

Ultrasound Evaluation of Kidneys in Chronic Type II Diabetes

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ABSTRACT

To investigate whether a correlation was found with various clinical stages of the disease and sonographic findings by using Duplex Doppler Ultrasound. To assess whether increased renal vascular resistance in asymptomatic patients correlated with mild renal functional impairment. It is well known that the prevalence of type 2 diabetes is expanding its territory all over the world with no realms. The additional fact that increased toll of mortality due to cardiovascular diseases and end-stage renal diseases which has been profoundly correlated with the most prevalent disease condition is also encroaching an alarming state. In numbers, there were an estimated 422 million adults who were diagnosed with diabetes in the year 2014. Overall, none of the patients had acquired cystic kidney disease. In this study it was found that most of type 2 diabetic patients with Chronic Renal Failure had "small kidneys".

Key words: Diabetes, Ultrasound, Dyslipidaemia, Nephropathy

HOW TO CITE THIS ARTICLE: M Jayanth, V Chandrasekharm Prabakaran, Ultrasound Evaluation of Kidneys in Chronic Type II Diabetes, J Res Med Dent Sci, 2021, 9(6): 117-122

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Received: 03/04/2021
Accepted: 14/06/2021

INTRODUCTION

It is well known that the prevalence of type 2 diabetes is expanding its territory all over the world with no realms. The additional fact that increased toll of mortality due to cardiovascular diseases and end-stage renal diseases which has been profoundly correlated with the most prevalent disease condition is also encroaching an alarming state. In numbers, there were an estimated 422 million adults who were diagnosed with diabetes in the year 2014 which was four times higher than that in the 1980s 1,2. India well known as the diabetic capital has the largest proportion of diabetics in the general population pushing back China and United States to the second and third positions in the 21st century beginning. Currently there were 62 million of them burdening this country with the silent killer disease 3. Chronic kidney diseases with its correlates parallel to that of diabetes was affecting about 11 of the population of United States and globally the tally will be equivalent to more than 50 million people 4,5. The deadly correlation has been portrayed in one study wherein 45 of those who receive dialysis, diabetes remained a primer in to cause renal failure 6. Those with moderate to severe CKD were diabetic in about 23 of the patients 6,7. This is in addition to the condition poor prognosis for rehabilitation and survival in the diabetic and uraemic patients.

The proteinuria which occurs as a complication to diabetes which when follows the disappearance of glucosuria, the fatal outcome is mostly decisive. Micro-albuminuria is when albumin excretion rate is 20 -200 g per minute. When macro-albuminuria occurs (an excretion of 300 mg per day) patients are also prone for hypertension that will manifest itself. This further progresses to ESRF and this is also dependent on both genetic and environmental factors as well. This incipient progression can be recognized with the help of other laboratory tests like urinary albumin excretion (UAE), the upper limit of which is 30 mg per 24 hours or 20 g per day. Other factors like creatinine clearance, dyslipidaemia in addition to urinary tract infection, heart failure or fever has also to be evaluated as it may confound the results 8.

The Diabetes and Chronic Kidney Disease work group of the National Kidney Foundation Kidney Disease Outcomes Quality Initiative (KDOQI) has suggested that a diagnosis of CKD presumed to be caused by diabetes shall be referred as diabetic kidney disease or DKD and the term diabetic nephropathy shall be attributed to diabetes with histopathological injury that has been evidenced by renal biopsy 9. CKD, is defined as either kidney damage or decreased kidney function for 3 months 10. Staging of CKD has five levels grouped by kidney function as described by the estimated glomerular filtration rate (eGFR).

Despite the disparity of explicitness in the definitions for Diabetic Kidney Disease and its clinical and radiological correlations, this hospital based study was undertaken for identification of the role of Duplex Doppler Ultrasonography in detecting the disease prognosis, in

MATERIALS AND METHODS

The current study was Hospital-based comparative cross-sectional study.

Inclusion criteria

- Diabetics aged more than 18 years of age who give consent for the study.
- Biochemically diagnosed for nephropathy in cases group.

Exclusion criteria

- Any secondary causes or co-morbid conditions.
- Previously diagnosed renal anomalies and chronic renal diseases.
- Treated for any known renal pathology in last 1 year.

Study period

The data collection for the study was done between April 2017 to October 2018.

Study procedure

After obtaining the informed written consent, all the study participants were evaluated by detailed clinical history, physical and radiological examination.

