

Correlation of 4 Hour Urine Samples with 24-Hour Urine Samples for the Diagnosis of Preeclampsia

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Abstract

Background: Preeclampsia is one of the causes of maternal and prenatal mortality and morbidity. The 24-hour urine sample is considered as a gold standard for preeclampsia diagnosis and shortening the time of urine collection will result in the patients' convenience and shorter hospitalization. The goal of this study was to determine the diagnostic accuracy of 4 hour urine protein in comparison with 24 hour urine protein in pregnant women.

Methods: One hundred pregnant women, with a gestational age of more than 20 weeks, and were suspicious to preeclampsia were enrolled. The 24-hour as well as the 4-hour urine sample were collected. All data were analyzed using the SPSS software, version 20 (SPSS Inc., Chicago, IL, USA). The correlation coefficient was used to determine relationship between the 4 and 24-hour urine proteins. Receiver operating characteristic (ROC) curve was used to determine optimal cut-off values of 4 hour proteinuria.

Results: The mean age and mean gestational age of participants was 26.8 & 6.1 years and 34.1 & 3.4 weeks. The mean 4-hour urine protein was 165.6 & 170.2 mg and the mean 24 hour urine protein was 926 & 1013 mg. The mean age, 4-hour urine protein, and 4 as well as 24 hour urine volumes were significantly different between cases with no, mild, or severe proteinuria. Pearson correlation coefficient between 4 and 24 hour proteinuria was strong ($r = 0.97$ and $p < 0.001$). The best cut off point for 4-hour proteinuria to determine proteinuria was 69.5 mg with a sensitivity of 93% and specificity of 100%. (Area under the curve = 0.99, $p < 0.001$).

Conclusions: Women that are suspicious to have preeclampsia, the total 4-hour urine protein values positively correlated with values of 24-hour samples.

Keywords: Urine Protein, Preeclampsia, Correlation, Sever, Moderate, Mild

1. Background

One of the important causes of maternal and prenatal mortality and morbidity is preeclampsia (1). Preeclampsia occurs in 2 - 7 (2) of all pregnancies, which is responsible for 10% - 15% of maternal deaths that occurs each year, which are related to pregnancy hypertensive disorders (1). It is a multi-system disorder that affects maternal kidneys, liver, brain, and clotting systems (3). It is characterized by high blood pressure and proteinuria, although its exact etiology and pathophysiology is not clear. Impaired placentation is considered as one of the leading causes of preeclampsia (4). It has been considered that women with proteinuria had a poorer outcome than women without it (only gestational hypertension) (5). International Society for the Study of Hypertension in Pregnancy (ISSHP) defined proteinuria as ≥ 300 mg/day of protein in a 24-hour

urine collection or a spot urine protein/creatinine ratio ≥ 30 mg/mmol (6).

The 24-hour period collection of the urine is not desirable for the patients and may cause diagnosis and treatment delay (7). Shortening the time of urine collection will result in patient's convenience and shorter hospitalization (7).

The goal of this study was to determine diagnostic accuracy of 4 hour urine protein in comparison with 24 hour urine protein in pregnant women.

2. Methods

In this cross-sectional study, which was conducted in the Amir-almomenin hospital (affiliated Hospital of Zabol University), between August 2014 and August 2015, 100

pregnant women with a gestational age of more than 20 weeks, suspicious to have preeclampsia (blood pressure equal or more than 140/90 mmHg), and admitted in the hospital were enrolled.

Exclusion criteria included: chronic kidney, heart, liver disease, lupus erythematosus, diabetes mellitus, and urinary infection.

All patients were asked to fill informed consent forms, although the local ethics committee had approved the study.

Patients were in supine position and 2 containers were used to collect the urine (24-hour urine and 4-hour urine).

By means of graduated cylinder, the volume of each container was measured and recorded. On the other hand, modified Fujita method (Sigma Diagnostics Microprotein-PR, procedure No. 611) was applied to measure protein of each container (8).

The urine concentration was determined by using a modified Jaffe reaction by Sigma Diagnostics (procedure No. 555) (8).

We categorized patients due to 24 hour proteinuria into 3 groups:

1. Protein less than 300 mg (no proteinuria)
2. Protein between 300 - 2000 mg (mild proteinuria)
3. Protein more than 2000 mg (severe proteinuria)

All data were analyzed using the SPSS software, version 20 (SPSS Inc., Chicago, IL, USA). Data were presented as mean \pm SD for continuous variables. One-way ANOVA applied to compare continuous variables. Correlation coefficient was used to determine the relationship between 4 and 24-hour urine proteins.

ROC curve was used to determine the optimal cut-off values of 4-hour proteinuria.

Area under the curve (AUC) was calculated.

P value less than 0.05 was considered significant.

3. Results

One hundred women were enrolled in this study. The mean age and gestational age of participants was 26.8 ± 6.1 years and 34.1 ± 3.4 weeks. The mean 4-hour urine protein was 165.6 ± 170.2 mg and the mean-24 hour urine protein was 926 ± 1013 mg. The mean 4 and 24-hour urine creatinine were 205.4 ± 68 and 1168.8 ± 265.1 .

