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Research Article

DIAGNOSTIC USEFULNESS OF ESTIMATED GLOMERULAR FILTRATION RATE FOR GRADING CKD CATEGORIES AND TO CORRELATE IT WITH BUN/CREATININE RATIO

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ABSTRACT

The earliest test still being used to screen for kidney diseases are based on qualitative urine tests for micro, sugar and albumin and this test is used even today as the first line test for screening infection, DM and renal failure. Measurements of urea and creatinine in serum are the standard biochemical tests to evaluate kidney diseases. The stepwise evaluation of kidney diseases are measurement of GFR, which involves the measurements of creatinine in serum and in a 24hr urine and Tubular function tests such as concentration and dilution tests. The procedure for measuring GFR is time consuming and a timed and correctly collected urine is very important to avoid errors. The kidney research foundation, through a series of research has developed a simple and fairly accurate formula to calculate GFR using only serum creatinine value. In this research paper, we have measured BUN and creatinine in serum and eGFR was calculated using the established formula by National kidney foundations, USA for grading of CKD based on GFR values.

A total of 200 patients, comparing of both males and females in different age groups who attended the routine master health checkup served as population for this study. eGFR for each patient was calculated online using serum creatinine and age of the patient. Based on the eGFR values, CKD grading was done for each group of patients. The BUN/Creatinine was then correlated to eGFR and good correlations ranging from < 0.01 to <0.0001was observed for all the groups of patients studied indicating that BUN/creatinine will serve as an index for evaluating eGFR.

Among 200 patients screened for CKD grading, 40.5% patients were grouped as G1 (normal), and the remaining grades were: G2 14.5%, G3a 2.5 %, G3b 16 %, G4 8.0 % and G5 18.5 %. Hence it is recommended that each patient for whom creatinine is investigated be screened for eGFR.

The outcome of this research will help to classify the CKD status of the patients and to refer such patients to nephrologists for proper diagnosis and to decide the treatment modalities by further laboratory diagnosis.

INTRODUCTION

According to kidney research foundation statistics, approximately 10% of population in the world suffer from some form of kidney related disorders and one million die each year. While 80% have affordable treatment in developed countries, it is much less in developing countries. In a country like India, the numbers of elderly are on the increase and hence kidney related diseases are increasing proportionately. Among people above 65 years who are suffering from uncontrolled DM, 1 in 4 or 1 in 5 may develop CKD.

Many studies on chronic kidney disease (CKD) have predicted it as the global health problem which increase the economic cost of a country which if not controlled will lead to an increase in cardiovascular disease (CVD). CKD have been graded as per Glomerular Filtration Rate (GFR) either measuredusing24 hrs urine and serum creatinine or calculated using the established and accepted formula with creatinine only. Hence GFR using serum creatinine may serve as preliminary guideline to nephrologists to classify the stage of CKD and start appropriate treatement modalities. Urea and creatinine are the two nitrogenous waste products solely used for the diagnosis of kidney disease and creatinine is a better predictor as it does not change due to diet and is dependent on muscle mass. This article is an attempt to establish BUN/creatinine ratio as an index of GFR by correlating it to GFR with different age group populations. The mean GFR estimated by Creatinineclearance-Clearance urea (Crc-Cu) and by Modification of Diet in Renal Disease (MDRD) formula were 10.04 +/- 3.10 mL/min and 10.55 +/- 3.60 mL/min, respectively, and the two parameters

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correlated significantly. GFR by the MDRD formula tended to overestimate the highest values of Crc-Cu. The mean percent difference between both methods was 6.5 +/- 23.6. MDRD predictive equation overestimated significantly Crc-Cu in patients older than 70 years (mean over estimation of 15%), males (10%), diabetics (10%), and mainly in patients with comorbidity (17%). The GFR estimated by MDRD formula is very similar to Crc-Cu in young uremic patients without comorbidity. However, major discrepancies between these two methods could be observed in older patients, and mainly in those with comorbidity(1).

