Original Research Paper

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General Medicine

A COMPARISION BETWEEN RENAL CORTICAL THICKNESS AND RENAL SIZE AS AN INDICATOR OF RENAL FUNCTION IN CHRONIC KIDNEY DISEASE CASES, IN TERTIARY CARE CENTRE, KING GEORGE HOSPITAL, VISAKHAPATNAM, AP,INDIA.

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KEYWORDS :

INTRODUCTION

The prevalence of chronic kidney disease has increased worldwide because of the growing numbers of cases of hypertension, diabetes, obesity, in addition to aging of the general population Chronic kidney disease is a worldwide public health problem, both for the number of patients and cost of treatment involved. Globally, CKD is 12th cause of death and 17th cause of disability, respectively. This is an underestimate as patients with CKD are more likely to die of cardiovascular diseases than to reach end stage renal disease (ESRD). Laboratory findings and clinical symptoms are utilized in the diagnosis of CKD. Radiological examination is an important tool for the differential diagnosis. Plain abdominal radiography, intravenous pyelography, ultrasonography (US), and computed tomography (CT) are commonly used methods. US is a simple, cost-effective, and non-invasive method that is easy to use for renal imaging[3]. Length, volume, echogenicity, and cortical thickness are important parameters in making an ultrasonographic diagnosis. Length is feasible to measure, but is not necessarily diagnostic, as it is not always measured using a standardized approach and is related to body size. In previous studies, kidney volume was used as a direct indicator of kidney size, rather than kidney length, but evaluating renal volume is difficult and requires experience. Renal cortical thickness (RCT) and echogenicity have also been used in the diagnosis of CKD. With the progression of the disease, RCT decreases and echogenicity increases. Laboratory assays play a supportive role tracking the progression of the disease during follow-up, along with the previously mentioned methods. However, echogenicity is mainly based on the evaluation of a specialist, which in turn may yield subjective results; moreover, no established standardized normal range values currently exist for echogenicity, and a normal result for renal echogenicity does not exclude the possibility that the patient's kidney is damaged. The aim of this study was to evaluate the correlations between laboratory findings and ultrasonographic measurements of renal length and cortical thickness in patients of CKD.

AIMS AND OBJECTIVES

1) To determine whether there is relation between renal cortical thickness and renal size measured on ultrasonogram and degree of renal impairment in chronic kidney disease
2) To determine whether renal cortical thickness is better than renal size as an indicator of renal function in chronic kidney disease.

REVIEW OF LITERATURE

CKD encompasses a spectrum of different pathophysiologic process associated with abnormal kidney function and a progressive decline in glomerular filtration rate (GFR). Previously CKD had been staged solely by the GFR. However the risk of worsening of kidney function is closely linked to amount of albuminuria and so it has been incorporated into classification . The following figure provides a recently updated classification in which stages of CKD are stratified by both estimated GFR and degree of albuminuria, in order to predict risk of progression of CKD.

RISK FACTORS FOR CKD:

- Small for gestational birth weight
- Childhood obesity
- Hypertension
- Diabetes
- Advancing age
- Autoimmune disease
- African ancestry
- Family history of kidney disase
- Previous episode of acute kidney injury
- Prescence of proteinuria
- nephrotoxins
- Structural abnormalities of urinary tract
- obstructive sleep apnea

LEADING CATEGORIES OF ETIOLOGIES OF CKD:

1) diabetic nephropathy
2) glomerulonephritis
3) hypertension associated CKD.
4) autosomal dominant polycystic kidney disease
5) other cystic and tubulointerstitial nephropathy

MATERIALS AND METHODS

STUDY AREA:

KING GEORGE HOSPITAL , VISAKHAPATNAM

SAMPLE SIZE:

50 cases and 50 controls

MODE OF SELECTION:

By simple random method

LABORATORY METHODS:

1) Estimation of serum creatinine by jaffes reaction using alkaline picrate.
2) Ultrasonogram performed using standard gray scale b mode imaging with a 3.5Mhz measurements.

STUDY POPULATION :

50 Patients admitted in department of general medicine, KING GEOGE HOSPITAL from march 2018 to September 2019.

INCLUSION CRITERIA:

1) Cases of chronic kidney disease confirmed by ultrasound and serum creatinine levels
2) Those willing to participate in the study
3) Patients not on dialysis
4) Age 15 to 80 yrs

EXCLUSION CRITERIA:

1) Patient known diabetic
2) Patient on dialysis
3) Adult polycystic kidney disease
4) Chronic pyelonephritis
5) Previous history of acute renal failure
6) CKD due to post renal causes

METHODOLOGY:

