

INTRARENAL HAEMODYNAMIC IN TYPE 2 DIABETICS MELLITUS AND ITS CORRELATION WITH BIOCHEMICAL PARAMETERSC. L. Thukral¹, Meenakshi Aggarwal², S. B. Nayyar³**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: AIMS & OBJECTIVES: The evaluation of resistance index of interlobar artery on Color Doppler imaging in type 2 diabetes mellitus patients and comparison with healthy controls and the Correlation among Colour Doppler sonographic findings and biochemical parameters in type 2 diabetic patients. **MATERIALS AND METHODS:** 200 patients with type 2 diabetes mellitus and 30 healthy controls were included in this study. The resistive index of interlobar renal arteries was used to assess the internal haemodynamic changes in diabetic patients as compared to normal subjects. **RESULTS:** The patients were divided into four groups: Group I: consisted of patients with 24 hour urinary protein less than 30 mg per ml; Group II: 30 to 300 mg per ml, Group III: more than 300 mg per ml and Group IV: serum creatinine more than or equal to 1.5mg per dl. The mean of intrarenal RI value was 0.66 ± 0.21 in controls, 0.69 ± 0.42 in group I, 0.72 ± 0.24 in group II, 0.76 ± 0.34 in group III and 0.84 ± 0.35 in group IV. RI values in group II, III and IV were significantly higher than those in controls ($p < 0.001$). And those in group IV were significantly higher than those in group I, II and III. Also, there was a significant effect of duration of diabetes on intra renal hemodynamics with mean RI value 0.72 ± 0.43 in patients with diabetes of less than 10 year duration and mean RI value of 0.78 ± 0.34 in patients with diabetes more than 10 year duration. **CONCLUSION:** Type 2 diabetic patients have higher values of RI as compared to non-diabetics and this increment is proportional to the duration of diabetes. An intra renal RI value of >0.7 identifies diabetic patients at risk of progressive renal disease. Higher RI correlates to higher protein in urine and duration of diabetes in diabetic patients. **KEYWORDS:** Diabetes Mellitus, Resistance Index.

INTRODUCTION: Diabetes has emerged as one of the major health care problems in India. According to the Diabetes atlas published by the International Diabetes Federation (IDF), there were estimated 40.7 million persons with diabetes in India in 2007 and this number is predicted to rise to almost 60.9 million by 2025. It is also known that almost 50% of the people with diabetes remain undetected and some may even present with microvascular and macrovascular complications at the time of diagnosis.¹

Assuming that 40 million people in India have Diabetes, this translates to 0.8 million with nephropathy. Thus the burden due nephropathy is very high in India due to sheer number of people with diabetes. Diabetic nephropathy is a progressive kidney disease caused by angiopathy of capillaries in the kidney glomeruli, characterised by albuminuria which progresses from normal albuminuria to microalbuminuria to macroalbuminuria ultimately leading to End Stage Renal Disease.²

Intrarenal resistivity index (IRI) is a measure of the hemodynamic changes in the intra-renal arteries. In diabetic nephropathy, changes in the compliance of the vessels and the resistance of the vessels affect the resistivity index. Hence, early changes in blood flow are picked up by renal Doppler and they reflect the progression of diabetic nephropathy.²

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Hence this study was undertaken to study the role of intrarenal resistance index in type 2 diabetic patients and to study its correlation with parameters of renal dysfunction.

MATERIAL AND METHODS: 200 type 2 diabetic patients and 30 age and sex matched controls, attending outdoor patients department or admitted to Sri Guru Ram Das Charitable Hospital attached to Sri Guru Ram Das Institute of Medical Sciences and Research, Sri Amritsar and referred to the Department of Radiodiagnosis and Imaging were included in the study. Patients below the age of 20 years, cardiac failure, microscopic or macroscopic haematuria, with conventional B mode ultrasound findings of obstructive uropathy, unilateral or bilateral contracted kidneys, congenital anomalous kidney and renal masses were excluded from the study. All of the patients were examined by means of color Doppler Imaging with a 1 to 5 -MHz convex transducer on equipment voluson E8 Expert BT09 of WIPRO GE Healthcare Pvt. Ltd. Three different measurements were obtained from interlobar arteries from each kidney in its upper, middle and lower poles. RI was determined as follows-RI=(PSV-EDV)/PSV. M±SD of RI in three poles of each kidney were taken and compared with healthy controls. Values of RI higher than 0.7 were considered pathological. Haemoglobin (HB), total leukocyte count (TLC) differential leukocyte count (DLC), urine complete examination, fasting blood sugar(FBS), blood urea nitrogen(BUN), serum creatinine(SC), 24 hour urinary protein and HbA_{1c} were done in all the patients. The results were statistically analyzed.

