Spot Urine Protein-to-Creatinine Ratio to Predict the Magnitude of 24-Hour Total Proteinuria in Preeclampsia of Varying Severity

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Abstract

Objective: The predictive value of spot urine protein-to-creatinine ratio (PCR) for estimating total 24-hour proteinuria in severe preeclampsia is unclear. This study aimed to assess the diagnostic accuracy of spot urine PCR for ascertaining the magnitude of proteinuria in women with preeclampsia of varying severity.

Methods: A total of 205 patients with prediagnosed preeclampsia were included in this prospective cohort study. Patients were allocated into one of the three groups categorized by severity of disease, as follows: gestational hypertension, group 1 (n = 41); preeclampsia, group 2 (n = 88); and severe preeclampsia, group 3 (n = 76). We assessed the spot urine PCRs to determine significant proteinuria and the magnitude of proteinuria in these groups.

Results: The spot urine PCR was 0.53, with 81% sensitivity and 93% specificity to detect significant proteinuria. A significant correlation was found between PCR and 24-hour total proteinuria in group 1 ($r = 0.473$, $P = 0.002$). There were also significant correlations in group 2 ($r = 0.814$, $P < 0.001$) and group 3 ($r = 0.912$, $P < 0.001$). The established formula using spot urine PCR to estimate 24-hour total proteinuria in severe preeclampsia was $Y = 832.02X + 378.74$ mg ($r^2 = 0.8304$).

Conclusion: Although 24-hour urine collection remains a merely reliable test to determine the degree of total proteinuria, our findings suggest that it is likely to assess the magnitude of proteinuria by the spot urine PCR, especially in severe preeclampsia.

Clinical trial registration: www.clinicaltrials.gov NCT01623791

Key Words: Severe preeclampsia, spot urine protein-creatinine ratio, total proteinuria

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Résumé

Objectifs : On ne connaît pas exactement la valeur prédictive du rapport protéinurie/créatininurie (RPC) d'une miction isolée pour estimer la protéinurie sur 24 heures en cas de prééclampsie grave. Cette étude visait donc à évaluer la précision diagnostique de cette méthode pour évaluer l'importance de la protéinurie chez des femmes atteintes de prééclampsie à divers degrés de gravité.

Méthodologie : Nous avons mené une étude de cohorte prospective auprès de 205 patientes ayant déjà reçu un diagnostic de prééclampsie. Les patientes ont été réparties dans trois groupes selon la gravité de leur état : hypertension gravidique (groupe 1; n = 41); prééclampsie (groupe 2; n = 88); prééclampsie grave (groupe 3; n = 76). Nous avons ensuite évalué le RPC de mictions isolées afin de détecter les cas de protéinurie marquée et de déterminer l'importance de la protéinurie.

Résultats : Nous avons utilisé une valeur de RPC de mictions isolées de 0,53; la sensibilité et la spécificité pour la détection d'une protéinurie marquée étaient respectivement de 81 % et de 93 %. Nous avons observé une corrélation significative entre le RPC et la protéinurie totale sur 24 heures dans le groupe 1 ($r = 0{,}473$; $P = 0{,}002$), le groupe 2 ($r = 0{,}814$; $P < 0{,}001$) et le groupe 3 ($r = 0{,}912$; $P < 0{,}001$). La formule établie pour estimer la protéinurie sur 24 heures à partir du RPC d'une miction isolée chez les cas de prééclampsie grave était la suivante : $Y = 832{,}02X + 378{,}74$ mg ($r^2 = 0{,}8304$).

Conclusion : Bien que la collecte d'urine sur 24 heures demeure d'une certaine fiabilité pour déterminer le degré de protéinurie totale, nos résultats indiquent qu'il serait possible d'évaluer l'importance de la protéinurie à l'aide du RPC d'une miction isolée, plus particulièrement dans les cas de prééclampsie grave.

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INTRODUCTION

Preeclampsia is a heterogeneous multisystem disorder. Its main renal expressions are decreased renal plasma flow, glomerular filtration rate, and proteinuria.[1] Proteinuria is the characteristic finding in preeclampsia.