Chronic renal failure (CRF) is the progressive loss of function of kidney and patient requires a long time treatment in the form of renal replacement therapy. Haemodialysis (HD) is one of the renal replacement therapies, during which body's waste products, including creatinine, urea and excess water, are removed. 53% of patients had serum urea level above 200 mg/dL but after dialysis, 66% of patients had urea level below 200 mg/dL. Concerning serum creatinine, 57% of patients had values between 7-12 mg/dL before dialysis, whereas after dialysis, in 58% of patients the values were reduced below 7 mg/dL.(2)

eGFR calculated from serum creatinine at least once a year is recommended in all people with diabetes for detection of kidney dysfunction. eGFR remains an independent and significant predictor after adjustment for conventional risk factors including age, sex, duration of diabetes, smoking, obesity, blood pressure, and glycemic and lipid control, as well as presence of diabetic retinopathy. Cystatin-C (CysC) may in future be the preferred marker of diabetic nephropathy due to differences in measurements of serum creatinine by various methods. The appropriate reference limit for CysC in geriatric clinical practice must be defined by further research. Various studies have shown the importance of measurement of albuminuria, eGFR, serum creatinine and hemoglobin level to further enhance the prediction of end stage renal disease (ESRD).(3)

A serum creatinine-based prediction equation viz MDRD can be used to estimate GFR.CysChas been proposed as an alternative filtration marker to creatinine.(4) Recent guidelines state that the CysCbased prediction equation cannot be recommended for use in clinical practice. With prediction equations based on serum creatinine, the National Kidney Disease Education Program (NKDEP) recommendations are to report a numerical estimate in round numbers only for GFR values <60 mL/min per 1.73 m^2. The MDRD equation generally out performs the Cocrcroft-Gault (C-G) equation but may still have a high level of bias, depending on creatinine assay calibration and low precision. According to Kidney Disease Improving Global Outcomes (KDIG) recommendations, many indications remain for GFR measurements using a clearance method. In that context, it should be recalled that radiolabeled-tracer plasma or urinary clearance methods, are safe, simple, accurate and reproducible.(5)

Estimates of GFR are the best overall indices of the level of kidney function. The level of GFR should be estimated from prediction equations that take into account the serum creatinine concentration and some or all of the following variables: age, gender, race, and body size. In adults, the MDRD study and C-G equations provide useful estimates of GFR. In children, the Schwartz and Counahan-Barratt (SCB) equations are useful. The serum creatinine concentration should not be used alone to assess the level of kidney function. Clinical laboratories should report eGFR using a prediction equation, in addition to reporting the creatinine measurements. Autoanalyzer manufacturers and clinical laboratories should calibrate serum creatinine assays using an international standard. Measurement of creatinine clearance using timed (e.g., 24-hour) urine collections does not improve the estimate of GFR over that provided by prediction equations. A 24-hour urine sample provides useful information for estimation of GFR in individuals with exceptional dietary intake (vegetarian diet, use of creatine supplements) or muscle mass (amputation, malnutrition, muscle wasting). It is also useful for assessment of diet and nutritional status and need to start dialysis.(6)

The equations for estimating GFR based on creatinine have been found to have limitations and have not been generalizable across all populations. Equations based on CysC provide an alternative method to estimate GFR. Whether the equation based on CysCalone or combined creatinine would improve GFR estimates has not been validated among Chinese patients with CKD and diabetes.(7)

In an attempt to reduce late referral and to improve the care of patients with CKD, different organizations have issued guidelines on when to refer patients to the nephrologist. Most suggest referral of patients with a GFR below 60 mL/min/1.73 m^2, and demand referral if the GFR is below 30 mL/min/1.73 m^2. It is recommended to use the abbreviated MDRD equation to estimate GFR. This formula is, however, sensitive to the creatinine assay methodology. In addition, the impact of the implementation of such guidelines on the nephrology practice has never been evaluated. Established guidelines identifies the true burden of CKD in a population and simulates the effects of a 100% implementation of the guidelines on the nephrology work load, and to evaluates the validity of the estimated GFR using the abbreviated MDRD formula when routinely provided.(8)

