IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 17, Issue 2 Ver. 13 February. (2018), PP 19-26
www.iosrjournals.org

Study of Metacarpocortical Index (MCI) In Chronic Kidney Disease

Dr. Maaz Ahmad Khan[1], Dr. Gregory Minz[2]
[1](Junior Resident /Department of Medicine/ R.I.M.S/Ranchi University, India)
[2](Associate Professor/Department of Medicine/ R.I.M.S/ Ranchi University, India)
Corresponding author: Dr. Maaz Ahmad Khan[1]

Abstract:
Introduction: *Chronic Kidney Disease may result in abnormal turnover, coupling, and mineralization. As nephron loss causes the glomerular filtration rate (GFR) to fall below 60 ml/minute, phosphate is retained and calcium secreted inducing a rise in parathyroid hormone (PTH)that causes decrease in cortical thickness in bone and reabsorption of calcium from kidney to maintain calcium homeostasis and finally develops Renal Osteodystrophy.*
Material and methods: *The present study was carried out at Department of Medicine, RIMS Ranchi, India during October 2016 to September 2017. Total 143 (cases and controls) subjects were selected randomly for Analytical Case Control study. All blood parameters were measured and Metacarpocortical index was calculated.*
Results: *total 143 subjects were studied in which 71 suffered with CKD and 72 were controls. Mean Metacarpocortical index in cases was 0.387 whereas in controls group was 0.607. Metacarpocortical index was decreased by rise of serum urea, creatinine and phosphorus. Metacarpocortical index was increased by increase of serum calcium. Metacarpocortical index was deceased by deceased in eGFR.*
Conclusions: *The study revealed that renal osteodystophy in CKD patients can be measured by simple reliable and accessible method of calculating metacarpocortical index.*
Keywords: *Chronic Kidney Disease, Renal osteodystophy, Metacarpocortical index.*

Date of Submission: 10-02-2018 Date of acceptance: 26-02-2018

I. Introduction

Chronic renal failure (CRF) is a common renal problem; where the renal injury is of a more sustained nature, often not reversible leading to a progressive destruction of nephrons and culminating in glomerular and tubular insufficiency. The clinical manifestations vary according to the severity of involvement of tubulointerstitium and glomerulus. Uremia is a complex state with a constellation of distinctive signs and symptoms, that result from renal failure.

Bone disease is common in patients with chronic renal failure as the glomerular filtration rate (GFR) falls below 60 ml/minute. Renal osteodystrophy is a type of bone disease that occurs when the kidneys are unsuccessful to maintain proper levels of calcium and phosphorus in the blood. It is common in people with kidney disease. The bone changes from renal osteodystrophy can begin many years before symptoms appear in adults with kidney disease so it also called as silent crippler.[1] The kidneys play an important role in maintaining healthy bone mass and structure by maintaining the levels of calcium and phosphorus in the blood. Healthy kidneys turn vitamin D into an active hormone (calcitriol), which helps increase calcium absorption from the intestines into the blood.[2,3] If calcium levels in the blood become too low, parathyroid hormone draws calcium from the bones to raise blood calcium levels. Too much PTH in the blood will remove too much calcium from the bones; over time, the constant removal of calcium weakens the bones. Phosphorus also helps regulate calcium levels in the bones. Healthy kidneys remove excess phosphorus from the blood. When the kidneys stop working normally, phosphorus levels in the blood can become too high, leading to lower levels of calcium in the blood and resulting in the loss of calcium from the bones. If calcitriol levels drop too low, PTH levels increase, and calcium is removed from the bones. Calcitriol and PTH work together to keep calcium balance normal and bones healthy. In a patient with kidney failure, the kidneys stop making calcitriol. The body then can't absorb calcium from food and starts removing it from the bones.[4-6] The constant removal of calcium weakens the bones. This can lead to renal bone diseases like renal osteodystrophy.[7]

When renal bone disease is assessed using a combination of biochemical markers, histology and bone densitometry, early intervention and the careful use of an increasing number of effective therapies can reduce the morbidity associated with this common problem.

One of the earliest radiological changes in chronic renal failure is metacarpocortical index (MCI). It is sum of medial + lateral cortical thickness of second metacarpal bone at mid point divided by total thickness of second metacarpal bone. This study is conducted to measure bone density by calculating metacarpocortical thickness of second metacarpal bone by X-ray which is simple and reliable method to predict bone changes (MCI index) in comparison with biochemical parameters like serum creatinine, urea, calcium, phosphorus, PTH level, eGFR. The current study aims to determine whether metacarpocortical index is correlated to chronic renal failure or not.

