

## STUDY OF LIPID PROFILE IN ECLAMPSIA

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### ABSTRACT

#### BACKGROUND

Eclampsia occurs in about 1.56% of pregnancies in our country and is an important cause of foetal and maternal morbidity and mortality. Altered lipid synthesis leading to decrease in PGI<sub>2</sub>:TxA<sub>2</sub> ratio is also supposed to be an important way of pathogenesis in pregnancy-induced hypertension leading to eclampsia.

The aim of this study was to determine and compare the serum lipid levels among women with eclampsia and women having normal pregnancy without hypertension.

#### MATERIALS AND METHODS

This is a descriptive comparative study where lipid profile of 100 normal pregnant women was compared with 100 eclamptic women.

#### RESULTS

Serum cholesterol, LDL & VLDL showed a steady rise with an increase in systolic and diastolic blood pressure. The range of serum HDL showed a steady fall with an increase in systolic & diastolic blood pressure.

#### CONCLUSION

There was an increase in the level of serum cholesterol, serum triglycerides, HDL, LDL and VLDL in the eclamptic subjects but not in the control group of normal pregnant women, thus eclamptic women had deranged lipid profile due to abnormal lipid metabolism.

#### KEYWORDS

LDL, VLDL, HDL, Eclampsia.

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#### BACKGROUND

Pregnancy is a physiological state but eclampsia is a pathological condition which sometimes leads to death of both mother and foetus. The term 'eclampsia means a life-threatening condition in which a pregnant woman who does not have a history of epilepsy experiences seizures (tonic-clonic). Eclampsia is a serious complication of preeclampsia which is a disorder that can occur during pregnancy that is characterised by hypertension, proteinuria with or without oedema.<sup>1</sup>

Eclampsia occurs in about 1.56% of pregnancies in our country and is an important cause of foetal and maternal morbidity and mortality.<sup>2</sup> Eclampsia occurs during second and third trimester of pregnancy and it is more common in nulliparous women.<sup>3</sup> It is characterised by blood pressure of  $\geq 140/90$  mmHg or rise in systolic blood pressure of more than 30 mmHg or diastolic blood pressure of more than 15 mmHg after 20 weeks of gestation, in conjugation with proteinuria  $>300$  mg/24 hours or greater or equal to 1+ or 100 mg/dL by dipstick response.<sup>4</sup>

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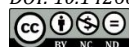
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The association of alteration of serum lipid profile in eclampsia is well documented. An abnormal lipid profile is known to be strongly associated with atherosclerotic cardiovascular diseases and has a direct effect on endothelial dysfunction. The most important feature in eclampsia is hypertension which is supposed to be due to vasospastic phenomenon in kidney, uterus, placenta and brain. Altered lipid synthesis leading to decrease in PGI<sub>2</sub>:TxA<sub>2</sub> ratio is also supposed to be an important way of pathogenesis in pregnancy-induced hypertension leading to eclampsia. Thus, abnormal lipid metabolism seems important in the pathogenesis of eclampsia. Significantly elevated plasma concentration of triglycerides (TG), phospholipids and total lipids and decreased high density lipoprotein – cholesterol (HDL-C) concentrations were found in women with eclampsia in comparison to normal pregnancy.<sup>5,6,7,8</sup>

#### Aim of the Study

The purpose of this study was to determine and compare the serum lipid levels among women with eclampsia and women having normal pregnancy without hypertension.

#### MATERIALS AND METHODS

The present study was a descriptive comparative study done in VSS Medical College from November 2013 to November 2015 and participants were selected on the basis of nonprobability convenient sampling. Patients had singleton pregnancies, diagnosed as having eclampsia.

Informed consent was taken from all individual subjects inducted into the study. The study comprised of 100 normal healthy pregnant women and 100 eclampsia cases. The diagnosis of eclampsia was based on the definition of American College of Obstetrics and Gynecologists.

A detailed general physical examination was conducted and history was taken. The arterial blood pressure in the brachial artery was measured by using a simple mercury sphygmomanometer on right arm in a comfortable sitting position after 10 minutes of rest. Blood pressure was measured using both palpatory and auscultatory methods. The reported values represent the mean of two readings taken at 5 minutes interval. The blood samples were collected under strict aseptic measures. Each sample was labelled with patient's name and identification number. Samples were analysed in one run at the end of the study. Lipid profile was determined by enzymatic colorimetric method.

