Original Article

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Comparison of the Accuracy of Spot Urinary Protein/Creatinine Ratio and Urinary Dipstick with the 24-h Urine Protein Estimation in Children with Nephrotic Syndrome

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Abstract

Introduction: Nephrotic syndrome is a common renal disease. 24-h urinary protein (HUP) excretion, which is commonly accepted method for quantification of proteinuria, is time-consuming and inconvenient. A spot urine examination would be more acceptable and less time consuming. A simple, easy and precise method is necessary for proteinuria detection.

Aim: To compare the accuracy of spot urinary protein/creatinine ratio and urinary dipstick with the 24-HUP estimation in children with nephrotic syndrome.

Materials and Methods: An observational study was conducted on 102 children with all types of nephrotic syndrome under the age of 12 years in the Government Madurai Medical College Hospital, Madurai, for 1 year.

Results: The correlation between spot protein creatinine ratio (PCR) and 24-h proteinuria is statistically significant irrespective of the degree of proteinuria ($P \leq 0.001$). Dipstick correlates well with 24-HUP in all ranges of proteinuria ($P \leq 0.001$).

Conclusion: Spot PCR can be used as a reliable test to detect proteinuria even on an outpatient basis. The dipstick can be used to give an instant reliable test for proteinuria detection. Nephrotic syndrome is a chronic disease and having multiple relapses. Parents can be trained for earlier detection of proteinuria using the dipstick, so it can be helpful in management.

Key words: 24-h urine protein, Dipstick, Nephrotic syndrome, Proteinuria, Spot protein/creatinine ratio

INTRODUCTION

In Nephrotic syndrome, proteinuria detection is used diagnostically. A common accepted method for quantification of proteinuria is 24-h urinary protein (HUP) excretion. However, it is time consuming, cumbersome, and imprecise due to collection error. A spot urine examination would be more acceptable and less time consuming.[1-3]

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Recent studies have shown that the correlation between spot urinary protein/creatinine ratio (UPr:UCr), urinary dipstick, and 24-HUP estimation was statistically highly significant for all levels of proteinuria.

The most widely used screening test is urine dipstick test.[1] It is usually highly specific, but sensitivity is not always high enough as in quantitative methods. False positive and false negative results may occur in some situations. A simple, convenient and accurate method is crucial for proteinuria detection.[4-6]

This study is done to compare the accuracy of spot UPr:UCr and urinary dipstick method with the 24-h protein estimation in children with nephrotic syndrome.

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MATERIALS AND METHODS

This is an observational study conducted in the Government Madurai Medical College Hospital, Madurai, for 1 year. The study population includes children with all types of nephrotic syndrome under age of 12 years. The study excludes proteinuria with alkaline urine (pH>8), diluted urine (specific gravity <1.002), gross hematuria, and pyuria since it may give false positive or false negative results with dipstick.

Informed consent was obtained from the parent/guardian for the study. Data were collected about the age and sex. Height and weight were measured. Body surface area was arrived using Mosteller formula. Patients were asked to collect urine for 24 h. Collection time starts from 7.00 am on the 1st day and completed by 7.00 am the next day. The 24-HUP was determined. The next random urine sample should be subjected to spot protein creatinine ratio (PCR) and dipstick tests. The results of the spot PCR, dipstick, and 24-HUP were recorded as normal, abnormal, and nephrotic proteinuria. The accuracy of spot UPr:UCr and urinary dipstick were compared with the 24-HUP estimation. For the determination of 24-HUP excretion, measure the urine volume and calculate the result as follows:

$$\text{24 h urine protein} = \frac{\text{Urine protein in mg/dl} \times \text{total volume of urine excreted in 24 h}}{100}$$

Result reported as[2] normal range of proteinuria - <4 mg/m^2/h, abnormal proteinuria - 4-40 mg/m^2/h, nephrotic proteinuria - >40 mg/m^2/h.

The next random urine sample should be subjected to following tests.

Spot UPr:UCr

UPr can be estimated by the sulfosalicylic acid method. UCr can be estimated by the Jaffe's method (picric acid method).[4,5]

Spot UPr:UCr is arrived by dividing UPr concentration (mg/dl) by UCr concentration (mg/dl).

Results reported as

- Normal protein excretion - <0.5 in children <2 years of age
- <0.2 in children ≥2 years of age
- Abnormal proteinuria - 0.5-2 in children <2 years of age
- 0.2-2 in children ≥2 years of age
- Nephrotic proteinuria - >2.

Dipstick Test

Using DIP 'N' READ, a 10 reagent strip, proteinuria was measured. 5-10 ml of urine was taken in a test tube. The strip was immersed completely in the urine and withdrawn immediately. Prolonged immersion will produce a false positive result due to leak of buffer. Specific gravity, pH, leukocytes, and blood were also determined using this A-10 reagent strip. The study excludes proteinuria with alkaline urine (pH>8) since it may give false positive results; diluted urine (specific gravity >1.010)[3] since it may give false negative. Gross hematuria was excluded by detecting red blood cells in the dipstick. By detecting leukocytes, pyuria was excluded.

