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Pregnant Women with Antepartum Pre Eclmpsia: Correlation of Maternal and Perinatal outcomes with Serum LDH Levels

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Abstract
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. Overall, 10%-15% of maternal deaths are directly associated with pre-eclampsia and eclampsia. Some epidemiological findings support the hypothesis of a genetic and immunological etiology. After obtaining written informed consent, demographic data such as age, detailed history (including obstetric history, family history and other comorbid conditions) was obtained through an interview. Also presenting complaints were noted. Further these women were subjected to complete examination (general and systemic examination). In the present study maternal mortality was noted in eight women and the causes of mortality in two women each (25%) were abruption, DIC and intracranial bleed. In this study maternal mortality was noted in 5.3% of the women and all women had LDH levels of > 800 IU/L (p<0.001). In the present study neonatal mortality noted only in mothers with LDH levels of >800 IU/L (32.26%) (p<0.001).

Keywords: Antepartum Pre eclmpsia, maternal and perinatal outcomes, serum LDH levels

Introduction
The criteria that define pre-eclampsia have not changed over the past decade. These are: onset at >20 weeks gestational age and 24-hour proteinuria ≥300 mg/day or, if not available, a protein concentration ≥30 mg (≥1+ on dipstick) in a minimum of two random urine samples collected at least 4-6 hours but no more than 7 days apart, a systolic blood pressure >140 mmHg or diastolic blood pressure ≥90 mmHg as measured twice, using an appropriate cuff, 4-6 hours and less than 7 days apart, and disappearance of all these abnormalities before the end of the 6th week postpartum. Nonetheless, some presentations of pregnancy-related hypertension combined with clinical or laboratory abnormalities or intrauterine growth restriction should also be considered as potential pre-eclampsia [1, 2].

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. Overall, 10%-15% of maternal deaths are directly associated with pre-eclampsia and eclampsia. Some epidemiological findings support the hypothesis of a genetic and immunological etiology. The risk of pre-eclampsia is 2-fold to 5-fold higher in pregnant women with a maternal history of this disorder. Depending on ethnicity, the incidence of pre-eclampsia ranges from 3% to 7% in healthy nulliparas and 1% to 3% in multiparas. Moreover, nulliparity and a new partner have been shown to be important risk factors [3, 4].

The prevalence of hypertension during pregnancy is not well-documented in Indian literature and the studies related to hypertension in pregnancy in India were mostly hospital based. However, the prevalence of hypertension during pregnancy was found to be 6.9% in a rent study by Mehta B *et al* in Community Health Center (CHC) Chiri, Block Lakhanmajra, Haryana. Sachdeva *et al.*, in Gujarat, reported incidence of pregnancy-induced hypertension (PIH) to be 15% among women of rural background. In a population-based study carried out by Sayeed *et al.*, in a rural community of Bangladesh, prevalence of systolic and diastolic hypertension was reported as 6.8 and 5.4%, respectively [5].

LDH is an intracellular cytoplasmic enzyme, LDH enzymes are ubiquitous to all the major organ systems ex- heart, kidney, muscle, leucocytes and erythrocytes. Cellular enzymes in the extra cellular space although of no further metabolic function in this space, are still of benefit because

they serve as indicators suggestive of disturbance of cellular integrity induced by pathological conditions and is used to detect cell damage or cell death. Hence, serum LDH levels can be used to assess the extent of cellular death and thereby the severity of disease. Furthermore, serum LDH is abnormal in a host of disorders therefore, the total serum LDH is highly sensitive but nonspecific test. Hence, the present study was undertaken to ascertain the prognostic significance of serum LDH as a marker for preeclampsia-eclampsia and its severity which may be used in making decision, regarding management strategies to improve maternal and fetal outcome [6].

Methodology

Study design

The study design was a prospective comparative study.

Study period

This study was conducted for a period of 18 months.

Source of data

All the pregnant women with ≥ 20 weeks of gestation who fulfilled the selection criteria registered in the Department of Obstetrics and Gynaecology, enrolled in this study.

Sample size

A total of 151 women registered in the Department of Obstetrics and Gynaecology, during the study period were studied.