The data was processed on computer software package SPSS version 11. The numerical data was presented as mean  $\pm$  SD. The Student's t test was used to evaluate mean differences in maternal serum lipid concentrations between patients and control subjects. Significance among the means of groups was expressed in term of 'P' value. 95% Confidence Interval ( $P < 0.05$ ) was considered as significant.

#### Inclusion Criteria

Pregnant women of any gravida with normal BP, no proteinuria and without any other systemic and endocrine disorder. They were age matched with the cases. All subjects included were in third trimester.

In the study group which comprised of 100 subjects, the diagnosis of eclampsia was based on the definition of American College of Obstetrician and Gynaecology.

Eclampsia was defined as the occurrence of hypertension at  $>20$  weeks of gestation with proteinuria, oedema, tonic-clonic convulsions/coma and with systolic blood pressure  $\geq 140$  mmHg and diastolic blood pressure  $\geq 90$  mmHg on repeated readings at least 6 hours apart within one week.

#### Exclusion Criteria

Diabetes mellitus, obesity, severe anaemia cases, patients suffering from any other systemic or endocrine disorder or having twin pregnancy, polyhydramnios, hydatid mole.

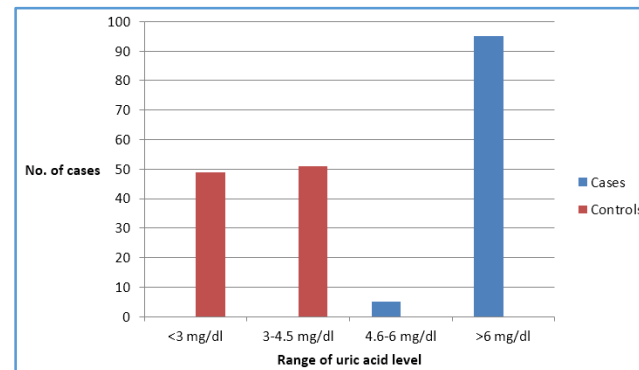
#### RESULTS

Age Groups (p = 0.947)		No. of Cases	No. of Controls
	$\leq 20$	24(24%)	17(17%)
Gravida (p = 0.156)	21-25	51(51%)	46(46%)
	26-30	15(15%)	32(32%)
	$>30$	10(10%)	5(5%)
	Total	100(100%)	100(100%)
Period of Gestation (p = 0.453)	G1	67(67%)	59(59%)
	G2	22(22%)	27(27%)
	G3	9(9%)	10(10%)
	G4 or more	2(2%)	4(4%)
	Total	100(100%)	100(100%)
Period of Gestation (p = 0.453)	$\leq 30$ weeks	12(12%)	0(0%)
	31-36 weeks	55(55%)	13(13%)
	$\geq 37$ weeks	33(33%)	87(87%)
	Total	100(100%)	100(100%)

**Table 1. Distribution of Cases and Controls According to Age Group, Gravida & Period of Gestation**

Blood Pressure systolic (in mmHg)	Range	No. of Cases
	140-160	34(34%)
Blood Pressure diastolic (in mmHg)	161-180	56(56%)
	$>180$	10(10%)
	90-100	29(29%)
Blood Pressure diastolic (in mmHg)	101-110	52(52%)
	$>110$	19(19%)

**Table 2. Systolic & Diastolic BP of Cases**



**Graph 1. Comparison of Range of Serum Acid Level of Cases and Controls**

#### Statistical Analysis of Serum Cholesterol in Eclamptic Patients

Range of Serum Cholesterol	Age Group								Total	
	≤20 Years		21-25 Years		26-30 Years		>30 Years			
	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls
≤200 mg/dL	0	1	0	10	0	13	0	4	0	28
201-250 mg/dL	1	16	1	34	1	19	0	1	3	70
251-300 mg/dL	15	0	31	2	10	0	3	0	59	2
>300 mg/dL	8	0	19	0	4	0	7	0	38	0

**Table 3. Ranges of Serum Cholesterol of Cases and Controls**

While no cases had serum cholesterol less than 200 mg/dL, 28 controls had serum cholesterol less than 200 mg/dL. 59 cases had serum cholesterol in the range of 251-300 mg/dL and 70 controls had serum cholesterol in the range of 201-250 mg/dL and there were 38 cases and no controls in the range of serum cholesterol of more than 300 mg/dL.

