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ASSOCIATION OF SERUM BIOMARKERS WITH SEVERITY AND OUTCOMES OF ECLAMPSIA IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Eclampsia remains a major cause of maternal and perinatal morbidity and mortality in low- and middle-income countries. Early identification of women at risk of severe disease using easily available biochemical markers is crucial for appropriate management. This study aimed to evaluate the association of commonly measured serum biomarkers with the severity of eclampsia and related maternal and perinatal outcomes.

Methods: A cross-sectional observational study was conducted among 85 eclamptic women admitted to a tertiary care hospital between January and December 2024. Clinical data, biochemical parameters including LDH, uric acid, platelet count, AST, ALT, and serum creatinine were recorded. Disease severity was classified as mild–moderate or severe based on clinical and laboratory features. Maternal and perinatal outcomes were compared across biomarker categories. Data were analyzed using descriptive statistics, Chi-square test, and $p < 0.05$ was considered statistically significant.

Results: Elevated LDH (≥600 IU/L) was present in 49.41% of the participants and was significantly associated with severe eclampsia (67.74% vs. 31.48%; $p = 0.001$). Thrombocytopenia (<1,00,000/mm³) also showed a significant association with severe disease (22.58% vs. 7.41%; $p = 0.043$). Elevated uric acid, AST, ALT, and creatinine levels were more common in severe cases but did not reach statistical significance. High LDH levels were associated with recurrent seizures, ICU admission, acute kidney injury, and DIC. Severe eclampsia was linked to higher rates of preterm birth (61.29%), low birth weight (64.52%), and low 5-minute Apgar scores (35.48%).

Conclusion: LDH elevation and thrombocytopenia are strong predictors of severe eclampsia and adverse maternal outcomes, while other biochemical markers show limited utility when interpreted in isolation. Incorporating LDH and platelet count into routine clinical evaluation may enhance early risk stratification and improve maternal and perinatal outcomes, particularly in resource-limited settings.

Keywords: *Eclampsia; Serum biomarkers; LDH; Thrombocytopenia; Maternal outcomes; Perinatal outcomes; Hypertensive disorders of pregnancy.*

Introduction

Eclampsia is one of the most severe hypertensive disorders of pregnancy and continues to be a major contributor to maternal morbidity and mortality worldwide. Globally, hypertensive disorders account for nearly 14% of all maternal deaths [1]. According to the World Health Organization (WHO), eclampsia remains a significant cause of adverse maternal outcomes in low-resource settings where delays in diagnosis and management are common [2]. In India, the burden is disproportionately high, with an estimated 1.5–2% of all pregnancies affected by eclampsia and a considerable case-fatality rate [3].

Although the exact pathophysiology of eclampsia is not completely understood, endothelial dysfunction, oxidative stress, abnormal placentation, and systemic inflammatory responses are recognized as major contributors to disease progression [4]. These pathophysiological changes lead to widespread multi-organ involvement, manifesting as hepatic, renal, hematological, neurological, and vascular complications.

Serum biomarkers such as lactate dehydrogenase (LDH), uric acid, platelet count, serum creatinine, and liver transaminases (AST/ALT) are frequently utilized to assess disease progression and identify severe cases early. Elevated LDH levels represent cellular injury and hemolysis, while increased uric acid levels reflect oxidative stress and impaired renal function. Thrombocytopenia and elevated liver enzymes are indicators of severe disease, often associated with HELLP syndrome and adverse clinical outcomes [5]. Previous studies have reported a strong association between deranged biochemical parameters and maternal–fetal complications, including seizure recurrence, placental abruption, ICU admission, and perinatal mortality [6].

Early recognition and interpretation of serum biomarkers can greatly aid clinicians in predicting disease severity, planning timely interventions, and reducing maternal and perinatal morbidity. Hence, assessing the association of these biomarkers with the severity of eclampsia is crucial for improving clinical decision-making, particularly in resource-limited settings.

The present study aims to evaluate the relationship between commonly measured serum biomarkers and the severity of eclampsia among pregnant women admitted to a tertiary care hospital, with the objective of identifying reliable biochemical indicators for early detection of severe disease.

