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Clinical, Haematological and Obstetric Characteristics Across Proteinuria Severity in Hypertensive Pregnancy: A Prospective Observational Study

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ABSTRACT

Background: The clinical significance of increasing proteinuria in preeclampsia remains debated. We examined clinical, haematological and delivery characteristics across quantitative proteinuria strata.
Methods: In this secondary analysis of 150 hypertensive pregnancies, 24-hour protein excretion was classified as ≤300 mg, 301–2000 mg and >2000 mg. Continuous variables were compared using Kruskal–Wallis tests and categorical variables using chi-square tests. A parsimonious exploratory logistic model evaluated severe proteinuria.
Results: There were 37 women without significant proteinuria, 87 with moderate proteinuria and 26 with severe proteinuria. Increasing proteinuria was associated with earlier gestation (median 38, 34 and 31 weeks), higher systolic blood pressure (median 152, 170 and 188 mmHg), higher diastolic pressure (96, 106 and 113 mmHg), lower haemoglobin (11.8, 9.0 and 5.9 g/dL) and lower platelet count (2.1, 1.7 and 0.82 lakh/mm^3); all $p<0.001$. Mode of delivery did not differ ($p=0.421$). In exploratory adjusted analysis, systolic pressure and lower platelet count were associated with severe proteinuria.
Conclusion: Greater proteinuria clustered with earlier gestation, higher blood pressure, anaemia and thrombocytopenia but not mode of delivery. These associations should not be interpreted causally or as proof that proteinuria alone predicts outcomes.

Keywords: Preeclampsia; proteinuria severity; hypertension; thrombocytopenia; anaemia; pregnancy outcome.

INTRODUCTION

Preeclampsia is a multisystem hypertensive disorder in which proteinuria reflects renal endothelial injury but is not required when other maternal organ dysfunction is present.[1] Contemporary management is therefore guided by the complete maternal and fetal clinical picture rather than the absolute quantity of urinary protein alone.

Evidence regarding the prognostic meaning of proteinuria is mixed. Some cohorts report that increasing protein excretion identifies earlier-onset disease and greater maternal or perinatal risk,[2–5] whereas systematic review evidence suggests that proteinuria alone is a poor predictor of individual complications.[6] Severe hypertension, thrombocytopenia, renal or hepatic dysfunction and fetal compromise remain central to risk assessment.

The present analysis compared demographic, clinical, haematological and delivery characteristics across three 24-hour proteinuria categories in hypertensive pregnancy. We hypothesised that higher proteinuria would cluster with higher blood pressure, earlier gestation and thrombocytopenia.

METHODS

Design and participants: This secondary observational analysis used the 150-patient master dataset from a prospective study at Rajkiya Mahila Chikitsalaya/Zanana Hospital, Jawaharlal Nehru Medical College, Ajmer, from March 2008 to

December 2009. Women were beyond 28 weeks with newly detected hypertension and suspected preeclampsia. Chronic hypertension, diabetes, pre-existing renal disease or proteinuria, collagen vascular disease, multiple pregnancy and bacteriuria were excluded.

Measurements and groups: Maternal age, residence, antenatal visits, parity, gestation, weekly weight gain, systolic and diastolic pressure, oedema grade, haemoglobin, platelet count and delivery mode were recorded. Proteinuria categories were ≤300 mg/24 hours (no significant proteinuria), 301–2000 mg/24 hours (moderate), and >2000 mg/24 hours (severe). Platelets were recorded in lakh/mm³.

Statistical analysis: Continuous variables were presented as median (IQR) and compared by Kruskal–Wallis test because of non-normality and ordinal grouping. Categorical variables were compared using chi-square tests. An exploratory logistic model for severe proteinuria included standardised systolic blood pressure, platelet count and gestational age, limited to three predictors because only 26 severe cases were available. Adjusted odds ratios (aORs) were reported per one standard deviation (SD). Analyses were exploratory, and no adjustment was made for multiple comparisons.

RESULTS

The cohort included 37 (24.7%) women with ≤300 mg, 87 (58.0%) with 301–2000 mg and 26 (17.3%) with >2000 mg protein/24 hours. Age, gestation, weight gain, blood pressure, haemoglobin and platelet count differed across groups. The severe group presented at a median of 31 weeks and had median systolic pressure 188 mmHg, haemoglobin 5.9 g/dL and platelet count 0.82 lakh/mm³.

