Original Article

Validating the Diagnostic Accuracy of Dipstick Urine Analysis in Single Voided Urine by using 24 Hours Collection as Gold Standard for Diagnosis of Proteinuria in Patients with Pregnancy Induced Hypertension

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Abstract

Objective: To evaluate the diagnostic accuracy of dipstick urine analysis in single voided urine by using 24 hours collection as gold standard for diagnosis of proteinuria in patients with pregnancy induced hypertension.

Methodology: This cross sectional study was conducted at the Department of Obstetrics and Gynecology, Jinnah Hospital, Unit-I, Lahore from 26-01-2016 to 25-07-2016. A total of 355 pregnant women were included in this study. Details of each subject's urinary protein was assessed by urine dipstick in single voided urine as well as in 24 hours urinary collection (gm/24 hours) was sent to a laboratory for analysis.

Results: Mean age of the patients was 24.5±8.5 years. Out of 355 patients, positive proteinuria on dipstick was observed in 176 (49.6%). Comparison of urine dipstick in the diagnosis of proteinuria in PIH patients by taking 24 hours collection as gold standard shows true positive cases 166, false positive 10, false negative 102 and true negative were 77. In the diagnosis of proteinuria in PIH patients urine dipstick sensitivity was 61.9%, specificity 88.5%, diagnostic accuracy 68.4%, Positive predictive value 94.3% and Negative predictive value 43.0%.

Conclusion: Accepting >2 + dipstick proteinuria improves overall diagnostic accuracy for preeclampsia at the expense of a higher false negative rate. This study emphasizes the need to confirm dipstick proteinuria with a further test such as a spot urine protein/creatinine ratio in all hypertensive pregnant women, particularly in research studies.

Key words: Pregnancy induced hypertension, Proteinuria, Diagnosis accuracy, Urine Dipstick.

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Introduction

Polyhydramnios Preeclampsia contributes substantially to maternal and fetal morbidity and mortality.[1] Along with eclampsia, it ranks second only to hemorrhage as a direct &particular cause of maternal death.[2] It affects 5 to 8 % of all pregnancies.[1] Preeclampsia is a serious complication of pregnancy, and it is vital to diagnose the condition as early as possible.[3] Pre-eclampsia is diagnosed when a previously normotensive woman has blood pressure 140mmHg or higher systolic or 90mmHg or higher diastolic and proteinuria 300 mg or

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more in 24 hours urine collection.[4]

The previous history of preeclampsia put women at an increased risk of preeclampsia and other adverse pregnancy outcomes in subsequent pregnancies.[3] The risk that a woman will die of preeclampsia or eclampsia in developing countries is 300 times greater than in developed countries.[2]

Preeclampsia can worsen quickly from a mild to life-threatening condition therefore it is important to treat preeclampsia earlier than late. It would benefit both mother and the baby.[4] The association of hyperuricaemia with pre-eclampsia is reported and it has been tested in early pregnancy for its ability to predict the later onset of the disease.[5] It is characterized by the development of hypertension with proteinuria after 20 weeks of gestation.[6] In the hypertensive disorder of pregnancy, especially pre-eclampsia urinalysis for proteinuria by quantification of urinary protein in 24 hours urine collection play an important role.[7]

A study done on the accuracy of urine dipstick by Gangaram et al showed a sensitivity of 51% (95% CI [0.41-0.61]) and specificity of 91% (95% CI [0.81-0.96]). The PPV and NPV was 89% (95% CI [0.77-0.95]) and 58% (95% [0.48-0.67]), respectively.[8] Another study done by Abebe et al showed a sensitivity and specificity of dipstick test 81% and 47%, respectively.[9]

We conducted this study because the presence of protein in hypertensive disorders of pregnancy is a sign of a worsening condition and thus requires early intervention to prevent adverse consequences especially in developing countries like ours. Urine dipstick is still the quickest, easily available, cheapest and rapid method of assessing proteinuria and is widely practiced clinically but previous studies show a wide range of sensitivity and specificity.