GFR is central to the diagnosis, evaluation and management of CKD. The MDRD Study equation had a bias of 3.0 %, interquartile range of 29.0 % and percentage of estimates within 30 % of the measured GFR value of 82 % for estimates below 60 mL/ (min x 1.73 m^2). Above this value, the bias was greater and estimates are less useful since 30 % error is a large absolute error in GFR. Results vary across studies but are generally similar with disappointing performance in the high GFR range, which is of particular interest in early diabetic nephropathy. New equations using serum creatinine can reduce the bias present in the high GFR range but are unlikely to dramatically improve precision, suggesting a need for additional markers. Algorithms are needed to tailor clinical practice based on data from GFR estimates and other participant characteristics, including the population source and level of proteinuria.(9)Accurate measurement of renal function is important for the diagnosis, stratification and management of kidney disease. As the use of recommended filtration markers is limited by cumbersome and costly techniques, renal function

is typically estimated by using various specifically derived prediction equations. Most of these equations have been derived from Caucasian patients suffering from varying degrees of CKD (10).

Prediction formulas based on serum creatinine are most commonly used and appear acceptable for clinical purposes in the majority of patients with CRF. However, especially in patients at the extremes of body composition, the results from creatinine-based equations should be interpreted with caution. Apart from inulin clearance, no method can be considered the gold standard in the assessment of GFR. In cases of doubt, the decision to use gadolinium-enhanced magnetic resonance imaging should always be based on clinical risk-benefit judgment. (11) National Kidney Foundation Kidney Disease Outcomes Quality Initiative guidelines recommend that all people with a GFR<60 mL/min/1.73 m^2 undergo evaluation for anaemia and metabolic bone disease.(12) A decline in renal function suggests progression of CKD. This can be determined by measured GFR (e.g., iothalamate clearance), serum creatininebased GFR estimates, or creatinine clearance. Predictor associations were strongest with measured GFR. Misclassification from changes in non-GFR factors (e.g., creatinine production, tubular secretion) conservatively biased associations with eGFR. Misclassification from method imprecision attenuated associations with creatinine clearance.(13)

A prospective randomized controlled trial comparing incremental dialysis with dietary protein restriction in patients with GFR < or = 10.5 mL/min/1.73 m^2 with properly defined outcome measures like morbidity, mortality, decline of GFR and quality of life needs to be conducted. Comparisons of incremental HD and incremental peritoneal dialysis need to be made especially with regard to technique survival and preservation of residual renal function. (14)

MATERIALS AND METHODS

Selection of Patients

All patients,both male and female in different age groups who attended the master health check up (MHC) and for whom urea and creatinine were investigated as part of MHC was enrolled for this study. A part of fasting blood sample from each enrolled patient was used to measure urea and creatinine and the age of each patient was noted down.50 male patients in the age group of 19-50 years and 51-75 year as well as 50 female patients in the age of 21-50 years and 52 to 85 years served as the population for this study.

Analytical methods used

State of art fully automated Randox RX-Imola Analyser and kits supplied by the same company were used to measure urea, by the urease-GLDH method and creatininebykinetic method using Jaffe's picrate reaction. Bio rad assayed controls at two levels were used everytime when the population samples were run to validate the accuracy of results obtained in this study.

Statistical tools used

eGFR was calculated using CKD-EPI creatinine 2009 formula (15), which excludes weight and uses age and creatinine values only. Online calculations carried out for't' and 'p' using the website https://www.graphpad.com/quickcalcs/ttest1/

RESULTS

The individual results obtained for the 4 groups of patients and the statistical parameters evaluated to link BUN and BUN/Creatinine ratio to eGFR are presented under Tables I to VI. The kidney research foundation classifications of CKD are (16)

GFR categories in CKD		
Category	**GFR ml/min/1.73 m^2**	**Terms**
G1	≥90	Normal or high
G2	60-89	Mildly decreased
G3a	45-59	Mildly to moderately decreased
G3b	30-44	Moderately to severely decreased
G4	15-29	Severely decreased
G5	<15	Kidney failure

