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STUDY TO ASSESS THE MATERNAL AND FOETAL OUTCOME IN WOMEN WITH SIGNIFICANT PROTEINURIA IN PRE-ECLAMPSIA- A PROSPECTIVE COMPARATIVE STUDY

Obstetrics & Gynaecology

Dr. Nandkishor More Associate Professor, Department of Obstetrics and Gynaecology, Swami Ramanand Teerth Rural Government Medical College and Hospital, Ambajogai, Maharashtra.

Dr. Nikita Chandwani Third year Junior Resident, Department of Obstetrics and Gynaecology, Swami Ramanand Teerth Rural Government Medical College and Hospital, Ambajogai, Maharashtra.

Dr. Ganesh Tondge Associate Professor and Head of Department, Obstetrics and Gynaecology, Swami Ramanand Teerth Rural Government Medical College and Hospital, Ambajogai, Maharashtra.

ABSTRACT

Introduction: Hypertensive disorders of pregnancy (HDP), including preeclampsia, are serious complications that affect maternal and foetal health. Preeclampsia, characterized by hypertension and proteinuria, impacts 4-5% of pregnancies and can lead to severe outcomes if untreated. The 24-hour urine protein collection is the gold standard for diagnosing proteinuria, but it is time-consuming and impractical in clinical settings. This study aims to assess the diagnostic accuracy of the spot urine protein-to-creatinine ratio compared to the 24-hour urine collection in preeclampsia and evaluate its impact on maternal and foetal outcomes. **Objective:** To compare the diagnostic accuracy of the spot urine protein-to-creatinine ratio with the 24-hour urine protein collection in detecting significant proteinuria in preeclamptic patients and to evaluate associated maternal and foetal outcomes. **Methods:** This prospective, comparative study was conducted over 18 months in the Department of Obstetrics and Gynaecology at a tertiary care hospital, involving 200 antenatal women with preeclampsia beyond 20 weeks of gestation. Simple random sampling was used. Women with systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg and proteinuria ≥1+ by dipstick were included. Exclusion criteria included chronic hypertension, renal disease, and other conditions affecting urinary protein measurements. **Results:** The study included 200 participants, with the majority (51.5%) aged between 20-25 years. Most participants (71%) had prior pregnancies. The most common symptoms were headache (30%), nausea/vomiting (20%), and chest pain/dyspnea (20%). **Conclusion:** The spot urine protein-to-creatinine ratio provides a practical alternative to the 24-hour urine collection in quantifying proteinuria in preeclampsia, although further research is needed to validate its diagnostic accuracy. Proper management of significant proteinuria can improve maternal and fetal outcomes.

KEYWORDS

Preeclampsia; Hypertensive disorders of pregnancy; Proteinuria; Spot urine protein-to-creatinine ratio; Maternal outcomes

INTRODUCTION

Hypertensive disorders of pregnancy (HDP) represent a spectrum of conditions that include chronic hypertension, gestational hypertension, preeclampsia, and eclampsia. These disorders are among the most common complications of pregnancy, posing significant risks to both maternal and fetal health. HDP can lead to life-threatening outcomes for the mother and the fetus, and in severe cases, may necessitate the early termination of pregnancy to safeguard both lives. This spectrum of hypertensive disorders is recognized as a multi-organ, heterogeneous condition associated with considerable maternal and neonatal morbidity and mortality, requiring prompt diagnosis and management to minimize its devastating impact [1].

The National High Blood Pressure Education Program (NHBPEP) Working Group on High Blood Pressure in Pregnancy has proposed the most widely accepted classification and definition of hypertensive disorders of pregnancy. According to this definition, HDP is diagnosed when blood pressure readings reach or exceed 140/90 mm Hg on two separate occasions at least four hours apart during pregnancy. This guideline provides clinicians with a clear diagnostic threshold to identify and manage hypertensive complications in pregnancy [2].

Globally, hypertensive disorders of pregnancy affect approximately 10-15% of pregnancies, although the incidence varies depending on geographical regions and the diagnostic criteria used. The definition of HDP and population factors such as parity, age, and race significantly influence the incidence in different populations. For instance, in a hospital-based study conducted in India in 2006, the incidence of HDP was reported to be 5.38% [3]. Among the cases, preeclampsia, eclampsia, and HELLP syndrome (hemolysis, elevated liver enzymes, and low platelet count) accounted for 44%, 40%, and 7%, respectively. Chronic hypertension and superimposed preeclampsia constituted the remaining 9% of cases. The same study also reported alarming maternal and perinatal mortality rates of 5.5% and 37.5%, respectively, highlighting the critical need for timely intervention and management of these conditions.