Age Group	Mean Cholesterol Level(mg/dL) $\pm$ SD
$\leq 20$ years	294.5 $\pm$ 24.02
21-25 years	301.12 $\pm$ 25.08
26-30 years	298.53 $\pm$ 27.65
$>30$ years	328.2 $\pm$ 27.83

**Table 4. Serum Cholesterol According to Age Group in Eclamptic Subjects**

		Range of Cholesterol (mg/dL)	Mean Cholesterol Level (mg/dL) $\pm$ SD
Systolic BP (in mmHg)	140-160	248-348	288.5 $\pm$ 19.39
	161-180	225-379	305.94 $\pm$ 27.20
	>180	276-354	324.3 $\pm$ 23.93
Diastolic BP (in mmHg)	90-100	248-352	293.79 $\pm$ 25.98
	101-110	225-379	301.59 $\pm$ 25.70
	>110	275-354	314.84 $\pm$ 26.48

**Table 5. Comparison of Serum Cholesterol According to Systolic BP**

Thus, the range of serum cholesterol showed a steady rise with an increase in systolic and diastolic blood pressure.

Mean Cholesterol Levels (mg/dL) $\pm$ SD	P value
Cases 301.85 $\pm$ 26.65	<0.001
Controls 215.53 $\pm$ 19.10	

**Table 6. Mean Cholesterol in Eclamptic and Control Groups**

It's suggesting that the serum cholesterol in eclamptic patients is much more than in normal pregnant women.

Range of Serum Triglyceride	Age Group								Total	
	≤20 Years		21-25 Years		26-30 Years		>30 Years			
	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls
≤200 mg/dL	0	13	2	34	1	25	0	5	3	77
201-250 mg/dL	5	4	7	12	2	7	1	0	15	23
251-300 mg/dL	13	0	21	0	7	0	5	0	46	0
>300 mg/dL	6	0	21	0	5	0	4	0	36	0
Table 7. Ranges of Serum Triglyceride of Cases and Controls										

Age Group	Mean Triglyceride Level (mg/dL) $\pm$ SD
$\leq 20$ years	277.42 $\pm$ 37.99
21-25 years	285.74 $\pm$ 39.36
26-30 years	285.4 $\pm$ 45.54
>30 years	291.6 $\pm$ 25.82

**Table 8. Serum Triglyceride According to Age Group in Eclamptic Subjects**

		Range of triglyceride level (in mg/dL)	Mean triglyceride level (mg/dL) $\pm$ SD
Systolic BP (in mmHg)	140-160	181-348	270.38 $\pm$ 45.49
	161-180	216-382	290.84 $\pm$ 34.47
	>180	268-320	294.8 $\pm$ 20.34
Diastolic BP (in mmHg)	90-100	181-348	281.10 $\pm$ 45.37
	101-110	210-382	283.19 $\pm$ 38.88
	>110	230-320	292.10 $\pm$ 24.97

**Table 9. Comparison of Serum Triglyceride According to Systolic BP, Diastolic BP**

Thus, the range of serum triglyceride showed a steady rise with an increase in systolic & diastolic blood pressure.

Mean Triglyceride levels (mg/dL) $\pm$ SD	P value
Cases 284.28 $\pm$ 38.59	<0.001
Controls 187.81 $\pm$ 22.29	

**Table 10. Mean Triglyceride Levels in Eclamptic and Control Groups**

The mean serum triglyceride level of cases was 284.28 mg/dL and that of controls was 187.81 mg/dL which was highly significant ( $p < 0.001$ ,  $t$  statistics 21.64).

#### Statistical Analysis of Serum HDL

Range of Serum HDL	Age Group								Total	
	≤20 years		21-25 Years		26-30 Years		>30 Years			
	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls
≤30 mg/dL	1	0	5	0	0	0	1	0	7	0
31-60 mg/dL	16	0	31	4	12	1	8	1	67	6
61-90 mg/dL	7	16	15	40	3	30	1	2	26	88
>90 mg/dL	0	1	0	2	0	1	0	2	0	6

Table 11. Ranges of Serum HDL of Cases and Controls

A total maximum of 67 number of cases had serum HDL in the range of 31-60 mg/dL and 26 cases had serum HDL in the range of 61-90 mg/dL and no cases had serum HDL more than 90 mg/dL. A total maximum number of 88 controls had serum HDL in the range of 61-90 mg/dL and 6 subjects in the control group had serum HDL more than 90 mg/dL.