Methodology

This hospital-based cross-sectional observational study was conducted in the Department of Obstetrics and Gynaecology at a tertiary care teaching institute over a period of one year, from January 2024 to December 2024. All pregnant women diagnosed with eclampsia and admitted to the labour ward, emergency obstetric unit, or ICU were screened for eligibility. Eclampsia was defined as the occurrence of one or more generalized tonic-clonic seizures in a woman with pre-eclampsia, in accordance with standard WHO diagnostic criteria. Women with known seizure disorders, epilepsy, metabolic seizures, or incomplete medical records were excluded. Based on an anticipated prevalence of elevated LDH in severe eclampsia of 70%, with a 10% margin of error and 95% confidence interval, the minimum required sample size was calculated to be 81 participants; however, to increase the study's power and account for attrition, a final sample size of 85 consecutive eligible eclamptic women admitted during the study period was included. Detailed clinical, demographic, and obstetric data were collected from patient case sheets, labour ward records, and electronic medical records using a structured proforma.

Venous blood samples collected at admission as part of routine evaluation were used to obtain laboratory parameters including serum LDH, uric acid, platelet count, serum creatinine, AST, and ALT. Severity of eclampsia was classified based on clinical features, laboratory abnormalities, and maternal complications as per ACOG/WHO guidelines. Biomarker values were categorized into normal, mild elevation, and severe elevation according to institutional laboratory reference ranges. Maternal outcomes assessed included recurrence of seizures, ICU admission, HELLP syndrome, DIC, placental abruption, acute kidney injury, and maternal mortality. Perinatal outcomes included gestational age at delivery, birth weight, NICU admission, and perinatal mortality. Data were entered in Microsoft Excel and analyzed using SPSS version 26. Descriptive statistics were presented as mean ± SD or proportions. Associations between biomarker levels and severity of eclampsia were assessed using Chi-square test, t-test, and ANOVA as appropriate, and a p-value < 0.05 was considered statistically significant.

Results

Table 1. Socio-demographic and obstetric characteristics (n = 85)

Variable	Category	n	%
Age (years)	<20	12	14.12%
	20–24	32	37.65%
	25–29	26	30.59%
	≥30	15	17.65%
Residence	Rural	58	68.24%
	Urban	27	31.76%
Gravida	Primigravida	53	62.35%
	Multigravida	32	37.65%
Gestational age	<34 weeks	21	24.71%
	34–37 weeks	38	44.71%
	>37 weeks	26	30.59%
ANC visits	None	17	20.00%
	<4 visits	40	47.06%
	≥4 visits	28	32.94%
Referral status	Referred	56	65.88%
	Direct	29	34.12%

The socio-demographic and obstetric profile of the 85 eclamptic women included in the study is presented in Table 1. The majority belonged to the 20–24 year age group (37.65%), followed by 25–29 years (30.59%), while adolescents (<20 years) constituted 14.12% of the cases. Most participants were from rural areas (68.24%), and nearly two-thirds were primigravida (62.35%). Regarding gestational age at admission, 44.71% presented between 34–37 weeks, 30.59% were term (>37 weeks), and 24.71% were below 34 weeks of gestation. Antenatal care utilization was suboptimal, with 47.06% having fewer than four ANC visits and 20.00% having received no antenatal care at all. A significant proportion of women (65.88%) were referred from peripheral health facilities, while only 34.12% were direct admissions to the tertiary center.