Preeclampsia, a significant component of HDP, is a multisystem disorder with an unknown etiology. It affects approximately 4-5% of pregnancies and can progress to a more severe condition known as eclampsia, characterized by seizures in women with preeclampsia. In cases of eclampsia, blood pressure can surge to dangerously high levels, increasing the risk of life-threatening complications such as end-organ damage for both mother and fetus [4].

A hallmark feature of preeclampsia is proteinuria, which serves as both a diagnostic criterion and a predictor of the severity of the condition. The traditional gold standard for detecting proteinuria in pregnancy is the measurement of protein in a 24-hour urine sample. Significant proteinuria is defined as 0.3 g or more of protein excreted per day. However, while the 24-hour urine collection method has been widely used, it poses several practical challenges. Collecting urine over such a long period is time-consuming and inconvenient, often resulting in incomplete collections, especially when delivery occurs before the sample is complete [5]. In fact, less than half of women admitted with preeclampsia undergo a full 24-hour urine collection. Furthermore, waiting for the results of this test can delay clinical decision-making, leading to prolonged hospital stays, increased healthcare costs, and heightened anxiety for patients.

Given these limitations, alternatives to the 24-hour urine collection have been explored for the diagnosis of proteinuria in pregnancy. One commonly used alternative is the urinary dipstick test. While inexpensive and easy to use, dipsticks have demonstrated low sensitivity and specificity compared to the 24-hour urine collection, which limits their utility in diagnosing significant proteinuria.

Another alternative to the 24-hour urine collection is the urinary spot protein-to-creatinine ratio, a test that has been extensively studied outside of pregnancy. This ratio is recommended by the National Kidney Foundation for diagnosing proteinuria in most clinical settings, though it does not specifically address pregnancy [6]. Several professional organizations, including the Australasian Society for the Study of Hypertension in Pregnancy and the International Society for the Study of Hypertension in Pregnancy, have endorsed the use of the urinary spot protein-to-creatinine ratio as a viable alternative to the traditional 24-hour collection in pregnancy.

Despite these endorsements, the accuracy and reliability of the spot protein-to-creatinine ratio in detecting significant proteinuria in

preeclampsia remain a subject of debate. Studies on the correlation between the spot protein-to-creatinine ratio and 24-hour urine protein excretion have produced conflicting results, with some studies supporting its use and others suggesting that it may not be as accurate in pregnant populations. For instance, while some research has demonstrated that the spot protein-to-creatinine ratio is a reliable substitute for 24-hour protein measurements, other studies have raised concerns about its sensitivity and specificity in diagnosing preeclampsia [7].

Hypertensive disorders of pregnancy, particularly preeclampsia and eclampsia, pose significant challenges to maternal and fetal health. Early detection and proper management are crucial for improving outcomes. While the 24-hour urine collection remains the gold standard for detecting proteinuria in preeclampsia, the drawbacks of this method have prompted the exploration of alternative diagnostic tools. The spot protein-to-creatinine ratio offers a promising alternative, though its reliability in pregnancy continues to be debated. As research in this area advances, there is hope for more convenient and accurate methods to diagnose and manage hypertensive disorders of pregnancy, ultimately improving the prognosis for both mother and baby [8].

The aim of the study is to evaluate the diagnostic accuracy of the spot urine protein-creatinine ratio in comparison to the 24-hour urine protein for quantifying proteinuria in preeclampsia and to assess the maternal and fetal outcomes in women with significant proteinuria. The objectives include determining the accuracy of both tests for quantifying proteinuria, examining the relationship between 24-hour urinary protein and the spot protein-creatinine ratio in preeclampsia, and assessing the impact of significant proteinuria on maternal and fetal outcomes.

MATERIALS AND METHODS

The study, conducted in the Department of Obstetrics and Gynaecology at a tertiary care teaching hospital, is a prospective, comparative study involving antenatal mothers with preeclampsia beyond 20 weeks' gestation. Using simple random sampling, pregnant women aged 19 years and older were included, with systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg and proteinuria ≥1+ by dipstick. Exclusion criteria included those with chronic hypertension, renal disease, urinary tract infection, ruptured membranes, molar pregnancy, and refusal to participate. The study duration is 18 months, and patients requiring early delivery before completing a 24-hour urine collection were excluded.

RESULTS

The study includes 200 participants, with 103 (51.5%) falling in the 20-25 group, 46 (23.0%) in the <20 group, 39 (19.5%) in the 26-30 group, and 12 (6.0%) in the >30 group, showing that more than half are aged 20-25. Regarding obstetric history, 58 participants (29.0%) are first-time mothers (Primi), while 142 (71.0%) have had multiple pregnancies (Multi), indicating that the majority have previous childbirth experience.

