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RESEARCH ARTICLE

A correlation of lactate dehydrogenase (LDH) enzyme levels in hypertensive disorders of pregnancy with severity of disease, maternal and perinatal outcome

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ABSTRACT

Objectives: The objective of the study is to measure the lactate dehydrogenase enzyme (LDH) levels in pregnant women with hypertensive disorders of pregnancy and correlate the levels with the severity of disease, maternal and the perinatal outcome. **Methods:** In this prospective observational study, a total of 200 pregnant women were studied. Out of these 200 women, 100 were control and 100 were cases. 100 women had normal blood pressure, 33 women had non-severe preeclampsia, 30 women had severe preeclampsia and 37 women had eclampsia. The serum LDH levels were measured in third trimester and patients followed up until early postpartum period and babies were followed up till early neonatal period to assess the maternal and neonatal outcomes. **Results:** Higher lactate dehydrogenase enzyme (LDH) levels were observed in pregnant women with severe form of hypertensive disorder and those with high levels of LDH, a poor maternal and perinatal outcome was observed. This is statistically significant ($p<0.001$) showing the role of Serum lactate dehydrogenase as a predictor of adverse feto-maternal outcomes in cases of preeclampsia and eclampsia. **Conclusions:** Lactate dehydrogenase enzyme (LDH) level is a useful biochemical marker to assess and predict the severity of disease, maternal and perinatal outcome, as higher levels of the enzyme are associated with worsening severity of disease, a poor maternal and perinatal outcome.

Keywords: Eclampsia, LDH, outcome, severe preeclampsia.

Preeclampsia is a pregnancy-specific condition that is characterized by hypertension and proteinuria occurring after 20 weeks of gestation. It complicates 5–8% of all pregnancies [1]. Although the precise etiology of preeclampsia is not clear, defective placentation and endothelial dysfunction are considered the core features of pre-eclampsia. Various factors including genetic, racial, immunological, dietary, increased insulin resistance, increased oxidative stress, hypoxia, and prostaglandin imbalance have been linked to these abnormalities. It carries substantial risks for both fetus and mother with a subsequent increase in the perinatal and maternal morbidity and mortality [1, 2].

Lactate dehydrogenase (LDH) is an intracellular enzyme which converts pyruvic acid to lactic acid during the process of glycolysis. Glycolysis is the major energy pathway in the placenta. Hypoxia in preeclampsia further enhances glycolysis and increases LDH activity. Studies have shown that LDH activity and gene expression are higher in placentas of preeclampsia than normal pregnancy [3-5].

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Elevated levels of LDH are indicative of cellular damage and dysfunction, so it can be used as a biochemical marker because it reflects the severity of the disease, occurrence of complications and fetal outcome. Its estimation would prove useful because these complications are preventable. This can be further used as help in making decision, regarding the management strategies to improve the maternal and fetal outcome. We conducted a research with an aim to study the role of serum lactate dehydrogenase as a predictor of adverse feto-maternal outcomes in cases of pre-eclampsia and eclampsia

Methodology

A prospective comparative case control study was done in department of Obstetrics and Gynaecology between September 2016 to August 2018. In the present study 200 pregnant women in 3rd trimester admitted in labour room were included. Out of 200 subjects, 100 were normotensive healthy pregnant women as control group and remaining 100 were cases.

Women admitting in the labour room in third trimester for the purpose of delivery where the case was defined based on inclusion and exclusion criteria.

Inclusion Criteria: Healthy pregnant woman, pregnant woman with non-severe preeclampsia, pregnant woman with severe preeclampsia, pregnant woman with eclampsia.

Exclusion Criteria: Patient with essential hypertension, renal disease, epilepsy, chronic hypertension, diabetes mellitus, liver disorders, thyroid disease, multiple pregnancy, haemolytic anemias.

Cases were also divided according to the serum LDH levels into following groups: 1)<600 IU/L, 2)600 - 800 IU/L, 3) >800 IU/L. Control group was defined as healthy normotensive pregnant women admitting to labour room in third trimester for the purpose of delivery. Control group was matched as regards to age, parity, sociodemographic status, gestational age with cases.

