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Absar Ali
Aga Khan University

Naila Asif
Liaquat National Hospital

Sonia Yaqub
Aga Khan University

Waqar Kashif
Aga Khan University

Diamond Merchant
Aga Khan University

See next page for additional authors

Authors
Absar Ali, Naila Asif, Sonia Yaqub, Waqar Kashif, Diamond Merchant, and Iffat Yazdant

Spot Urine Protein: Creatinine Ratio versus 24 Hour Urine Protein at Various Levels of GFR patients referred to a Tertiary Care Hospital of Pakistan

Absar Ali[1], Naila Asif[2], Sonia Yaqub[3], Waqar Kashif[4], Diamond Merchant[5], Iffat Yazdani[6]

Aga Khan University Hospital[1,3,4,5], Liaquat National Hospital Karachi, Pakistan[2,6]

Abstract

Objective: To determine the correlation of "random single voided urine protein: creatinine ratio" to "twenty four hour urine protein" at different levels of glomerular filtration rate (GFR) in Pakistani population.

Methods: A total of 107 patients were included in this cross section study. Patients were divided into five groups according to the GFR. Spot urine protein: creatinine ratio and 24 hour urine protein was measured by the standard methods. The correlation coefficient (r) between the two was calculated in each group separately.

Results: The GFR in groups 1 to 5 was ≥ 90, 60-89, 30-59, 15-29, and <15 ml/minute/1.73m^2 respectively. In group one correlation coefficient "r" was 0.96, in group two "r" was 0.81, in group three "r" was 0.94, in group four "r" was 0.82 and in group five "r" was 0.80.

Conclusion: "Random single voided urine protein : creatinine ratio" may be used as an alternative to "24 hour urine collection for protein" at all levels of GFR in Pakistani population (JPMA 58:476;2008).

Introduction

Measurement of 24 hour urine protein is one the most important test ordered in the investigation of renal disease. It helps in reaching the correct diagnoses, making a judgment on prognosis, and formulating the treatment strategy[1]. The 24 hours urine protein excretion also distinguishes between macro and microalbuminuria. It is now known that microalbuminuria is a risk factor for developing overt diabetic nephropathy and cardiovascular disease[2]. The wide spread use of 24 hours urine protein excretion measurement forced the researchers to find a simpler and quicker method to get the result. One of the simpler methods is use of spot single voided urine protein/creatinine ratio as an alternative to 24 hours urine collection.

A number of papers are published on this subject in the western world but the data is relatively lacking in Pakistani population[3,7]. In addition, there is a concern by

some of the practicing physicians that random spot urine protein/Creatinine ratio may not give the accurate results if the GFR is severely compromised[5]. To answer this question we decided to compare the 24 hours urine collection for protein to single voided (spot) urine protein /creatinine ratio at various levels of glomerular filtration rate (GFR). We also wanted to examine the notion "Urine Protein/Creatinine ratio is as good as 24 hour urine collection" in our community.

Patients and Methods

It was a cross section study of 107 patients who agreed to do "24 hours urine collection for protein and creatinine" and "Random single voided urine protein and Creatinine" at the same setting. Study was performed at Liaquat National Hospital, in collaboration with the department of medicine, Aga Khan University Hospital Karachi Pakistan..

All the cases of ≥18 years, referred for 24 hours urine protein and spot urine protein /Creatinine ratio, from June 1st 2006 for three months were included.

Urine collection method was explained in detail to the patients. Random urine sample was collected either before or after the 24 hours urine collection, but always within 12 hours.

The 24 hours urine protein and Creatinine were measured by Hitachi analyzer 912. Serum electrolytes and Creatinine were measured by lova CRT analyzer. Urine analysis was done on urisays 1800 machine.

Protein and Creatinine were expressed in mg/dl. Weight of the patient was measured in kilogram and body surface area in meter^2. The 24 hour urine protein was expressed in gram/24h / 1.73 m^2. GFR was calculated by standard UV/ p formula and corrected to weight and body surface area of 1.73 m^2. All patients were divided in 5 groups according to glomerular filtration rate as follows:

1. GFR ≥ 90ml/min/1.73m^2
2. GFR between 60-80 ml/min/1.73m^2
3. GFR between 30-59 ml/min/1.73m^2
4. GFR between 15-29 ml/min/1.73m^2
5. GFR less than 15 ml/min/1.73m^2

The grouping was done similar to chronic kidney disease classification[8,9] for convenience. No attempt was made to distinguish between acute and chronic renal failure.

Statistical analyses were conducted by using the Statistical package for social science SPSS (Release 15.0, standard version, copyright © SPSS; 1989-02). A descriptive analysis was done for baseline characteristics of the patients and results are presented as mean ± standard deviation for quantitative and number (Percentage) for qualitative variables. Correlation was tested using the Pearson correlation coefficient. P<0.05 was selected as the level of significance.

Results

A total of 107 (male: 47, female: 60) participants were included in the study. Mean age was 49 ± 18.25 years. Table 1 shows the number of patients in each of the five groups.