Table 1: Distribution of Symptoms Among the Study Participants

Symptoms	N	%
Nausea/ Vomiting	40	20.0%
Headache	60	30.0%
Visual Disturbances	30	15.0%
Abd/ Vaginal Bleeding	12	6.0%
Chest pain/ Dyspnoea	40	20.0%

The table shows symptom distribution among 200 participants. Headache is the most common symptom, affecting 60 participants (30%). Nausea/vomiting and chest pain/dyspnea each occur in 40 participants (20%), followed by visual disturbances in 30 participants (15%). Abdominal or vaginal bleeding is the least common symptom, reported by 12 participants (6%). This data emphasizes headache as the most frequent symptom and bleeding as the least common.

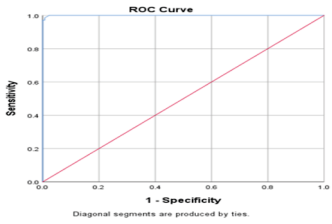

Figure 1: ROC Curve Demonstrates ESR's Excellent Diagnostic Accuracy with an AUC

The ESR shows excellent diagnostic accuracy with an AUC of 0.977. A standard error of 0.023 and a p-value below 0.01 indicate statistical significance. The 95% confidence interval, ranging from 0.98 to 1.12, further supports its accuracy. The ROC curve highlights near-perfect sensitivity and specificity, confirming the effectiveness of ESR as a reliable diagnostic marker.

Table 2: Spot Urine PCR vs. Significant Proteinuria by Severity Grade

Spot Urine PCR >30 mg/ mmol	Significant Proteinuria (24-hour urinary protein ≥300mg/day)		Total
	No	Yes	
Grade III	123	0	123
Grade I/ II	8	69	77
Total	131	69	200

Spot Urine PCR values with significant proteinuria (≥300mg/day) in 200 participants. In Grade III, none of the 123 participants had significant proteinuria, whereas in Grades I/II, 69 of 77 participants exhibited significant proteinuria. Overall, 69 participants had significant proteinuria, indicating a strong association between lower-grade disease (I/II) and higher levels of proteinuria.

Table 3: Diagnostic Performance Metrics

Parameters	%
Sensitivity	100.0%
Specificity	93.9%
PPV	89.6%
NPV	100.0%
Accuracy	96.0%

The diagnostic performance of a test. It shows 100% sensitivity, meaning the test correctly identifies all true positive cases. With a specificity of 93.9%, it accurately excludes most false positives. The positive predictive value (PPV) is 89.6%, and the negative predictive value (NPV) is 100%, indicating excellent reliability. Overall, the test's accuracy is 96%.

Table 4: Association Between Significant Proteinuria and Maternal Complications

Maternal Complications	Significant Proteinuria		Total	p-value
	No (n-131)	Yes (n-65)		
APH	3	5	8	0.127
	2.3%	7.2%	4.0%	
HEELP	3	5	8	0.127
	2.3%	7.2%	4.0%	
AKI	3	1	4	1.00
	2.3%	1.4%	2.0%	
Near Miss	1	3	4	0.12
	0.8%	4.3%	2.0%	
Mortality	0	3	3	0.04
	0.0%	4.3%	1.5%	

The table highlights maternal complications associated with significant proteinuria. APH and HELLP syndrome occurred in 7.2% of cases with proteinuria versus 2.3%, though not statistically significant (p=0.127). AKI occurred in 4 cases with no difference (p=1.00). Near miss events were more frequent with proteinuria (4.3% vs. 0.8%, p=0.12), while mortality was significantly higher (4.3% vs. 0%, p=0.04).

Table 5: Gender of Baby in Relation to Significant Proteinuria

Gender of baby	Significant Proteinuria		Total
	No	Yes	
Female	75	29	104
	57.3%	42.0%	52.0%
Male	56	40	96
	42.7%	58.0%	48.0%
Total	131	69	200
	100.0%	100.0%	100.0%
p- value - 0.053			

The table compares the gender distribution of babies with the presence of significant proteinuria in 200 participants. Among females, 42% had significant proteinuria, while 58% of males had it. Overall, 52% of the babies were female and 48% male. The p-value of 0.053 indicates a marginal, but not statistically significant, association between gender and significant proteinuria.

Table 6: Fetal Complications in Relation to Significant Proteinuria

Fetal Complications	Significant Proteinuria		Total	p-value
	No (n-131)	Yes (n-65)		
LBW	27	14	41	1.00
	20.6%	21.5%	20.5%	
IUGR	13	13	26	0.03
	9.9%	20.0%	13.0%	
Sepsis	8	3	11	0.75
	6.1%	4.6%	5.5%	
Birth Asphyxia	10	3	13	0.54
	7.6%	4.6%	6.5%	
RDS	6	3	9	1.00
	4.6%	4.6%	4.5%	
MAS	5	3	8	1.00
	3.8%	4.6%	4.0%	
Mortality	3	3	6	0.75
	2.3%	4.6%	3.0%	

The table shows fetal complications related to significant proteinuria. Low birth weight (LBW) rates were similar between groups (20.6% vs. 21.5%, p=1.00), while intrauterine growth restriction (IUGR) was significantly higher in the proteinuria group (20.0% vs. 9.9%, p=0.03). Other complications showed no significant differences (p=0.54-1.00).

