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Original Research Article

Liver and renal biochemical parameters in preeclampsia: a cross sectional study

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ABSTRACT

Background: Pre-eclampsia is a multisystem disorder of human pregnancy with a genetic predisposition. It occurs more frequently in first pregnancies and leads to elevation in blood pressure and mainly affects maternal renal, cerebral, hepatic and clotting functions. This study evaluated biomarkers of renal and liver function among preeclamptic women.
Methods: This was a cross-sectional study conducted among 150 preeclamptic women and 150 normotensive healthy pregnant women in hospital. The baseline data comprising age, gestational age, and blood pressure were obtained. Serum urea, creatinine, and plasma levels of liver enzymes ALT and AST, total protein, albumin, globulin and glucose were measured.
Results: The plasma total protein, and albumin in preeclamptic group were significantly decreased ($p<0.05$) when compared with control. There was statistically significant increase ($p<0.05$) in urea creatinine, glucose, serum AST, and ALT activities in preeclamptic group.
Conclusions: Preeclampsia has harmful effects on renal and liver function as shown by alteration of these parameters.

Keywords: Liver function, Preeclampsia, Renal function

INTRODUCTION

Hypertensive disorders of pregnancy (HDP) are one of the foremost causes of morbidity and mortality in obstetric population, especially in lower- and middle-income countries.[1] It is a major health problem related to pregnancy disorders and ranges from pre-eclampsia (PE), gestational hypertension, chronic hypertension (CH) and chronic hypertension superimposed pre-eclampsia. Each group has a different pathophysiology and feto-maternal consequences.[2] Pre-eclampsia is defined as new-onset hypertension (blood pressure ≥140/90 mmHg) in combination with proteinuria (24-hr urinary protein ≥ 0.3 gm) or any sign of end-organ damage after 20 weeks of gestation. The presence of 300 mg or more of protein in a 24-hour urine collection or a urine dipstick protein of +1 is termed proteinuria.[3] Proteinuria, however, is not a requirement anymore to make a diagnosis of pre-eclampsia.[4]

The main primary disease mechanism is endothelial dysfunction affecting multiple organs, including the brain, liver, kidneys, and placenta in conjunction with other symptoms such as impaired liver and kidney function, oliguria, headache, hyperreflexia, or right upper quadrant and epigastric pain, and thrombocytopenia [hemolysis elevated liver enzymes and low platelets syndrome (HELLP)].[4-6] Liver and kidney dysfunctions are common manifestations of end-organ damage due to preeclampsia.[3]

Pre-eclampsia is also the most common cause of liver dysfunction in 3% of pregnancies because of microvesicular fat deposition and reduced blood flow to the liver potentially causing ischemia and periportal hemorrhage.[7,8] Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) levels are usually normal, but when they become elevated and are accompanied by abdominal pain, it often suggests a severe form of the disease spectrum.[9-11]

Preeclampsia is more common in women with an underlying kidney disease. On the other hand, it has been suggested that preeclampsia itself may increase the risk of kidney disease later in life.[12] It is a disease with worldwide implications to mothers and infants; it may have health hazards that increase maternal, fetal, and infant morbidity and mortality.[12,13] It has been shown that preeclampsia has worse consequences more in developing countries, where it accounts for 20-80% of unusually increased maternal mortality, while in developed countries, preeclampsia has a main effect on fetuses and neonates.[12-14]

As such, this study was undertaken to evaluate the utility of levels of liver function tests and kidney function tests as biomarkers of pre-eclampsia-related end-organ damage among pregnant women with and without preeclampsia.

METHODS

Study population

A hospital based cross sectional study of 300 pregnant women divided into two groups: comprising 150 apparently healthy normotensive pregnant participants without preclampsia and 150 preeclamptic participants admitted in obstetrics wards of LD hospital an associated tertiary care hospital of GMC Srinagar. The study was conducted from January to August 2022 after the ethical committee approval.

All the subjects of the study were included after taking proper relevant history and informed consent.

The subjects were classified as preeclampsia if they had de novo hypertension of ≥140/90 mmHg after 20 weeks gestation accompanied by proteinuria and/or evidence of maternal acute kidney injury, liver dysfunction, neurological or cerebral features like headache, visual disturbances, hemolysis or thrombocytopenia, and/or fetal growth restriction.

Inclusion criteria

The inclusion criteria for this study include the following: apparently healthy pregnant females with gestational age greater than 20 weeks, preeclamptic women with no previous history of hypertension and proteinuria before gestational age of 20 weeks and above.