Table 1: Continuous characteristics by 24-hour proteinuria category

Characteristic	≤300 mg (n=37)	301–2000 mg (n=87)	>2000 mg (n=26)	p
Age, years	31.0 (28.0–32.0)	23.0 (21.0–25.0)	25.0 (23.0–28.0)	<0.001
Gestational age, weeks	38.0 (37.0–39.0)	34.0 (32.0–34.0)	31.0 (30.0–32.0)	<0.001
Weekly weight gain, kg	0.4 (0.3–0.6)	0.8 (0.6–1.3)	1.8 (1.6–2.0)	<0.001
Systolic BP, mmHg	152.0 (146.0–158.0)	170.0 (162.0–180.0)	188.0 (184.5–190.0)	<0.001
Diastolic BP, mmHg	96.0 (94.0–106.0)	106.0 (100.0–108.0)	113.0 (110.0–119.5)	<0.001
Haemoglobin, g/dL	11.8 (11.0–12.6)	9.0 (7.9–10.0)	5.9 (5.6–6.8)	<0.001
Platelet count, lakh/mm³	2.1 (1.9–2.8)	1.7 (1.4–2.4)	0.8 (0.7–1.1)	<0.001

Values are median (IQR). BP=blood pressure; IQR=interquartile range. Kruskal–Wallis test.

Table 2: Selected categorical characteristics by proteinuria category

Characteristic	≤300 mg	301–2000 mg	>2000 mg
Rural residence	19 (51.4%)	60 (69.0%)	19 (73.1%)
Nulliparous	5 (13.5%)	63 (72.4%)	16 (61.5%)
Any antenatal visit	13 (35.1%)	38 (43.7%)	10 (38.5%)
LSCS	14 (37.8%)	28 (32.2%)	10 (38.5%)
Instrumental delivery	4 (10.8%)	11 (12.6%)	0 (0.0%)

Parity differed across the three groups (p<0.001). Residence (p=0.111), antenatal attendance (p=0.654) and mode of delivery (global p=0.421) did not differ significantly. LSCS=lower-segment caesarean section.

Table 3: Exploratory multivariable model for severe proteinuria (>2000 mg/24 h)

Predictor (per 1 SD)	Adjusted OR	95% CI	p
Systolic BP (SD 14.7 mmHg)	94.61	6.55–1367.74	<0.001
Platelet count (SD 0.78 lakh/mm³)	0.18	0.04–0.75	0.018
Gestational age (SD 3.13 weeks)	0.56	0.12–2.57	0.456

CI=confidence interval; OR=odds ratio; SD=standard deviation. Estimates are unstable because of near-separation and should be regarded as exploratory.

DISCUSSION

Greater 24-hour protein excretion clustered with earlier gestation, higher systolic and diastolic pressure, lower haemoglobin and lower platelet count. Mode of delivery did not differ across groups. These findings describe phenotypic clustering rather than causal effects: proteinuria, hypertension and haematological abnormalities may all reflect underlying disease severity.

Earlier gestation with heavier proteinuria agrees with Guida et al., who observed shorter pregnancy duration and more severe disease with increasing proteinuria.[2] Chan et al. found that higher P/C ratios were associated with adverse maternal and fetal outcomes but provided only moderate discrimination.[3] Other cohorts have associated ≥2 g/24 hours with maternal complications, though the predictive value of proteinuria alone was limited.[4,5]

The association with thrombocytopenia is biologically plausible in severe preeclampsia, reflecting platelet activation and consumption. Hall et al. also evaluated quantitative protein excretion in the expectant management of early-onset severe preeclampsia.[7] However, the magnitude of the adjusted systolic-pressure association and the almost ordered separation of clinical variables across proteinuria strata are unusually strong. The adjusted analysis should therefore be interpreted cautiously and validated in an independent dataset.

Importantly, systematic review evidence indicates that proteinuria alone is a poor predictor of maternal and fetal complications.[6] The current dataset does not contain maternal organ complications, fetal growth, birth weight, Apgar scores, NICU admission or mortality. It therefore cannot establish prognostic value for clinical outcomes. The lack of association with delivery mode further cautions against using protein quantity in isolation.

Limitations

This was a single-centre secondary analysis with only 26 severe-proteinuria observations. Several variables were closely ordered by proteinuria category, creating near-separation and unstable regression estimates. There was no adjustment for disease-onset timing, treatment or other laboratory markers. Neonatal outcomes and major maternal complications were not available for analysis.

CONCLUSION

Increasing proteinuria was associated with earlier gestation, higher blood pressure, lower haemoglobin and thrombocytopenia in this cohort, but not with mode of delivery. Proteinuria should be interpreted as one component of multisystem assessment rather than an isolated severity or outcome marker. Prospective studies incorporating validated maternal and neonatal outcomes are required.

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Ethical considerations: Ethics approval was obtained from the Institutional Ethics Committee of Jawaharlal Nehru Medical College, Ajmer; and informed-consent was taken from all the patients.

Data availability: De-identified data may be made available by the corresponding author on reasonable request, subject to institutional ethics approval and protection of participant confidentiality.

Use of artificial intelligence: ChatGPT assisted with language revision, and reference formatting. Authors confirmed responsibility for the final manuscript.

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