Study tool

Real time gray scale ultrasound was performed with logic 3, LSD 30269WS5, General electric, USA system with 3.5 MH curve linear transducer with a wide 7 cm contact surface.

Statistical methods

Descriptive statistics: Descriptive analysis was carried out by mean and standard deviation (SD) as well as median and interquartile range (IQR) for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots.

Inferential statistics: The association between explanatory variables and Doppler findings was assessed by cross tabulation and comparison of percentages. Pearsons chi square test, Fishers exact test, one way ANOVA with post-hoc test of LSD were used to test for the statistical significance.

P value 0.05 was considered statistically significant.

IBM SPSS version 22 was used for statistical analysis.

Ethical considerations

Clearance was obtained from ethical committee of Sree Balaji Medical College, Chennai. Tamilnadu for the study, written and informed consent was sought from the patients and their attendants. They were given the option of quitting from study if so desired by them. No element of compulsion was exerted. All data was kept confidential.

RESULTS

The prospective observational study was conducted by following-up 120 diabetic subjects, grouped into controls (n30) patients and cases (n90) diagnosed to have diabetic nephropathy clinically and radiologically, attending to the department of Radiodiagnosis for evaluation and treatment. The mean age of the study participants was 56.4 10.8 years for controls and 58.7 11.5 years for cases. The age distribution is given in Table 1 and Figure 1.

Table 1: Age distribution of study subjects.

Groups	Age (in years)		p-value
	Mean	SD	
Controls (n30)	56.4	10.8	0.12
Cases (n90)	58.7	11.5	

Independent t-test used p-value 0.05 is significant.

The Table 2 and Figure 1 shows the categorization of age among the diabetic nephropathy group. It was found that, maximum of the patients were falling under 50-69 age groups (54.4) that was followed by persons aged 50 years (28.8) and only 2 persons belonged to age group 80 years. This difference in distribution was statistically

significant. Non parametric chi square equation was used giving 2 15.6 and associated p-value .001.

Table 2: Age categorization of the cases (Diabetic nephropathy).



Age categories (in years)	Frequency	Percentage	15.6	p-value
50	26	28.8		
50-69	49	54.4		
70-79	13	14.4		
80	2	2.2		
Total	90	100		

Non-parametric chi-square test used p-value.05 is significant.

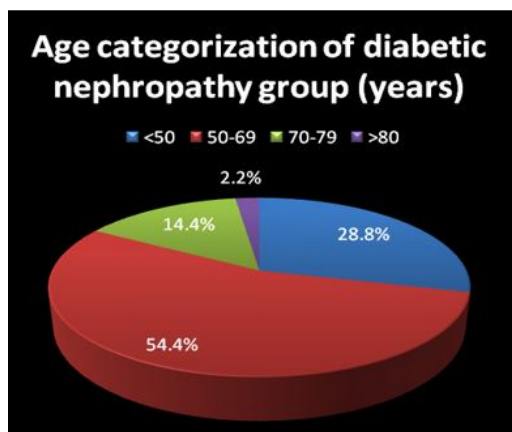


Figure 1: Shows the age categorization.

The median (50th percentile) renal length (inter- quartile range, i.e between 25th percentile and 75th percentile) fluctuated with values of 10.9 (10.8, 11.0), 11.9 (11.7, 12.0), 11.3 (11.1, 11.4), 11.0 (10.9, 11.1), 10.0 (9.9, 10.02) and 9.2 (9.12, 9.27) respectively among controls, group I, group II, group IIIA, group IIIB, group IIIC that have been included in this study.

The interpretation is that the length diminished while the disease was getting progressed and was projected. The median (50th percentile) renal length (inter- quartile range, i.e between 25th percentile and 75th percentile) fluctuated with values of 13.9 (13.8, 14.0), 15.0 (14.9, 15.1), 14.15 (15.0, 14.3), 13.5 (13.4, 13.67), 12.05

(11.9, 12.27) and 10.3 (10.22, 10.3) respectively among controls, group I, group II, group IIIA, group IIIB, group IIIC that have been included in this study.

The interpretation is that the renal parenchymal thickness diminishes as the disease was getting progressed and was projected in figure 4. Table 4 shows the distribution of renal parenchymal thickness between the groups of right kidney. The range, mean and standard deviations, median and inter-quartile range were displayed. The statistical analysis used here was one-way ANOVA with LSD post-hoc testing done. The mean and SD of controls, group I, group II, group IIIA, group IIIB, group IIIC were 14.6 .19, 15.5 .23, 15.03 v 21, 14.29 .20, 12.38 .13, 10.7 .09 millimeters respectively.

