

Assessment of renal parenchymal diseases in diabetes mellitus by color doppler study of intrarenal vessels in DMCH

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Abstract

Colour Doppler study of intra-renal vessels for assessment of renal parenchymal changes and change in intra-renal vascular structures in early nephropathy due to diabetes mellitus. Colour Doppler study of intra-renal vessels in late stages of diabetes nephropathy with or without change in renal size or parenchymal echogenicity. Early detection of patient at risk before irreversible renal disease who are recommended medical treatment. To come for a conclusion whether intra-renal Doppler changes can be diagnosed earlier than biochemical changes.

Key Words: renal parenchymal diseases, diabetes mellitus, color doppler.

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Received Date: 03/01/2017 Revised Date: 29/01/2017 Accepted Date: 10/02/2017

Access this article online	
Quick Response Code:	Website: www.medpulse.in
	DOI: 03 June 2017

INTRODUCTION

Diabetes mellitus is caused by decreased insulin secretion or action. It leads to hyperglycemia and affects carbohydrate, protein and fat metabolism. The main identifying feature of diabetes mellitus is chronic and substantial elevation of blood glucose level. Diabetes affects the kidneys primarily through vascular changes. Diabetic nephropathy is a relatively common micro-vascular complications of both insulin dependent (IDDM) and non-insulin dependent (NIDDM) diabetes mellitus. Diabetic nephropathy involves two distinct pathologic patterns that may or may not coexist: Diffuse and Nodular glomerulosclerosis. The appearance of diabetic kidney on gray scale ultrasound is inconsistent, with variable change in size and reflectivity as the disease progresses. However changes in Doppler indices e.g., increased RI (Resistive

Index) of intra renal arteries (more than 0.7 is diagnostic of nephropathy) could be detected by Doppler study in early stages of nephropathy. So RI of renal vessels is more useful than increased parenchymal echogenicity of gray scale USG.

MATERIAL AND METHODS

The study was performed in Department of Radiodiagnosis DMCH. 100 patients were selected from indoor medical and surgical wards and diabetic clinic and other outpatient departments of DMCH. 12 controls were selected from medical and surgical OPD. All the patient selected in these study had fulfilled the following selection criteria: Diabetic patients having

- Microalbuminuria
- Macroalbuminuria
- Normal or increased serum creatinine

Exclusion Criteria

Diabetic patients without the above criteria were excluded from this study. All the controls had satisfied the below

Inclusion Criteria

- Normal blood sugar
- Normal serum creatinine
- Normal Albuminuria

Patients satisfying the above criteria were selected for this study and subjected to a protocol which included history, laboratory examination, ultrasonographic examination of

kidneys. History was taken for age and sex of the patient, any diabetic symptoms, presence or absence of other renal disease for exclusion. Investigations like blood sugar (fasting and post-prandial), blood urea, serum creatinine, quantitative assessment of 24 hour urinary protein. Sonographic examination was done after bowel gas preparation. Ultrasound machine of GE P3 with 5 Mhz convex transducer and 5 to 10 Mhz linear transducer with colour Doppler. B-mode technique was done:

1. To evaluate the anatomical location of kidney
2. To evaluate size of kidney
3. To evaluate parenchymal echogenicity of kidney
4. To evaluate cortico-medullary junction

Pulse Doppler technique

Pulse Doppler sample volume was placed at the level of arcuate/intra-lobar arteries and Doppler wave-form assessed for measuring resistive index. Spectral wave-form of intra-renal arteries was taken.

Examination Protocol

After taking proper patients history B-mode images were taken in supine and lateral left and right decubitus position. Kidneys were examined in longitudinal and axial plane from upper pole to lower pole with 5Mhz curvilinear transducer. Kidney size parenchymal echogenicity and corticomedullary differentiation were assessed. Finding in b-mode image of each kidney were recorded and any incidental findings were also noted. Colour Doppler method was performed with 5MHZ curvilinear transducer. Doppler signals of intra-renal arteries were taken at the level of upper, mid and lower polar region and spectral waver-forms were recorded. Resistive index of spectral waveforms were recorded and mean of these three values were calculated.

Documentation

Documentation of RI changes and gray-scale findings of kidney.