Table I Males < 50 Years

S.No	AGE 19-50yrs	BUN <23 mg/dL	Creatinine <1.5 mg/dL	Bun/Creat	eGFR
1	19	8.45	0.90	9.39	123.40
2	20	11.96	1.30	9.20	78.50
3	23	11.82	1.00	11.82	105.60
4	23	13.03	1.08	12.06	96.20
5	24	12.10	1.15	10.52	88.60
6	24	18.68	1.10	16.98	93.50
7	25	8.41	1.00	8.41	104.10
8	25	9.20	0.86	10.70	120.50
9	25	9.81	1.20	8.17	83.50
10	25	10.09	0.80	12.61	124.20
11	25	18.68	1.00	18.68	104.10
12	26	11.58	0.80	14.48	123.30
13	27	9.95	0.80	12.43	122.40
14	28	7.47	0.80	9.34	121.60
15	28	13.17	0.80	16.46	121.60
16	28	13.45	1.10	12.23	90.90
17	30	9.53	1.30	7.33	73.20
18	30	9.81	1.00	9.81	100.50
19	31	18.73	1.50	12.48	61.20
20	32	9.34	0.90	10.38	112.60
21	32	9.57	0.90	10.64	112.60
22	32	10.13	0.90	11.26	112.60
23	32	10.18	1.21	8.41	78.70
24	32	11.21	0.90	12.45	112.60
25	33	8.78	0.74	11.86	121.20
26	33	13.87	1.01	13.73	93.70
27	34	11.58	0.90	12.87	111.00
28	34	13.08	1.10	11.89	87.10
29	35	10.74	1.10	9.76	86.50
30	35	19.61	1.20	16.35	77.90
31	37	9.39	0.80	11.73	114.10
32	37	10.04	0.80	12.55	114.10
33	40	7.29	0.60	12.14	125.80
34	40	10.27	0.90	11.42	106.50
35	40	11.53	1.30	8.87	68.30
36	40	16.35	0.70	23.35	118.00
37	41	7.94	0.80	9.92	111.00
38	41	11.63	1.00	11.63	93.10
39	41	12.00	1.10	10.91	82.90
40	43	9.34	0.80	11.68	109.40
41	43	11.58	1.00	11.58	91.80
42	43	23.35	1.30	17.96	66.80
43	44	12.14	0.90	13.49	103.50
44	45	12.14	1.00	12.14	90.50
45	45	12.84	1.00	12.84	90.50
46	49	15.32	1.1	13.93	78.40
47	49	16.95	1.5	11.30	53.90
48	50	8.69	0.9	9.65	99.20
49	50	10.32	1	10.32	87.40
50	50	12.14	0.7	17.35	110.00
MEAN	34.4	11.90	0.99	12.15	99.17
SD	8.56	3.4	0.2	3.0	18.2

Table I present the results obtained for males in the age of 19-50 years for BUN, Creatinine, BUN/Creatinine ratio and the eGFR calculated online using creatinine values with the help of the formula mentioned . This table also gives the mean and SD values for all the parameters studied. The CKD classification according to National kidney foundation showed the following data. Out of 50 patients, 35 were classified as having G1, 14 with G2 and one with G3.