Complete obstetric history, general physical examination and systemic examination were carried out on specially designed proforma. Written informed consent from all participants recruited in study was taken after they had been made aware of purpose of study. Subjects in control and study group underwent detailed clinical examination and all the relevant investigations including renal function tests, liver function tests, serum LDH were performed. Plain blood sample was collected for analysis of LDH which was done in fully automated biochemical analyser. All women were followed up until delivery and early postpartum period and their babies were followed up till early neonatal period. Patients were followed up in terms of maternal outcome (Eclampsia, HELLP syndrome, mode of delivery, etc) and fetal outcome (birth weight, preterm birth, Apgar score at 1 and 5 min, NICU admissions etc).

Statistical analysis**:** Data were entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation (SD). ANOVA (Analysis of variance) was the test of significance to identify the mean difference between more than two groups for quantitative data. P value (probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests. Statistical software: MS Excel, SPSS version 22 (IBM SPSS Statistics, Somers NY, USA) was used to analyse data.

Results

The present study was carried out on 200 cases, admitted in the department of Obstetrics and Gynaecology at a tertiary care hospital. These cases were studied thoroughly regarding incidence, demographic characteristics, blood pressure on admission, laboratory findings, complications, maternal death, neonatal weight and fetal outcome. In present study there was no significant difference between cases and controls according to age, gravidity, gestational age and

Table 1: Demographic details of the study population

Categories	Normal N=100	Non-severe N= 33	Severe N=30	Eclampsia N=37	P value
Mean age	25.87±3.702	25.87±3.776	24.8±3.89	26.3±3.743	0.167
Primigravida	65 (65.0%)	17 (51.5%)	16 (53.3%)	22 (59.5%)	0.193
Mean GA	37.806±2.465	36.671±3.301	34.8 +2.12	33.74±3.244	< 0.001
Booked	39 (39.0%)	12 (36.4%)	8 (26.7%)	8 (21.6%)	0.217
Unbooked	61 (61.0%)	21 (63.6%)	22 (73.3%)	29 (78.4%)	
$\chi 2$ =15.96,	GA = Gestational age				

Table 2: Distribution of cases according to serum LDH levels

LDH IU/L	Normal N=100	Non-severe N= 33	Severe N=30	Eclampsia N=37
<600	100 (100%)	31 (93.9%)	14 (46.7%)	6 (16.2%)
600-800	0	2 (6.1%)	10(33.3%)	10 (27.0%)
>800	0	0 (0%)	06(10%)	21(56.8%)
$\chi 2$ =134.11, df =6, P <0.001*				

booking status (table 1). All normal or cases taken as control had levels of LDH<600 IU/L. Group II with LDH 600-800 IU/L had preeclampsia and eclampsia cases and no normal cases. Group III (LDH >800 IU/L) had majority of eclampsia cases. Therefore, it is clearly seen that there is a significant rise in LDH levels with increasing severity of disease (table 2). In the study there was significant difference in mean Hb, platelet count, SGPT, serum creatinine and serum bilirubin between LDH groups. With increase in LDH levels there was decrease in Hb%, platelet count and increase in SGPT, serum creatinine and serum bilirubin levels. In the study there was significant association between LDH and SBP distribution. Those with higher LDH levels had higher SBP levels. In the study there was significant association between LDH and DBP distribution. On statistical analysis it was found that high diastolic BP was associated with higher levels of serum LDH (P < 0.001) (table 3). In the study there was significant association between LDH and mode of delivery. Those with higher levels of LDH underwent LSCS (table 4). In the study there was significant association between LDH levels with LBW, NICU, IUGR, IUD, neonatal death. Higher levels of LDH had high incidence of LBW, NICU admission, IUGR, IUD, neonatal deaths and ARDS (table 5). In this study there was significant association between LDH levels with HELLP, PPH, ARF, abruptio placenta, DIC, CVA, pulmonary edema, ARDS, sepsis, MODS, ventilator and death. Those with higher levels of LDH had higher incidence of HELLP, PPH, ARF, abruptio placenta, DIC, CVA, pulmonary edema, ARDS, sepsis, MODS, ventilator and death (table 6).