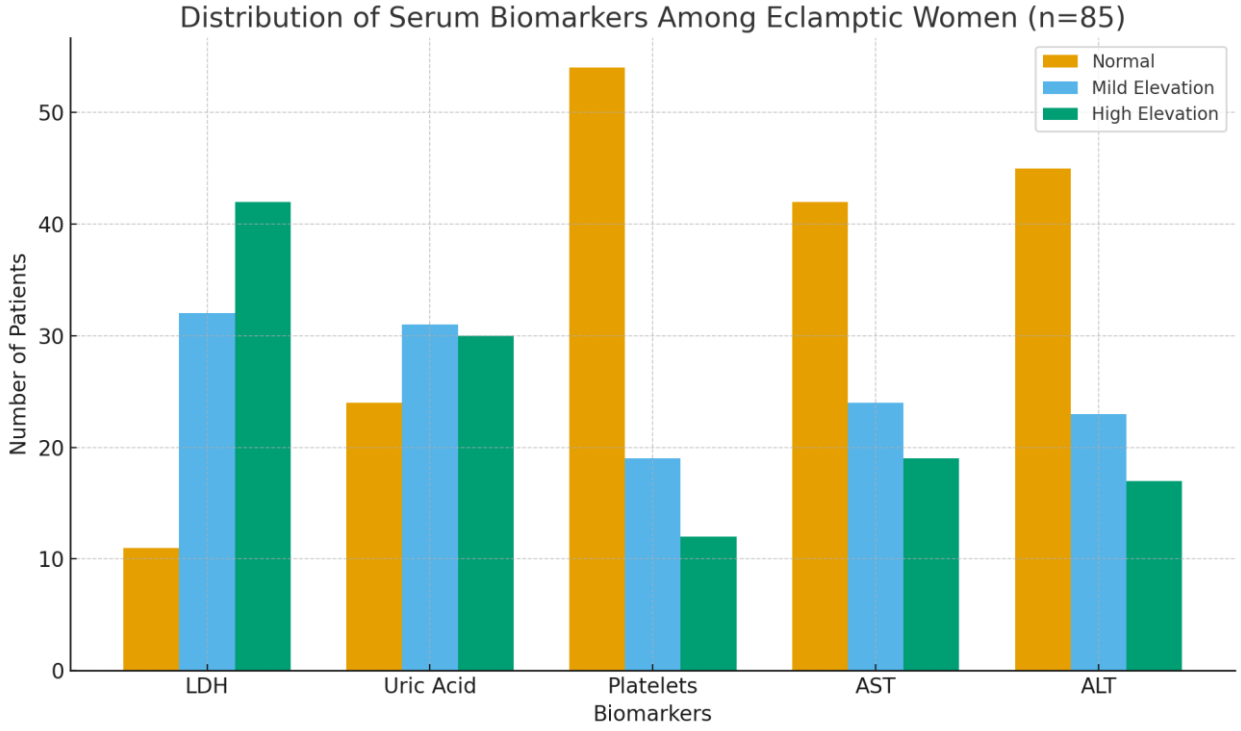
Table 2. Distribution of serum biomarkers (n = 85)

Biomarker	Mean ± SD	Normal n (%)	Mild ↑ n (%)	High ↑ n (%)
LDH (IU/L)	618 ± 205	11 (12.94%)	32 (37.65%)	42 (49.41%)
Uric acid (mg/dL)	6.58 ± 1.29	24 (28.24%)	31 (36.47%)	30 (35.29%)

Biomarker	Mean ± SD	Normal n (%)	Mild ↑ n (%)	High ↑ n (%)
Platelets (/mm³)	1,51,800 ± 54,920	54 (63.53%)	19 (22.35%)	12 (14.12%)
AST (U/L)	55.92 ± 27.44	42 (49.41%)	24 (28.24%)	19 (22.35%)
ALT (U/L)	53.41 ± 25.12	45 (52.94%)	23 (27.06%)	17 (20.00%)
Serum creatinine (mg/dL)	1.05 ± 0.33	71 (83.53%)	10 (11.76%)	4 (4.71%)

Table 2 describes the distribution of serum biomarkers among the 85 eclamptic women included in the study. LDH levels were markedly elevated, with nearly half of the participants (49.41%) showing high LDH values and an additional 37.65% showing mild elevation, reflecting significant tissue injury and hemolysis. Uric acid was also raised in a substantial proportion, with 36.47% having mild elevation and 35.29% showing markedly elevated levels. Thrombocytopenia was observed in 14.12% of the women, while 22.35% had borderline low platelet counts. Liver enzymes demonstrated a similar pattern, with AST elevated in 50.59% and ALT elevated in 47.06% of the cases, indicating hepatic involvement.

Fig 1- Distribution of Serum Biomarkers Among Eclamptic Women



Serum creatinine levels were largely within normal limits for most patients (83.53%), while only a small proportion showed mild (11.76%) or high (4.71%) elevation, suggesting that significant renal impairment was less frequent. Overall, LDH and uric acid were the most commonly deranged biomarkers among the study population.