II. Material and Method

Source of data: Rajendra institute of medical sciences, Ranchi.
Study Design: Analytical Case Control study.
Duration of study: October 2016 to September 2017.
Ethical consideration: Prior approval for this study was granted by the Institutional Ethics Committee, RIMS Ranchi. Written informed consent was obtained from the subject or from their relatives.
Sample Size: 143 subjects

Inclusion Criteria:
Study group
1. CKD of any cause
2. Both male and female
3. Age between 16-5O yrs in male
4. Age between 16-45 yrs in female

Control group
1. No evidence of CKD
2. b) Apparently healthy
3. Age between 16-50 yrs in male
4. Age between 16-45 in female

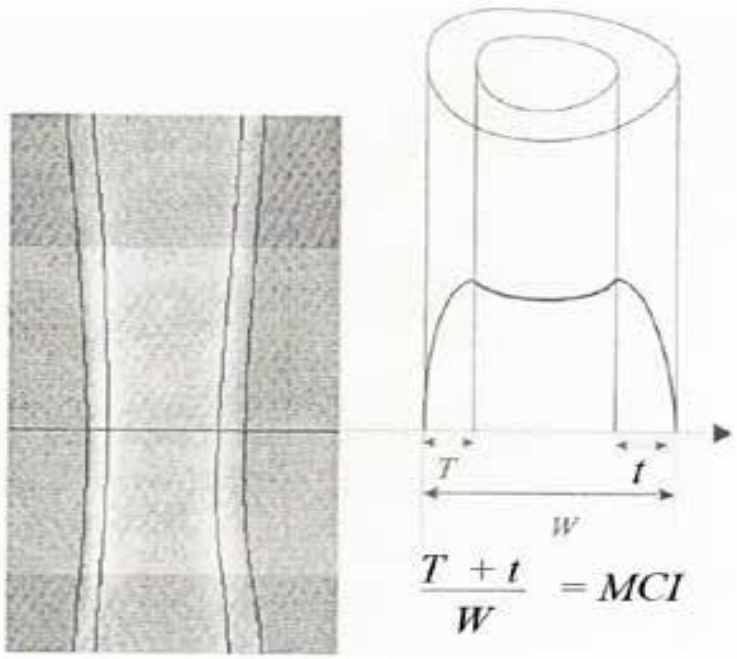
Most common cause of CKD are diabetes mellitus, hypertension, glomerulonephritis, connective tissue disease etc.

Exclusion Criteria:
a) Patients with Acute renal failure due to any cause
b) Having Bones changes other than CKD (like thyroid disorder etc.)
c) Patients age below 16 yrs
d) Patients not on certain medications and toxic agents which causes bone changes
e) Not suffering with genetic and developmental disorders of bone like osteogenesis imperfecta.
f) Not having primary tumors or secondaries in bone.
g) Recent surgery or trauma.

III. Methodology:

A thorough history & physical examination along with measurement of Metacarpocortical Index (MCI), after obtaining written informed consent were performed..
Metacarpocortical index (MCI) will be correlated with simple biochemical parameters like serum levels of creatinine, urea, calcium, phosphorous, PTH level, and eGFR .

Calculation of MCI:-
X-ray of AP view of right hand will be taken.
MCI =Medial + lateral cortical thickness of second metacarpal bone at midpoint / Total thickness of second metacarpal bone at mid point



I

Calculation of eGFR:-

Equation from the modification of Diet in renal Disease study

Estimated GFR (mL/min per $1.73m^2$) = $1.86 \times (S_{Cr})^{-1.154} \times (age)^{-0.203}$

Multiply by 0.742 for women

Multiple by 1.21 for African ancestry

CKD-EPI equation

$GFR = 141 \times \min (S_{Cr}//k, 1)^{\alpha} \times \max(S_{Cr}//k, 1)^{-1.209} \times 0.993^{Age}$

Multiply by 1.018 for women

Multiply by 1.159 for African ancestry

Where S_{Cr} is serum creatinine in mg/dL, k is 0.7 for females and 0.9 for males, α is -0.329 for females and -0.411 for males, min indicates the minimum of S_{Cr}/k or 1, max indicates the maximum of S_{Cr}/k or 1.