DISCUSSION

Hypertensive disorders of pregnancy pose significant risks to both mother and fetus, leading to increased maternal and neonatal morbidity and mortality. In severe cases, pregnancy termination may be necessary. Proteinuria, a key marker of preeclampsia, traditionally requires 24-hour urine collection to diagnose significant proteinuria (≥0.3 g/day), though this method is laborious and error-prone. This study assesses the diagnostic accuracy of the spot urinary protein/creatinine ratio compared to 24-hour urine collection in 200 preeclamptic women, defining significant proteinuria as ≥300 mg/24 hours or a protein/creatinine ratio ≥30 mg/mmol [9].

The mean age of preeclampsia cases in this study was 21.6 years, with over half (51.5%) between 20 and 25 years. Overall, 71% were primiparous and 29% were multi-parous. Similar demographic patterns were observed in other studies. Ranjana et al. reported a mean age of 25.7 years, while Nautiyal et al. and Sharma et al. found mean ages of 25.5 and 25.9 years, respectively. Kumar S et al. reported a mean age of 25.07 years, primarily in the 21-25 age group [10, 11, 12, 13].

Pre-eclampsia is primarily a condition of primigravida, as seen in this study, where 63.8% of cases were primi-gravida. Similar findings were reported by Ranjana et al. [99], Bangal et al., and Sardesai et al., who observed 70%, 75%, and 79% of pre-eclampsia cases in primi-parous women, respectively. Abi-Said D et al. identified primigravidity (OR = 2.87) and age <20 years (OR = 1.55) as significant predictors of pre-eclampsia. Grum T et al. also found primigravida (AOR: 2.68) significantly associated with pre-eclampsia [10, 14, 15, 16, 17].

The most common presenting symptom among preeclampsia cases was headache (30%), followed by nausea/vomiting and dyspnea (20% each), and visual disturbances (15%). Maternal symptoms, indicative of end-organ damage, are crucial in patient management. Srivastava et al. Reported blurring of vision (54.16%) and headache (34.2%) as common symptoms, while Agrawal A et al. also noted visual disturbances and headache. Cavkaytar et al. found that headache, visual changes, and epigastric pain in HELLP syndrome predicted adverse maternal outcomes, with similar findings by Yen et al. [18, 19, 20, 21].

In this study, significant proteinuria was observed in 34.5% of preeclamptic women. Phillips JK et al. reported 45% and Osmundson SS et al. found 43% of pregnancies with >300 mg protein/24 hours. The spot urine protein-creatinine ratio showed an AUC of 0.977, with a cutoff of >30 mg/mmol, achieving 100% sensitivity and 93.9% specificity. Basharat A et al.and Jan S et al. observed similar correlations between spot PCR and 24-hour urine protein. Obeid N et al. and Shrestha P et al. also validated PCR as a reliable alternative [22, 23, 24, 25, 26,27].

An important question is whether pregnant women with hypertension and proteinuria face different maternal or perinatal outcomes compared to hypertensive women without proteinuria. Proteinuria with hypertension is linked to worse maternal and neonatal outcomes. In this study, caesarean section prevalence was higher with significant proteinuria (65.2% vs. 48.1%, p=0.025), along with increased maternal complications (APH, HELLP), near-miss cases, and mortality. Fetal complications, particularly IUGR, were also more common (20% vs. 9.9%). Similar findings were reported by Lei T et al., Hu M et al., and Hauth JC et al. [28,29,30].

The current study found a strong correlation between the spot urinary protein creatinine ratio and 24-hour urine protein estimation. ROC analysis demonstrated high diagnostic accuracy of the spot ratio for detecting significant proteinuria. These findings suggest that the spot urinary protein creatinine ratio could serve as an alternative to the 24-hour urine test in pre-eclampsia patients. Additionally, significant proteinuria was linked to adverse perinatal outcomes.

CONCLUSION

The present study found a significant correlation between the spot urinary protein/creatinine ratio and 24-hour urine protein estimation. ROC analysis demonstrated that the spot ratio has good diagnostic accuracy for detecting significant proteinuria, suggesting it can serve as a reliable alternative to the traditional 24-hour urine test in preeclampsia cases. Additionally, severe proteinuria was associated with adverse outcomes, including increased maternal complications such as higher rates of caesarean deliveries, antepartum hemorrhage, acute kidney injury, and maternal near miss/mortality. Fetal outcomes, including a higher incidence of intrauterine growth restriction (IUGR), were also observed with severe proteinuria.

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