Age Group	Mean HDL Level (mg/dL) $\pm$ SD
$\leq 20$ years	53.71 $\pm$ 18.23
21-25 years	47.98 $\pm$ 17.51
26-30 years	49.8 $\pm$ 12.07
>30 years	45.6 $\pm$ 13.35

**Table 12. Serum HDL According to Age Group in Eclamptic Subjects**

Systolic BP (in mmHg)	Range of Serum HDL (mg/dL)	Mean HDL Level (mg/dL) $\pm$ SD
140-160	20-86	53.11 $\pm$ 18.52
161-180	20-81	48.68 $\pm$ 15.33
>180	22-65	40.7 $\pm$ 14.12
Diastolic BP (in mmHg)	Range of serum HDL (mg/dL)	Mean HDL level (mg/dL) $\pm$ SD
90-100	20-86	52.38 $\pm$ 19.00
101-110	25-80	50.09 $\pm$ 14.96
>110	20-81	42.89 $\pm$ 16.16

**Table 13. Comparison of Serum HDL According to Systolic BP & Diastolic BP**

Thus, the range of serum HDL showed a steady fall with an increase in systolic & diastolic blood pressure.

Mean HDL Levels		P value
Cases	49.39 ± 16.61	<0.001
Controls	75.25 ± 9.53	

**Table 14. Mean HDL Levels in Eclamptic and Control Groups**

The mean serum HDL in cases was 49.39 ± 16.61 mg/dL and in controls was 75.25 ± 9.53 mg/dL which was statistically significant (p<0.001, t statistics 13.50).

Range of Serum LDL	Age Group								Total	
	≤20 years		21-25 Years		26-30 Years		>30 Years			
	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls
≤100 mg/dL	5	3	4	3	2	5	1	1	12	12
101-150 mg/dL	7	14	23	43	9	26	6	4	45	87
151-200 mg/dL	12	0	17	0	3	1	1	0	33	1
>200 mg/dL	0	0	7	0	1	0	2	0	10	0
Table 15. Ranges of Serum LDL of Cases and Controls										

Age Group	Mean LDL Level (mg/dL) ± SD
≤20 years	135.72 ± 42.36
21-25 years	148.72 ± 36.65
26-30 years	135.40 ± 38.08
>30 years	144.90 ± 46.49

**Table 16. Serum LDL According to Age Group in Eclamptic Subjects**

The mean LDL in ≤20 years age group was 135.72 mg/dL and in 21-25 years age group was 148.72 mg/dL and in 26-30 years was 135.40 mg/dL and in more than 30 years was 144.90 mg/dL.

Systolic BP (in mmHg)	Range of LDL (mg/dL)	Mean LDL level (mg/dL) ± SD
140-160	68-226	135.90 ± 40.29
161-180	43-232	146.49 ± 39.70
>180	110-206	149.8 ± 31.44
Diastolic BP (in mmHg)	Range of serum LDL (mg/dL)	Mean LDL level(mg/dL) ± SD
90-100	68-232	139.84 ± 40.60
101-110	43-214	141.75 ± 41.03
>110	107-228	152.42 ± 31.59

**Table 17. Comparison of Serum LDL According to Systolic & Diastolic BP**

Thus, the range of serum LDL showed a steady rise with an increase in systolic & diastolic blood pressure.

Mean LDL Levels		P value
Cases	143.22 ± 39.19	<0.001
Controls	115.53 ± 12.01	

**Table 18. Mean LDL Levels in Eclamptic and Control Groups**

The mean serum LDL in cases was 143.22 ± 39.19 mg/dL and in controls was 115.53 ± 12.01 mg/dL which was statistically significant (p<0.001 t statistics 6.75).

