycerides (TG) were noted in 70.8% (121 participants). Increased (LDL) levels were found in 63.2% (108 participants), and increased (VLDL) levels were seen in 70.2% (120 participants). Additionally, decreased (HDL) levels were observed in 19.9% (34 participants). Overall, 71.3% (122 participants) exhibited dyslipidemia, highlighting the prevalence of lipid abnormalities among the 171 study participants.

Association of dyslipidaemia with pre-eclampsia

The association of dyslipidemia with preeclampsia among the study participants. Among those without preeclampsia, 73.0% (89 patients) had dyslipidemia, while 91.9% (45 patients) did not have dyslipidemia. Conversely, among those with preeclampsia, 27.0% (33 patients) had dyslipidemia, compared to 8.1% (4 patients) without dyslipidemia. A statistically significant correlation between dyslipidemia and preeclampsia is indicated by the p=0.014.

Association of preeclampsia with Increased cholesterol and TG

Table 2 presents the association of increased cholesterol and TG with preeclampsia among the study participants. Among those without preeclampsia, 44.7% (60 patients) had increased cholesterol and 67.9% (91 patients) had increased TG, while 55.3% (74 patients) did not showed increased cholesterol.

Conversely, among those with preeclampsia, 81.1% (30 patients) had increased cholesterol, compared to 18.9% (7 patients) without increased cholesterol. A statistically significant correlation between elevated TG and cholesterol and preeclampsia is indicated by the p=0.001.

Table 1: Distribution of lipid profile among the study participants.

Characteristics	Serum triglycerides	Serum total cholesterol	Serum HDL	Serum LDL
Mean	274.275	228.567	44.977	158.871
Median	264.000	236.000	42.000	157.000
SD	127.3540	73.1484	10.6914	58.4834
Minimum	51.0	61.0	25.0	36.0
Maximum	609.0	528.0	107.0	380.0

Table 2: Association of preeclampsia with increased cholesterol and TG.

Increased cholesterol and TG	No pre-eclampsia				Pre-eclampsia				P value
	Count of cholesterol	Count of TG	Cholest-erol (%)	TG (%)	Count of cholesterol	Count of TG	Cholesterol (%)	TG (%)	
Yes	60	91	44.7	67.9	30	30	81.1	81.1	0.001
No	74	43	55.3	32.1	7	7	18.9	18.9	
Total	134	134	100.0	100.0	37	37	100.0	100.0	

Association of preeclampsia with increased LDL and increased VLDL

Table 3 presents the association of increased LDL with preeclampsia among the study participants. Among those without preeclampsia, 59.7% (80 patients) had increased LDL, while 40.3% (54 patients) did not. Conversely, among those with preeclampsia, 75.7% (28 patients) had increased LDL, compared to 24.3% (9 patients) without increased LDL. Also, the Table 3 presents the association

of increased VLDL with preeclampsia among the study participants. Among those without preeclampsia, 67.2% (90 patients) had increased VLDL, while 32.8% (44 patients) did not. Conversely, among those with preeclampsia, 81.1% (30 patients) had increased VLDL, compared to 18.9% (7 patients) without increased VLDL. A statistically significant correlation between elevated levels of LDL and VLDL and preeclampsia is indicated by the p=0.001.

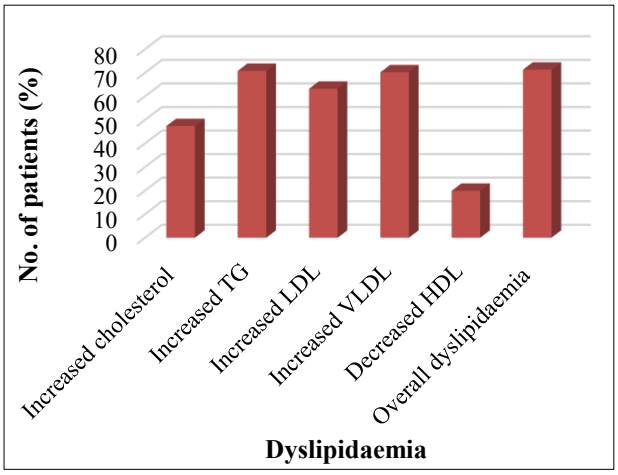

Figure 1: Distribution of study participants according to dyslipidaemia.

Distribution of study participants according preeclampsia

The distribution of study participants based on the occurrence of preeclampsia is shown in the table. Preeclampsia was identified in 37 patients, or 21.6% of the total (Figure 2).

Association of dyslipidaemia with pre-eclampsia

Table 4 presents the association of dyslipidemia with preeclampsia among the study participants. Among those without preeclampsia, 73.0% (89 patients) had dyslipidemia, while 91.9% (45 patients) did not have dyslipidemia. Conversely, among those with preeclampsia, 27.0% (33 patients) had dyslipidemia, compared to 8.1% (4 patients) without dyslipidemia. A statistically significant correlation between dyslipidemia and preeclampsia is indicated by the p=0.014.

