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Diagnostic Accuracy of Urinary Protein/Creatinine Ratio versus 24-Hour Urinary Protein in Evaluating Pre-Eclampsia and Perinatal Outcomes: A Comparative Study

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Abstract

Background: Pre-eclampsia remains a leading cause of maternal and perinatal morbidity and mortality. Accurate and timely diagnosis is crucial for preventing adverse outcomes. Although the 24-hour urinary protein excretion is considered the gold standard for assessing proteinuria, it is cumbersome and time-consuming. The spot urine protein-to-creatinine ratio (UPCR) offers a simpler, quicker alternative. This study aims to evaluate the diagnostic accuracy of UPCR compared to 24-hour urinary protein estimation and to examine its association with perinatal outcomes.

Methods: A prospective observational study was conducted at Gauhati Medical College and Hospital, Assam, between September 2022 and October 2023. A total of 102 pregnant women with suspected pre-eclampsia were enrolled. Both 24-hour urinary protein levels and UPCR were measured, and outcomes were assessed. Diagnostic performance was evaluated using sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV).

Results: UPCR demonstrated a high sensitivity of 92.9% and specificity of 84.6% in detecting significant proteinuria when compared to 24-hour urinary protein. The PPV was 97.2%, while the NPV was 64.7%. A strong correlation was observed between UPCR and adverse perinatal outcomes such as low birth weight, NICU admission, and preterm delivery.

Conclusion: The UPCR is a reliable, rapid, and patient-friendly alternative to 24-hour urinary protein measurement for diagnosing proteinuria in pre-eclampsia. It shows strong diagnostic accuracy and can aid in early intervention. However, its lower NPV warrants cautious interpretation in exclusion scenarios.

Keywords: Diagnostic Accuracy, Perinatal Outcomes, Proteinuria Assessment

INTRODUCTION

Pre-eclampsia is a hypertensive disorder of pregnancy that significantly contributes to maternal and perinatal morbidity and mortality worldwide. It is characterized by new-onset hypertension after 20 weeks of gestation, often accompanied by proteinuria and multi-organ dysfunction. Affecting approximately 2–8% of pregnancies, pre-eclampsia presents a diagnostic and management challenge, particularly in low-resource settings where timely intervention can be critical.

Proteinuria is a hallmark diagnostic feature of pre-eclampsia, reflecting renal endothelial dysfunction. Traditionally, a 24-hour urinary protein estimation has been the gold standard for quantifying proteinuria. However, this method is time-consuming, inconvenient for patients, and prone to collection errors. These limitations often delay clinical decision-making in acute care settings.

The spot urine protein-to-creatinine ratio (UPCR) has emerged as a potential alternative, offering quicker results and improved patient compliance. Several studies have reported good correlation between UPCR and 24-hour protein

excretion, but there is variability in diagnostic performance across populations and clinical settings. Moreover, the association of UPCR with perinatal outcomes remains an area of growing interest.

This study aims to evaluate the diagnostic accuracy of UPCR in comparison with 24-hour urinary protein estimation and to assess its predictive value for perinatal outcomes in women diagnosed with pre-eclampsia.

MATERIALS AND METHODS

Study Design and Setting:

This was a prospective, hospital-based observational study conducted in the Department of Obstetrics and Gynaecology at Gauhati Medical College and Hospital, Guwahati, Assam. The study period extended from September 2022 to October 2023.

Study Population:

A total of 102 pregnant women, either attending the outpatient department or admitted to the inpatient wards with suspected pre-eclampsia, were enrolled. Informed written consent was obtained from all participants.

Inclusion Criteria:

- Pregnant women ≥20 weeks of gestation
- Newly diagnosed hypertension (BP ≥140/90 mmHg)
- Willingness to undergo both 24-hour urine collection and spot UPCR testing

Exclusion Criteria:

- Chronic hypertension or renal disease predating pregnancy
- Urinary tract infection (confirmed by urinalysis)
- Multiple pregnancies
- Incomplete 24-hour urine collection

Data Collection:

All participants underwent routine antenatal evaluation, including blood pressure measurement, ultrasonography for fetal growth, and laboratory investigations. Urine samples were collected for both 24-hour protein estimation and spot UPCR on the same day. Maternal and perinatal outcomes were recorded, including gestational age at delivery, birth weight, NICU admission, APGAR score, and incidence of complications.