Sample size calculation

The sample size was calculated considering following formula.

$$n = \frac{2(Z_\alpha + Z_\beta)^2 pq}{(P_0 - P_1)^2}$$

Based on the above formula the minimum effect size required in each group was 19. However, during the study period a total of 151 women were eligible and provided written informed consent. Hence a total of 151 women were studied.

Sampling technique

These women were divided into four cohorts as below.

- **Normal pregnancy (NP):** Normotensive (Normal) pregnant women
- **Mild preeclampsia (MPE):** Women with mild preeclampsia**.**
- **Severe preeclampsia (SPE):** Women with severe preeclampsia**.**
- **Antepartum eclampsia (APE):** Women with anterpartum eclampsia

Selection Criteria

Inclusion criteria

Pregnant women with gestational age of ≥20 weeks of pregnancy (according to a reliable last menstrual period and ultrasound confirmation) with either mild, severe or antepartum preeclampsia.

Exclusion criteria

Pregnant women with history of

- Liver disease
- Diabetes mellitus
- Renal failure
- Hemolytic anemias
- Stroke
- Coronary artery disease
- Chronic lung diseases
- Connective tissue disorder
- DIC
- Seizures
- Chronic hypertension
- Gestational diabetes mellitus (GDM)
- Multiple pregnancy
- Hepatotoxic drugs.

Informed Consent

All the women fulfilling the selection criteria were explained about the nature of the study and a written informed consent was obtained before enrollment.

Data collection

After obtaining written informed consent, demographic data such as age, detailed history (including obstetric history, family history and other comorbid conditions) was obtained through an interview. Also presenting complaints were noted. Further these women were subjected to complete examination (general and systemic examination). Blood pressure was recorded by Residents using a mercury sphygmomanometer and stethoscope from the upper arm after the subjects had been sitting for more than 5 minutes according to the guidelines of the American Heart Association. Three readings were recorded after 5 minutes rest interval between the measurements and the average value was recorded. These findings were noted on a predesigned and pretested proforma.

Investigations

All the pregnant women underwent routine hematological test including haemoglobin, blood grouping, human immunodeficiency (HIV)/ surface antigen of the hepatitis B virus (HBsAg), ultrasound examination special investigations were done which included blood urea, serum creatinine, serum uric acid, serum electrolytes, blood sugar level, liver function tests, fundoscopy, bleeding time, clotting time, coagulation profile, urine routine and urine culture. Further all these women were subjected to Serum LDH investigation.

Results

Table 1: Distribution of women according to the maternal mortality and its association with LDH levels

LDH Levels (IU/L)	Maternal mortality				Total	
	No		Yes			
	No	%	No	%	No	%
<600	63	100.00	0	0.00	63	63.00
600 to 800	47	100.00	0	0.00	47	47.00
> 800	33	80.49	8	19.51	41	41.00
Total	143	94.70	8	5.30	151	100.00

$p < 0.001$

In this study maternal mortality was noted in 5.3% of the women and all women had LDH levels of > 800 IU/L ($p<0.001$).

Table 2: Distribution of women according to the causes of maternal mortality

Causes	Total (n=8)	
	No.	%
Abruption	2	25.00
DIC	2	25.00
Intracranial bleed	2	25.00
Acute pulmonary oedema	1	12.50
Atonic PPH with DIC	1	12.50
Total	8	100.00

In the present study maternal mortality was noted in eight women and the causes of mortality in two women each (25%) were abruption, DIC and intracranial bleed.

Table 3: Association of LDH levels with maternal complications

LDH Levels (IU/L)	Maternal complications				Total	
	No		Yes			
	No	%	No	%	No	%
<600	54	85.71	9	14.29	63	63.00
600 to 800	39	82.98	8	17.02	47	47.00
> 800	26	63.41	15	36.59	41	41.00
Total	119	78.81	32	21.19	151	100.00

p = 0.017

In the present study 14.29% of the women with LDH levels <600 IU/L had maternal complications compared to 17.02% of the women with LDH levels between 600 to800 IU/L and 36.59% of the women with LDH levels > 800 IU/L and this difference was statistically significant (p<0.017). atonic PPH was the common complication noted 17 women while two women each had intracranial bleed and DIC.