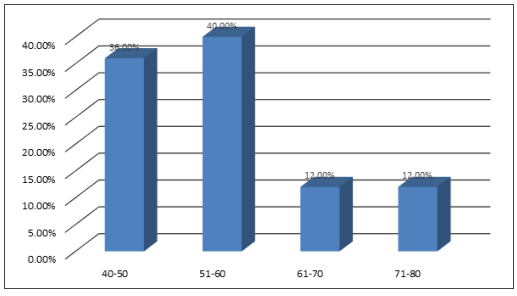
Present study is conducted on 50 patients admitted in DEPARTMENT

OF GENERAL MEDICINE, KING GEORGE HOSPITAL, VISAKHAPATNAM,AP. Patients underwent renal ultrasound and at least three serum creatinine levels during period of hospital stay. lowest creatinine is used for calculating estimated glomerular filtration rate using both Cockcroft gault formula and modification of diet in renal disease equations. Cortical thickness is measured in sagittal plane over a medullary pyramid perpendicular to capsule. size will be measured pole to pole. linear regression is used for statistical analysis. Simultaneously 50 controls matched by age and sex and willing to participate is included in study.

OBSERVATION AND RESULTS

Table 1:

AGE GROUP	FREQUENCY	PERCENT
40-50	18	36.0
51-60	20	40.0
61-70	6	12.0
71-80	6	12.0
TOTAL	50	100.0



So the majority of cases that is about 40% falls in the age group between 51 to 60 years followed by 36% of individuals between 41 to 50 years, 12% between 61 to 70 yrs and another 12% between 71 to 80 yrs.

TABLE 2:

SEX	FREQUENCY	PERCENT
FEMALE	16	32.0
MALE	34	68.0
TOTAL	50	100.0

So above table shows gender predilection more for males compared to females contributing about 68%

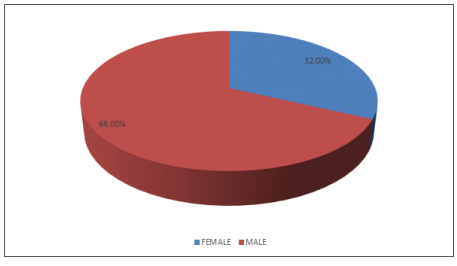


Table 3: Associated Chronic Diseases

DISEASE	NO.OF PATIENTS	PERCENTAGE
HYPOTHYROIDISM	5	10
HYPERTENSION	50	100
RESPIRATORY	10	20
CARDIAC PROBLEM	22	44
PSYCHIATRY	2	4

The mean age of population included in this study was 55.8 years. The mean renal length 9.972 cms and mean renal cortical thickness is 0.6056cms with mean MDRD EGFR 35.6736 and CG EGFR 35.0064.

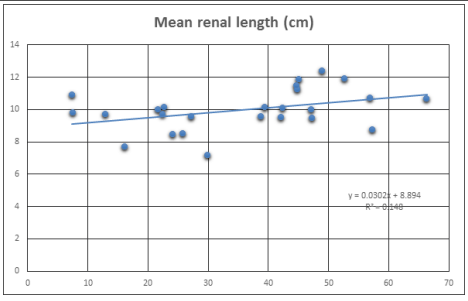
Table 4:

	Age	MDRD EGFR	CG EGFR	Mean Renal Length CM	Mean Renal Cortical Thicknesscm
Mean	55.800	35.6736	35.0064	9.9720	0.6056
Std. Deviation	10.6694	16.06737	19.05109	1.26201	0.19220
Minimum	40.0	7.35	10.72	7.15	0.28
Maximum	80.0	66.33	99.38	12.40	1.10

Correlation of MDRD egfr with renal length:
This shows a statistically significant positive correlation between renal length and egfr calculated by MDRD .

Table 5:

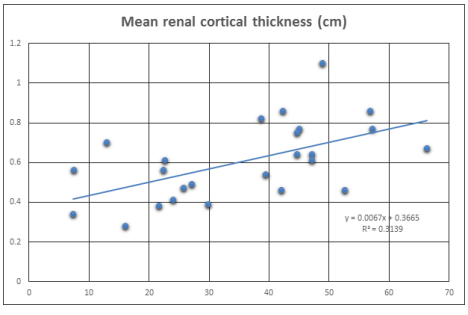
	MDRD EGFR	MEAN RENAL LENGTH CM	
MDRD EGFR	**PEARSON CORRELATION**	1	.385**
	SIG. (2-TAILED)		.006
	N	50	50
**. CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED).			



Correlation of MDRD egfr with renal cortical thickness:
This shows a statistically significant positive correlation between renal cortical thickness and egfr calculated by MDRD.