The result was reported as[2,3] negative no protein, trace - 10-20 mg/dl, 1±30 mg/dl, 2±100 mg/dl, 3±300 mg/dl, 4±1000-2000 mg/dl.

The results of the spot PCR, dipstick, and 24-HUP were depicted as normal, abnormal, and nephrotic proteinuria, respectively (Table 1).

RESULTS

In this study, 1% of the case was an infant, 46.1% of cases belonged to 6-12 years age group, and 52.9% of cases belonged to children more than 6 years. Mean age is 6.87 years. Standard deviation is −3.4418. Out of the 102 cases, 61 cases (59.8%) were males and 41 cases (40.2%) were females (Table 2).

Results of dipstick are shown in Table 3. Out of the 102 cases, 29.4% of spot PCR results were <0.5/<0.2 in children <2 years or more than 2 years, respectively. 33.3% were 0.5-2/0.2-2 in children <2 years of age or more than 2 years of age, respectively. 37.3% of spot PCR results were >2 (Table 4).

Out of the 102 cases, 29.4% of 24-HUP results were <4 mg/m^2/h. 35.3% were 4-40 mg/m^2/h. 35.3% of 24-HUP results were <4 mg/m^2/h (Table 5).

Comparison between the Three Groups

The following comparisons were done

- Comparison between urine spot protein/creatinine ratio and 24-HUP
- Comparison between urine dipstick and 24-HUP.

Comparison of Spot PCR and 24-HUP (Table 6)

When spot PCR was compared with 24-HUP, 86.7% (26/30) of samples with spot PCR <0.5/<0.2 had a protein excretion of <4 mg/m^2/h. 82.4% (28/34) of samples with spot PCR 0.5-2/0.2-2 had a protein excretion of 4-40 mg/m^2/h.

Table 1: The results of the spot PCR, dipstick, and 24-HUP

Proteinuria	Dipstick	Spot PCR	24-HUP
Normal proteinuria	Negative Trace 1+	<2 year <0.5 ≥2 year <0.2	<4 mg/m²/hr
Abnormal proteinuria	2+	<2 year 0.5-2 ≥2 year 0.2-2	4-40 mg/m²/hr
Nephrotic proteinuria	3+ 4+	>2	>40 mg/m²/hr

Spot PCR: Spot protein creatinine ratio, 24-HUP: 24-hour urine protein, PCR: Polymerase chain reaction

Table 2: Age and wise distribution (*n*=102)

Age in years	*N* (%)		Total *N*
	Male	Female	
0-1	1 (1)	-	1
1-6	29 (28.4)	18 (17.6)	47
>6	31 (30.4)	23 (22.6)	54
Total	61 (59.8)	41 (40.2)	102

Table 3: Results of dipstick

Results	*N* (%)
Negative	19 (18.6)
Trace	6 (5.9)
1+	9 (8.8)
2+	32 (31.4)
3+	10 (9.8)
4+	26 (25.5)
Total	102 (100)

Table 4: Results of spot PCR

Results	*N* (%)
<0.5/<0.2	30 (29.4)
0.5-2.0/0.2-2.0	34 (33.3)
>2	38 (37.3)
Total	102 (100)

PCR: Polymerase chain reaction

Table 5: Results of 24-HUP

Results	*N* (%)
<4 mg/m²/hr	30 (29.4)
4-40 mg/m²/hr	36 (35.3)
>40 mg/m²/hr	36 (35.3)
Total	102 (100)

24-HUP: 24-hour urine protein

89.5% (34/38) of samples with spot PCR >2 had a protein excretion of >40 mg/m²/h. This was statistically significant ($P \leq 0.001$) in all ranges of proteinuria.

Comparison of Dipstick and 24-HUP (Table 7)

When dipstick was compared with 24-HUP, 82.4% (28/34) of samples with dipstick negative/trace/1+ had a protein excretion of <4 mg/m²/h. 75% (24/32) of samples with dipstick positivity of 2+ had a protein excretion of 4-40 mg/m²/h. 83.3% (30/36) of samples with dipstick positivity of 3+/4+ had a protein excretion of >40 mg/m²/h. This was statistically significant ($P \leq 0.001$) in all ranges.

