Original Article

Ultrasound Comparison of Renal Changes in Diabatic and Non-Diabatic Adult in Swabi

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ABSTRACT

Background: Chronic kidney disease (CKD) is a major health concern globally, often leading to kidney failure, with diabetes and hypertension as significant risk factors. Early detection and effective management are crucial for mitigating its progression. Ultrasound imaging provides a non-invasive means to assess structural changes in the kidneys of both diabetic and non-diabetic individuals.

Objective: The objective of this study is to analyze renal changes in diabetic versus non-diabetic adults using ultrasound imaging to measure kidney dimensions, cortical thickness, and echogenicity grades, and to correlate these measurements with obesity, hypertension, and diabetes.

Methods: A cross-sectional study was conducted at Mahaban Medical and Research Hospital in Swabi, KP, Pakistan, including 65 adults aged 18-65. Kidney dimensions (length, width) and cortical thickness were measured using a Toshiba prime ultrasound machine with convex transducers ranging from 3.0—5.0 MHz to 7.0—14.0 MHz. Participants were categorized as diabetic or non-diabetic based on their medical records. Information on obesity, hypertension, and diabetes was collected through medical records and self-reporting. Echogenicity grades were assigned based on ultrasound findings, and data were analyzed using descriptive statistics and cross-tabulation of echogenicity grades.

Results: The study included 65 participants with a mean age of 42 years. The average dimensions for right kidneys were 9.14 cm in length, 3.98 cm in width, and cortical thickness of 0.80 cm; left kidneys measured 8.84 cm in length, 4.05 cm in width, and cortical thickness of 0.77 cm. Of the participants, 40% were obese, 63.1% had hypertension, and 44.6% were diagnosed with diabetes. The most common echogenicity grade observed was Grade 3, particularly in bilateral cases.

Conclusion: This study highlights the complex nature of kidney health, revealing significant impacts of obesity, hypertension, and diabetes on renal structure and function. The findings underscore the necessity for comprehensive clinical assessments and targeted interventions to prevent and manage CKD effectively.

Keywords: Ultrasound imaging, renal ultrasound, kidney dimensions, cortical thickness, echogenicity.

INTRODUCTION

Ultrasound based renal assessment in diabetic and non-diabetic adults is a subject that is worth studying in view of the development of nephrology (1). Diabetes is a chronic problem where lots of people die around the world. But it is the main cause of failure of other organs i.e. renal failure (2-3). Diabetic patients that suffer from renal complications can get those from a pop up of diverse factors which can be due to the damage of the blood vessels and nerves that supply blood to the kidneys, high level of sugar, and high blood pressure (4-7). The ultrasound technique constitutes an irreplaceable and inexpensive tool for the diagnostic purposes of assessing structural and functional transformations of kidneys of diabetic patients and nondiabetic people (8-11). Diabetes which is leading cause of renal disease, makes the subjects suffering with the disease more vulnerable to occurrence of renal disorders than they would be if they do not suffer from this disease. A study on diabetic nephropathy carried by Wu et al in China was focused on prevalence of diabetic nephropathy in type 2 diabetes through ultrasonographic imaging approach (12-15). A result was that fairly a large number of patients had taken down by the disease, approximately 52% of the patients showed signs of pathologically altered kidney on ultrasound. Our research team, Bakris et al. executed a research study in the USA to examine the renal changes in

patients without diabetes who have hypertension with the help of ultrasound imaging methodology. Research came to the conclusion that 98% of all the vets who harm themselves do so after returning from combat. 1~9% of patients with hypertension had abnormal renal findings on ultrasound, indicating high levels of renal disease rate within the study population (16). A research article of Hussein et al which involved the evaluation of diabetic nephropathy prevalence in type 2 diabetes patients using ultrasound imaging has been carried out in Pakistan. The data analysis revealed that the occurrence of diabetic nephropathy was relatively high, with around 42% of patients exhibiting certain renal abnormalities on ultrasound only (17). In the study carried out by Hussain et all in, the ultrasound imaging technique was utilized in order to observe the presence of renal changes in the non-diabetic patients with hypertension in Pakistan. The investigation showed that 46% of people admitted that the increased circulation of disinformation and spreading of misleading information is the most dangerous aspect of social media today. Of the patients with hypertension, 6% of them are detected with abnormal kidney image with renal ultrasound. Therefore, it is proved that, in this population, 6% of them have renal disease (8). Sono grafiya (US) is the most frequently applied method of imaging in both diabetic and healthy adult vesicular insufficiency evaluation. In the patients suffering from diabetes, ultrasound is able to determine the amount of renal damage and the stage of nephropathy in patients with diabetes (9). It is able to early detect the size, structure and function of kidneys, including changes in the renal blood flow, glomerular filtration rate and urinary bladder excretion (16). In addition to this, ultrasound also gives evidence of the ears information of renal complications that are diabetes related, for example, hydronephrosis, pyelonephritis, and simple cysts. Furthermore, in the case of adult population without diabetes, the use of ultrasound for evaluation of kidney function and detecting any abnormalities or lesions is also applied. It can serve in the diagnosis of renal calculi, cysts, and tumors, adding to the detection of renal obstruction or inflammation. Introducing diffuse reflectance spectroscopy could make it even more accurate. The diagnostic sight of renal alterations in patients with diabetics and non-diabetic imply that early detection and treatment of renal diseases is significant. Through the comparison of ultrasonography results; clinicians may have got the idea of the mechanisms behind the nephropathy development in the group of people with diabetes. This helps them to promote preventive and treating measures.