Table II Males > 50 Years

S.No	AGE 51 -75yrs	BUN 24-122 mg/dL	CREATININE 0.8-8.5 mg/dL	BUN/CREAT	eGFR
1	52	24.42	1.00	24.42	86.10
2	58	25.17	1.84	13.68	39.40
3	45	25.22	2.00	12.61	39.10
4	72	25.45	1.60	15.91	42.40
5	45	25.59	2.00	12.80	39.10
6	75	25.69	1.70	15.11	38.60
7	58	25.69	2.00	12.84	35.70
8	54	25.69	2.50	10.27	28.00
9	52	26.20	2.10	12.48	35.10
10	60	26.34	2.50	10.54	26.90
11	75	27.09	1.80	15.05	36.00
12	75	27.09	1.70	15.93	36.80
13	75	30.68	1.60	19.18	41.50
14	64	33.02	3.46	9.54	17.70
15	61	33.25	1.50	22.17	49.50
16	73	35.49	0.80	44.37	88.60
17	56	51.37	7.80	6.59	10.70
18	66	56.04	5.50	10.19	9.90
19	66	59.31	6.30	9.41	8.40
20	66	63.51	5.80	10.95	9.30
21	56	63.98	8.50	7.53	6.30
22	72	68.18	0.80	85.23	89.20
23	54	105.36	1.10	95.78	75.70
24	54	106.48	4.30	24.76	14.60
25	54	109.75	3.30	33.26	20.10
26	54	110.54	5.50	20.10	10.80
27	54	112.08	4.50	24.91	13.60
28	54	115.82	3.70	31.30	17.50
29	54	121.89	6.10	19.98	9.50
30	56	43.80	1.10	39.82	74.60
31	57	44.22	2.30	19.23	30.40
32	57	47.17	5.20	9.07	11.30
33	58	51.14	0.87	58.78	95.10
34	58	70.52	4.50	15.67	13.40
35	58	72.39	4.50	16.09	13.40
36	59	75.79	4.40	17.23	13.70
37	62	26.29	1.45	18.13	5.10
38	62	26.34	1.77	14.88	39.70
39	64	27.04	2.00	13.52	34.20
40	65	27.09	2.20	12.31	30.10
41	65	27.09	2.00	13.54	34.00
42	65	27.23	2.20	12.38	30.30
43	66	27.37	2.40	11.40	27.10
44	66	27.41	2.50	10.97	25.60
45	67	27.79	2.90	9.58	21.40
46	68	27.79	1.95	14.25	34.30
47	70	29.93	2.88	10.39	21.10
48	70	26.29	1.45	18.13	48.40
49	71	26.34	1.58	16.67	43.40
50	71	27.04	2.00	13.52	32.60
MEAN	61.78	47.45	2.91	20.25	33.11
SD	7.7	29.8	1.8	17.3	22.6

The data presented in Table II is similar to the one shown in Table I, but for males in the age group of 51-75 years.In this group only one patient was classified as having G1, 5 in G2, 2 in G3a, 18 in G 3b, 12 in G4 and 12 in G5.

Table III Females < 50 Years

S.No	AGE 21-50yrs	BUN 7-23 mg/dL	CREATININE <1.4 mg/dL	BUN/CREAT	eGFR
1	21	8.87	0.90	9.86	121.70
2	21	11.16	0.89	12.54	122.20
3	22	9.34	0.70	13.34	134.00
4	23	8.87	1.29	6.88	77.60
5	23	9.67	0.73	13.24	13.70
6	24	10.88	1.00	10.88	104.90
7	25	10.27	1.00	10.27	104.10
8	26	8.17	0.80	10.22	123.30
9	26	8.73	0.90	9.70	117.50
10	26	13.31	0.86	15.48	119.70
11	27	9.34	1.00	9.34	102.70
12	27	12.05	0.90	13.39	116.60
13	28	18.68	2.80	6.67	29.40
14	28	18.77	2.20	8.53	39.30
15	28	18.82	2.30	8.18	37.30
16	30	6.77	0.70	9.67	126.60
17	30	8.87	0.90	9.86	114.20
18	30	9.48	0.90	10.53	114.20
19	32	8.83	0.94	9.39	106.80
20	33	7.29	0.50	14.57	142.40
21	33	9.48	0.80	11.85	117.40
22	33	12.00	0.80	15.00	117.40
23	35	6.72	1.00	6.72	97.10
24	35	9.11	0.96	9.49	102.00
25	36	8.03	0.72	11.16	120.00
26	36	8.87	0.80	11.09	114.90
27	38	9.34	0.80	11.68	113.30
28	38	11.35	0.80	14.19	113.30
29	38	17.93	1.00	17.93	95.10
30	38	23.12	1.30	17.78	69.20
31	39	8.50	0.80	10.62	112.50
32	39	8.64	0.96	9.00	99.20
33	39	15.18	0.90	16.86	107.20
34	40	8.41	0.80	10.51	111.70
35	41	8.73	0.80	10.92	111.00
36	41	9.53	0.80	11.91	111.00
37	41	10.93	1.39	7.86	62.50
38	42	8.41	0.80	10.51	110.20
39	42	9.85	0.90	10.95	105.00
40	43	9.67	0.80	12.08	109.40
41	43	9.81	0.70	14.01	115.60
42	44	8.27	0.74	11.17	112.20
43	45	10.18	0.87	11.70	104.20
44	45	7.47	0.88	8.49	103.70
45	50	11.35	0.9	12.61	99.20
46	48	20.08	1.1	18.26	79.00
47	49	7.47	0.8	9.34	104.90
48	50	8.27	0.95	8.70	93.00
49	50	8.64	0.8	10.80	104.00
50	50	8.87	0.7	12.68	110.00
MEAN	35.42	10.65	0.97	11.37	101.87
SD	8.6	3.7	0.4	2.8	25.6