Abbreviation : CKD-EPI, Chronic Kidney Disease Epidemiology Collaboration.

Blood sample was drawn in the fasting and sent to Biochemistry laboratory for the following investigations, such as Serum creatinine, Blood urea, Serum calcium, Serum phosphorous, serum PTH level and eGFR.

Statistical analysis:

Data was tabulated using MS Excel, Word and was analysed using SPSS 20.0 software & MED CALC software. Mean and standard deviation of the measured values were calculated as appropriate. Data is represented as mean±standard deviation. Unpaired student's t-test (Independent sample t Test) was used to calculate p value and assess statistical significance of differences between groups, p value <0.05 was considered as statistically significant. Chi-square test used and Pearson's correlation coefficient was used to assess the linear relationships between a pair of variables and p value of <0.05 is considered significant. Multivariate analysis was done using binary logistic regression procedure to study the influence of independent variables on dependent variable of interest.

IV. Results and analysis

In this study total 143 subjects were taken. Among them 65.03% of the patients studied were males and 34.97% were females. Maximum number of patients were in the age group of 41-50 years followed by the age group of 31-40 years and then age group of 16-30 years .

Most of patients were Hindu (86.71%) followed by Muslim (12.59%) and Christian (0.7%).

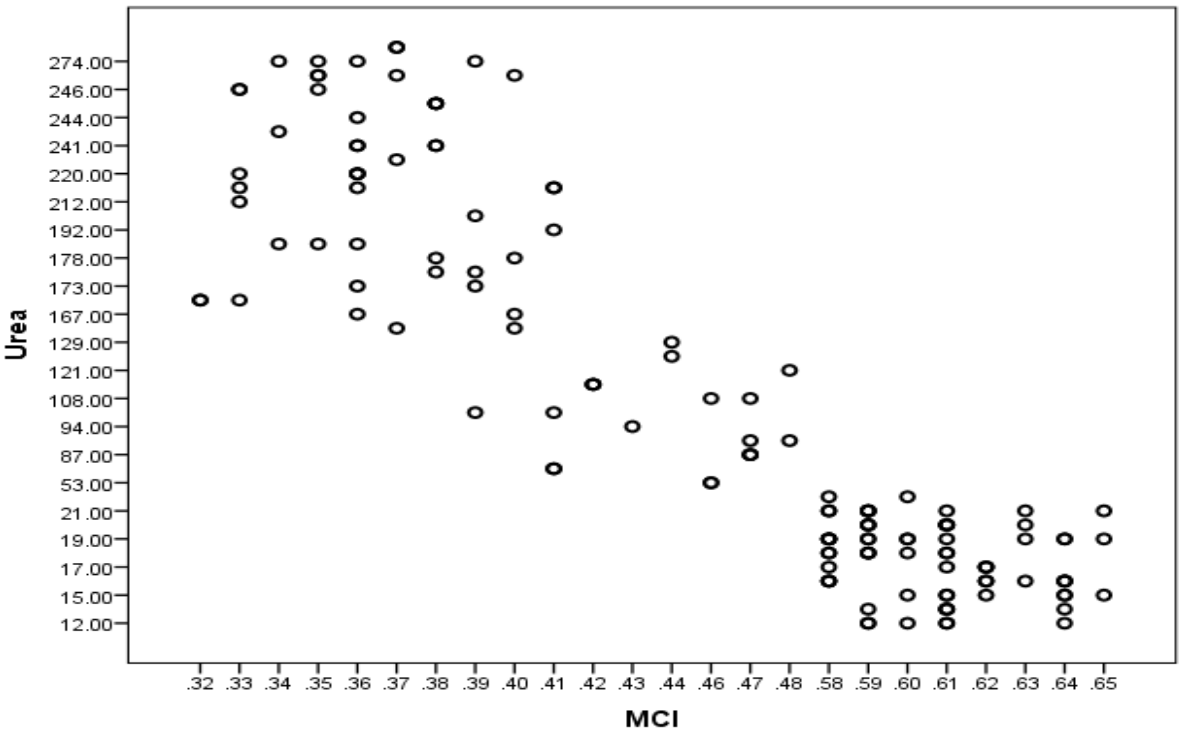
Most of cases (55.24%) CKD were not associated with any disease but it was most commonly (29.37%) associated with HTN in which Males were (26.88%) and Females were (34%) followed by DM (14.68%) in which Males were (12.90%) and Females were (18%).

