ESTIMATION OF CHRONIC RENAL INSUFFICIENCY BY COCKROFT-GAULT FORMULA AND CREATININE CLEARANCE

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ABSTRACT

Background/Objectives: To compare the estimation of chronic renal insufficiency by Cockcroft Gault formula and Creatinine Clearance.

Methodology: The study was conducted in Endocrinology department of Hayatabad Medical Complex, Peshawar. The laboratory data was collected from 100 inpatients in six months. Data was collected on a structured proforma. Descriptive analysis was done.

Results: Comparison was made between Cockcroft & Gault (CG) equation and conventional 24 hour creatinine clearance on 100 cases with mean age was 52 ± 9.5 SD, ranged from 33 to 70 years. The results reveal that mean blood sugar was 219±80SD accounting 96% type II diabetes. The mean GFR as estimated by the 24 hour creatinine clearance (CrCl) and CG formula was 75.98 ml/min/1.73m2 and 82.57±28.17 ml/min/1.73m2 respectively resulted the average mean difference (bias) of 6.6 ml/min/1.73m2 (P< 0.0001).

Conclusion: We concluded that Cockcroft Gault formula over estimates the GRF rate as compared to 24 hour CrCl however, the creatinine based prediction equation could be a cost effective tool for monitoring the progression of renal disease.

Keywords: Chronic renal insufficiency, Cockcroft Gault formula, Diabetic nephropathy, Creatinine clearance

INTRODUCTION

Chronic kidney insufficiency (CKI) is an irreversible decline in renal function which develops over many years. It is a slow process and does not produce symptoms unless there is significant loss of function[1,2]. Chronic renal failure (CRF) has been recognized as overwhelming problem for both patients and their families in Indo Pakistan[3,4].

There are many underlying causes but diabetes mellitus and diabetic nephropathy are leading causes of chronic renal disease[5]. An estimated glomerular filtration rate (GFR) of less than 60 ml/min per 1.73m^2 is linked with increased risk of adverse outcomes of chronic kidney disease[6].The late diagnosis of patients with renal disease is associated with optimal predialysis care, cost and increased mortality[7].There are many markers for assessing kidney function but they are costly , difficult and risky for the patients[8].

Creatinine is economic and easily measured but is influenced by various factors so these are taken into account in the formulas for estimation of renal function[4]. Cockcroft and Gault is a reliable index which gives absolute GFR values.

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METHODOLOGY

It was a cross sectional study conducted in Endocrinology unit in Hayatabad Medical Complex, Peshawar. The duration of study was six months comprising of those patients who were suffering from diabetes and renal failure based on study findings.

Both type 1 and type 2 diabetics were included, between the age group 15 to 65 years, who had the disease for more than 5 years duration. Patients with previous renal surgery, renal stones and background of glomerulonephritis, renal failure, acute urinary tract infection, septicemia due to any other infection and menstruating or pregnant females were excluded from the study.

The data was collected on a structured proforma with demographic, clinical examination and biochemical profile. Demographic and socio-economic information was collected through questionnaires. Samples were collected for the estimation of blood sugar, HbA1C, lipid profile, serum creatinine, 24 hour creatinine clearance, blood complete, serum electrolytes and urine routine examination. 24 hour creatinine clearance by the standard clearance equation and CG was calculated by Cockcroft-Gault equation

1.Clearance of creatinine in ml per min per 1.73m^2 = U x V x 1.73 / P x1440 x BSA

U is for creatinine level in urine in milligram per decilitre, V is for volume of urine in 24 Hours in millilitre, P is serum creatinine levels in mg/dl , BSA is body surface area. BSA = weight (kg) 0.425 x height (cm) 0.725 × 7.1 x 10

2. CG estimated creatinine clearance in ml/min=(140-age) x BW (body weight in kg)/serum creatinine in mg/dl x 72 x 0.85 if female

RESULTS

Type II diabetes was the leading risk factor for development of diabetic nephropathy and progression to renal failure, observed in nearly 96% of diabetic patients as shown in table 1. Longer duration of diabetes contributed to additional progression of the renal failure. Most of the patients were nonsmokers, only 2% of them had a positive cigarette smoking history

Table 1: Risk factors of renal failure

Characteristics	Frequency	Percent
Type of Diabetes		
Diabetes I	4	04.0%
Diaetes II	96	96.0%
Duration of Diabetes since diagnosed		
a. 5 Years	12	12.0%
b. 5-10 Years	30	30.0%
c. 10-15 Years	40	40.0%
d.> 15 Years	18	18.0%
Treatment status of patients		
Yes	100	100%
No	0	00%
Smoking Status		
Yes	0	02%
No	98	98%

The bi-variate analysis shown that there is a positive correlation of Cockcroft Gault equation with the 24 hours urine collection clearances. Pearson correlation was determined (r= 0.60, r sq linear = 0.36) indicates that there are 60% correlation between these two methods, which was statistically significant (P = < 0001).