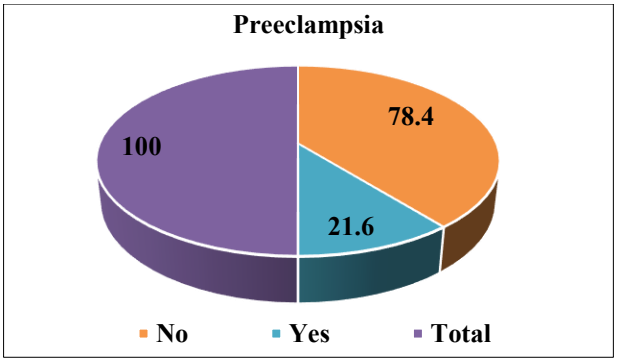

Figure 2: Distribution of study participants according preeclampsia.

Accuracy of various dyslipidaemias to diagnose the preeclampsia

The sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy of the several dyslipidemias in identifying preeclampsia are shown in the table.

Total cholesterol (TC)

Sensitivity of 81.1%, specificity of 55.3%, PPV of 25.0%, NPV of 91.4%, and accuracy of 68.2%.

Triglycerides (TG)

Sensitivity of 81.1%, specificity of 32.1%, PPV of 24.8%, NPV of 86.0%, and accuracy of 56.6%.

Low-density lipoprotein (LDL)

Sensitivity of 75.7%, specificity of 40.3%, PPV of 28.6%, NPV of 85.7%, and accuracy of 58.0%.

Very low-density lipoprotein (VLDL)

Sensitivity of 81.1%, specificity of 32.8%, PPV of 25.0%, NPV of 86.3%, and accuracy of 57.9%.

High-density lipoprotein (HDL)

Sensitivity of 18.9%, specificity of 79.9%, PPV of 20.6%, NPV of 78.1%, and accuracy of 49.4%.

Table 3: Association of preeclampsia with increased LDL and increased VLDL.

Increased LDL and VLDL	Pre-eclampsia				Pre-eclampsia				P value
	Count of LDL	Count of VLDL	LDL (%)	VLDL (%)	Count of LDL	Count of VLDL	LDL	VLDL (%)	
Yes	80	90	59.7	67.2	28	30	75.7	81.1	
No	54	44	40.3	32.8	9	7	24.3	18.9	0.001
Total	134	134	100.0	100.0	37	37	100.0	100.0	

Table 4: Accuracy of various dyslipidaemias to diagnose the preeclampsia.

Variable	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)
TC	81.1	55.3	25.0	91.4	68.2
TG	81.1	32.1	24.8	86.0	56.6
LDL	75.7	40.3	28.6	85.7	58.0
VLDL	81.1	32.8	25.0	86.3	57.9
HDL	18.9	79.9	20.6	78.1	49.4

DISCUSSION

This study aimed to investigate the early second trimester's blood lipid profile levels (14-20 weeks) as an indicator for preeclampsia and to correlate types of dyslipidemia with pre-eclampsia. The study assessed lipid profiles at different gestational ages within the early second trimester comparing this to other studies, it was observed that there were some variations in the timing of lipid profile assessment. For example, Murmu et al in 2020 focused on early second-trimester lipid profiles but did not specify exact gestational age ranges.[12] Ewa et al in 2018 and Adank MC et al in 2019 looked at lipid profiles in the mid-second trimester, which might be slightly different from the present study.[13,14] This study found a high prevalence of dyslipidemia among participants, with 71.3% exhibiting some form of lipid abnormality. Vani I et al in 2015 also reported significant increases in total cholesterol, LDL, VLDL, and triglycerides, and a decrease in HDL in pre-eclamptic women compared to normotensive pregnant women.[15] Our findings are consistent with this, showing high prevalences of increased cholesterol, triglycerides, LDL, and VLDL. It is found that our study cohort had a high frequency of dyslipidemia even prior to the development of preeclampsia. This suggests that lipid abnormalities may precede the clinical manifestation of pre-eclampsia, supporting the potential use of lipid profiles as early predictors of pre-eclampsia risk. According to the study, triglycerides and total cholesterol had the best sensitivity but the lowest specificity for predicting pre-eclampsia. VLDL and LDL had limited specificity but strong sensitivity. HDL had the highest specificity and the lowest sensitivity. TC was the most accurate overall.

CONCLUSION

This observational study provides valuable insights into the role of early second-trimester serum lipid profiles as predictors of pre-eclampsia and explores the relationships between different types of dyslipidemia and preeclampsia. The study found significant associations between various lipid abnormalities and pre-eclampsia risk, with total cholesterol demonstrating the highest overall accuracy as a predictor. The study found that 71.3% of participants had dyslipidemia, with triglycerides, VLDL, and LDL being common abnormalities. Pre-eclampsia was linked to elevated LDL, VLDL, triglycerides, and total cholesterol. Dyslipidemia also linked to adverse fetal outcomes, particularly low birth weight. The study suggests a combination of lipid parameters for more reliable pre-eclampsia risk prediction.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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