Exclusion criteria

The exclusion criteria for this study include the following: pregnant women with other medical conditions such as viral hepatitis, diabetes mellitus renal failure, autoimmune diseases, anaemia, tuberculosis, chronic hypertension, and myeloproliferative disorders.

Data analysis

The data from the study was analyzed using SPSS version 26.0. Quantitative data were expressed as mean, standard deviation, and standard error of mean. Independent t-test was used to compare the groups. The level of significance for all the inferential statistics was set at $p<0.05$.

RESULTS

A total of 300 pregnant female study participants were recruited, 150 of whom were pre-eclamptic pregnant women while 150 of who were normotensive pregnant women with gestational age above 20 weeks.

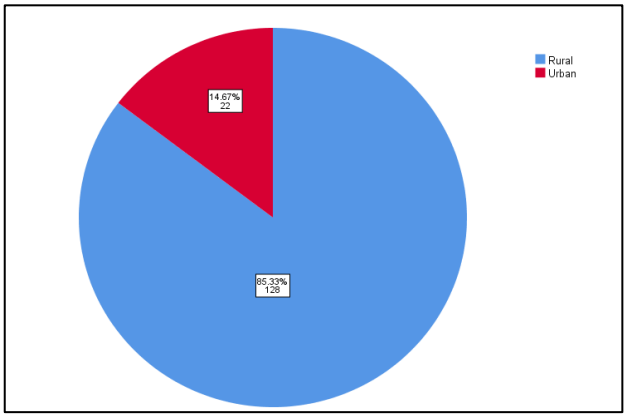

Figure 1: Pie chart showing residence of preeclampsia group.

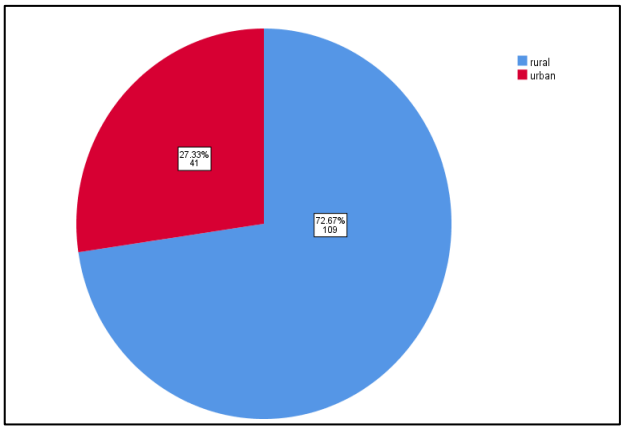

Figure 2: Pie chart showing residence of control group.

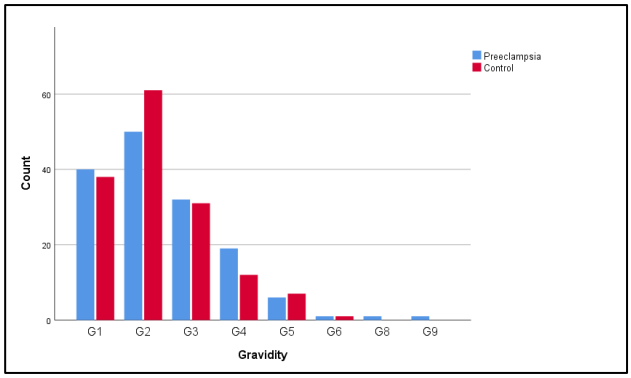

Figure 3: Bar graph showing gravidity of control and preclampsia group.

Among preeclampsia patients 85% (n=128) were from rural areas while 15% belonged to urban areas as compared to 72% (n=109) from rural and 18% (n=41) from urban areas (Figures 1 and 2).

Majority of the preeclampsia females and control group were multigravidae, about 26% (n=40) were primigravidae both in preeclampsia group and control group (Figure 3). The mean ages and standard deviation (SD) of preeclamptic patients and controls were 29.24(3.43) and 29.09 (3.08) years respectively. The mean gestational ages of pre-eclamptic patients and normotensive pregnant women were 33.82 weeks and 34.56 weeks respectively. The differences in mean age and gestational age did not reach statistical significance ($p>0.05$) (Table 1).

Table 1: Baseline characteristics of study participants.