Their lengths ranged from 13.7 to 14.3, 14.0 to 15.3, 13.8 to 14.4, 13.2 to 14.3, 11.8 to 13.5 and 10.2 to 10.4 among the controls, group I, group II, group IIIA, group IIIB, group IIIC respectively. proportion of subjects in RI 0.70

group was higher in diabetic nephropathy group IIIA, group IIIB, group IIIC than the RI 0.70 group and the values are as follows, 75.0 vs 25.0, 78.6 vs 21.4, 100.0 vs 0.0 respectively. The difference in proportion was found to be statistically significant.(p. 001) (Figure 2 to Figure 8 and Table 3).

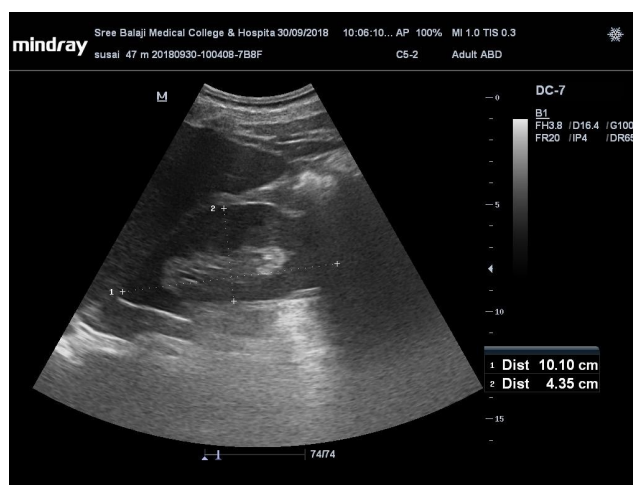


Figure 2: Shows ultrasound image of the measurement of right kidney length.

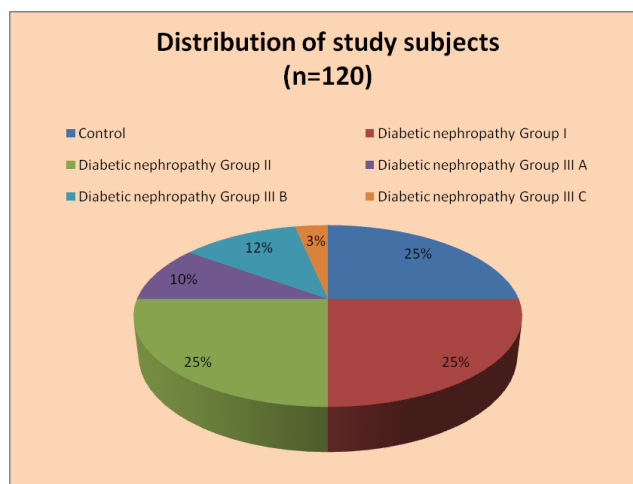


Figure 3: General distribution of study subjects.



Figure 4: Shows reduced kidney size, suggestive of chronic renal disease.

Figure 6: Comparison of left renal parenchymal thickness.

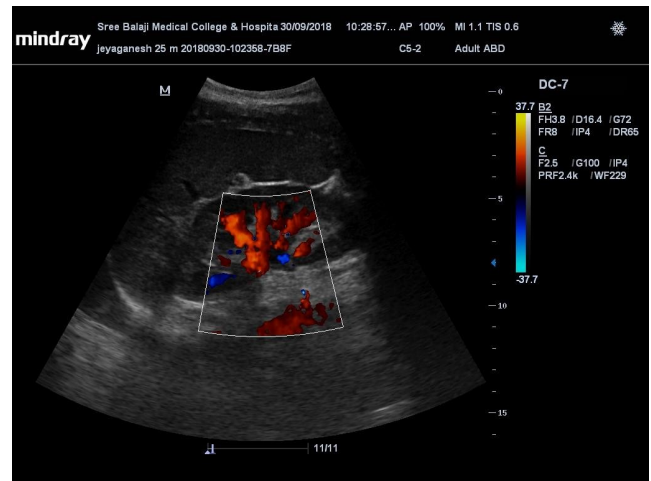


Figure 7: Show colour doppler study of the kidneys with measurement of resistive index.