Table 4: Comparison of APGAR score at one minute with preeclampsia

APGAR score at one minutes	Groups								Total	
	NP		MPE		SPE		APE			
	No.	%	No.	%	No.	%	No.	%	No.	%
< 7	6	12.00	8	29.63	11	23.40	11	40.74	36	25.53
≥ 7	44	88.00	19	70.37	29	61.70	13	48.15	105	74.47
Total	50	100.00	27	100.00	40	85.11	24	88.89	141	100.00

P = 0.016

In this study significantly higher number of neonates born to the mother with APE (40.74%) had APGAR score of ≤7 at one minute (p=0.016).

Table 5: Comparison of mean APGAR score at one minute

Groups	Number of patients (n)	APGAR score	
		Mean	SD
NP	50	8.22	1.93
MPE	27	6.89	2.34
SPE	40	7.13	2.22
APE	24	6.00	3.04
Overall	141	7.28	2.42
F value	5.545		
p value	0.001		

In the present study the mean APGAR score at one minute in neonates born to the mothers with APE were significantly low 6.00±3.04 (p=0.001).

Table 6: Comparison of APGAR score at five minutes with preeclampsia

APGAR score at five minutes	Groups								Total	
	NP		MPE		SPE		APE			
	No.	%	No.	%	No.	%	No.	%	No.	%
< 7	6	12.00	8	29.63	10	21.28	11	40.74	35	24.82
≥ 7	44	88.00	19	70.37	30	63.83	13	48.15	106	75.18
Total	50	100.00	27	100.00	40	85.11	24	88.89	141	100.00

p = 0.015

In this study significantly higher number of neonates born to the mother with APE (40.74%) had APGAR score of ≤7 at five minutes (p=0.015).

Table 7: Comparison of mean APGAR score at five minutes

Groups	Number of patients (n)	APGAR score	
		Mean	SD
NP	50	8.30	1.92
MPE	27	6.93	2.69
SPE	40	7.10	2.41
APE	24	6.29	2.90
Overall	141	7.35	2.49
F value	4.605		
p value	0.004		

In the present study the mean APGAR score at five minutes in neonates born to the mothers with APE were significantly low 6.29±2.90 (p=0.004).

Table 8: Distribution of neonates according to the APGAR score at one minute and its association with LDH levels

LDH Levels (IU/L)	APGAR score at one min				Total	
	< 7		≥ 7			
	No.	%	No.	%	No.	%
<600	5	7.94	58	92.06	63	63.00
600 to 800	5	10.64	42	89.36	47	47.00
> 800	26	83.87	5	16.13	31	31.00
Total	36	25.53	105	74.47	141	100.00

p < 0.001

In the present study significantly higher number of neonates who were born to the mothers with LDH levels of >800 IU/L had APGAR score of <7 (83.87%) at one minute compared to those who were born to the women with LDH levels between 600 to 800 IU/L (10.64%) and those with LDH levels < 600 IU/L (7.94%) (p<0.001).

Table 9: Distribution of neonates according to the APGAR score at five minutes and its association with LDH levels

LDH Levels (IU/L)	APGAR score at five min				Total	
	< 7		7 or more			
	No.	%	No.	%	No.	%
<600	5	7.94	58	92.06	63	63.00
600 to 800	4	8.51	43	91.49	47	47.00
> 800	26	83.87	5	16.13	31	31.00
Total	35	24.82	106	75.18	141	100.00

p < 0.001

In this study significantly higher number of neonates who were born to the mothers with LDH levels of >800 IU/L had APGAR score of <7 (83.87%) at five minutes compared to those who were born to the women with LDH levels between 600 to 800 IU/L (8.51%) and those with LDH levels < 600 IU/L (7.94%) (p<0.001).