Table 3. Association of biomarkers with severity of eclampsia (n = 85)

Biomarker	Mild/Moderate (n=54) n (%)	Severe (n=31) n (%)	p-value
LDH ≥600 IU/L	17 (31.48%)	21 (67.74%)	**0.001**
Uric acid >7 mg/dL	13 (24.07%)	12 (38.71%)	0.139
Platelets <1,00,000/mm³	4 (7.41%)	7 (22.58%)	**0.043**
AST >70 U/L	10 (18.52%)	10 (32.26%)	0.144
Creatinine >1.5 mg/dL	2 (3.70%)	2 (6.45%)	0.597

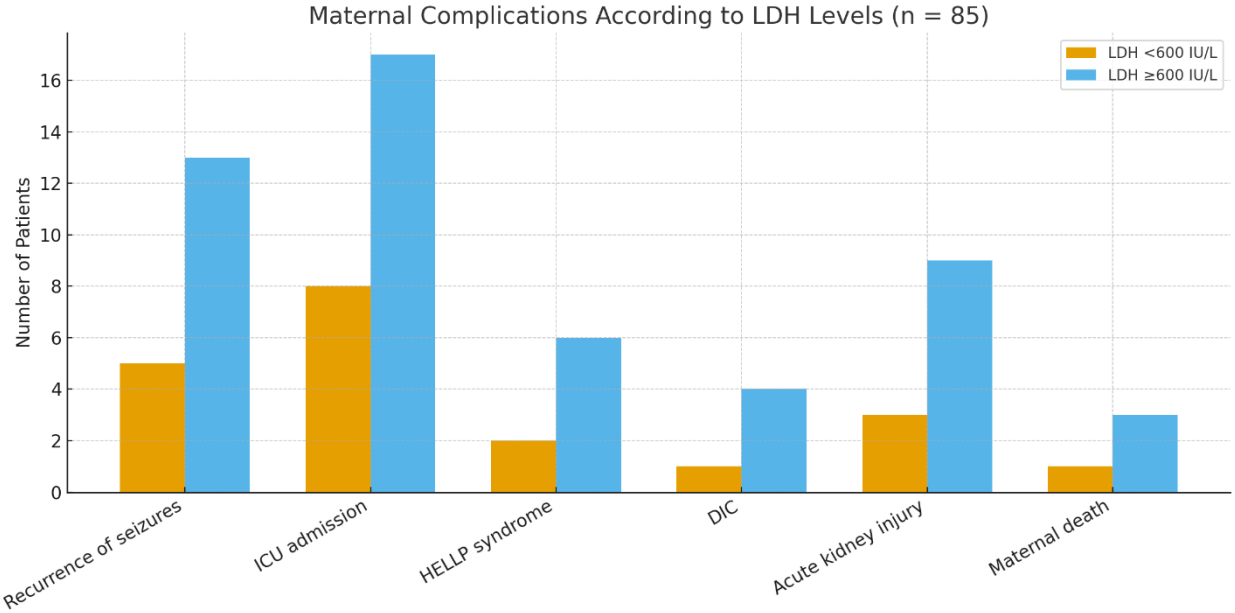
Table 3 shows the association between various serum biomarkers and the severity of eclampsia among the study participants. Elevated LDH levels (≥600 IU/L) were significantly more common in women with severe eclampsia (67.74%) compared to those with mild or moderate disease (31.48%), with a highly significant association (p = 0.001). Thrombocytopenia, defined as a platelet count <1,00,000/mm³, was also significantly associated with severe eclampsia, occurring in 22.58% of severe cases versus 7.41% of mild/moderate cases (p = 0.043). Although elevated uric acid (>7 mg/dL) and raised AST (>70 U/L) were more frequent among severe eclampsia cases (38.71% and 32.26%, respectively), these differences did not reach statistical significance (p = 0.139 and p = 0.144). Elevated serum creatinine (>1.5 mg/dL) was uncommon in both groups and showed no meaningful association with disease severity (p = 0.597). Overall, LDH elevation and thrombocytopenia emerged as the most reliable biomarkers correlating with severe eclampsia in this cohort.

Table 4. Maternal complications according to LDH level (n = 85)

Complication	LDH <600 n (%)	LDH ≥600 n (%)	p-value
Recurrence of seizures	5 (11.63%)	13 (30.95%)	**0.027**
ICU admission	8 (18.60%)	17 (40.48%)	**0.018**
HELLP syndrome	2 (4.65%)	6 (14.29%)	0.135
DIC	1 (2.33%)	4 (9.52%)	0.164
Acute kidney injury	3 (6.98%)	9 (21.43%)	**0.049**
Maternal death	1 (2.33%)	3 (7.14%)	0.320

Table 4 presents the distribution of maternal complications according to LDH levels in the study population. Women with LDH ≥600 IU/L experienced a higher frequency of adverse outcomes compared to those with lower LDH levels. Recurrence of seizures was significantly more common in the high-LDH group (30.95% vs. 11.63%; p = 0.027), as was the need for ICU admission (40.48% vs. 18.60%; p = 0.018). Acute kidney injury also showed a significant association, occurring in 21.43% of women with elevated LDH compared to 6.98% in the lower LDH group (p = 0.049).