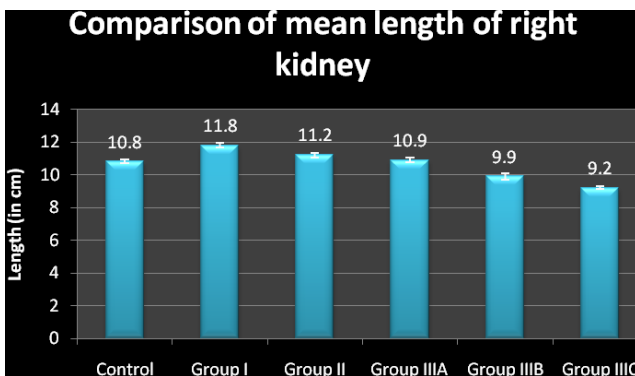


Figure 5: Distribution of renal length between the groups of right kidney (in cm).

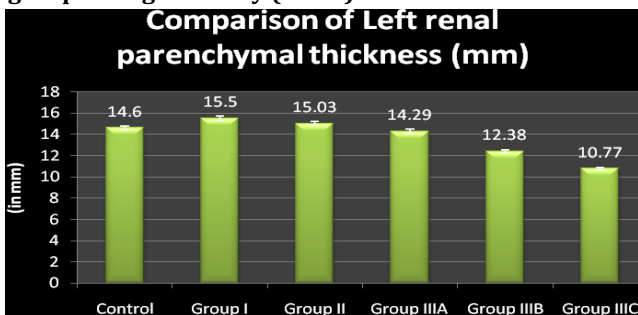
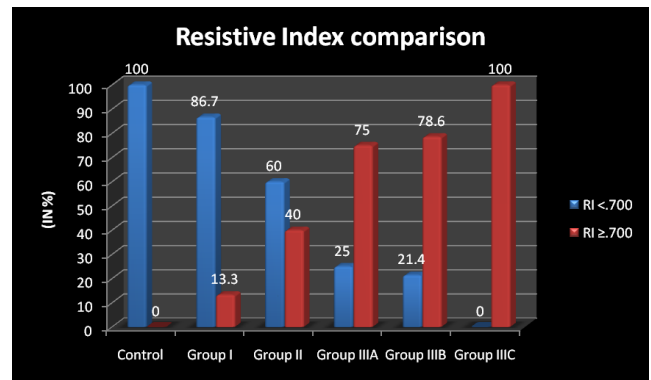


Figure 8: Resistive Index comparison taking 0.70 as cut-off.

Table 3: Distribution of Renal parenchymal thickness for Right Kidney (in mm).

Groups	Min	Max	Mean	SD	Median	IQ Range
Control	13.7	14.3	13.9	0.17	13.9	13.8, 14
Diabetic nephropathy Group I	14	15.3	14.9	0.3	15	14.9, 15.1
Diabetic nephropathy Group II	13.8	14.4	14.1	0.28	14.15	15.0, 14.3
Diabetic nephropathy Group III A	13.2	14.3	13.5	0.23	13.5	13.4, 13.67
Diabetic nephropathy Group III B	11.8	13.5	12.2	0.47	12.05	11.9, 12.27
Diabetic nephropathy rroup	.	.	.3	.	.3	. . .3

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DISCUSSION

In kidney diseases, ultrasonography is used as a first-line imaging technique, and its role in medical nephropathy is to exclude urological pathologies, to differentiate between acute and chronic renal failure, to follow-up on the course of a disease, to guide needle biopsy, etc. Our study has overall portrayed the utility of ultrasonography in diagnosing DKD and its clinical relevance 14,15. The mean age of the study participants was 56.4 10.8 years for controls and 58.7 11.5 years for cases. The age group of controls and cases were not significantly differing from each other. The age group of our study participants were comparable with the Sudanese diabetic patients between the mean of ages was 57.6 years 13. This was relatively low when compared to study from okoyama et al. 16 where the mean age was 73 years. It was found that, maximum of the patients were falling under 50 -69 age groups (54.4) that was followed by persons aged 50 years (28.8) and only 2 persons belonged to age group 80 years.