Mean serum urea level in Controls was 17.52±2.80 and in cases was 185.48±68.38 by taking in account of confidence interval of 95% whose correlation coefficient r- value= -0.923 and p- value 0.000.

Similarly mean serum creatinine level in Controls was 0.81±0.18 and in cases was 8.77±4.39 whose r-value=-0.905 and p- value 0.000
And mean serum calcium level in Controls was 8.56±0.54 and in Cases was 6.55±1.17 whose r- value 0.803 and p-value 0.000.
And mean serum phosphate level in Controls was 5.33±0.51 and in Cases was 7.55±1.13 whose r- value= -0.843 and p-value 0.000.
And mean serum PTH level in Controls was 53.80±6.47 and in Cases was 249.23±108.32 whose r-value=-0.878 and p-value 0.000.
And eGFR in Controls was102.22±28.88 and in Cases was 9.45±7.97 whose r-value=0.948 and p-value 0.000.
r-value = ±1 means strong linear relationship, while p- value <0.05 is highly significant.

Table No. 1 : Serum urea vs MCI

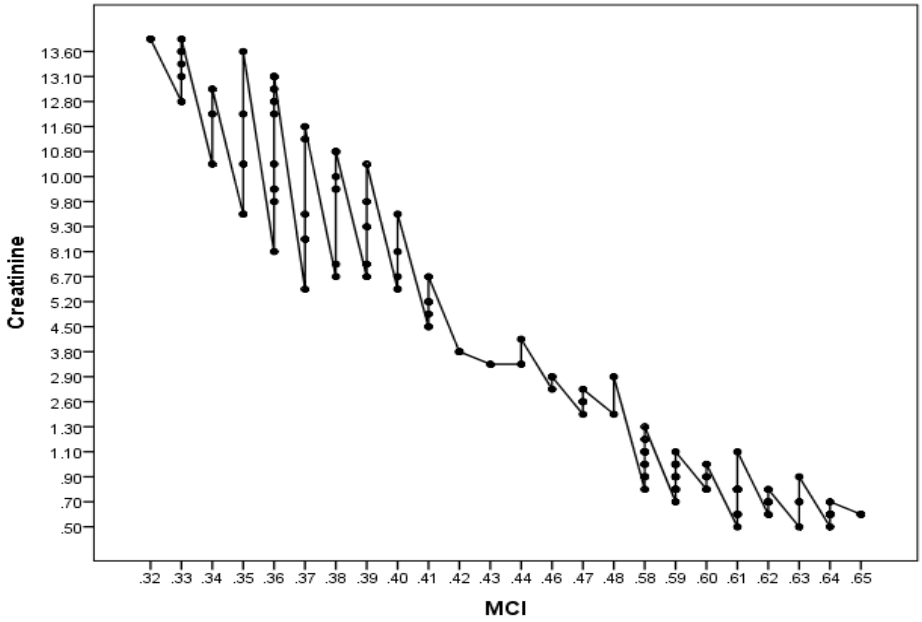
Serum Urea (mg/dl)	MCI
<15	0.609
15-79	0.581
80-159	0.423
160-240	0.369
>240	0.359