#### Statistical Analysis of Serum VLDL

Range of Serum VLDL	Age Group								Total	
	≤20 Years		21-25 Years		26-30 Years		>30 Years			
	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls	No. of Cases	No. of Controls
≤40 mg/dL	8	11	14	21	4	21	1	2	27	55
41-60 mg/dL	11	6	23	25	8	11	6	3	48	45
61-80 mg/dL	3	0	12	0	3	0	2	0	20	0
>80 mg/dL	2	0	2	0	0	0	1	0	5	0
Table 19. Ranges of Serum VLDL of Cases and Controls										

Age Group	Mean VLDL Level (mg/dL) ± SD
≤20 years	50.38 ± 23.60
21-25 years	50.71 ± 17.58
26-30 years	50.47 ± 11.36
>30 years	56.95 ± 20.04

**Table 20. Serum VLDL According to Age Group in Eclamptic Subjects**

Systolic BP (in mmHg)	Range of Serum VLDL(mg/dL)	Mean Serum VLDL Level(mg/dL) ± SD
140-160	19-72	46.53 ± 14.24
161-180	13-125	52.63 ± 18.34
>180	13-100	59.20 ± 28.62
Diastolic BP (in mmHg)	Range of serum VLDL(mg/dL)	Mean VLDL level(mg/dL) ± SD
90-100	19-72	47.17 ± 14.96
101-110	13-125	52.30 ± 19.25
>110	19-100	54.42 ± 21.28

**Table 21. Comparison of Serum VLDL of Cases According to Systolic & Diastolic BP**

Thus, the range of serum VLDL showed a steady rise with an increase in systolic & diastolic blood pressure.

Mean VLDL Levels (mg/dL)		P value
Cases	51.21 ± 18.55	<0.001
Controls	40.78 ± 6.18	

**Table 22. Mean VLDL Levels in Eclamptic and Control Groups**

The mean serum VLDL in cases was 51.21 ± 18.55 mg/dL and in controls was 40.78 ± 6.18 mg/dL which was statistically significant (p<0.001, t statistics 5.33).

## DISCUSSION

Worldwide diverse studies have reported elevated lipid levels in pregnancy-induced hypertension patients (Turpin CA et al, 2008). Some earlier studies reported that the striking changes in the lipid profile in normal pregnancy is serum hypertriglyceridaemia, which may be as high as two to three folds in the third trimester over the levels in non-pregnant women (Shyn SK, et al).

Age Group	Sunita TH et al. (2013)	Choudhary P (2003)	Present Study
<20 years	40%	46.8%	24%
21-25 years	45%	40.42%	51%
26-30 years	10%	6.38%	15%
>30 years	5%	6.38%	10%

**Table 23. Incidence of Eclampsia According to Age Group**

The present study had the maximum number of cases from the age group of 21-25 years (51%). Sunita et al (2013)<sup>9</sup> reported 45% cases in that age group and Choudhary P (2003)<sup>10</sup> reported 40.42% cases in that age group.

Gravida	Marina Khanum et al (2004)	Sunita TH et al (2013)	Present study
Primigravida	58%	79%	67%
Multigravida	42%	21%	33%

**Table 24. Incidence of Eclampsia According to Primigravida or Multigravida**

In our present study, 67% of the cases were primigravidae and 33% cases were multigravidae. Studies by Sunita TH et al (2013)<sup>9</sup> and Marina Khanum et al<sup>11</sup> had almost similar findings.

Gestational Age	Sunita TH et al (2013)	Marina Khanum et al (2004)	Present Study
Preterm	45%	66%	67%
Term	55%	34%	33%

**Table 25. Incidence of Eclampsia According to Gestational Age at Admission**

Study by Sunita TH et al<sup>9</sup> had 45% of eclamptic patients who were less than 37 weeks upon admission and 55% who were term. Marina Khanum et al<sup>11</sup> reported 34% term eclamptic patients admission and 66% preterm, which was similar to our study group of 33% term and 67% preterm eclamptic patients on admission.

Blood Pressure	Musleh Uddin Kalar et al(2012)	Present Study
Mean systolic blood pressure	154 ± 0.55	170 ± 11
Mean diastolic blood pressure	102 ± 0.73	108.9 ± 7.09

**Table 26. Systolic and Diastolic BP of Eclamptic Patients**

A study by Musleh Uddin et al<sup>12</sup> in 2012 had mean systolic blood pressure of 154 ± 0.55 mmHg and diastolic blood

pressure of 102 ± 0.73 mmHg while in our study the mean systolic blood pressure was similar at 170 ± 11 mmHg and diastolic blood pressure was 108.9 ± 7.09 mmHg.