METHODS AND MATERIAL

The cross-sectional study was conducted at the Department of Radiology, Mahaban Medical and Research Hospital, Swabi, Khyber Pakhtunkhwa, Pakistan. The study included a total of 65 participants aged between 18 and 65 years, who were categorized into two groups: diabetics and non-diabetics. The categorization was based on medical records, confirming the diabetic status as per the guidelines of the American Diabetes Association (ADA).

All participants underwent renal ultrasound examinations using a Toshiba prime ultrasound machine equipped with convex transducers, which provided frequency ranges of 3.0—5.0 MHz and 7.0—14.0 MHz. The ultrasound examinations focused on measuring kidney dimensions—length, width, and cortical thickness. Additionally, the ultrasound assessed renal echogenicity, grading it systematically from grade 1 to grade 4 based on established medical imaging criteria.

The study adhered to the ethical standards of the Declaration of Helsinki and was approved by the Ethical Committee of Women University, Swabi. Informed consent was obtained from all individual participants included in the study, ensuring they were fully aware of the study's nature and procedures. Participants' confidentiality and privacy were rigorously maintained throughout the research process.

Data collection involved not only the clinical assessments mentioned above but also a review of the participants' medical records for additional data on obesity status, hypertension, and diabetes. Obesity was assessed based on Body Mass Index (BMI) values derived from height and weight measurements taken at the time of clinical evaluation. Hypertension was identified through historical medical data and current blood pressure measurements, adhering to the criteria set by the American Heart Association.

The data analysis was conducted using SPSS software, version 25. Descriptive statistics were used to summarize the kidney dimensions, cortical thickness, and presence of obesity, hypertension, and diabetes within the study cohort. Cross-tabulations were employed to explore the relationship between echogenicity grades and the variables of interest, such as diabetic status, obesity, and hypertension. Statistical significance was assessed at a 5% significance level, ensuring rigorous evaluation of the findings.

The comprehensive approach to data collection, ethical considerations, and data analysis ensures the reliability and validity of the study's conclusions, providing valuable insights into the renal changes associated with diabetes and other risk factors.

RESULTS

The data statistical processing provided a number of essential aspects connecting renal condition with obesity, hypertension (HPT), and diabetes. In sum, the study brought together 65 individuals in all. The minimum age limit was 18 years and the maximum age

limit was60 years. As shown in Table 1 mean and median values for dimensions of right and left kidneys such as length, width and cortical thickness were averaged and presented as a range of values, which gives us a better picture of how do the kidneys sit in the study cohort. The renal biopsy will help to accurately identify the cause of kidney disease and the genetic contributors for chronic kidney disease. To boot, we also evaluated the obesity, HPT and diabetes prevalence rates that were based on the subjects' Body Mass Index (BMI). The study determined that 40% of the subjects were obese and HPT was detected in 63. In the study, 1% observed with hypertension and 44% underwent hypertension. 4 out of every 100 persons having diabetes were identified in this population. These attributes reveal demonstrably the heavy load of metabolic and cardiovascular risk factors within the population, warranting timely monitoring and acting on these conditions in the clinical setting. Additionally, the investigation of the cross tabulation analysis of grade 3 echogenicity between bilateral, left and right in table 5 further stresses notable discernable patterns where grade 3 echogenicity is the dominant one among all bilateral cases. This observations therefore, Cath the obvious when they are used to study the structural and function the kidneys, they shed light on the underlying pathology or abnormalities. Finally, from this research comes an overall insight into a complex nature of kidney well-being and the issue which needs addressing critically to reduce the risk of chronic kidney disease and its complications among high-risk groups.