The data presented in Table III are the results obtained for females in the age groups of 21-50 years along with the results as shown in the tables for males. The CKD classifications for this group were ; 42 in G1, 4 in G2, 2 in G3b,1 in G4 and 1 in G5.

The data presented in Table IV are similar to the one presented in Table III, but for females in the age group of 52-85 years. The CKD classifications for this group were : 3 in G1, 5 in G2, 2 in G3a, 12 in G3b, 4 in G4 and 24 in G5

Table IV Females 52 -85 Years

S.No	Age 52-85yrs	Bun 25 - 159 mg/dL	Creatinine 0.9-10.1 mg/dL	Bun/Creat	eGFR
1	52	26.06	2.40	10.86	29.90
2	65	43.80	1.10	39.82	70.10
3	71	44.22	2.30	19.23	27.50
4	58	47.17	5.20	9.07	11.30
5	70	51.14	8.70	5.88	95.60
6	60	70.52	4.50	15.67	13.20
7	66	72.39	4.50	16.09	12.70
8	63	75.79	4.40	17.23	13.30
9	65	76.96	4.20	18.32	13.90
10	66	112.08	5.40	20.76	10.20
11	67	128.43	5.80	22.14	9.30
12	60	140.66	8.70	16.17	6.0
13	80	149.44	6.00	24.91	8.10
14	55	158.78	6.00	26.46	9.70
15	58	24.05	1.10	21.86	73.60
16	65	24.28	1.00	24.28	78.60
17	84	24.28	0.90	26.98	78.20
18	85	24.52	1.40	17.51	45.50
19	69	24.84	1.80	13.80	37.60
20	74	24.98	1.60	15.62	41.80
21	60	24.98	1.00	24.98	81.40
22	55	25.22	1.90	13.27	38.80
23	66	25.69	1.80	14.27	38.40
24	64	25.73	0.90	28.59	89.90
25	57	26.06	0.90	28.95	94.50
26	73	26.15	2.00	13.08	32.20
27	56	26.29	1.45	18.13	53.50
28	66	26.34	1.58	16.67	44.90
29	66	27.04	2.00	13.52	33.80
30	66	27.09	1.95	13.89	34.80
31	56	27.27	2.20	12.40	32.30
32	72	27.23	2.20	12.38	28.90
33	54	27.37	2.40	11.40	29.50
34	54	27.41	2.00	13.71	36.70
35	54	27.79	2.90	9.58	23.40
36	54	27.79	1.95	14.25	36.70
37	59	28.02	2.40	11.68	28.50
38	62	28.07	3.00	9.36	21.30
39	62	29.93	2.90	10.32	22.20
40	64	51.37	7.80	6.59	6.60
41	65	56.04	5.50	10.19	10.00
42	65	56.97	6.30	9.04	8.50
43	65	63.51	5.80	10.95	9.40
44	66	64.91	9.50	6.83	5.10
45	66	105.36	10.10	10.43	4.80
46	72	106.48	4.30	24.76	12.80
47	73	109.75	3.39	32.37	17.00
48	77	110.21	4.19	26.30	12.80
49	80	112.08	4.50	24.91	11.50
50	79	115.35	3.88	29.73	14.20
MEAN	65.22	56.16	3.59	17.30	31.97
SD	8.1	39.3	2.4	7.5	25.88

Table V Mean & SD for BUN, Creatinine, BUN/Creatinine&eGFR for all patient group.