	Rubina Nazli et al (2013)	Suchanda Sahu et al (2008)	Present Study
Mean cholesterol level of cases (mg/dL) ±	216.63 ± 5.17	293.3 ± 15.7	301.85 ± 26.65
Mean cholesterol level of controls (mg/dL) ±	202.23 ± 4.6	172.1 ± 9.3	215.53 ± 19.10

**Table 27. Total Cholesterol Level**

According to a study done by Rubina Nazli et al<sup>5</sup> in 2013, the mean cholesterol level in eclamptic patients was higher (216.63 ± 5.17 in cases compared with 202.23 ± 4.6 in controls). Our study also showed a definite rise in serum cholesterol in eclamptics (mean 301.85 ± 26.65) compared with controls (215.53 ± 19.10).

Another study by Suchanda et al<sup>6</sup> in 2008 also gave similar results showing an appreciable rise in serum cholesterol in eclamptics compared to normal pregnant women. The mean cholesterol was 293.3 ± 15.7 mg/dL in the study which was similar to our study.

	Rubina Nazli et al (2013)	Swapan Das et al (2013)	Present Study
Mean triglyceride level of cases (mg/dL)	337.71 ± 14.34	212.75 ± 50.29	284.28 ± 38.59
Mean triglyceride level of controls (mg/dL)	212.30 ± 7.28	185.60 ± 40.67	187.81 ± 22.29

**Table 28. Serum Triglyceride Level**

The mean triglyceride level showed a definite increase in eclamptic patients as compared to controls in our study.

	Rubina Nazli et al (2013)	Gohil J. T. et al (2011)	Present Study
Mean serum HDL level of cases (mg/dL) ±	40.83 ± 0.92	42.1 ± 1.9	49.39 ± 16.61
Mean serum HDL level of controls (mg/dL) ±	52.20 ± 1.14	60.3 ± 1.2	75.25 ± 9.53

**Table 29. Serum HDL**

Serum HDL was decreased in eclamptic subjects (mean 49.39 ± 16.61 mg/dL) as compared to normal pregnant women (mean 75.25 ± 9.53) in our study.

	<b>NAF Islam et al (2006)</b>	<b>Musleh Uddin Kalar et al (2013)</b>	<b>Present Study</b>
Mean serum LDL level of cases(mg/dL) $\pm$	133.4 $\pm$ 11.75	132.95 $\pm$ 32.26	143.22 $\pm$ 39.19
Mean serum LDL level of controls(mg/dL) $\pm$	115.2 $\pm$ 10.72	99.36 $\pm$ 17.75	115.53 $\pm$ 12.01
<b>Table 30. Serum LDL</b>			

Serum LDL in the present study showed an increase in level (143.22  $\pm$  39.19 mg/dL in cases compared with 115.53  $\pm$  12.01 mg/dL in controls).

	<b>RubinaNazli et al(2013)</b>	<b>Gohil J. T et al (2011)</b>	<b>Eman Chafat et al (2010)</b>	<b>Present Study</b>
Mean serum VLDL level of cases(mg/dL)	66.93 $\pm$ 2.84	54.1 $\pm$ 0.31	48.68 $\pm$ 2.7	51.21 $\pm$ 18.55
Mean serum VLDL level of controls(mg/dL)	42.22 $\pm$ 1.46	43.04 $\pm$ 0.40	40.46 $\pm$ 3.33	40.78 $\pm$ 6.18
<b>Table 31. Serum VLDL</b>				

Serum VLDL showed a rise in eclamptic patients in our study (mean serum VLDL in cases was 51.21  $\pm$  18.55 mg/dL and in controls was 40.78  $\pm$  6.18 mg/dL). Other studies by Rubina Nazli et al(2013),<sup>5</sup> Gohil J. T et al(2011)<sup>13</sup> and Eman Chafat et al(2010)<sup>14</sup> showed similar rise in serum VLDL in eclamptic patients as compared to normal pregnant women.

## CONCLUSION

There was increase in level of serum cholesterol, serum triglycerides, HDL, LDL and VLDL in the eclamptic subjects, but not in the control group of normal pregnant women, thus eclamptic women had deranged lipid profile due to abnormal lipid metabolism.

This relationship may be significant in understanding the pathological process of eclampsia and may help in developing strategies for prevention and early diagnosis of eclampsia.

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