Fig 2- Maternal Complications According to LDH Levels



Although HELLP syndrome and DIC were observed more frequently among women with high LDH values (14.29% and 9.52%, respectively) than in those with lower levels (4.65% and 2.33%), these differences were not statistically significant. Maternal mortality remained low overall and did not

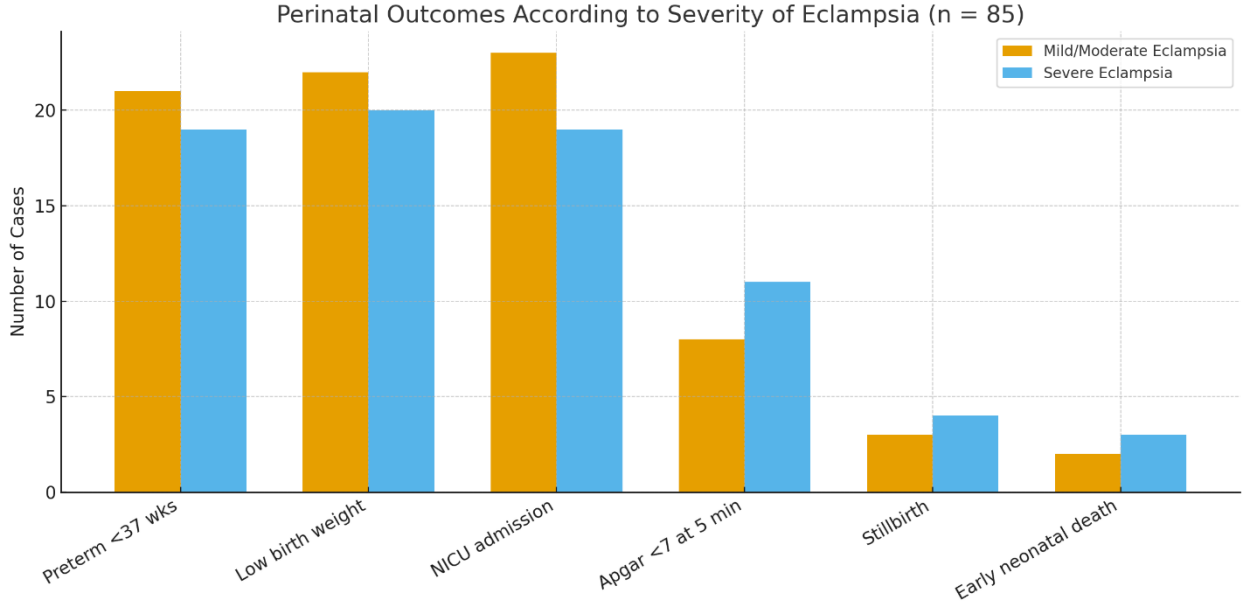
show a significant relationship with LDH levels (p = 0.320). Overall, elevated LDH was strongly associated with more severe maternal complications, underscoring its role as an important prognostic marker in eclampsia.

Table 5. Perinatal outcomes according to severity (n = 85)

Outcome	Mild/Moderate (n=54) n (%)	Severe (n=31) n (%)	p-value
Preterm <37 wks	21 (38.89%)	19 (61.29%)	**0.041**
Low birth weight	22 (40.74%)	20 (64.52%)	**0.033**
NICU admission	23 (42.59%)	19 (61.29%)	0.106
5-min Apgar <7	8 (14.81%)	11 (35.48%)	**0.032**
Stillbirth	3 (5.56%)	4 (12.90%)	0.228
Early neonatal death	2 (3.70%)	3 (9.68%)	0.238

Table 5 outlines the perinatal outcomes in relation to the severity of eclampsia among the study participants. Preterm delivery was significantly more common in women with severe eclampsia (61.29%) compared to those with mild or moderate disease (38.89%) (p = 0.041). Similarly, low birth weight was observed in a higher proportion of severe cases (64.52% vs. 40.74%; p = 0.033), highlighting the substantial impact of disease severity on fetal growth. A greater proportion of neonates born to mothers with severe eclampsia required NICU admission (61.29% vs. 42.59%), although this difference did not reach statistical significance (p = 0.106).