Scatter diagram 1: Relation of Serum urea with MCI

Table No.-2: Serum Creatinine vs MCI

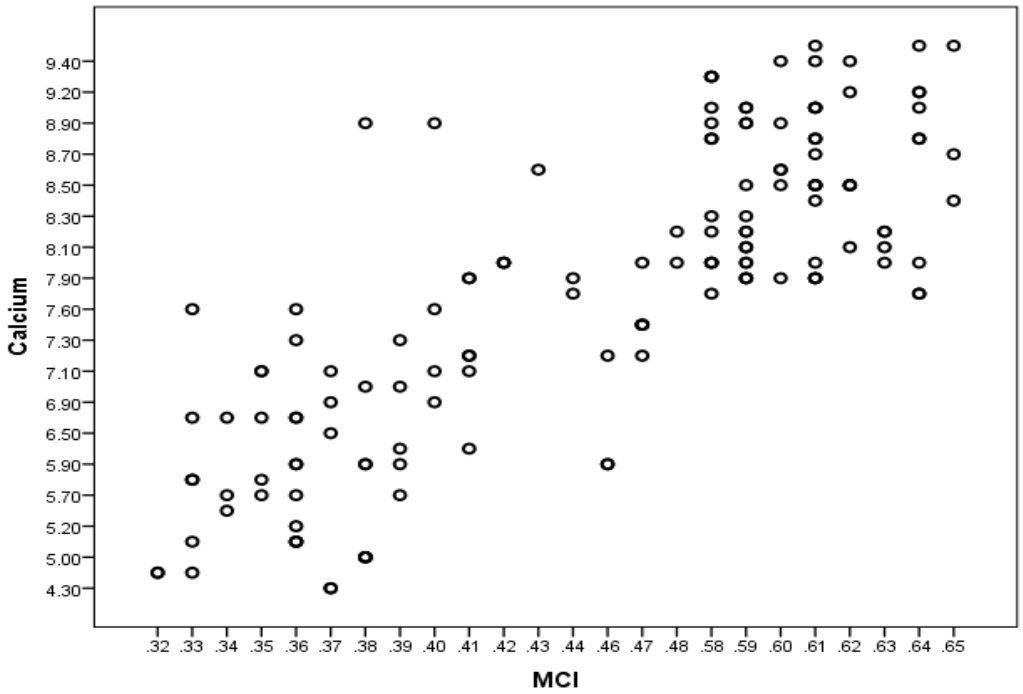
Serum Creatinine (mg/dl)	MCI
<1.3	0.607
1.3-4	0.455
4.1-8	0.401
8.1-12	0.372
12.1-16	0.344
>16	0.323



Scatter Diagram 2: Relation of serum creatinine with MCI

Table No. 3: Serum Calcium vs MCI

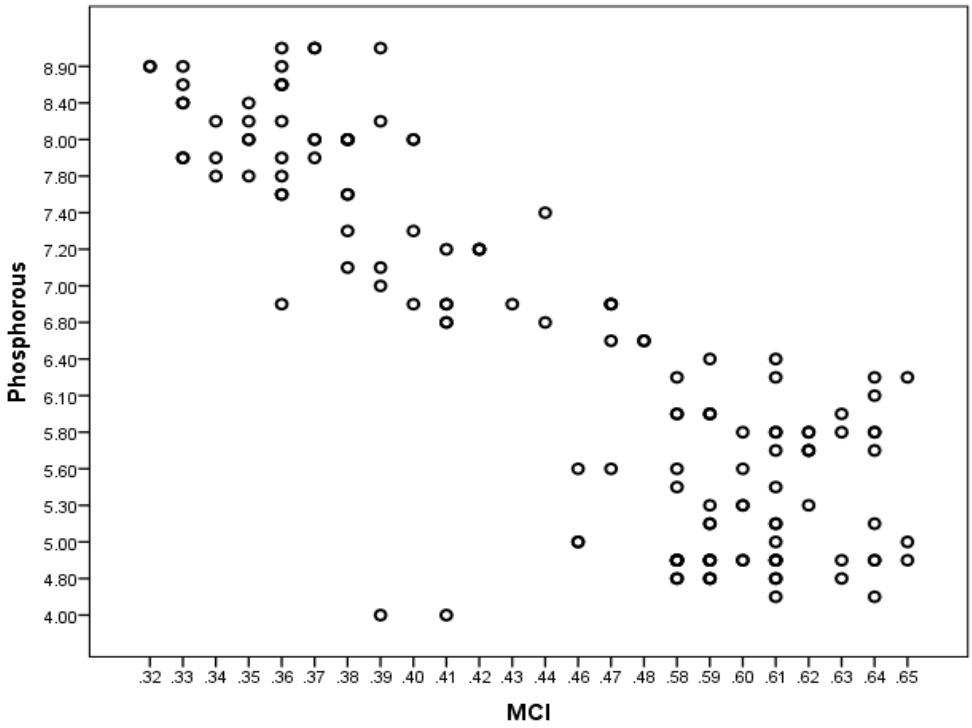
Serum Calcium (mg/dl)	MCI
< 6.5	0.367
6.5 - 7.4	0.390
7.5 - 9	0.456
> 9	0.616