Group Statistics					
	Category	**N**	**Mean**	**SD**	**Std. error mean**
Age (years)	Preeclampsia	150	29.24	3.43	0.28009
	Control	150	29.09	3.08	0.25212
Gestation age (weeks)	Preeclampsia	150	33.82	3.72	0.30385
	Control	150	34.56	3.96	0.32391
SBP (mmHg)	Preeclampsia	150	154.28	22.31	1.82185
	Control	150	119.08	12.20	0.99664
DBP (mmHg)	Preeclampsia	150	100.21	12.34	1.00774
	Control	150	74.34	6.22	0.50845

Table 2: Independent sample t-test shows statistically significant difference of means in systolic blood pressure and diastolic blood pressure among preeclamptics and control group ($p<0.01$).

Independent samples test										
		Levene's test for equality of variances		**t-test for equality of means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean diff.**	**Std. error diff.**	**95% CI of the diff.**	
									Lower	**Upper**
Age	Equal variances assumed	1.033	0.310	0.389	298	0.697	0.14667	0.37685	-0.59496	0.88829
	Equal variances not assumed			0.389	294.762	0.697	0.14667	0.37685	-0.59499	0.88832
Gestation age	Equal variances assumed	1.135	0.288	-1.651	298	0.100	-0.73333	0.44412	-1.60735	0.14068
	Equal variances not assumed			-1.651	296.790	0.100	-0.73333	0.44412	-1.60736	0.14070
SBP	Equal variances assumed	39.994	0.000	16.950	298	0.000	35.20000	2.07664	31.11327	39.28673
	Equal variances not assumed			16.950	230.849	0.000*	35.20000	2.07664	31.10842	39.29158
DBP	Equal variances assumed	54.994	0.000	22.916	298	0.000	25.86667	1.12874	23.64535	28.08798
	Equal variances not assumed			22.916	220.244	0.000*	25.86667	1.12874	23.64215	28.09118

Table 3: Mean and standard deviation (SD) of liver function tests between preeclamptic and normotensive pregnant women (control).

		N	Mean	SD	Std. error mean
AST	Preeclampsia	150	57.77	75.11	6.13333
	control	150	43.24	49.92	4.07629
ALT	Preeclampsia	150	56.44	58.75	4.79725
	control	150	39.76	47.63	3.88939
Total serum protein	Preeclampsia	150	6.32	0.70	0.05774
	control	150	6.73	0.59	0.04858
Serum albumin	Preeclampsia	150	3.21	0.42	0.03505
	control	150	3.45	0.35	0.02923
Serum globulin	Preeclampsia	150	3.09	0.49	0.04025
	control	150	3.28	0.43	0.03544

Table 4: Independent t-test for mean comparison of liver function tests between preeclamptic and normotensive pregnant women.

Independent samples test										
		Levene's test for equality of variances		t-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean diff.	Std. error diff.	95% CI of the diff.	
									Lower	Upper
AST	Equal variances assumed	7.020	0.008	1.974	298	0.049	14.53733	7.36437	0.04458	29.03009
	Equal variances not assumed			1.974	259.141	0.049*	14.53733	7.36437	0.03571	29.03895
ALT	Equal variances assumed	0.396	0.530	2.701	298	0.007*	16.68000	6.17583	4.52623	28.83377
	Equal variances not assumed			2.701	285.782	0.007	16.68000	6.17583	4.52411	28.83589
Total serum protein	Equal variances assumed	4.229	0.041	-5.363	298	0.000	-0.40467	0.07546	-0.55316	-0.25617
	Equal variances not assumed			-5.363	289.543	0.000*	-0.40467	0.07546	-0.55318	-0.25615
Serum albumin	Equal variances assumed	2.680	0.103	-5.361	298	0.000*	-0.24467	0.04564	-0.33448	-0.15485
	Equal variances not assumed			-5.361	288.664	0.000	-0.24467	0.04564	-0.33449	-0.15484
Serum globulin	Equal variances assumed	1.448	0.230	-3.419	298	0.001*	-0.18333	0.05363	-0.28887	-0.07780
	Equal variances not assumed			-3.419	293.294	0.001	-0.18333	0.05363	-0.28888	-0.07779

The differences between the mean systolic blood pressure and diastolic blood pressure reached statistical significance between the preeclamptic and control group ($p<0.05$) (Table 2).

The mean AST, ALT in preeclamptic females was higher than control group, while as the mean serum total protein, albumin levels and globulin levels were lower than the control group (Table 3). An independent sample t-test showed that there was a statistically significant difference in the mean serum AST ($p<0.05$) and mean serum ALT levels ($p=0.007$) between preeclamptic women and normotensive pregnant women. There was a statistically significant difference in the mean serum total protein ($p=0.000$), albumin ($p=0.000$) and globulin ($p=0.001$) levels between preeclamptic pregnant women and normotensive pregnant women (Table 4).