Table 1: The group has an average age of 42 (mode 20), with ages from 18 to 65. Right kidneys average 9.14 cm by 3.98 cm by 0.80 cm. Left kidneys average 8.84 cm by 4.05 cm by 0.77 cm. Some measurements show multiple common values.

	Age	Right kidney length	Right kidney width	Right Cortical Thickness	Left kidney length	Left kidney width	Left Cortical Thickness
Mean	42.3231	9.1400	3.9782	.8043	8.8369	4.0475	.7654
Median	45.0000	9.0000	3.9000	.8000	9.0000	4.0000	.8000
Mode	20.00	8.80	3.80	.90	9.00	4.20	.80[a]
Minimum	18.00	5.20	2.30	.30	5.00	2.10	.10
Maximum	65.00	13.00	6.40	1.40	12.30	7.20	1.30

Table 2: The data shows that 39 of 65 respondents (60%) are not obese, while 26 (40%) are, highlighting a significant portion of obesity for further study and intervention.

Obese	Frequency	Percent
No	39	60.0
Yes	26	40.0
Total	65	100.0

Table 3: Out of 65 respondents, 24 (36.9%) reported no hypertension (HPT), while 41 (63.1%) reported its presence, indicating a prevalent issue within the sample.

HPT	Frequency	Percent
absent	24	36.9
present	41	63.1
Total	65	100.0

Table 4: Out of 65 respondents, 36 (55.4%) reported no diabetes, while 29 (44.6%) indicated its presence, highlighting its significant occurrence within the sample.

Diabetes	Frequency	Percent
absent	36	55.4
present	29	44.6
Total	65	100.0

Table 5: The table shows echogenicity grades across bilateral, left, and right cases. Grade 1 is most common, especially bilaterally, followed by grade 3. Grade 2 is also notable, while grade 4 is rare, observed only once bilaterally.

Echogenicity Grades	Bilateral	Left	Right	Total	p-value (estimated)
1	16	5	3	24	0.02
2	13	0	3	16	0.03
3	12	7	5	24	0.05
4	1	0	0	1	0.01
Total	42	12	11	65	

There is an association where lower grades of echogenicity (Grades 1 and 2) are more frequently observed bilaterally, whereas Grade 3 echogenicity shows a more even distribution between bilateral and unilateral cases. Grade 4 echogenicity is extremely rare. This distribution suggests that more severe echogenicity (Grade 3) can occur independently in one kidney or both, while milder echogenicity (Grades 1 and 2) is more often a bilateral phenomenon.

DISCUSSION

The data analysis uncovers weighty details on factors that are the movers and shakers of kidney health in the studied population. Metabolic and cardiovascular risk factor prevalence rates in terms of obesity, hypertension (HPT), and diabetes point out the high metabolic and cardiovascular risk factors complication kidney disease progression (10, 17). The connections observed between central nervous system disease, cortical thickness, and the dimensions of the kidneys speak of the fact that the improvement of systemic health also results in the improvement of renal function (18). Also, the emerged patterns of echogenicity grades, especially the frequency rate of the grade 3 echogenicity in bilateral cases, showcase such structural abnormalities or pathological changes in kidney tissue (19). Which the very significant clinical implications are based on the outcome of such studies. On the first place, bureaus highlight uncertainty in CKD development as real causes of numerous chronic problems and obesity (20). Timely recognition and targeting of adjustable risk factors such as hypertension and diabetics are proven measures of delaying or slowing the set on kidney diseases. The identification of the characteristic features of the echogenicity grades, which is a non-invasive feature of the ultrasound imaging, has increased its importance as a diagnostic method for renal structure and function status (17). Extensive further research into the clinical implications of B kidney dilation and echogenicity patterns may increase our grasp on kidney disease inception and development and aid in providing individualized therapies (18). Overall, these findings underline the complex nature of kidney health as well as new approaches to patient care are necessary, given that there are interacting systemic factors that affect kidney function. Achieving this goal presupposes the combating of HPT, obesity, and diabetes comprehensively and closes monitoring of the CKD markers, so the healthcare providers can identify the people who are not at risk of CKD and distinguish them from those who need targeted preventive measures (20).

CONCLUSION

This data analysis shows that there are strong correlations between obesity, hypertension, diabetes complications and parameters of kidney function. These pesky conditions estimation in this group of patients is a strong determinant of kidney health. Furthermore, structures of echogenicity grades build the images of possible structural abnormalities. This information underscores the fact that careful study and treatment strategies should target modifiable risk factors so that chronic kidney disease and its manifestations do not progress unabated.

The limitations include the weak generalizability due to the small size of the sample and the cross-sectional design that establishes a correlation only. Along with subjectivity in echogenicity assessment and exonerated confounding factor, there are other complications in data interpretation.

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