Table 6:

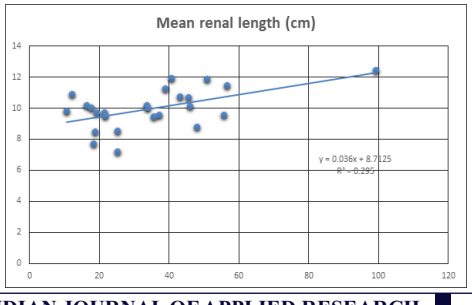
	MDRD EGFR	MEAN RENAL CORTICAL THICKNESS CM	
MDRD EGFR	**PEARSON CORRELATION**	1	.560**
	SIG. (2-TAILED)		.000
	N	50	50
**. CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED).			



Correlation of CG egfr with renal length: This shows a statistically significant positive correlation between renal length and egfr calculated by CG.

Table 7:

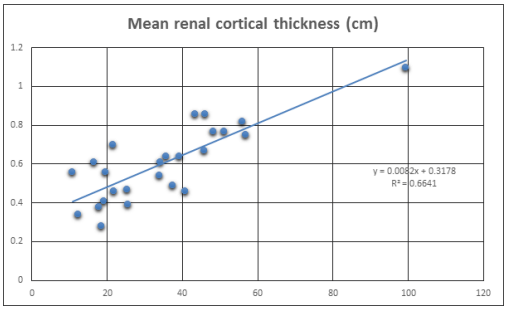
	CG EGFR	MEAN RENAL LENGTH CM	
CG EGFR	**PEARSON CORRELATION**	1	.543**
	SIG. (2-TAILED)		.000
	N	50	50
**. CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED).			



Correlation of CG egfr with renal cortical thickness: This shows a statistically significant correlation between renal cortical thickness and egfr calculated by CG.

Table 8:

	CG EGFR	MEAN RENAL CORTICAL THICKNESS CM	
CG EGFR	PEARSON CORRELATION	1	.815**
	SIG. (2-TAILED)		.000
	N	50	50
**. CORRELATION IS SIGNIFICANT AT THE 0.01 LEVEL (2-TAILED).			



DISCUSSION

The burden of CKD has dramatically increased and is consuming the resources of both developed and developing economies . For this reason , efforts to reduce the cost of managing this disease are always welcomed. CKD encompasses a spectrum of different pathophysiologic process associated with abnormal kidney function and a progressive decline in glomerular filtration rate (GFR). Although serum urea and creatinine concentrations are used to measure the excretory capacity of the kidneys, accumulation of these two products themselves do not account for many symptoms and signs that characterize the uremic syndrome in advanced renal failure. A host of metabolic and endocrine functions normally performed by kidneys is also impaired or suppressed , and this results in anemia, malnutrition and abnormal metabolism of carbohydrates, proteins and fats. Furthermore, plasma levels of many hormones, including PTH, FGF-23, insulin, glucagon, steroid hormones including vitamin D and sex hormones, and prolactin, change with CKD as a result of reduced excretion, decreased degradation, or abnormal regulation. Finally CKD is associated with worsening systemic inflammation Elevated levels of c reactive protein are detected along with other acute phase reactants where as levels of so called negative phase reactants such as albumin and fetuin decline with progressive reduction in GFR. Thus the inflammation associated with CKD is important in malnutrition inflammation atherosclerosis / calcification syndrome, which contributes in turn to acceleration of vascular disease and comorbidity associated with advanced kidney disease. Levels of C reactive protein in CKD patients is highly valuable in predicting risk of cardiovascular morbidity. CKD shows significant effect on various organ systems of human body. These include bones (osteitis fibrosa cystica, osteomalacia), calciphylaxis, cardiovascular abnormalities (congestive heart failure, pericarditis, arrhythmias, sudden cardiac death) , hematological (anemia), neuromuscular abnormalities, acid base and electrolyte imbalance (metabolic acidosis , hyperkalemia , sodium retention), peripheral neuropathy, gastrointestinal abnormalities, endocrine abnormalities, dermatological abnormalities. These wide variety of organ system involvement make CKD an important clinical entity and lead to more economic burden on health care systems. Clinically CKD is staged on the prescence of albumiruia and EGFR. Albuminuria is incorporated into classification system to assess the risk of progression of disease.**35-**The aim of this study was to identify a simpler method of determining the functional capacity of kidneys in individuals with CKD, and attempted to determine the usefulness of RCT measurements obtained via US as an indicator of kidney function. Ultrasound with Doppler examination of intrarenal vessels is commonly performed in cases with CKD , and it is common to have a normal exam. Most useful imaging study is renal ultrasound, which can verify the presence of two kidneys, determine if they are symmetric, provide an estimate of kidney size, and rule out renal masses and evidence of obstruction. The widely accepted consensus is that a relationship exists between renal length and functionality. Although renal length can be normal in HIV, DM nephropathy, amyloidosis. Based on the current study, it seems that cortical thickness measured using US may be more closely related to eGFR than renal length in patients .