Fig 3- Perinatal Outcomes According to Severity of Eclampsia



Poor neonatal condition at birth, indicated by a 5-minute Apgar score <7, was significantly more frequent in the severe group (35.48%) than in the mild/moderate group (14.81%) (p = 0.032). Stillbirths and early neonatal deaths were also more common among women with severe eclampsia, but the differences were not statistically significant. Overall, severe eclampsia was associated with markedly poorer perinatal outcomes, especially in terms of prematurity, low birth weight, and immediate neonatal condition.

DISCUSSION

In this cross-sectional study of 85 women with eclampsia, we found that elevated serum LDH and thrombocytopenia were significantly associated with severe disease and with higher rates of maternal and perinatal complications. These findings reinforce the growing evidence that biochemical markers of cellular injury, endothelial dysfunction, and hematological derangement

play a pivotal role in determining the severity and outcomes of hypertensive disorders of pregnancy. LDH was the most consistently deranged biomarker in our study, with nearly half of the participants exhibiting values ≥600 IU/L. Several Indian and international studies have similarly reported that elevated LDH is a strong indicator of disease severity, hemolysis, and multi-organ involvement, and correlates with adverse maternal outcomes such as seizures, ICU admission, and organ dysfunction [7,8].

Although uric acid elevation was common in our cohort, its association with severe eclampsia did not reach statistical significance. This aligns with recent observations suggesting that uric acid may be less reliable as an isolated prognostic marker compared to LDH or platelet count, despite its traditional role in the assessment of preeclampsia [9]. Platelet counts <1,00,000/mm³, however, were significantly associated with severe disease in our study, reflecting the known importance of thrombocytopenia in predicting HELLP syndrome, DIC, and poor outcomes. This is consistent with earlier studies that have identified platelet count as a key hematological marker in hypertensive disorders of pregnancy [10].

Maternal complications such as ICU admission, recurrent seizures, acute kidney injury, and DIC were significantly more common among women with high LDH levels. These observations are in line with reports from tertiary centers in India, where LDH has been shown to be one of the strongest biochemical predictors of maternal near-miss events and mortality in eclampsia [11]. The relatively low maternal mortality in our cohort, despite substantial morbidity, may reflect improvements in early identification, referral, and critical care management.

Perinatal outcomes were also significantly affected by disease severity. Severe eclampsia was associated with higher rates of preterm birth, low birth weight, and poor 5-minute Apgar scores. Similar findings have been widely reported, as endothelial dysfunction and placental insufficiency in severe hypertensive disorders directly impair fetal growth and oxygenation [12]. Although stillbirth and early neonatal death rates were higher in the severe group, these did not reach statistical significance, possibly due to the modest sample size. Nonetheless, the pattern mirrors national data showing disproportionately high perinatal mortality among pregnancies complicated by severe preeclampsia and eclampsia [13-18].

Overall, our findings support the clinical utility of LDH and platelet count as reliable biomarkers for risk stratification in eclampsia. Incorporating these biomarkers into routine evaluation may enable earlier identification of severe disease, timely referral, and appropriate critical care interventions, especially in resource-limited settings. Future studies with larger samples and prospective designs may further clarify the prognostic value of serum biomarkers and help refine prediction models for maternal and perinatal outcomes.

Conclusion

In this study, elevated LDH levels and thrombocytopenia emerged as the most reliable serum biomarkers associated with the severity of eclampsia and with adverse maternal outcomes. Women with LDH ≥600 IU/L had significantly higher rates of recurrent seizures, ICU admission, acute kidney injury, and other complications, highlighting the value of LDH as a strong predictor of disease progression. Severe eclampsia was also associated with poor perinatal outcomes, particularly preterm birth, low birth weight, and low 5-minute Apgar scores. In contrast, uric acid, AST, ALT, and serum creatinine showed limited predictive value in isolation. Overall, the findings underscore the importance of incorporating LDH and platelet counts into routine evaluation and risk stratification of eclamptic women, particularly in resource-limited settings where early identification of severe disease can substantially improve maternal and neonatal outcomes.

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