Methodology

The study design was cross sectional validation study. It was done in the Department of Obstetrics and Gynaecology, Jinnah Hospital, Unit-I, Lahore. The study was carried out over six months from 26-01-2016 to 25-07-2016. The patients included in this study had Age 20-40 years and cases with Single pregnancy (confirmed on ultrasonography), and the cases at 20 weeks of gestation with blood pressure 140mmHg or higher systolic or 90mmHg or higher diastolic. The patients excluded in this group were Molar pregnancy (determined on ultrasonography), and the Patients with urinary tract infection determined on the history of frequency, burning micturition and positive of bacteria in urine routine examination, and Known case of chronic renal disease on history and clinical examination.

Total of 355 pregnant women fulfilling the inclusion criteria were included in this study. After informed consent from subjects and collection of demographic details, each subject's urinary protein was assessed by urine dipstick in single voided urine as well as in 24 hours urinary collection (gm/24 hours) was sent to a laboratory for analysis. All the information was collected in a structured proforma.

The data was entered and analyzed by SPSS version 17.0. Diagnostic accuracy, specificity, sensitivity, positive predictive, and negative predictive values of urine dipstick was calculated by using 2 X 2 table and 24 hours urinary proteins was taken as the gold standard. The mean standard deviation was calculated for a numerical variable like age. Frequency and percentages were calculated for qualitative variables like positive and negative results of proteinuria on dipstick and 24 hrs. urinary protein.

Results

In the present study, 355 pregnant women with blood pressure 140mmHg or higher systolic or 90mmHg or higher diastolic were included in the study. Most common age group was between 20-30 years old. Mean age of the patients was 24.5±8.5 years.

Out of 355 patients, positive proteinuria on dipstick was observed in 176 (49.6%) patients. (Table I)

Urine dipstick in the diagnosis of proteinuria in PIH patients by taking 24 hours collection as gold standard shows true positive cases 166, false positive 10, false negative 102, and true negative were 77 (Table-2).In the diagnosis of proteinuria in PIH patients urine dipstick sensitivity was 61.9%, specificity 88.5%, diagnostic accuracy 68.4% PPV 94.3% and NPV 43.0% (Table III).

Table I: Proteinuria on dipstick (n= 355)

Proteinuria	Number
Positive	176 (49.6%)
Negative	179 (50.4%)
Total	**355 (100%)**

Table II: Comparison of urine dipstick in the diagnosis of proteinuria in PIH patients by taking 24 hours collection as gold standard (n=355)

Dipstick results	24 hours urinary protein (Gold Standard)		Total
	Positive	Negative	
Positive	166 (TP)	10 (FP)	176
Negative	102 (FN)	77 (TN)	179
Total	268	87	**355**

Key: TP= True positive FP = False positive FN = False negative TN = True negative

Table III: Sensitivity, Specificity, Diagnostic Accuracy and Predictive value of urine dipstick in the diagnosis of proteinuria in PIH patients

$$\text{Sensitivity rate} = \frac{\text{True Positive}}{\text{True Positive + False Negative}} \times 100 = 61.9\%$$

$$\text{Specificity rate} = \frac{\text{True Negative}}{\text{True Negative + False Positive}} \times 100 = 88.5\%$$

$$\text{Diagnostic Accuracy} = \frac{\text{True Positive + True Negative}}{\text{True Positive + True Negative + False Positive + False Negative}} \times 100 = 68.4\%$$

$$\text{Predictive value of Positive test} = \frac{\text{True Positive}}{\text{True Positive + False Positive}} \times 100 = 94.3\%$$

$$\text{Predictive value of Negative test} = \frac{\text{True Negative}}{\text{True Negative + False Negative}} \times 100 = 43\%$$

Discussion

In current study, urine dipstick sensitivity was 61.9%, specificity 88.5%, diagnostic accuracy 68.4% PPV 94.3% and NPV 43.0%. These findings are consistent with the study of Gangaram et al.[9] Both false positive and false negative results have their implications. Over investigations and unnecessary intervention can follow false positive results while false negative results may lead to maternal and fetal morbidities. The reasons for such results are many ranging from improper collection of urine samples to various laboratory errors. Women are generally not guided over how to give a urine sample so false results occur. In laboratories dipstick test properties, interpretation errors and variation in gold standard assays used may lead to false results.[9]