Table 1: Baseline characteristics of study population (n=107)

Characteristics	n(%)
Age, Years Mean ± SD	49 ± 18.25
Gender	
Male	47(44%)
Female	60(56.1%)
Weight, kg Mean ± SD	64 ± 13.57
Glomerular filtration rate, ml/min/1.73m2	
Mean ± SD	35.15 ± 30.57
Median(IQR)	20(48-14)
Groups	
≥ 90 ml/min/1.73 m2	7(6.5)
60-80 ml/min/1.73 m2	13(12.1)
30-59 ml/min/1.73 m2	24(22.4)
15-29 ml/min/1.73 m2	34(31.8)
<15 ml/min/1.73 m2	29(27.1)
Spot Urine Protein/Creatinine Ratio	
Mean ± SD	4.40 ± 4.05
Median(IQR)	2.90(6.80-1.20)
24 hour Urine Protein	
Mean ± SD	3.48 ± 3.30
Median(IQR)	2(4.80-1)

The mean spot Protein/Creatinine ratio and mean twenty four hour urine protein at different levels of GFR in the five groups is shown in Table 2.

Table 2: Random single voided urine "Protein: Creatinine ratio" to "twenty four hour urine protein" at different levels of glomerular filtration rate (GFR) (n=107)

GFR ml/ minute	N	24 hour protein ¥	Protein/creatinine Ratio ¥
≥ 90	7	4.92 ± 4.83	5.03 ± 5.07
60 - 89	13	5.64 ± 3.72	5.48 ± 3.52
30 - 59	24	3.15 ± 3.16	3.77 ± 4.26
15 - 29	34	2.56 ± 2.81	3.48 ± 3.14
< 15	29	3.49 ± 3.0	5.36 ± 4.65

¥Mean ± SD

The correlation between "Protein: Creatinine ratio" values in spot urine specimens and "24 hour urinary protein" excretion at different levels of GFR were checked. The results can be seen in Figure.

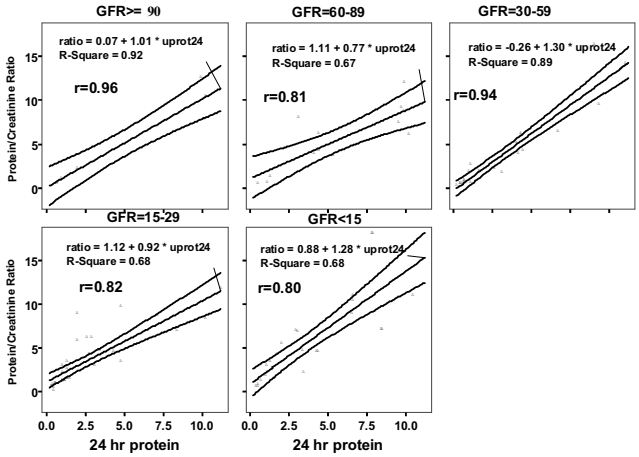

Fig. 1: Correlation between urine protein:creatinine ratio to "twenty four hour urine protein" at different level of Glomerular Filtration Rate.

Discussion

Urinary protein excretion rate measurement is the fundamental test in the work up of any nephrology case. Dipstick is the most commonly used test to check urinary protein. However it has minimal to nil value in the quantification of the protein, because it depends not only on the amount of protein but also on the volume of urine at the time of testing.

Twenty four hours urine collection to measure protein and creatinine is a traditional and long tested method and considered a "gold standard". It is now known that this method is not free of caveats. The main problem is accuracy of collection, which usually depends upon the patients. To circumvent this 24 hours collection procedure, the scientists ultimately discovered the very simple method of single voided spot urine patient/creat ratio. It is claimed that spot protein /creatinine ratio corresponds to 24 hours urine protein excretion. For example if the spot urine protein is 300 mg / dl and spot urine creatinine is 150 mg / dl, the ratio will be 300 / 150 = 2 which means 24 hours urine protein excretion is 2 gram.

Use of single voided urine prot/creat ratio as an alternative to 24 hours urine collection was suggested first in 1980s[6,7]. Thereafter several articles have been published on this topic. Some concerns were raised regarding the variables affecting the results. One of the factors was the effect of body mass[10]. It is suggested that low muscle mass may overestimate and high muscle mass may under estimate the proteinuria. The timing of single voided urine has been a matter of debate[6]. The protein /creat ratio may vary with ethnicity and race too[11,12]. It is generally thought that this variability is not necessarily clinically important. In addition, orthostatic proteinuria may be missed by protein /creat ratio.

In the presented study the results of spot urine protein /creatinine ratio was correlated with 24 hour urine protein excretion at different levels of GFR. It was hypothesized that spot urine protein/creat ratio method may overestimate the 24 hour protein excretion rate at low GFR. The patients were divided in 5 groups according to the GFR. The protein/creat ratio was used instead of albumin/creat ratio. A number of studies support that prot/creat ratio is similar to albumin/creat ratio if 24 hours protein excretion is more than 500 mg[13]. In our study all the patients had proteins more the 500 mg/24hrs. Cases with microalbuminuria were not included.

The correlation coefficient between 24 hour protein and spot urine prot/creat ratio was significant (0.80 to 0.96) in all five groups, confirming that the ratio can be used instead of 24 hours urine collection. However the result of group 5 (GFR= less than 15 ml/min) was not very convincing.

Conclusion

The study concluded that a random single voided urine protein/creatinine ratio is an alternative to 24 hour urine collection at all levels of GFR. Single voided protein/Creatinine ratio may overestimate the protein excretion at lower levels of GFR.

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