Laboratory Methods:

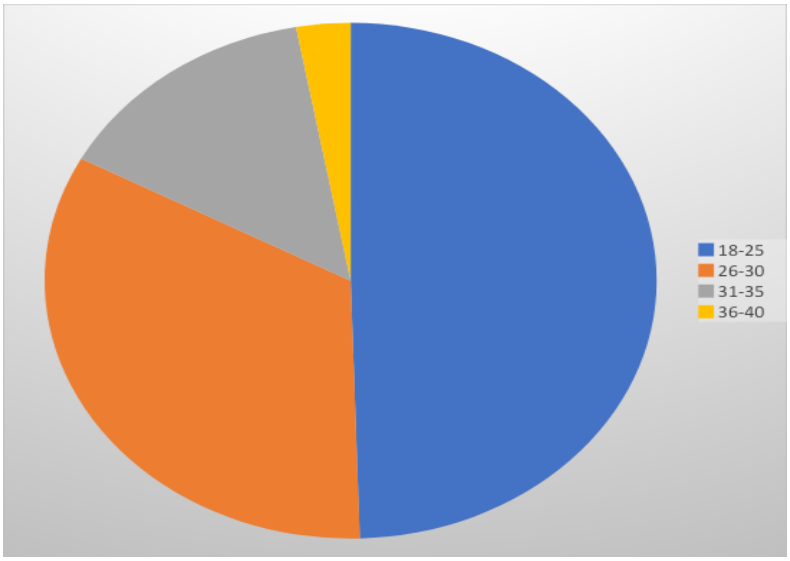
- 24-hour urinary protein: Collected and analyzed using turbidimetric method. A value ≥300 mg/24 hours was considered significant.
- Urinary protein/creatinine ratio (UPCR): Measured from a spot urine sample. A ratio ≥0.3 mg/mg was considered diagnostic for proteinuria.

Statistical Analysis:

Data were analyzed using SPSS software (version 22.0). Sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of UPCR were calculated using 24-hour urinary protein estimation as the reference standard. Pearson's correlation coefficient was used to determine the relationship between UPCR and 24-hour urinary protein values. P-values <0.05 were considered statistically significant.

RESULTS

A total of 102 pregnant women diagnosed with pre-eclampsia were included in the study. The mean maternal age was 25.2 ± 3.6 years, with the majority (63.3%) between 20–25 years of age. Most patients presented between 32–36 weeks of gestation, with a mean gestational age at delivery of 37.8 ± 1.8 weeks in the proteinuria group, compared to 39.1 ± 0.3 weeks in the non-proteinuria group.



Maternal Age Distribution: Fig 1

Comparison Between UPCR and 24-Hour Urinary Protein

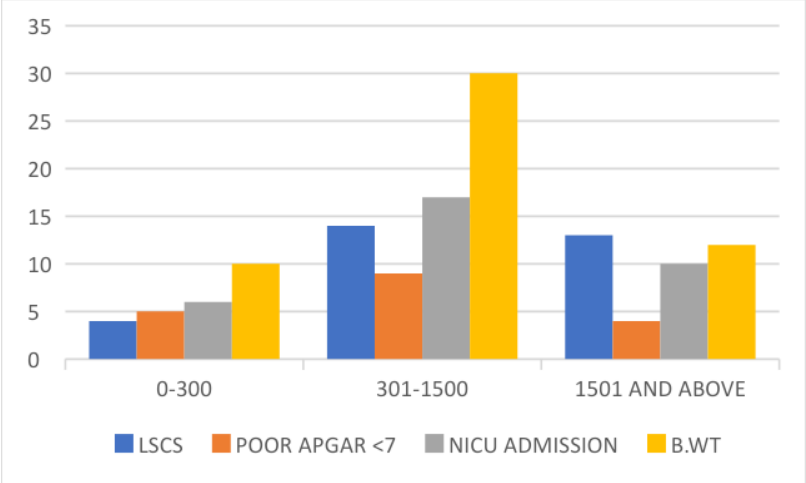
Spot urine protein/creatinine ratio (UPCR) values showed a strong correlation with 24-hour urinary protein estimation. A correlation coefficient (r) of 0.87 ($p < 0.001$) was observed. The diagnostic characteristics of UPCR compared to the 24-hour urinary protein (considered gold standard) were as follows:

P/C RATIO(MG/DL)	24 HR URINARY PROTEIN		
	>=300MG/DAY	<300MG/DAY	TOTAL
	N	N	
>=0.3	79(TRUE POSITIVE)	4(FALSE POSITIVE)	83
<0.3	6(FALSE NEGATIVE)	16(TRUE NEGATIVE)	22
TOTAL	85	20	

- Sensitivity: 92.9%
- Specificity: 84.6%
- Positive Predictive Value (PPV): 97.2%
- Negative Predictive Value (NPV): 64.7%

This indicates that UPCR is a highly sensitive and specific method for diagnosing proteinuria in pre-eclampsia and may serve as a reliable alternative to the more time-consuming 24-hour collection.

Association with Perinatal Outcomes

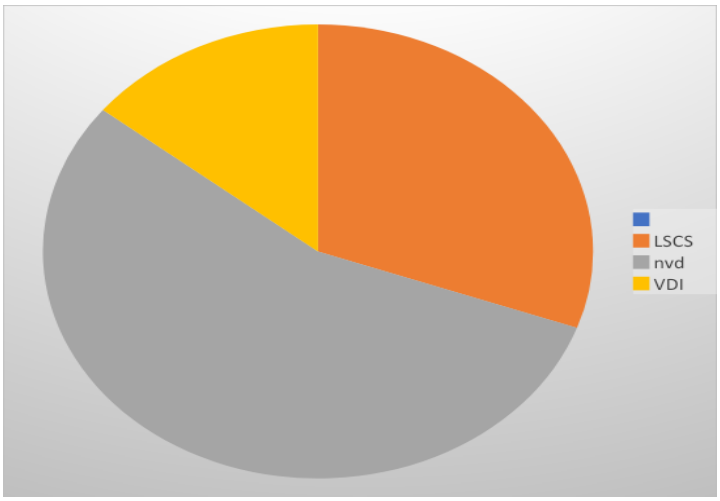


24 hour urinary protein and perinatal outcome
Analysis of perinatal outcomes revealed the following:

- Preterm delivery (<37 weeks): 41% of the cases
- Low birth weight (LBW <2.5 kg): 54% of neonates, with a mean birth weight of 2.37 ± 0.42 kg in proteinuric mothers versus 2.61 ± 0.41 kg in non-proteinuric mothers
- NICU admissions: 14.3%
- Apgar score <7 at 5 minutes: 25%
- Intrauterine fetal demise (IUFD): 20%
- Neonatal death: 1.2%

Higher UPCR values were significantly associated with increased risk of LBW, NICU admission, poor Apgar scores, and perinatal mortality.

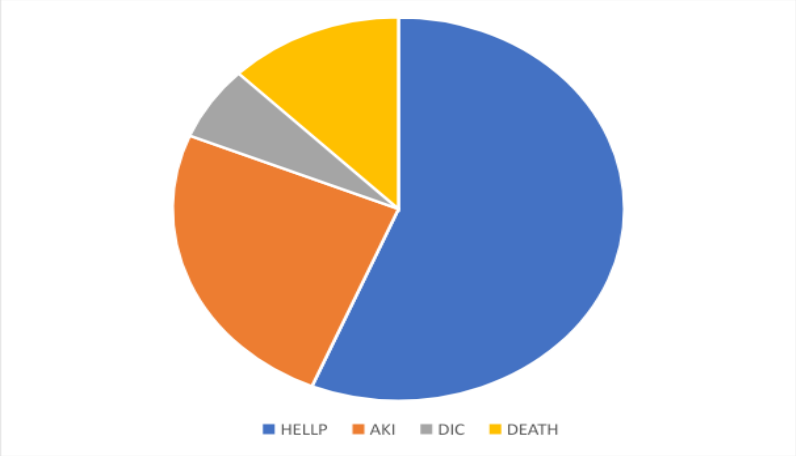
Mode of Delivery



- Caesarean section: 56%, primarily for fetal distress, severe pre-eclampsia, or failed induction
- Vaginal delivery: 44%, in stable cases without maternal or fetal compromise

The increased caesarean rate in the proteinuric group further underscores the impact of severe disease on obstetric outcomes.