Table 10: Distribution of neonates according to the birth weight and its association with LDH levels

LDH Levels (IU/L)	Birth weight (Kg)				Total	
	< 2.5		≥2.5			
	No.	%	No.	%	No.	%
<600	14	22.22	49	77.78	63	63.00
600 to 800	25	53.19	22	46.81	47	47.00
> 800	21	67.74	10	32.26	31	31.00
Total	60	42.55	81	57.45	141	100.00

$p < 0.001$

In the present study significantly higher number of neonates who were born to the mothers with LDH levels of >800 IU/L had birth weight of <2.5 kg (67.74%) compared to those who were born to the women with LDH levels between 600 to 800 IU/L (53.19%) and those with LDH levels < 600 IU/L (22.22%) (p<0.001).

Table 11: Distribution of neonates according to the complications and its association with LDH levels

LDH Levels (IU/L)	Neonatal complications				Total	
	No		Yes			
	No.	%	No.	%	No.	%
<600	59	93.65	4	6.35	63	63.00
600 to 800	44	93.62	3	6.38	47	47.00
> 800	20	64.52	11	35.48	31	31.00
Total	123	87.23	18	12.77	141	100.00

$p < 0.001$

In this study complications were significantly high in neonates who were born to the mothers with LDH levels of >800 IU/L (35.48%) compared to those who were born to the women with LDH levels between 600 to 800 IU/L (6.38%) and those with LDH levels < 600 IU/L (6.35%) (p<0.001).

Table 12: Distribution of neonates according to the neonatal mortality and its association with LDH levels

LDH Levels (IU/L)	Neonatal mortality				Total	
	No		Yes			
	No.	%	No.	%	No.	%
<600	63	100.00	0	0.00	63	63.00
600 to 800	47	100.00	0	0.00	47	47.00
> 800	21	67.74	10	32.26	31	31.00
Total	**131**	**92.91**	**10**	**7.09**	**141**	**100.00**

$p < 0.001$

In the present study neonatal mortality noted only in mothers with LDH levels of >800 IU/L (32.26%) (p<0.001).

Table 13: Distribution of neonates according to the gestational age and its association with LDH levels

LDH Levels (IU/L)	Gestational age				Total	
	Preterm		Term			
	No.	%	No.	%	No.	%
<600	1	1.59	62	98.41	63	63.00
600 to 800	7	14.89	40	85.11	47	47.00
> 800	13	41.94	18	58.06	31	31.00
Total	21	14.89	120	85.11	141	100.00

$p < 0.001$

In this study significantly higher number of neonates were preterm who were born to the mothers with LDH levels of >800 IU/L (41.94%) compared to those who were born to the women with LDH levels between 600 to 800 IU/L (14.89%) and those with LDH levels < 600 IU/L (1.59%) (p<0.001).

Discussion

In the present study maternal complications were noted in 32 women (21.19%) and atonic PPH was the common maternal complication noted 51.13% of the women followed by abruption (25%). Though, 25.53% of the women with SPE and 37.04% of the women with APE had complications, no association was found between maternal complications with severity of preeclampsia (p=0.051).

Further, In the present study significantly higher number of women with serum LDH levels > 800 IU/L had complications (36.59%) compared to women with LDH levels <600 IU/L (14.29%) and serum LDH levels between 600 to800 IU/L (17.02%) (p<0.017). These findings suggest that, women with raised serum LDH levels are likely to develop maternal complications. Studies by Qublan *et al.* [7] (2005) Demir SC *et al.* [8] (2006) and Martin JN *et al.* [9] (1999) all have also shown statistically significant relationship between maternal complications and high LDH values. [10] Martin JN *et al.* [9] (1999) reported that, a high serum level of LDH (>1,400 IU/l) were shown to have a high predictive value for significant maternal morbidity. Demir SC *et al.* [8] (2006) in their study concluded that there was a relationship between maternal complications and high LDH levels which was statistically significant. In a study by Hemalatha KR and Kittur S [10] (2018) from our hospital, perinatal morbidity was increased in women with higher LDH values, the perinatal death being 28%. In a study conducted by Umasatyasri *et al.* [11] (2015) they observed an increase in maternal morbidity with increasing serum LDH level. They observed that higher serum LDH levels were associated with increased incidence of maternal complications like abruptio placenta, renal failure, HELLP syndrome, cerebrovascular accidents etc. as is the case in the present study. Andrews L *et al.* [12] (2016) in their study had similar results.

