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Ultrasonographic Correlation of Cortical Thickness and Echogenicity Among Patients Suffering From Chronic Renal Failure

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Abstract

Background: Chronic Renal Failure (CRF) is a terminology used for heterogeneous disorders affecting the anatomy and physiology of the kidney. The variation in disease expression is related partly to cause and pathology, severity, and rate of progression Chronic Renal Failure (CRF) being recognized as a life-threatening disorder. Objective: The aim of this study was to assess the correlation of cortical thickness and echogenicity among patients suffering from chronic renal failure using ultrasound. Methodology: Cross-sectional prospective study 138 patients were included in the study. All the patients had been collected from indoor, outdoor, and emergency department of Mayo Hospital, Lahore. After informed consent, data were collected through ultrasound machine Toshiba Nimo 7. Results: Findings revealed that 138 CRF patients, 82 patients were male and 56 patients were female, and 56 patient belongs to the age group 15-35, 42 patient belongs to age group 36-55 and 40 patient belong to age group 56-75. P value is .131, which is greater than the significance level .05, which shows that there is no significant relation between both variables. Conclusion: It is concluded that there is no ultrasonographic correlation of cortical thickness and echogenicity among patient suffering from chronic renal failure

Keywords: Renal Echogenicity, Renal Cortical Thickness, Ultrasonography

Introduction

Kidneys appear as a bean-shaped structure that weighs almost 150g in men and 135g in women, and its size varies from 10-12 cm in length, 5-7 cm in width, 2-3 cm in thickness.(Wein et al., 2011) Kidneys are retroperitoneal structures that are to be found bilaterally among the transverse process of T12 to L3 while the left kidney is marginally higher in position than the right kidney. Normal renal function is of great importance as this

includes filtration and excretion process of the metabolic waste product such as urea and ammonium; regulation of electrolytes; fluid and acid-base balance; aids in production of red blood cells which is used to maintain the blood pressure through the renin-angiotensin-aldosterone system and to control water resorption; maintain the volume of blood in vessels.(Saldana et al., 2007) Chronic kidney disease is a term for heterogeneous disorders affecting the anatomy and physiology of the kidney and is based on the presence of kidney damage (i.e., albuminuria) or decreased kidney function (i.e., glomerular filtration rate) [GFR] < 60 ml/min per 1.73 m^2 for three months or more.(Levey and Coresh, 2012)There are basically two subtypes of renal disease, vascular and parenchymal. Vascular relates to a medical condition which involves the blood vessel while, on the other hand, parenchymal relates a medical condition which involves the tissue, therefore renal parenchymal disease relates to a disease affecting the kidney tissue. On ultrasound, renal parenchymal disease signifies that the kidney function is partially lost or completely.(Yun and Lee, 2007) Parenchymal kidney disease can affect either one or both of the kidneys, causing scarring and tissue damage. If the kidney is severely damaged and is unable to do filtration process, then kidney waste and surplus fluid will begin to build up, causing serious edema, and ultimately kidney failure, and the disease may be either inherited or congenital.(Clark et al., 2011)Mineral and Bone Disorder is common in chronic kidney disease (CKD) and is a major cause of morbidity owing to shorter life expectancy and skeletal calcification associated with enhanced cardiovascular mortality.(Moe et al., 2006)Polycystic renal disorders are hereditary renal disorders, primarily owing to mutations in genes that control the growth and function of cells in the renal tubules.(Wilson, 2004) Hypertension may also trigger kidney issues, or in certain cases, result from kidney disease itself if unmanaged high blood pressure may boost the potential risk of kidney disease, which may lead to the diagnosis of unnoticed serious kidney disease and parenchymal renal disease.(Hall, 2003)Obesity leads to renal vasodilation and glomerular hyper-filtration, which works as a countervailing mechanism to retain sodium equilibrium despite enhanced tubular reabsorption.(Hall et al., 2014)Diabetes mellitus (DM) is a significant leading factor causing CKD and is described as 3-month renal damage characterized as morphological or physiological defects, including or excluding reduced glomerular filtration rate (GFR) 60 mL/min/1.73 m^2 or less, including or excluding renal injury. National Kidney Foundation statistics declare that around one-third of patients with type 2 diabetes mellitus remains at a threat of acquiring CKD, and about 10% to 40% of patients with type 2 diabetes mellitus have renal impairment.(Koro et al., 2009) Kidney disease, such as infection and stone, can often be readily managed. Chronic renal inflammation is though, frequently seen in kidney disease but can slowly advance to renal failure if not correctly managed.(Barsoum, 2006)Most kidney disease can be prevented, but when kidney disease advances to renal failure; dialysis or kidney transplantation may eventually be needed.(Lutz et al., 2014)The CKD and heart disease are correlated with each other and are broadened by several epidemiological studies as CKD significantly advances with causative factors. As a result, the chance of cardiovascular disease is particularly more in people with CKD, conventional cardiovascular risk variables, impaired kidney function, and enhanced levels of serum albumin in urine, which raises the possibility of heart disease by two to four times. Yet, cardiovascular disease is frequently underdiagnosed and undertreated in patients with chronic kidney disease.(Gansevoort et al., 2013)Ultrasound imaging is a method frequently used in the detection of renal obstruction and was restricted to the assessment of anatomical and pathological alterations in the collection mechanism and for the evaluation of patients with renal disorder in Real-time and US parameters, such as renal length, cortical echogenicity. Doppler technique shows variation in renal perfusion, which is a distinct but not a specific parameter for the assessment of renal parenchymal diseases. Scarring of the cortex and size <9 cm may signify tubular atrophy, although very constrained prescriptive data is obtained on which cortical thinning is evaluated including the size, the extent to which the size is decreased and is correlated with idiopathic parenchymal disease and fewer information on the echo-texture of the cortex, which is backscattering of sound produced in the ordinary cortex by structures like glomeruli, vessels, and tubules; the collagen involved in interstitial fibrosis and glomerulo-sclerosis is liable with high echogenicity, the echogenicity is generally evaluated qualitatively by the naked eye which is very inaccurate, and we have recently revealed that renal cortex echogenicity can be reliably evaluated and normal spectrum can be established in a tiny group of adults using ultrasound.(Manley and O'Neill, 2001) Levey AS conducted research on Compared the sonographic structures of kidneys in patients with the renal inability to examine the potential part of renal US to recognize acute from chronic renal failure and evaluated the demonstrative part of superficial body zone rectified renal length contrasted with estimated renal length. No important contrasts in age, serum albumin, creatinine, body mass index, stature, or sexual orientation appropriation were originated amongst patients with ARF and those with CRF, excluding from in serum hemoglobin. The bilateral parenchymal thickness and renal size were