Determining whether there is significant proteinuria (≥300 mg/d) is a main goal in the pregnant woman with hypertension.[2] A 24-hour urine collection is the gold standard for quantification of proteinuria in preeclampsia. The most important disadvantage of this method is that it is time consuming. For this reason, some alternative methods, including urinary dipsticks,[3] urine collections during a shorter period,[4] urinary spot protein-to-creatinine ratio,[5,6] and urinary spot albumin-to-creatinine ratio,[7] have been used for the determination of proteinuria in pregnancy. PCR has been studied to estimate significant proteinuria for the diagnosis of preeclampsia.[6,8] Several studies with discordant results and conclusions were conducted to evaluate the predictive value of spot urine PCR for significant proteinuria in different patients and settings. However, to the best of our knowledge, there is no evidence that spot urine PCR can predict the magnitude of proteinuria in patients with severe preeclampsia. This study aimed to evaluate the role of PCR for predicting significant proteinuria and the magnitude of proteinuria in patients with preeclampsia of varying severity.

MATERIAL AND METHODS

This prospective observational study was designed to evaluate potential preeclampsia and/or its severity in patients admitted to our tertiary university clinic (Cukurova University, Adana, Turkey) between May 2011 and March 2013. Approval of the Local Ethics Committee was obtained. Informed consent of all the participating patients was obtained at admission. The trial was registered (www.clinicaltrials.gov NCT01623791). The patients involved in the study were evaluated by a standard approach, and the eventual diagnosis of preeclampsia was reached by considering criteria for preeclampsia.[2] Preeclampsia was defined as severe in the presence of one or more of the following criteria: blood pressure, ≥160 mm Hg systolic or ≥110 mm Hg diastolic on two occasions at least 6 hours apart at rest; proteinuria, ≥5 g in a 24-hour urine sample or 3+ or more on two randomly collected urine samples for at least a 4-hour period; the presence of pulmonary edema or cyanosis, liver function insufficiency, thrombocytopenia, cerebral and visual disturbances, or epigastric or right upper quadrant pain; and fetal growth restriction. Patients with concurrent diseases, including urinary tract infection, chronic hypertension, diabetes mellitus, or pre-existing renal disease, and systemic diseases such as systemic lupus erythematosus, were excluded. During the study period, there were 276 enrolments, 71 of which were excluded because 24-hour urine was not collected and/or PCR was not measured. Patients were not accepted in the study more than once.

Urinary protein concentration by automated dipstick urine analysis, spot urinary PCR, and 24-hour total proteinuria by 24-hour urine collection were measured. Dipstick urine analysis was obtained at admission. Spot urine PCR was determined immediately after 24-hour urine collection. Thus, the evaluation of PCR did not change the management of these patients. Blood urea nitrogen and creatinine values were assessed at admission. Patients were scored as 1 (<50 mL), 2 (50−100 mL), or 3 (>100 mL) according to their hourly urine output at admission. Severely preeclamptic patients received $MgSO_4$, and their urine samples were obtained by urethral catheter. Excluding these cases, all other urine samples were collected by the clean-catch method. Urinary protein and creatinine were measured by the Pyrogallol Red and picrate methods, respectively (Beckman Coulter DXC 800, Beckman Coulter, Krefeld, Germany). Dipstick urine analysis was performed by protein error indicator. The results of the analysis were presented as negative (−), 1+, 2+, 3+, and 4+. All measurements were conducted with the help of the laboratory technicians who were blinded to the clinical conditions of the patients in the central laboratory of our hospital. When the magnitude of proteinuria in the 24-hour urine collection was ≥300 mg, it was defined as significant proteinuria.[2]

Data were analyzed using SPSS software version 20.0 (IBM, Armonk, NY). Continuous variables for the groups were compared using the Student *t* test and the Mann-Whitney U test according to their distribution, and they were expressed as mean ± standard deviation, median, maximum, and minimum values. Categorical values were compared among the groups with the chi-square test and were calculated as n and rate (%). $P < 0.05$ was considered statistically significant. Correlation analysis was performed with the Spearman sign rank correlation test. The discriminant cut-off values, sensitivity and specificity of spot urine PCR, and 24-hour total proteinuria were

ABBREVIATIONS

AUC	area under the curve
PCR	protein-to-creatinine ratio
ROC	receiver operating characteristic