The mean serum urea (19.00±8.94), creatinine (0.67±0.14) and random blood glucose (91.79±24.61) in preeclamptic females was higher than control group

(Table 5). An independent sample t-test showed that there was a statistically significant difference in the means of serum urea (p=0.001), serum creatinine levels (p=0.001) and random blood glucose levels (p=0.016) between preeclamptic women and normotensive pregnant women (Table 6).

Table 5: Mean and standard deviation (SD) of kidney function tests and random blood glucose between preeclamptic and normotensive pregnant women (control).

Group statistics					
	Category	**N**	**Mean**	**SD**	**Std. error mean**
Serum urea	Preeclampsia	150	19.00	8.94	0.73011
	Control	150	16.06	5.84	0.47728
Serum creatinine	Preeclampsia	150	0.67	0.14	0.01154
	Control	150	0.62	0.10	0.00849
Blood glucose	Preeclampsia	150	91.79	24.61	2.00996
	Control	150	85.88	16.91	1.38124

Table 6: Independent t-test for mean comparison of kidney function tests and random blood glucose between preeclamptic and normotensive pregnant women.

Independent samples test										
		Levene's test for equality of variances		**t-test for equality of means**						
		F	**Sig.**	**t**	**df**	**Sig. (2-tailed)**	**Mean diff.**	**Std. error diff.**	**95% CI of the diff.**	
									Lower	**Upper**
Serum urea	Equal variances assumed	13.780	0.000	3.363	298	0.001	2.93	0.87228	1.21673	4.64993
	Equal variances not assumed			3.363	256.682	0.001*	2.93	0.87228	1.21561	4.65106
Serum creatinine	Equal variances assumed	4.435	0.036	3.397	298	0.001	0.048	0.01433	0.02047	0.07686
	Equal variances not assumed			3.397	273.812	0.001*	0.048	0.01433	0.02046	0.07687
Blood glucose	Equal variances assumed	9.358	0.002	2.425	298	0.016	5.91	2.43880	1.11388	10.71279
	Equal variances not assumed			2.425	264.067	0.016*	5.91	2.43880	1.11136	10.71531

DISCUSSION

Pregnancy-induced hypertension is a major cause of maternal and fetal morbidity and mortality. It involves a multifactorial process and multiorgan dysfunction with no individual factor strictly essential or sufficient for causing it.[15]

In this study, there was no difference (p>0.05) in the mean age and gestational age of the preeclamptic test group when compared with the normotensive control.

We observed in our study that transaminases (ALT and AST) were significantly elevated among preeclamptic women (p<0.05). Our observation is analogous to the previous studies by Hazari et al Dacaj et al and Malvino et al.[16-18] It is thought that elevated transaminases among preeclamptic women are possibly due to hypoxic effect of preeclampsia on their livers, since hypoxia results in necrosis with a resultant degeneration of hepatocytes or this elevation may be due to placental ischemia followed by a systemic inflammatory response, resulting in endothelial dysfunction causing vasoconstriction and eventual liver and kidney dysfunctions.[17,19]

Moreover, the mean plasma total protein and albumin as observed in this study were significantly (p<0.05) lower among preeclamptic group when compared with normotensive control group. This could possibly be a consequence of urinary loss of protein among preeclamptics. It has been shown that proteinuria as seen in preeclampsia might be the consequence of a loss of both size and charge selectivity of the glomerulus.[20]

Our study showed that the mean plasma urea and creatinine, levels were significantly raised(p<0.05) among preeclamptic population when compared with normotensive control pregnant women. Our observation

was similar to the previous study by Vyakaranm et al that reported an increase in the creatinine values among preeclamptic patients.[21] Previous study has shown that blood urea nitrogen (BUN) and creatinine levels among preeclamptic women are similar to the levels seen in nonpregnant women because of reduced glomerular filtration rate (GFR) and reduced renal plasma flow (RPF) as against normal pregnancy that is characterized by increase in GFR as well as RPF.[22-24] Thus elevated levels of creatinine may be due to decrease urinary clearance secondary to reduced GFR and increased reabsorption.[25] It may be also due to endothelial dysfunction causing vasoconstriction and eventually kidney dysfunction.[19]

Limitation of the study was the sample size was small and is a single centric study.

CONCLUSION

Our study shows that preeclampsia effects renal and liver functions as shown by derangements in biomarkers of renal and liver function with respect to normotensive pregnancies. Thus, there is a need for close monitoring of women with preeclampsia to prevent maternal and fetal morbidity and mortality.

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

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