important in ARF patients than in those with CRF (p < 0.0001). The average parenchymal thickness and renal size were comparable in ARF patients and the controller gathering. Grade I hyperechogenicity was the most widely judgment during in sonograph (Ozmen et al., 2010).

Research undertaken by Levin A over the previous decade has seen a growing concentration on chronic kidney disease and its correlated problems, leading to a better comprehension of their effect on health care assets. Early detection of CKD has been facilitated by frequent reporting of estimated glomerular filtration levels (eGFR) and coaching of primary care physicians on the consequences of the detection of reduced eGFR in terms of patient health and safety as well as cardiovascular and renal results. Early CKD detection aims to avoid CKD development and related complications, thus enhancing patient results and decreasing the effect of CKD on medical care resources. This assessment discusses the advantages of early detection of CKD and outlines the constraints of present understanding and concerning diagnosis, early detection, and therapy, as well as the unintended consequences of evaluation. In fact, this study demonstrates what is presently known about cardiovascular and renal results and the impacts of intervention in CKD patients (Levin and Stevens, 2011).
The study is conducted to assess the ultrasonographic correlation of cortical thickness and echogenicity among patients suffering from chronic renal failure.

Methods

It was a prospective cross-sectional study. 138 patients included clinical suspicion of chronic renal failure. All the patients had been collected from indoor, outdoor, and emergency department of Mayo Hospital, Lahore. After informed consent, data were collected through ultrasound machine Toshiba Nimo 7. Renal Parenchymal changes, renal Size, and cortical Thickness were measured. While patient with no history of hypertension, diabetes, normal RFTs, and with age less than 15 years was excluded in our study. Study variable and information collected were entered into SPSS version 21.0 and analyzed through its statistical program. Ultrasound of the Kidney was done to saw the renal echogenicity and to measure the cortical thickness. Ultrasound of the Kidney was done to saw the renal echogenicity and to measure the cortical thickness. RFTs were considered as the gold standard for final diagnosis. Chi-Square test was used to correlate cortical thickness with echogenicity.

Results

This chapter deals with the analysis and interpretation of the results of the data collected from 138 Patients of Chronic Renal Failure (CRF). Table 1 shows that out of 138 CRF patient, 56 patient belong to age group 15-35, 42 patient belong to age group 36-55, and 40 patient belong to age group 56-75.

Table 1: Age of Patient (years)

Age		Frequency	Percent
Valid	15-35	56	40.6
	36-55	42	30.4
	56-75	40	29.0
	Total	138	100.0

According to Table 2, Out of 138 patients, 82 patients were male, and 56 patients were female.

Table 2: Gender of Patients (Male and Female)

Gender		Frequency	Percent
Valid	male	82	59.4
	female	56	40.6
	Total	138	100.0

Table 3 showed that cross table between renal echogenicity and renal cortical thickness explains that in grade I echogenicity, there were 20 patients in (16-19) section, 12 in (12-15), and 20 in (8-11)'s section of cortical thickness. Grade II, contain 10 patient in (16-19), 16 patients in (12-15) and 10 patients in (8-11) renal cortical thickness class. Grade III renal echogenicity 20 patients (16-19), 10 patients were in (12-15) section of cortical thickness and 20 patients were in (8-11) section of cortical thickness.

Table 3: Cross-tabulation of Renal Echogenicity and Renal Cortical Thickness.