Scatter Diagram:-3 Relation of serum calcium with MCI

Table No.4 : Serum Phosphate (Phosphorus)vs MCI

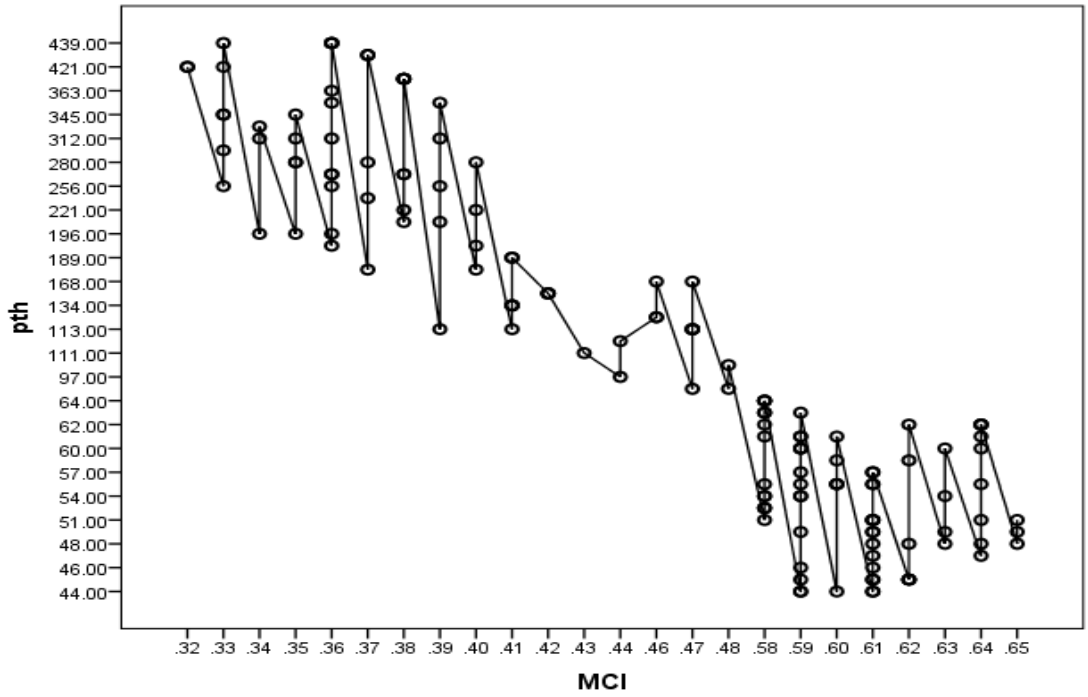
Serum Phosphate (mg/dl)	MCI
< 6	0.607
6.1 - 7.4	0.422
7.5 - 9	0.353
> 9	0.342