Table 3: **Clinical/lab parameters of the study population**

Categories	LDH < 600	LDH 600-800	LDH> 800	P value
Mean systolic BP (mm of Hg)	130.53 ± 17.32	154.27 ± 7.69	160.52 ± 14.45	χ 2 =69.466, df =4, p <0.001*
Mean diastolic BP (mm of Hg)	87.72 ± 13.86	107 ± 7.27	109.48 ± 9.78	χ 2 =71.953, df =4, p <0.001*
Hb (mean)	10.51±1.21	9.75±1.67	7.44±1.67	<0.001*
Platelet (mean)	78279.56±12. 23	14259.91±22.43	54296.30±129.21	0.004*
SGPT(mean)	22.77±4.71	43.14±31.6	122.15±67.65	<0.001*
Serum bilirubin (mean)	0.75±0.96	1.27+-0.85	6.74±1.60	0.009*
Serum creatinine (mean)	0.81±0.56	0.83±0.31	2.21±1.14	<0.001*

Table 4: Mode of delivery in the study population

Mode of delivery	LDH<600	LDH 600-800	LDH > 800	Total
Vaginal	120 (79.5%)	13 (59.1%)	5 (18.5%)	138 (69.0%)
LSCS	30 (19.9%)	9 (40.9%)	22(21.5%)	61 (31.5%)
Instrumental	1 (0.7%)	0 (0.0%)	0 (0.0%)	1 (0.5%)
χ 2 =42.39, df =4, P <0.001*				

Table 5: Neonatal outcome in study population

Neonatal outcome	LDH<600	LDH 600-800	LDH > 800	Total	P value
Apgar at 5min <7	0 (0%)	3 (18.8%)	3 (30.0%)	6 (3.5%)	<0.001
NICU admission	13 (8.6%)	13 (59.1%)	7 (25.9)	33(16.5%)	<0.001
LBW	23 (15.2%)	15 (68.2%)	24 (88.9%)	62(31.0%)	<0.001
IUGR	4 (2.6%)	4 (18.2%)	6 (22.2)	14(7.0%)	<0.001
IUFD	5 (3.3%)	5 (22.7%)	18 (66.7%)	28 (14.0%)	<0.001
Neonatal death	0 (0.0%)	2 (9.1%)	1 (3.7%)	3 (1.5%)	0.003
ARDS	2 (1.3%)	0(0.0%)	1 (3.7%)	3(1.5%)	0.534

NICU - Neonatal intensive care unit, LBW - Low birth weight, IUGR - Intrauterine growth restriction, ARDS - Acute respiratory distress syndrome

Discussion

Hypertensive disorders of pregnancy and their complications rank as one of the major causes of maternal mortality and morbidity in the world after obstetric haemorrhage. A total 200 individuals constituted the study population. Preeclampsia is a vascular endothelial disorder with varying degrees of involvement of multiple organs. Among the study population 37 (18.50%) had eclampsia, 30 (15%) had severe preeclampsia and 33 (16.50%) had non-severe preeclampsia. Serum LDH levels were correlated with maternal and fetal outcome in preeclampsia.

Most of the patients belonged to younger age group and were nulliparous. This finding was also observed by Jaiswar

Table 6: Maternal outcome of the study population

Maternal outcome	LDH<600	LDH 600-800	LDH > 800	Total	P value
HELLP	1(0.7%)	4 (18.2%)	21 (77.8%)	26 (13.0%)	<0.001
PPH	6 (4.0%)	6 (27.3%)	12(44.4%)	24(12.0%)	<0.001
ARF	1 (0.7%)	0(0.0%)	14 (51.9%	15(7.5%)	<0.001
Abruptio placenta	3(2.0%)	4 (18.2%)	18 (66.7%)	25 (12.5%)	<0.001
DIC	2(1.3%)	4 (18.2%)	19 (70.4%)	25 (12.5%)	<0.001
ARDS	0 (0.0%)	0(0.0%)	2(7.4%)	2 (1.0%)	<0.001
Pulmedema	0(0.0%)	0 (0.0%)	6 (22.2%)	6(3.0%)	<0.001
Sepsis	0(0.0%)	0 (0.0%)	9 (33.3%)	9(4.5%)	<0.001
MODS	0(0.0%)	0(0.0%)	6 (22.2%)	6(3.0%)	<0.001
Ventilator	1(0.7%)	5(22.7%	21(77.8%)	27(13.5%)	<0.001
CVA	0 (0.0%)	0(0.0%)	5(18.5%)	5 (2.5%)	<0.001
Death	0(0.0%)	0(0.0 %)	5(18.5%)	5 (2.5%)	<0.001

PPH - Postpartum haemorrhage, ARF - Acute renal failure, DIC - Disseminated intravascular coagulopathy, MODS - Multiple organ dysfunction syndrome, CVA - Cardiovascular accident.