Maternal Complications



While maternal complications were not the primary endpoint, hypertensive crises, postpartum hemorrhage, and elevated liver enzymes were observed more frequently in women with higher proteinuria levels. No cases of eclampsia were reported during the study period.

DISCUSSION

This study highlights the diagnostic utility of the spot urine protein/creatinine ratio (UPCR) as a reliable and efficient alternative to 24-hour urinary protein estimation in the evaluation of pre-eclampsia. The findings demonstrate that UPCR has a high sensitivity (92.9%) and specificity (84.6%) for detecting significant proteinuria, with a strong correlation ($r = 0.87$) to 24-hour protein values. These results are in agreement with prior studies by Olayinka et al. and Shraddha Rao et al., who reported similar correlation coefficients and diagnostic accuracy for UPCR in identifying proteinuria among pregnant women with hypertensive disorders.

The 24-hour urinary protein estimation, although considered the gold standard, is associated with practical limitations including poor patient compliance, potential for collection errors, and delayed results — which can hinder timely clinical decision-making. UPCR, in contrast, provides a faster, simpler, and less burdensome method for evaluating proteinuria. Our study supports its use in both outpatient and inpatient settings, particularly in resource-constrained environments where 24-hour collection is less feasible.

The perinatal outcomes in our study revealed a significant association between higher UPCR levels and adverse neonatal indicators such as low birth weight, preterm delivery, NICU admission, poor Apgar scores, and fetal demise. These findings are consistent with the work of Singh et al. and Nipanal et al., who also reported a strong association between elevated proteinuria markers and poor neonatal outcomes. The high PPV (97.2%) of UPCR in our cohort indicates its robustness in identifying true cases of pre-eclampsia, enabling early intervention to potentially mitigate complications.

However, the NPV of 64.7% suggests that while UPCR is excellent at confirming disease presence, its ability to reliably exclude pre-eclampsia is modest. This reinforces the need for clinical judgment and consideration of other parameters such as blood pressure trends, liver function, platelet count, and fetal surveillance when evaluating hypertensive pregnant women.

The high caesarean section rate (56%) observed in this study reflects the influence of pre-eclampsia severity on obstetric decision-making, aligning with similar trends noted in studies by Kollu et al. and Pasternak et al. The association of elevated UPCR values with maternal complications such as hypertensive crises and biochemical abnormalities also underscores the broader systemic implications of severe proteinuria.

Limitations:

Our study had a relatively small sample size and was limited to a single tertiary care center. The cross-sectional design limits the ability to assess long-term maternal and neonatal outcomes. Additionally, we did not assess the effect of repeated UPCR measurements over time.

CONCLUSION

This study confirms that the spot urine protein/creatinine ratio (UPCR) is a reliable, efficient, and patient-friendly alternative to the conventional 24-hour urinary protein test for the diagnosis of proteinuria in pre-eclampsia. With high sensitivity, specificity, and a strong positive predictive value, UPCR facilitates timely diagnosis and management of pre-eclampsia, which is critical in improving both maternal and perinatal outcomes.

However, due to its modest negative predictive value, UPCR should not be used in isolation to rule out pre-eclampsia. It is most effective when interpreted alongside clinical findings and other laboratory parameters. The strong association of higher UPCR levels with poor perinatal outcomes, including preterm birth, low birth weight, and NICU admission, further underscores its clinical utility as both a diagnostic and prognostic tool.

We recommend the incorporation of UPCR into routine clinical practice, especially in resource-limited settings, with continued research to validate its use across diverse populations and gestational age groups.

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