Table 6: Comparison of spot PCR and 24-HUP

Spot PCR	24-HUP, *N* (%)			Total *N*
	<4 mg/m²/hr	4-40 mg/m²/hr	>40 mg/m²/hr	
<0.5/<0.2	26 (86.7)	4 (13.3)	-	30
0.5-2.0/0.2-2.0	4 (11.8)	28 (82.4)	2 (5.9)	34
>2	-	4 (10.5)	34 (89.5)	38
Total	30 (29.4)	36 (35.3)	36 (35.3)	102

24-HUP: 24-hour urine protein, PCR: Polymerase chain reaction

Table 7: Comparison of dipstick and 24-HUP

Dipstick	24-HUP, *N* (%)			Total *N*
	<4 mg/m²/hr	4-40 mg/m²/hr	>40 mg/m²/hr	
Negative/ trace/1+	28 (82.4)	6 (17.6)	-	34
2+	2 (6.3)	24 (75)	6 (18.8)	32
3+/4+	-	6 (16.7)	30 (83.3)	36
Total	30 (29.4)	36 (35.3)	36 (35.3)	102

24-HUP: 24-hour urine protein, PCR: Polymerase chain reaction

DISCUSSION

Mean age in our study was 6.871 years. This is similar to Shastri *et al*.[6], study and Chahar *et al*.[7] study, in which the mean age were 6.7 years and 7.3 years, respectively. Out of the 102 cases, 61 cases (59.8%) were males and 41 cases (40.2%) were females. This is similar to Shastri *et al*.[6] study, in which 58.2% were males and 41.7% were females.

In this study, the range of values observed urine spot PCR was 0.12-50 with the mean value of 4.96. In Iyer *et al*.[8] study, the range of observed value of UP/UC 1.7-9.6 with the mean value of 5.5±2.

When spot PCR was compared with 24-HUP, the result was statistically significant ($P \leq 0.001$) in all ranges. This is similar to Shastri *et al*.,[6], Chahar *et al*.,[7] Indira Agarwal *et al*.,[9] Biswas *et al*.,[10] Mustafa *et al*.,[11] Mir *et al*.,[12] and Ginsberg *et al*.[13] studies where spot PCR correlates well with 24-HUP irrespective of the degree of proteinuria.

When dipstick was compared with 24-HUP, the result was statistically significant ($P \leq 0.001$) in all ranges of proteinuria. This is similar to Indira Agarwal *et al*.[9] and Biswas *et al*.[10] studies where dipstick correlates well with 24-HUP irrespective of the degree of proteinuria.

CONCLUSION

- Nephrotic syndrome is more common in males than females
- There is statistically significant correlation between spot PCR and 24-h proteinuria irrespective of the degree of proteinuria. So, spot PCR, which is a quantitative method can be used as a reliable test to detect proteinuria even on outpatient basis
- Dipstick correlates well with 24-HUP. So, dipstick can be used to give an instant reliable test for proteinuria detection.

Nephrotic syndrome is a chronic disease and having multiple relapses. Since earlier detection prevents relapse, parents can be trained for earlier detection of proteinuria using the dipstick.

REFERENCES

1. Kashif W, Siddiqi N, Dincer AP, Dincer HE, Hirsch S. Proteinuria: How to evaluate an important finding. Cleve Clin J Med 2003;70:535-7, 541-4, 546-7.
2. Behrman RE, Kleiman RM, Jenson HB. The nephrotic syndrome. Nelson Textbook of Pediatrics. 19th ed. New Delhi: Elsevier India Private Limited; 2011. p. 1799-807.
3. Leung AK, Wong AH. Proteinuria in children. Am Fam Physician. 2010;82:645-51.
4. Godkar PB, Godkar DP. Textbook of Medical Laboratory Technology. 2nd ed. Mumbai: Bhalani Publishing House; 2003. p. 243, 887-9.
5. Varley H. Practical Clinical Biochemistry. 4th ed. London: Interscience Book; 1988. p. 484-8, 605-7.
6. Shastri NJ, Shendurnikar N, Nayak U, Kotecha PV. Quantification of proteinuria by urine protein/creatinine ratio. Indian Pediatr 1994;31:334-7.
7. Chahar OP, Bundella B, Chahar CK, Purohit M. Quantitation of proteinuria by use of single random spot urine collection. J Indian Med Assoc 1993;91:86-7.
8. Iyer RS, Shailaja SN, Bhaskaranand N, Baliga M, Venkatesh A. Quantitation of proteinuria using protein-creatinine ratio in random urine samples. Indian Pediatr 1991;28:463-7.
9. Agarwal I, Kirubakaran C, Markandeyulu, Selvakumar. Quantitation of proteinuria by spot urine sampling. Indian J Clin Biochem 2004;19:45-7.
10. Biswas A, Kumar R, Chaterjee A, Ghosh JK, Basu K. Quantitation of proteinuria in nephrotic syndrome by spot urine protein creatinine ratio estimation in children. Mymensingh Med J 2009;18:67-71.
11. Mustafa G, Khan PA, Iqbal I, Hussain Z, Iqbal MM. Simplified quantification of urinary protein excretion in children with nephrotic syndrome. J Coll Physicians Surg Pak 2007;17:615-8.
12. Mir S, Kütükçüler N, Cura A. Use of single voided urine samples to estimate quantitative proteinuria in children. Turk J Pediatr 1992;34:219-24.
13. Ginsberg JM, Chang BS, Matarese RA, Garella S. Use of single voided urine samples to estimate quantitative proteinuria. N Engl J Med 1983;309:1543-6.

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