Renal echogenicity * Renal cortical thickness Cross tabulation						
			Renal cortical thickness			Total
			16-19	12-15	8-11	
Renal echogenicity	grade I	Count	20	12	20	52
		Expected Count	18.8	14.3	18.8	52.0
	grade II	Count	10	16	10	36
		Expected Count	13.0	9.9	13.0	36.0
	grade III	Count	20	10	20	50
		Expected Count	18.1	13.8	18.1	50.0
Total		Count	50	38	50	138
		Expected Count	50.0	38.0	50.0	138.0

Testing of Hypothesis

As P-value (.131) is greater than the significant level (0.05). Therefore, the **Null hypothesis** (**H0**: There is no ultrasonographic correlation of cortical thickness and echogenicity among patients suffering from chronic renal failure was accepted, and **Alternative Hypothesis (H1:** There is an ultrasonographic correlation of cortical thickness and echogenicity among patient suffering from chronic renal failure.) was rejected.

Table 4: This Chi-Square table shows that the P value is .131, which is greater than the significance level .05, which shows that there is no significant relation between both variables.

Chi-Square Tests			
	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.099[a]	4	.131
Likelihood Ratio	6.749	4	.150
Linear-by-Linear Association	.000	1	1.000
N of Valid Cases	138		

Discussion

Out of 138 CRF patients, 82 patients were male, and 56 patients were female, and 56 patients belong to age group 15-35, 42 patients belong to age group 36-55, and 40 patients belong to age group 56-75. Another similar study shows the demographics as following; the overall average age was 60.134, range from 26 to 80 years old72 males (35.8%) and 129 females (64.2%). (Moghazi et al., 2005) The present study's Results suggested that 61% of the patient are hypertensive, and 39% of patients are non-hypertensive. Hypertension is an important cause of CRF. Glodny B, et al., in their study "ultrasonography patterns for Hypertensive patients," they found that renal changes in hypertensive patients are detectable by conventional ultrasound only in very advanced stages of the disease (Glodny et al., 2009). Results of the present study also showed that 37% of patients of CRF have a history of diabetic, and 63% of patients are non-diabetic. This show that diabetes is the second most common cause in CRF patient. Mohammed A. Ali Omer, et al in their study entitled "ultrasonographic characteristics of diabetes impact in kidneys' morphology" they revealed that the diabetes directly affects the kidney morphology by increasing the renal volume and in early-stage cortical thickening is atrophied and become echogenic in latter stage and also shows a significant correlation between kidney size, Body mass index (BMI) and the duration of diabetes. (Omer et al., 2014)According to the present study, 45% of patients had an 0-4 level of serum creatinine, 38% had 4-8, and 17% had 8-12 serum creatinine levels, respectively. Alsafi Ahmed Abdella et al., in their study, recorded "ultrasound finding of renal failure patients and creatinine Serum level relationship" the study revealed that kidneys volume decreases as the creatinine serum level increases (Mohammed, 2016). According to present study there is no correlation of cortical thickness and echogenicity among patients suffering from chronic renal failure because p value is .131, which is greater than the significance level .05, which shows that there is no significant relation between both variables. Therefore, the **Null hypothesis (H0**: There is no ultrasonographic correlation of cortical thickness and echogenicity among patients suffering from chronic renal failure) was accepted. Same findings were seen in a previous study by Michael D. Beland results shows that average cortical thickness was 5.9 mm (range, 3.2–11.0 mm); average length was 10 cm (7.2–12.4 cm); average minimum serum creatinine was 2.1 mg/dL (1.1–6.1 mg/dL), and average glomerular filtration rate (eGFR) was 34.8 mL/min (10.6–99.4 mL/min). There was a statistically significant relationship between eGFR and cortical thickness ($p < 0.0001$). There was no statistical significant relationship between renal echogenicity and cortical thickness as ($p = 0.08$) (Beland et al., 2010). A study conducted on the topic evaluation of renal changes in diabetic and hypertensive patients using ultrasound and laboratory findings also supports present findings the study concluded that no significant sonographic correlation were observed in cortical thickness, cortical echogenicity and cortico-medullary differentiation(CMD). Estimated glomerular filtration level is the best lab investigation to detect and classify the renal function loss. Serum creatinine level played an important role in the calculation of the estimated glomerular filtration level (eGFR). We cannot depend on blood urea nitrogen (BUN) alone in the detection or determination of renal function loss because it relies on many other factors. Micro-albumin urea is the best lab test to detect small amount of albumin (protein) in urine, and this considers the early sign of renal function loss. In conclusion, lab investigations have superiority to ultrasound in detection and classification of renal function loss(Mohammed, 2016)and concluded that the patients with chronic renal failure the cortical echogenicity increases while decreasing the renal cortical thickness (Moghazi et al., 2005).

Conclusion

On the basis of the findings of the study, the most common disease history in Chronic Renal Failure (CRF) patients was hypertension. The second most common disease history in Chronic Renal Failure (CRF) patients was diabetes. There is no ultrasonographic correlation of cortical thickness and echogenicity among patients suffering from chronic renal failure.

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