SP et al, [6] Umasatyasri Y et al ,[7] where the mean age of normal controls was 30 years and those with severe preeclampsia was significantly younger with low parity. As our hospital is a tertiary referral center, majority of the cases are referral cases. Hence unbooked status is more common in our center. In our study 78.4% of eclampsia were admitted as emergency admissions whereas 61% of normotensive patients were admitted in emergency (table 1).

In the current study the mean LDH for the normal cases were 280.98 ± 92.05 mg/dl. The mean LDH level was 485.15 ± 71.29 mg/dl in non-severe preeclampsia, it was 646.79 ± 149.01 mg/dl in severe preeclampsia and 917.91 ± 369.38 mg/dl in eclampsia. The study found that the mean LDH level was significantly increasing according to the severity of preeclampsia(P <0.05).These findings were consistent with other studies. Qublan S et al [8] reported that LDH is a biochemical marker predicting adverse pregnancy outcomes in severe pre-eclampsia patients. In his study, an LDH level >600 IU/L was seen in 54.8 % of severe pre-eclampsia and 12.2 % of mildly pre-eclampsia cases. This can be explained on the basis of hypoxia theory in hypertensive disorders of pregnancy. As the severity of hypoxia increases in hypertensive disorders of pregnancy, LDH activity increases. The biological consequences of increased lactate levels within the placenta resulting from increased lactate dehydrogenase activity in preeclampsia results in the unfavourable environment for the fetus. Hence it can be very well correlated with the perinatal outcome and severity of the disease [9,10] (table 2).

Systolic and diastolic BP were significantly higher in patients with higher serum LDH levels (P < 0.001). Among the group with <600 IU/L LDH level, 108 (71.5%) participants had below 140 mmHg systolic blood pressure, 39 (25.8%) had 140 to 160 mmHg systolic blood pressure and 4 (2.6%) had >160 mmHg systolic blood pressure. Among the group with 600 to 800 IU/L LDH level, 1 (4.5%) participant had below 140 mmHg systolic blood pressure, 17 (77.3%) had 140 to 160 mmHg systolic blood pressure and 4 (18.2%) had >160 mmHg systolic blood pressure. Among the group with >800 LDH level, 3 (11.1%) participants had below 140systolic blood pressure, 16 (59.3%) had 140 to 160 mmHg systolic blood pressure and 8 (29.6%) had >160 mmHg systolic blood pressure. The difference in the proportion of systolic blood pressure level across LDH level was statistically significant (P value <0.001) (table 3). Among the group with <600 IU/L LDH level, 97 (64.2%) participants had below 90 mmHg diastolic blood pressure, 48 (31.8%) had 90 to 110 mmHg diastolic blood pressure and 6 (4%) had >110 mmHg diastolic blood pressure. Among the group with 600 to 800 IU/L LDH level, 1 (4.5%) participant had below 90 mmHg diastolic blood pressure, 16 (72.7%) had 90 to 110 mmHg diastolic blood pressure and 5 (22.7%) had >110 mmHg diastolic blood pressure. Among the group with >800 IU/L LDH level, 1 (3.7%) participants had below 90 mmHg diastolic blood pressure, 14 (51.9%) had 90 to 110 mmHg diastolic blood pressure and 12 (44.4%) had >110 mm hg diastolic blood pressure. The difference in the proportion of diastolic blood pressure level across control and case group was statistically significant (P value <0.001).

The mean haemoglobin of the subject in normal (control) group was 10.67 ± 1.16 g/dl, it was 9.93 ± 1.2 g/dl in non-severe preeclampsia group, it was 9.46 ± 1.98 g/dl in severe preeclampsia and 8.75 ± 2.13g/dl in eclampsia. Taking normal as baseline, the difference in the haemoglobin across the study group was statistically significant (P value <0.001). This finding was contradictory to the concept of

vasoconstriction in PIH [10]. But as we studied and analysed the study in detail, we found out that the cases of abruptio placentae and DIC were more in the severe preeclampsia and eclampsia cases. In present study mean serum creatinine was 1.25±0.78mg/dl in non-severe preeclampsia group, 1.57 ± 1.20 in severe preeclampsia, 1.99 ± 0.87 in eclampsia group. It is statistically significant (p <0.001). As severity of disease increases, there is falling glomerular filtration rate and consequently increase in serum creatinine levels are found in cases with increased LDH levels [3] (table 3).