The mean GFR as estimated by the 24 hour creatinine clearance (CrCl) was 75.98 ± 14.29 ml/min/1.73m2 (range 44.0–125) with CI of 73.1-78.8 while that by the CG formula was 82.57 ± 28.17 ml/min/1.73m2 (range 26.00–140) and CI of 76.9-88.1 respectively and P value of 0.0001 showing a significant relationship.

DISCUSSION

Table 2: the correlation between measured 24 hour crcl and that estimated by cockcroft-gault formula in patients

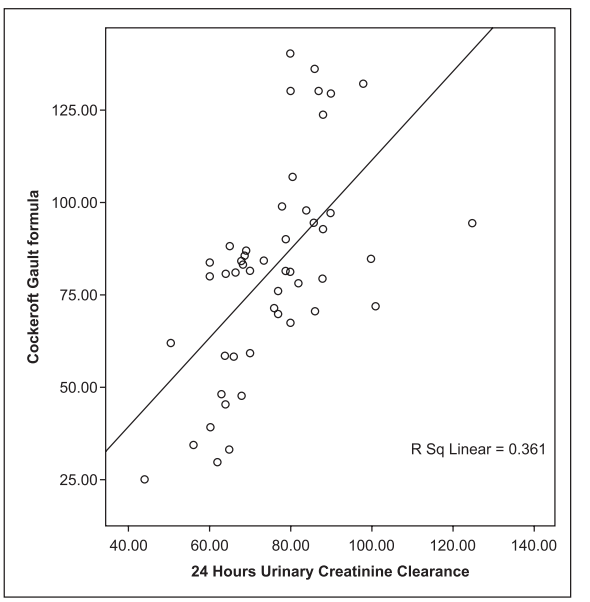

Table 3: The mean variation of gfr in the study population by two methods

Parameters	Mean	Std Deviation	Minimum	Maximum	CI	P value
GFR by Cockcroft Gault Formula (ml/min1.73m2	82.57	28.17	26.00	140.00	73.1-78.8	0.0001
GFR by 24 Hours Uninary Creatinine Clearance(ml/min/1.73m2)	75.98	14.29	44.00	125.00	76.9-88.1	

The rise in burden of the disease may lead to progression of renal insufficiency and renal failure which in turn will be an immense economic burden on the families of such it is very vital to have a cost effective, reliable, feasible, accessible diagnostic test available at every health care facility. There are many equations and methods to predict GFR[9,10].

Majority of the nephrologists prefer the 24 hour urinary CrCl measurement gives the closest measurement of the true GFR if the collection is done properly but is tedious. This test gives more accurate results if the subject is given a dose of simetidine or trimetho-

prim which cause suppression of creatinine secretion by the renal tubules some hours before the start of collection of urine [11,12,13]. All methods have their own accuracy rate but CG formula has the distinction of being simplest, quickest and in accuracy surpasses the other methods as it only involves serum creatinine and basic anthropometric measurements like body weight for GFR estimation.

The main result of our study was the finding that the Cockcroft Gault formula provides over estimation of GFR. The mean creatinine estimated by 24 hour CrCl was 75.98 ± 14.29 SD while that by the CG formula was 82.57 ± 28.17 SD. The average difference of both of procedures was 6.59[14]. The result of t-test from our study was also ($p < 0.0001$) which indicate that the difference was statistically significant. Present study result is also consistent with study conducted by[15] at National Cardiology Institute, Mexico City, Mexico.

According to our study a good correlation was found between CG formula and 24 hour CrCl, Pearson's correlation (r) between the two methods = 0.601 ($P < 0.001$). This indicates that both of the formulae have 60% correlation with each other which is statistically significant.

However it is difficult to find exact concordance between two methods, therefore it is necessary to determine whether CG formula varies in relation to 24 hours CrCl method, and once we come to know the relationship then its clinical application can be assessed to determine of CG formula can replace the 24 hour CrCl.

CONCLUSION

Based on the results, CG formula over estimates the GFR. Hence 24 hour creatinine clearance cannot completely be replaced by Cockroft Gault Equation. Further studies are needed to get reliable predictive equation for creatinine clearance in patients with diabetes and renal disease.

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