ultrasound machine is quite cheaply and widely available and provides real-time information on the renal measurements and echogenicity particularly in resource poor settings. Renal length has traditionally been considered a surrogate marker of renal function because renal length decreases with decreasing renal function. Renal lengths are universally reported and are usually the only measurements given at renal ultrasound . But renal length can vary depending on many confounding factors like BMI, height, age, gender, position of kidneys, stenosis and number of renal arteries. However, on the basis of this study, it appears that cortical thickness measured at ultrasound may be related more closely to eGFR than renal length in patients with chronic renal failure. Prior studies also have evaluated imaging measurements as surrogate markers of renal function. the retrospective consensual analysis of previously acquired imaging files. The present study included a study population of 50 patients admitted in department of general medicine .The current study excludes patients who are known diabetic and patients who are on dialysis. Patients underwent renal ultrasound and atleast three serum creatinine levels during period of hospital stay. Lowest creatinine is used for calculating estimated glomerular filtration rate using both cockgraft gault formula and modification of diet in renal disease equations.In the present study mean age of population is 55.8years and mean MDRD eGFR 35.6736 and mean CG eGFR is 35.0064 . mean renal length measured at ultrasound 9.972 cms and mean renal cortical thickness 0.6056 cms. Patients on dialysis were necessarily excluded from this study. Examining the relationship between renal function on the basis of serum creatinine and cortical thickness would be inherently flawed in this group because the creatinine used for calculation would be a measure of dialysis efficacy rather than native renal function. Statistical analysis of the data is made using linear regression. The present study showed a statistically significant correlation between renal length and eGFR .Both the equations used for measuring eGFR in this study showed a statistically significant positive relationship with renal length with CG formula showing more statistical correlation when compared to MDRD formula . In addition to this, the present study demonstrated a more statistically significant positive relationship for renal cortical thickness than renal length in both CG and MDRD equations. The statistically insignificant correlations of renal measurements with serum creatinine levels in the above mentioned studies can also be related by the facts that kidney length varies with body height in both adults and children. The renal length has also been showed to vary with weight and BMI of the person.. Some authors report that renal cortex thinning occurs in ischemic nephropathy, so the cortical thickness should be measured whenever possible However, an exception should be made in the case of diabetic kidney disease, as nephromegaly, characterized by hypertrophy, affects all components and, in some cases, measurements, including cortical thickness, remain normal until the final stage of CKD is present. So in the present study diabetics are excluded even though up to 20% of diabetic patients have renal failure resulting from causes not directly related to the disease. In summary the present study recommends routine measurement of not only renal length on ultrasound abdomen but also renal cortical thickness should be measured because renal length which can vary with height of the individual and BMI, unlike cortical thickness , which has more positive correlation with renal function measured in terms of eGFR with CG and MDRD formula. As mentioned above, various studies have demonstrated varying results in terms of renal length and renal cortical thickness measurement in terms of renal function .But the present study had proved that both renal length and renal cortical thickness had positive correlation with eGFR with renal cortical thickness being more significant than renal length and so must be done for every case of CKD to minimize economic burden ,to have good follow up, to decrease radiation to patient. The limitations of present study include small sample size , interpretation of US images generally involves relatively subjective observations made by a specialist Thus, one should keep in mind that some discrepancies could occur in the evaluation of US image reports, which means that it would be preferable for evaluations to be made in a double-blinded manner. Since ultrasonography is an operator dependent modality, measurements like cortical thickness has been shown to have inter-observer and intra-observer variations with poor reproducibility when comparing repeated measurements . The results presented here will serve as a pilot study prompting further studies with larger patient samples to validate the results. Future areas of investigation using

larger patient samples may include development of a predictive range of renal function given a particular cortical thickness Alternatively, a determination of a threshold cortical thickness above which renal function is preserved may be identified.

SUMMARY

From the present study

1) The mean age of population included in this study was 55.8 years.
2) The mean renal length 9.972 cms.
3) Mean renal cortical thickness is 0.6056cms.
4) Mean MDRD EGFR 35.6736 and CG EGFR 35.0064.
5) Both MDRD and CG equations correlated EGFR with both renal length and renal cortical thickness.
6) But statistically the amount of correlation is more with renal cortical thickness than with renal length.
7) statistically CG equation showed better correlation than MDRD equation with both renal length and renal cortical thickness

CONCLUSION

In summary the present study recommends routine measurement of not only renal length on ultrasound abdomen but also renal cortical thickness should be measured because renal length which can vary with height of the individual and BMI, unlike cortical thickness , which has more positive correlation with renal function measured in terms of eGFR with CG and MDRD formula. As mentioned above, various studies have demonstrated varying results in terms of renal length and renal cortical thickness measurement in terms of renal function .But the present study had proved that both renal length and renal cortical thickness had positive correlation with eGFR with renal cortical thickness being more significant than renal length and so must be done for every case of CKD to minimize economic burden ,to have good follow up, to decrease radiation to patient.

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