The proportion of normal vaginal delivery was 79%, 72.72%, 50% and 32.43% respectively among the normal, non-severe preeclampsia, severe preeclampsia and eclampsia groups. The difference in the proportion of normal vaginal delivery across the study groups was statistically significant (P value <0.001) (table 4) .The proportion of caesarean sections was 20%, 21.21%, 43.33% and 59.45% respectively among the normal, non-severe preeclampsia, severe preeclampsia and eclampsia groups. The difference in the proportion of caesarean section across the study groups was statistically significant (P value <0.001). This may be since as the severity of the disease increases, the maternal and fetal morbidity also increases as time passes.

The mean Apgar scores were significantly reduced at 5 min, in the present study, showing mild to severe depression of the new born baby with increasing LDH levels (P < 0.001) for Apgar score at 5 min. Jha N et al [11] reported that the mean APGAR score was significantly (P value<0.05) reduced at 5 (6.25 ±1.37) with higher serum LDH level. Increase in the incidence of perinatal deaths was observed by Dave et al. [13] in patients with increasing levels of serum LDH levels (P < 0.001). Intrauterine fetal death was seen in 4.8% of cases, intrauterine growth restriction in 33.9% and prematurity in 77.9%. Neonatal deaths were reported in 95.2% in severe preeclampsia group. Similar findings were obtained in the present study showing significant increase in neonatal complications (P = 0.003). In the current study the proportion of NICU admission was 7.95%, 50% and 25.93% respectively among the <600 IU/L LDH level, 600 to 800 IU/L LDH level and >800 IU/L LDH level. The difference in the proportion of NICU admission, across the three group was statistically significant (P value <0.001). Jha N et al [11], Jaiswar SP et al [6] and Dave A et al [12] studies found a similar association in their study. This can well be explained on the basis of hypoxic and unfavourable intrauterine environment with rising levels of LDH and hence a poor perinatal outcome (table 5). In current study the proportion of IUD was 3.31%, 22.72% and 66.67% respectively among the <600 IU/L LDH level, 600 to 800 IU/L LDH level and >800 IU/L LDH level. Intrauterine death was significantly higher when the LDH level was >800 IU/l (P value <0.001). The theory of vasoconstriction explains these phenomena of IUD.

Severely pre-eclamptic women with LDH levels of >800 IU/l showed a significant increase in complications in terms of eclampsia, abruption placenta and various other complications compared to women who had lower serum LDH levels, in the study of Qublan et al. [8]. A high serum level of LDH (>1,400 IU/l) were shown to have a high predictive value for significant maternal morbidity in a study conducted by Fabry et al.[13] Sarmah J et al[14] reported a subgroup of patients who had elevated levels of LDH manifested with hemolysis, elevated liver enzymes, low platelet count (HELLP) syndrome and were at a high risk for developing maternal mortality. Demir et al.[15] concluded that there was a statistically significant relation between maternal complications and high LDH levels. It was noted that in early onset severe preeclampsia, LDH levels before delivery were significantly higher in the abruption group Bera S, Gupta et al. [16]

Higher serum LDH levels were associated with increased incidence of maternal complications like abruption placenta, renal failure HELLP syndrome, cerebrovascular accidents etc. in the present study (table 6). There was a significant increase in maternal morbidity with increasing serum LDH levels (P < 0.001). Maternal mortality was 18.5% in patients with LDH levels >800 IU/l and this was a significant rise (P <0.05) which was comparable with other studies. Similar results were found bt Sarkar et al in their study [17].

Pre-eclampsia is considered an idiopathic multisystem disorder that is specific to pregnancy. A complex of endocrinological mechanisms is believed to be responsible for the multiorgan dysfunction. In order to prevent it, we must diagnose the disease at its earliest. The triad of high blood pressure, oedema and albuminuria is neither specific nor sensitive; therefore, the search is on for a reliable marker. In the present study, LDH has been evaluated as a biochemical marker for preeclampsia and as a prognosticator of the disease severity. Detection of high-risk patients with increased levels of LDH mandate close monitoring, prompt and correct management to prevent both maternal and fetal morbidity and mortality.

Conclusion

High serum LDH levels have significant association with severity of disease and maternal and fetal outcomes in

patients of preeclampsia and eclampsia and can be considered as a supportive prognostic tool from early third trimester.

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