S.No	Patient Group	BUN		Creatinine		Bun/Creatinine		eGFR	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
1	Males < 50	11.90	3.4	0.99	0.20	12.15	3.0	99.17	18.2
2	Males > 50	47.45	29.8	2.91	1.80	20.25	17.30	33.11	22.6
3	Females < 50	10.65	3.7	0.97	0.4	11.37	2.8	101.87	25.6
4	Females > 50	56.16	39.3	3.59	2.40	17.3	7.5	31.97	25.88

Table V presents the mean & SD results obtained for the measured & calculated parameters for all patients (Group 1 to 4). The mean & SD obtained for males and females < 50 years are fairly similar and is the same for males and females > 50 years.

Table VI Statistical Parameters

S.No	Patient Group	Parameters Compared	t	p
1	Males < 50	BUN/CREATVseGFR	33.36	<0.0001
2	Males > 50	BUN/CREAT VseGFR	3.19	<0.01
3	Females < 50	BUN/CREATVseGFR	24.84	<0.0001
4	Females > 50	BUN/CREAT VseGFR	3.85	<0.001

Table VI shows the statistical parameters viz t and p for the set of parameters compared. While the correlations between BUN &eGFR as well as BUN/Creatinine to eGFR is highly significant for males & females in the age group of <50 years (p <0.0001 for both group), similar comparisons done for both males and females > 50 years shows a p values of <0.01 for males and a highly significant p value of <0.001 for females.

DISCUSSIONS

CKD classifications is one of the most important kidney function evaluation criteria. GFR is usually determined bymeasuring creatinine in serum and 24 hr urine. Research done in the past has established simple and easy to use online formula for calculating eGFR using serum creatinine value and age of the patient.. Among the three suggested formulae viz MDRD, C-G and CKD-EPI Creatinine 2009, the last one is very easy to use by a small clinical laboratory in an Indian setup. The MDRD formula at times may give ± 10 % variations in values between measured and calculated (1). Although the use of CysC for calculating eGFR will give accurate results, the day to day measurements based on CysC is not feasible for laboratories in developed countries as the reagent for this test is expensive (3). In this study we used the simple CKD-EPI on line calculator as this provides both eGFR as well as CKD category classifications. We did not correlate our findings of eGFR with the measured GFR using serum and urine creatinine values. As the aim of this study was to screen CKD category in patients attending regular check-ups by calculating eGFR , practical measurements were not done. As the MDRD formula is sensitive to assay methodology of creatinine, we preferred to use the CKD-EPI formula (8). As GFR is central to the first line of diagnosis for CKD, we undertook this study to screen patients attending the outpatient clinic to find out if they have any degree of CKD disorders (9). We then classified the % of patients having CKD disorders using the guidelines provided by National Kidney Foundation of USA.We also found out correlation of eGFR to BUN/Creatinine ratio and very good correlations were obtained.

The results obtained in this study are in agreement with many previous studies at an error rate of ± 10% (11,12).

CONCLUSIONS

The outcome of this study has presented a simple and inexpensive method for mass screening of patients attending outpatient clinic to evaluate GFR and to grade the category of CKD.

Out of 200 patients screened (100 males & 100 females in different age groups) only around 40% of the patients CKD was found to be normal and the degree of CKD grading was found to be increased proportionately based on increase in creatinine values with age. While G3a and G4 grading were at the least for 2.5 % to 8.5 % of patients, G2 and G5 was

observed in 14.4% and 18.5 % respectively. Hence measurement eGFR rate for every patient who are investigated for creatinine will serve as a platform to find out the degree of CKD disorder and to recommend such patient for consultaion with a Nephrologist. This study also find out good correlations between eGFR to BUN/Creatinineraio and the P values ranged from <0.01 to <0.0001.

The outcome of this research will help to classify the CKD status of the patients and to refer such patients to nephrologists for proper diagnosis and to decide the treatment modalities by further laboratory diagnosis.

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