In the present study maternal mortality was noted in eight women and the causes of mortality in two women each (25%) were abruption, DIC and intracranial bleed. Further, maternal mortality was significantly high in women with SPE (10.64%) and APE (11.11%) compared to normal pregnancy (0%) and mild preeclampsia (0%) (p=0.016). These finding suggest that, risk of maternal mortality is high in women with preeclampsia and it is directly associated with severity of preeclampsia. Furthermore, all the women had LDH levels of > 800 IU/L expired (p<0.001). These findings suggest that, women with LDH levels of > 800 IU/L and developing preeclampsia are at high risk of mortality. In a study by Qublan et.al.[7] (2005) and Jaiswar SP *et al.* [13] (2011) have also shown increase in perinatal mortality and morbidity in women with higher LDH values. Qublan *et al.* [7] (2005) noted perinatal death in 61.5%. Munagavasala S. *et al.* [14] reported that, maternal mortality was 13.8% in patients with LDH levels >800 IU/l and this was a significant rise (p=0.006), they concluded LDH levels have significant association with various maternal and fetal outcomes in patients of preeclampsia and eclampsia.

In this study significantly higher number of neonates born to the mother with APE had APGAR score of ≤7 at one minute (40.74%; p=0.016) and at five minutes (40.74%; p=0.015). Also the mean APGAR score at one minute (6.00±3.04; p=0.001) and at five minutes (6.29±2.90; p=0.004). These findings suggest that, neonates delivered by the mother who develop preeclampsia are likely to have significant morbidity in terms of lower APGAR score. Similarly significantly higher number of neonates born to the mothers with LDH levels of >800 IU/L had

APGAR score of <7 at one minute (83.87%; $p<0.001$) and five minutes (83.87%; $p<0.001$). These finding suggest that, neonates delivered by the women with raised LDH levels who develop preeclampsia are likely to have significant neonatal morbidity in terms of lower APGAR scores at one minute and five minutes and may require NICU admission. These findings could not be compared with other studies as there is lack of relevant data in the literature showing relationship between APGAR score and serum LDH in women with preeclampsia.

In this study neonatal complications were noted in 12.77% of the babies. Though, maximum number of babies who were born to the women with APE developed complications (22.22) compared to the babies who were born to the mothers with SPE (10.64%), MPE (7.41%) and normal pregnancy (10%) the difference was statistically not significant (p=0.271). Also complications were significantly high in neonates who were born to the mothers with LDH levels of >800 IU/L (35.48%) compared to those who were born to the women with LDH levels between 600 to 800 IU/L (6.38%) and those with LDH levels < 600 IU/L (6.35%) ($p<0.001$). Again these findings suggest that, neonates delivered by the women with raised LDH levels who develop preeclampsia are likely to develop complications and require NICU admission. Accordingly 28 neonates were admitted to NICU and prematurity and birth asphyxia were the common causes of NICU admission (42.86% each) followed by sepsis (14.29%). Furthermore, significantly higher number of neonates born to the mothers with LDH levels between 600 to 800 IU/L (67.74%) required NICU admission compared to those who were born to the women with LDH levels < 600 IU/L (6.35%) ($p<0.001$).

In the present study neonatal mortality was noted in 10 babies (7.09%). Further the neonatal mortality was significantly high in babies born to the mothers with MPE (18.2%), SPE (6.38%) and APE (7.41%) while no neonatal mortality was noted in mother with normal pregnancy (p=0.010). these finding propose strong association between neonatal mortality and preeclampsia. Similarly, neonatal mortality noted only in mothers with serum LDH levels of >800 IU/L (32.26%) ($p<0.001$). So there is significant risk of mortality in babies born to the mothers with serum LDH levels of >800 IU/L.

Conclusion

In our study, not just the maternal morbidity was significant but also the fetal outcome was poor in patients having high serum LDH levels. The mean birth weight of the babies was low and the percentage of live births was low in pregnant women with high LDH levels compared to controls. Moreover, the neonatal complications and neonatal deaths were high in percentage compared to normal group.

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