Scatter Diagram 4: Relation of serum phosphate with MCI

Table no. 5: Serum PTH (Parathyroid hormone) level vs MCI

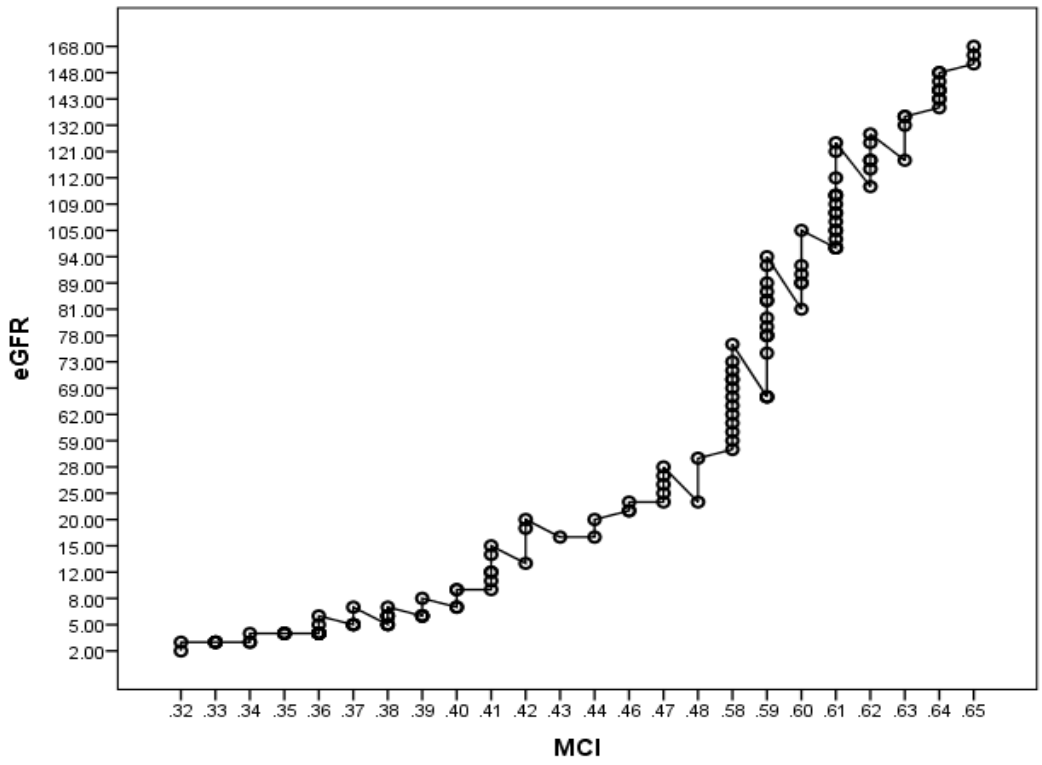
Serum PTH (pg/ml)							MCI				
<			6			5	0	.	6	0	7
6		5	-		9	9	0	.	4	3	4
1	0	0	-	1	9	9	0	.	4	1	6
2	0	0	-	2	9	9	0	.	3	7	2
3	0	0	-	4	0	0	0	.	3	5	4
>		4		0		0	0	.	3	3	3



Scatter Diagram:-5 Relation of serum PTH level with MCI

Table no.-6:eGFRvs MCI

eGFR (ml/min/1.73m2)	MCI
> 90	0.62758
60-89	0.58396
30-59	0.54787
15-29	0.52794
< 15	0.43700



Scatter Diagram 6 : Relation of eGFR with MCI

V. Discussion

In our study, reference age group for male is 16-50 years and for females 16-45 years. Among them large number of patients both males and females (73.11%, 62%) were in age group of 41-50 years. This means that frequency of CKD increases on increasing age, same type of study done by Keith et al[9] and Foley, et al.[8]

Among the cases there was male:female ratio is 1.9:1, while Udani Amit, et al[10] found that Male: Female- 1.77:1.

On religion wise study it was found that total patients 86.71% was Hindu and 12.59% was Muslim. In comparison to census figure, there had been under representation of Muslim patients.

Two most common cause of CKD is diabetes mellitus and hypertension. In our study we found that the after evaluating total patients 55.24% was not associated with any diseases while 29.87% were associated with Hypertension and 14.68% were associated with DM. It means that in our study CKD was most commonly associated with Hypertension which is almost similar to the study carried out by Chhetri, et.al.[11] , Udani Amit, et al.[10]In this study we were trying to established relationship between various biochemical parameters like serum urea, creatinine, calcium, phosphate, PTH level and eGFR with MCI.

In due course we found that mean serum urea for cases was 185.48±68, after interpreting result we found that as serum urea level increases value of MCI decreases. p- value 0.000 ($p < 0.05$) which means highly significant. In the study by Udani Amit, et al[10], by Chhetri, et al[12] and Bhan, et al[13] similar result was found

Mean serum creatinine for cases was 8.77±4.39, while by evaluating result we found that asserum Creatinine level increases value of MCI decreases whereas in study of Udani Amit, et al, Chhetri, et al, Bhan, et al, Shah, et.al.[13] similar result was obtained.

Mean serum Calcium for cases was 6.55±1.17, while by evaluating results we found that as serum Calcium level increases value of MCI also increases, whereas studied carried out by Shah et al, Juan, et al[14], Bhan, et al result was same.

Mean serum phosphate for cases was7.55±1.13, while after interpreting result we found that as serum phosphate level increases value of MCI decreases, whereas studied carried out by Juan et al[15], Alberto, et al[16] result was same.

Mean serum PTH level for cases was 249.23±108.32 while by evaluating result we found thatas serum PTH level increases value of MCI decreases, which was found similar in study conducted by Rahman MH, et al.[17]

Mean GFR in Cases (n=71) eGFR 9.45±7.97 while by evaluating result we found thatas eGFR decreases value of MCI also decreases, which was found similar in study conducted by Rahman MH, et al.[17]

VI. Conclusion

This study was conducted in 71 patients with chronic renal failure with accounting 72 controls document the renal osteodystrophy by measuring metacarpocortical index (MCI) of second metacarpal bone of right hand and to correlate the MCI index with serum levels of creatinine, urea, calcium, phosphate, PTH level, eGFR.