The mean 4 and 24-hour urine volume were 382.7 ± 139.2 cc and 1984.8 ± 697.2 cc.

Forty cases (40%) had no proteinuria, 46 (46%) had mild proteinuria and 14 (14%) had severe proteinuria. The mean age, 4 hour urine protein, 4 and 24-hour urine volumes were significantly different between cases with no, mild, or severe proteinuria [Table 1](#)

Pearson correlation coefficient between 4 and 24-hour proteinuria was significant ($r = 0.97$ and $P < 0.001$).

The best cut-off point for 4-hour proteinuria to determine proteinuria was 69.5 mg with sensitivity of 93% and specificity of 100%. (Area under the curve = 0.99, $P < 0.001$) ([Figure 1](#)).

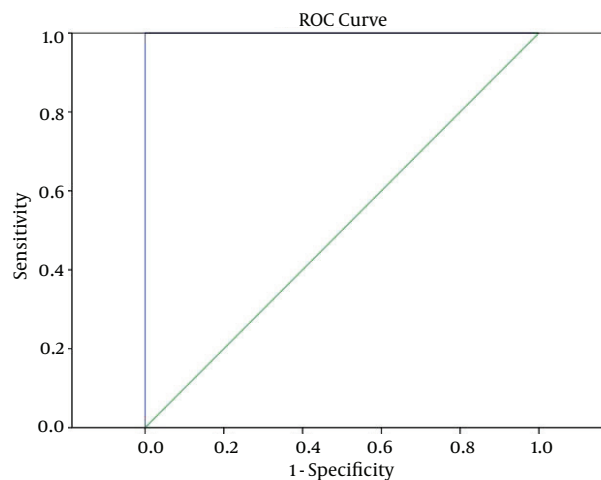


Figure 1. ROC Analysis to Determine 4 Hour Urine Protein Cut Off Point

4. Discussion

The results of this study showed that protein values for the first 4-hour of a 24-hour urine sampling were significantly correlated with a 24-hour urine protein in cases suspicious for preeclampsia. This finding is compatible with the Amirai et al. findings who found significant positive correlation between 4 and 24-hour in pregnant women with gestational hypertension (9). In their study 14 out of 100 cases had severe proteinuria, 44 had mild proteinuria and 42 had no proteinuria which is like our findings.

In this study, the cut-off value of 4-hour proteinuria had a sensitivity of 93% and specificity of 100%, while in their study, the 4-hour urine protein cut-off value for predicting proteinuria in pregnant women with gestational hypertension was 62 mg with sensitivity and specificity of 93% and 90% (9).

In another study, Adelberg et al. evaluated the diagnostic accuracy of 8 and 12-hour urine samples for predicting 24-hour proteinuria (7). They found that the 8-hour urine protein correlated with those of the 24-hour sample for patients with mild and severe disease, while 12-hour urine protein correlated with 24-hour urine protein in patients with and without proteinuria (7).

Table 1. Characteristics of the Patients

	No Proteinuria	Mild Proteinuria	Severe Proteinuria	P Value
Age	26.9 ± 6.1	28 ± 6.2	22.6 ± 3.9	0.01
Gestational age	34 ± 3.7	34.2 ± 3.2	33.8 ± 3.4	0.09
4 hour protein	34.6 ± 12.4	173.8 ± 90	513 ± 95	< 0.001
4 hour creatinine	216.8 ± 87	202.1 ± 54.6	183.7 ± 34.6	0.2
24 hour creatinine	1169.7 ± 305.1	1186.8 ± 251.9	1107 ± 177	0.6
4 hour urine volume	343 ± 132	423.2 ± 144.1	362.8 ± 110.6	0.02
24 hour urine volume	1753.2 ± 664.1	2180.5 ± 708.6	2000 ± 581	0.01

Wongkitisophon et al. evaluated 4-hour urine protein in 38 women with pregnancy hypertension and reported positive correlation between 4 and 24-hour urine proteins (10). Similar to their study, we also found a positive correlation between 4 and 24-hour urine protein ($r = 0.97$ and $P < 0.001$).

Singhal et al. investigated that 4-hour urine protein with cut-off point of 50 mg (sensitivity and specificity = 95% and 94%) is correlated with 24-hour urine protein. Their cut-off value was lower than our findings.

Determining proteinuria and quantitation of proteinuria is important for the diagnosis of preeclampsia and its severity.

Nowadays, the gold standard for evaluating proteinuria is 24-hour urine protein, which may lead to a delay in diagnosis and treatment. To reduce patient cost, inconvenience, and diagnosis delay, it would be better to replace the 24-hour urine collection with a shorter period of urine collection. This will help shorten the time of delivery and earlier administration of antenatal glucocorticoids.

4.1. Conclusion

In women who are suspicious to have preeclampsia, the total 4-hour protein values positively correlated with values of 24-hour samples.

Footnote

Conflict of Interest: Authors had no conflict of interest.

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