During pregnancy hypertensive disorders especially, pre-eclampsia increases maternal and infant risks[10], which affects nearly 2-8% of all pregnancies.[11] Hyperuricemia is one of the distinctive finding in pre-eclampsia. Increased fetal and maternal morbidity is reported with preeclampsia.[12] Similar pregnancy outcomes to non-hypertensive women noticed in women with mild chronic hypertension with no proteinuria but there are greater chances of fetal growth restriction, placental abruption and perinatal mortality if there is superimposed pre-eclampsia.[13]

The data collected from the normal pregnant women is used to define the threshold of significant proteinuria. The cutoff for normal proteinuria is 300mg protein in 24 hours.[12] Proteinuria 2+ or more on dipstick analysis is defined as significant proteinuria. Page et al study showed that when hypertension combined with significant proteinuria, it was associated with fetal growth restriction leading to increased rates of still births and neonatal morbidity.[14] Similarly Ferrazzani et al noted that pre-eclampsia was associated with higher serum uric acid levels. It is also observed that the babies born to such mothers have lower birth-weights and there were more preterm deliveries.[12] If the level of proteinuria goes beyond 5 g/24 hours, it is noted that delivery is usually required in 2 to 3 weeks due to adverse effects on others and fetus.[16]

As pre-eclampsia is associated with maternal and fetal morbidity, so the diagnosis of proteinuria with reliability is very important. Several studies have been conducted aiming at the relationship between dipstick urinalysis on urine samples randomly voided with subsequent 24 hours urine sample. The series of Brown et al in 1995 [15] produced false negative results of 8–18% and a very high false positive rate of 67% with 1+ scores. However, another study by Waugh et al found high false negative rates with 1+ proteinuria, showing the discrepancy between dipstick and 24 hours urine sample results.[17]

In a study by Amirabi and Dannaii in comparison of 4 and 24 hour urine sample for the diagnosis of proteinuria in pregnancy, the urine protein values of 4-hour samples correlated with those of the 24-hours samples for patients with mild and severe forms of the disease ($P<0.001$, $r=0.86$).[18]

In a study by Sapna et al Dipstick estimation and urine protein-creatinine ratio were compared to the 24-hour urinary protein results. Urine protein-creatinine ratio showed better sensitivity in predicting significant proteinuria as compared to dipstick method. This study

suggests that for assessment of proteinuria in hypertensive pregnant women, protein: creatinine ratio is a reliable investigation as compared to dipstick methods.[19]

A systematic review on the accuracy of dipstick has highlighted its poor performance. The likelihood of having clinically significant proteinuria is neither considerably raised by the presence of +1 proteinuria on dipstick, nor it is lowered by a normal dipstick result. So, it cannot be used in clinical decision making process due to its limitations. To interpret the accuracy of higher dipstick results i.e. greater than+1 is also not possible because the small poor quality data is available regarding them.[20]

There can be a significant fall in the false positive result rate, if the laboratory staff is trained and guided in interpreting the dipstick results.[21] Saudanet al observed that if visual testing is replaced by the automated technology in interpreting the dipstick result, false positive results can be improved. Automated technology has shown promising results with very few false positive results reported.[22]

However, as dipstick urinalysis is used widely due to its feasibility, it is not possible to remove it from antenatal care without finding a suitable alternative. But this requires improvement due to its inaccuracies and potential aftereffects of false results. With false negative results, some women with proteinuria will not be picked while in some there will be the apprehensions of a false positive result. Both such results actually put women and their pregnancies at risk.

Conclusion

Overall diagnostic accuracy for preeclampsia can be improved by accepting ≥2 + dipstick proteinuria, at the expense of a higher false negative rate. This study stresses the need of a further test such as spot protein: creatinine ratio to confirm dipstick proteinuriain all hypertensive pregnant women, especially in research studies.

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