The right kidney, the mean length (centimeters) and SD of controls, group I, group II, group IIIA, group IIIB, group IIIC were 10.8 .11, 11.8 .14, 11.2 .15, 10.9 .15, 9.9 .18, 9.2 .08 respectively. Their lengths ranged from 10.7 to 11.1, 11.6 to 12.1, 10.9 to 11.5, 10.7 to 11.2, 9.8 to 10.1 and 9.1 to 9.3 among the controls, group I, group II, group IIIA, group IIIB, group IIIC respectively. The median (50th percentile) renal length (inter-quartile range, i.e between 25th percentile and 75th percentile) fluctuated with values of 10.9 (10.8, 11.0), 11.9 (11.7, 12.0), 11.3 (11.1, 11.4), 11.0 (10.9, 11.1), 10.0 (9.9, 10.02) and 9.2 (9.12, 9.27) respectively among controls, group I, group II, group IIIA, group IIIB, group IIIC that have been included in this study.

The mean kidney length was (14.5 cm) was higher in diabetic patients of one study 17, which is contrary to that of our study subjects. This might be explained due to that there are differences in ethnicity between the groups as well as the duration of diabetes that will be differing in both the groups. Having most of the studies, dealing the renal length with progression of the disease, there was an interesting study which correlated the length with the type of diabetes which found was a significantly higher proportion of larger kidneys (11 cm or more) in the IDDM group than in the NIDDM group 18. Even they postulated that the mean length of kidneys were inversely related to the serum creatinine levels as was the correlation observed in our study.

The renal parenchymal thickness between the groups of left kidney was evaluated. The range, mean and standard deviations, median and inter-quartile range were decimated. The mean and SD of controls, group I, group II, group IIIA, group IIIB, group IIIC were 14.6 .19, 15.5

.23, 15.03 .21, 14.29 0.20, 12.38 0.13, 10.7 0.09 millimeters

Respectively. Their parenchymal thickness ranged from 13.7 to 14.3, 14.0 to 15.3, 13.8 to 14.4, 13.2 to 14.3, 11.8 to 13.5 and 10.2 to 10.4 among the controls, group I, group II, group IIIA, group IIIB, group IIIC respectively. The median (50th percentile) parenchymal thickness (inter-quartile range, i.e between 25th percentile and 75th percentile) fluctuated with values of 14.6 (14.5, 14.72), 15.6(15.4,15.7), 15.0 (14.9, 15.2), 14.25 (14.12, 14.47), 12.4 (12.3, 12.5) and 10.75 (10.7, 10.87) respectively among controls, group I, group II, group IIIA, group IIIB, group IIIC that have been included in this study.

In addition to it, there were significantly high correlations of RI with the proteinuria 19. Supporting this, Shirin M et al. 20 have observed a positive correlation between resistive index with serum creatinine (r=0.581, p=0.01) and albuminuria (r=0.725, p=0.01). The median RI was found to be less than 0.70 in the control group, group I and group II. The values raised 0.70 in the group III and the subgroup findings showed, the higher resistive index in group IIIC which was 0.80 and was comparable between group IIIA and group IIIB with the former group having slightly higher values than the later. The advancement of the disease would raise the resistance of the renal arteries being supplied. On the resistive index values, the subjects were compared for RI 0.70 and RI 0.70 and fisher's exact test was used to find if there were any statistically significant difference between the groups. It was found that the proportion of RI 0.70 was higher in the controls, group I and group II against the RI 0.70 group with the values as follows, 100.0 vs 0.0, 86.7 vs 13.3, 60.0 vs 40.0 respectively. Contrarily, the proportion of subjects in RI 0.70 group was higher in diabetic nephropathy group IIIA, group IIIB, group IIIC than the RI 0.70 group and the values are as follows, 75.0 vs 25.0, 78.6 vs 21.4, 100.0 vs 0.0 respectively.

The difference in proportion was found to be statistically significant (p=0.001) In concurrence with this, Soldo et al. 21 have also proposed that Resistive indices correlated well with renal function, and pathologic values were observed in 15 in the asymptomatic group and in 87 in the group with advanced nephropathy. Sari et al. 22 in a study have compared the renal arterial RI of the diabetics (0.79/-0.07) with the healthy persons and have found a significantly higher resistive index in diabetics than the healthy individuals (0.61/-0.04) that was also similar to the results of another study 23.

CONCLUSION

Ultrasonographic evaluation of the kidney size is a useful method for assessment of the progression and in some

FUNDING

No funding sources.

ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

The encouragement and support from Bharath University, Chennai is gratefully acknowledged. For provided the laboratory facilities to carry out the research work.

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