1. Mean RI was calculated from RI of upper mid and lower region.
2. Kidney size
3. Parenchymal echogenicity
4. Corticomedullary differentiation

Diagnostic criteria of ultrasonography:

1. Adult RI value greater than 0.7
2. Increased parenchymal echogenicity
3. Alteration of cortico-medullary differentiation
4. Decreased kidney size

RESULT AND ANALYSIS

This is a retrospective study of 100 cases by sonographic examination using both colour Doppler and grayscale display of diabetic kidneys in DMCH Darbhanga. 100 adult diabetic patients with early nephropathy and late nephropathy and 12 control group having age and sex

matched with the patient group from the diabetic clinic medical and surgical OPD and indoor wards. Patients were divided into groups. Group 1 composed of 41 treatment controlled and uncontrolled patients. There were 15 females and 26 males in the group. All the patients manifested microalbuminuria but normal serum creatinine. Group 2 composed of 14 treatment controlled and uncontrolled patients, 4 females and 10 males, with macroalbuminuria but normal serum creatinine. Group 3 composed of 45 patients 18 females and 27 males. Macroalbuminuria and raised serum creatinine were present in these patients. The RI values greater than 0.7 were observed in 180 kidneys out of 200 diabetic kidneys and less than 0.7 in rest of the kidneys. In non-diabetic control group RI value of greater than 0.7 was observed in 1 kidney and less than 0.7 in 23 kidneys. The sensitivity was 90% and specificity was 95.8%. The RI value in diabetic group was found to be significantly higher while serum creatinine value >1.2. The mean RI was shown to have higher values in patients with early diabetic nephropathy compared to controls. So duplex Doppler sonography may be useful test in the evaluation of diabetic nephropathy even in early stages.

Table 1: Distribution of sex in control and patient groups

Control group
F=6
M=6
Total=12
Normal albuminuria
Normal serum creatinine

Table 2:

Diabetic patient group		
Group I	Group II	Group III
F= 15	F=4	F=18
M=26	M=10	M=27
Total=41	Total= 14	Total=45
Microalbuminuria with normal serum creatinin	Macroalbuminuria with normal serum creatinine	Macroalbuminuria with raised serum creatinine

Table 3: Control vs diabetic nephropathy comparison of age ri and serum creatinine

		Mean	SD	SE
Age	Control	49.6	8.40	2.42
	Diabetic	53.2	7.96	.79
RI	Control	.61	.03	.011
	Diabetic	.76	.05	.005
S. creatinine	Control	.81	.15	.04
	Diabetic	1.48	.8	.08

Table 4: Distribution of sensitivity and specificity of RI in control and diabetic groups

Results RI	Diabetic Nephropathy	Control patients kidney
Pos RI increased	180 (true pos)	1
Neg RI normal	20 (false neg)	23 (true neg)

Table 5: Control VS early diabetic nephropathy comparison of RI

		Mean	SD	SE
AGE	Control group	49.6	8.4	2.42
	Early nephropathy group	54.19	9.7	1.52
RI	Control group	.61	.03	.011
	Early nephropathy group	.74	.04	.006

DISCUSSION

Diabetes mellitus is a serious metabolic disease so early detection and metabolic control are of prime importance to reduce complication. In present study we tried to find out role of USG in diagnosis of diabetes mellitus for appropriate patient management. We had selected 100 diabetic patients with early and late nephropathy for present study. The role of duplex Doppler sonography and gray scale imaging in diagnosis of both early and late diabetic nephropathy were studied. The parenchymal changes included glomerular, tubule-interstitial or arteriolar change. The mean of 3 bilateral renal RI value of each patient was calculated and any abnormal parenchymal echogenicity and altered corticomedullary differentiation of patient's kidney were noted. The RI and gray scale parameters were compared with biochemical parameter using analytical studies and alimentary statistical method. The RI of control and all patient groups was calculated and the sensitivity and specificity of US diagnosis for RI of intra-renal arteries were found to be 90% and 95.8% respectively. 94% nephrological RI values were observed in the group with advanced nephropathy. The relationship between RI of intra-renal arteries and serum creatinine had been studied in 200 of 100 diabetic patient and 24 kidneys of 12 controls. The mean RI of control and diabetic group were 0.61±0.03 (SD) and 0.76±0.05 (SD) respectively. 12 controls and 41 patients with early diabetic patients were evaluated with duplex sonography. The mean RI of control and early

diabetic group were 0.61±0.03 (SD) and 0.74±0.04 (SD) respectively. We compared mean serum creatinine of patient with normal renal parenchymal echogenicity with that of patient with increased renal parenchymal echogenicity. Soldo D *et al* also noted renal parenchymal hyper-echogenicity in advanced stage of diabetic nephropathy. The RI was positively and significantly correlated with serum creatinine for different group of diabetic nephropathy. Platt JF *et al* also observed that intra-renal RI was highly correlated with serum creatinine level.

CONCLUSION

Duplex Doppler sonography and gray scale imaging became an important complementary role to renal biopsy and scintigraphy. However we can conclude the following from this study

- Biochemical changes are significantly correlated with duplex Doppler sonography of intra-renal arteries.
- Intra-renal duplex Doppler changes are seen in both early and late nephropathy
- The intra-renal Doppler changes can be diagnosed earlier than the biochemical changes.
- Both duplex Doppler and gray scale sonography may be helpful in evaluation of renal functional status with diabetic renal disease.

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Source of Support: None Declared
Conflict of Interest: None Declared