Mean Metacarpocortical index in cases was 0.387 whereas in controls group was 0.607. Metacarpocortical index was decreased by rise of serum urea, creatinine and phosphorus. Metacarpocortical index was increased by increase of serum calcium.

Metacarpocortical index was deceased by deceased in eGFR.

References

[1]. Darren M Roberts and Richard F Singer. Management of renal bone disease. Aust Prescr. 2010;33:34-7.

[2]. Svara F. Chronic kidney disease mineral and bone disorder (CKDMBD): a new term for a complex approach. J Ren Care. 2009;35(Suppl 1):3–6.

[3]. Ho LT and Sprague SM. Women and CKD-mineral and bone disorder. Adv Chronic Kidney Dis. 2013;20(5):423-6.

[4]. Llach F. Secondary hyperparathyroidism in renal failure: the trade-off hypothesis revisited. Am J Kidney Dis. 1995;25(5):663-79.

[5]. Goodman WG. Medical management of secondary hyperparathyroidism in chronic renal failure. Nephrol Dial Transplant. 2003;18(Suppl 3):2-8.

[6]. Silver J and Levi R. Regulation of PTH synthesis and secretion relevant to the management of secondary hyperparathyroidism in chronic kidney disease. Kidney Int. 2005;(Suppl):S8- 12

[7]. http://www.medicinenet.com/osteodyst rophy/article.htm

[8]. Foley RN, MurrayAM, Li S, HerzogCA, McBean AM, Eggers PW, Collins AJ: Chronic kidney disease and the risk for cardiovascular disease, renal replacement, and death in the United States Medicare population, 1998 to 1999. J Am Soc Nephrol2005;16:489–495.

[9]. Keith DS, Nichols GA, Gullion CM, Brown JB, Smith DH: Longitudinal follow-up and outcomes among a population with chronic kidney disease in a large managed care organization. Arch Intern Med

[10]. Udani A. Clinical profile of CRF patients: Dissertation submitted to Saurashtra University, Gujarat; 2006.

[11]. Chhetri PK, Manandhar DN, Tiwari R, Lamlichhane S. In-centrehaemodialysis for end stage kidney disease at Nepal Medical College Teaching Hospital.Nepal Med Coll J 2009;11(1):61-63.

[12]. Chhetri PK, Manandhar DN, Bhattarai SP, Pahari LR, Shrestha R. Chronic kidney disease on hemodialysis in Nepal Medical College Teaching Hospital. Department of Medicine, Nepal Medical College Teaching Hospital, Jorpati, Kathmandu, Nepal. Nepal Med Coll J 2008;10(1):8-10.

[13]. Bhan I, Dubey A, Wolf M. Diagnosis and Management of Mineral Metabolism in CKD. J Gen Intern Med 2010; 25(7):710–61.

[14]. Shah NR, Dumler F. Hypoalbuminaemia – A Marker of Cardiovascular Disease in Patients with Chronic Kidney Disease Stages II – IV. Int J Med Sci 2008; 5(6):366-370.

[15]. Juan F, Navarro G, C MF, Mercedes M, Haridian H, Javier GC. Mineral Metabolism and Inflammation in Chronic Kidney Disease Patients: A Cross-Sectional Study. J Am SocNephrol 2009; 4: 1646–1654.

[16]. Alberto MC, José LG, José MP, Fernando DA, Aleix C, José L, Juan FN, Rafael M, et al. Baseline characteristics of patients with chronic kidney disease stage 3 and stage 4 in Spain: the MERENA observational cohort study. BMC Nephrology 2011;12:53.

[17]. Rahman MH, Hosain MM, Sultana S, Jamal CY, Karim MA. Correlation of Serum parathormone level with biochemical parameters in chronic renal failure. Indian Pediatrics 2005;42:250-54.

Dr. Maaz Ahmad khan"Study of Metacarpocortical Index (MCI) In Chronic Kidney Disease"."IOSR Journal of Dental and Medical Sciences (IOSR-JDMS), Volume 17, Issue 2 (2018), PP 19-26.