RESULTS: The patients were divided into four groups according to staging of diabetic nephropathy by American diabetic association: group I consisted of patients with urinary albumin excretion <30mg/ml (N=66), group II with urinary albumin excretion 30-300mg/ml (N=47), group III with urinary albumin excretion >300mg/ml (N=41) and group IV with serum creatinine>1.4mg/dl(N=46). These groups consisted of 33%, 23.5%, 20.5% and 23% patients respectively. The study group comprised 109(54.5%) females and 91(45.5%) males. Sex matched controls were taken with control group comprised of 16(53.3%) females and 14(46.7%) males. The analysis of age distribution in the present study showed that mean age in various groups I, II, III and IV were 51.9±14.159 S.D, 59.50±13.15 S.D, 52±13.5 S.D and 65.2±12.63 S.D respectively. 30 age matched controls were also included in the study with mean age 55.37±14.185. A positive correlation was found between age and resistance index with R value 0.643 and p value 0.001.

The mean resistance index in study group was 0.76±0.046 which was significantly higher than the mean resistance index in control group which was 0.63±0.27 (p value <0.0002).The mean resistance index in group I, II, III, IV was 0.70, 0.74, 0.78 and 0.82 respectively. A progressive increase in intra-renal resistance index value was noted with progression of diabetic renal disease, which was found to be statistically significant (p value<<0.0001). The mean duration of diabetes mellitus in group I, II, III, IV was 8.34 years, 9.65 years, 11.1 years and 15.2 years respectively. A direct correlation was found with duration of diabetes and intrarenal resistance index (R=0.804, p <0.001). Mean SC in group I, II, III and IV was .75mg/dl, .81mg/dl, .95mg/dl and 2.7mg/dl respectively. A positive correlation was found between serum creatinine and intrarenal resistance index with R value 0.538 and p value 0.001. No correlation was found between intrarenal resistance index with blood urea nitrogen, HbA_{1c} and fasting blood sugar.

DISCUSSION: Mean age in various groups I, II, III and IV were 51.95±14.159 S.D, 59.50±13.15 S.D, 52±13.5 S.D and 65.2±12.63 S.D respectively. We found a positive correlation between age and

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resistance index with R value 0.643 and p value 0.001. Ishimura et al³ in his study also found that as age increased, intrarenal resistive index increased.

Mean resistance index in the study group (0.76±0.046) was significantly higher than the mean resistive index in the control group (0.63±0.27) (p value <0.0002). Ishimura et al³ and Zwain et al⁴ also found a statistically significant difference between the resistive index of type 2 diabetic patients and control group. 39.3% (n=26) of the patients in group I had raised RI value. Padman et al⁵ observed that 10% of patients with no albuminuria showed raised intrarenal resistive index (>0.7). They observed that renal interlobar artery Doppler evaluation is sensitive to detect the early diabetic renal involvement, and rarely the Doppler study is seen to have an edge over the urine microalbuminuria assessment. The variation in percentage in this study is due to variation in sample size.

A progressive increase in intra-renal resistance index value was noted with progression of diabetic renal disease, which was found to be statistically significant (p value – 0.0001). Ishimura et al³ showed that RI values in group IV patients were significantly higher than those in group I, II and III. (p<0.0001). Fallah et al⁶ showed that the difference between groups with no albuminuria (mean RI 0.67), microalbuminuria (mean 0.71) and macroalbuminuria was statistically significant (p value <0.001). Ghadirpour et al⁷ showed that there was a progressive increase in RI values with increase in albumin in urine. The results of present study are consistent with their studies.

A direct correlation was found with duration of diabetes and intrarenal resistance index (R=0.804, p <0.001). Raut et al² in their study showed that mean duration of diabetes mellitus patients with intra-renal RI>0.7 was significantly higher as compared to those with normal intrarenal RI. Maja et al⁸ in their study showed that mean duration of diabetes was 4.4±4 years in patients with RI <0.68 and was 29.2±6.5 years in patients with RI equal to or more than 0.68. The results being consistent with the present study.

We found no correlation between fasting blood sugar and intra renal resistive index with R value 0.267 and p value 0.852(>0.005). Ishimura et al³ and Raut et al² also found no correlation between fasting blood sugar and intra renal resistance index.

We found a positive correlation between serum creatinine and intrarenal resistance index with R value 0.538 and p value 0.001. Ishimura et al³ also found a positive correlation between serum creatinine and intrarenal resistance index with p value <0.005. Similarly Platt et al⁹ in their study also observed that patients with intrarenal resistive index more than 0.7 had a mean serum creatinine of 3.2mg/dl as compared to that of 1.1 mg/dl in patients with intrarenal resistive index <0.7.

No correlation was found between HbA_{1c} and intra renal resistive index with R value 0.107 and p value 0.572(>0.005). Ishimura et al³ in their study observed that mean HbA_{1c} in groups I,II,III and IV was 10.2%, 9.9%, 9.3% and 6.8% respectively. No correlation was found between HbA_{1c} and intrarenal resistive index with p value 0.20406.

CONCLUSION: The study concludes that raised intrarenal resistive index identifies diabetic patients at risk of diabetic renal disease. RI of interlobar arteries seems to be a dependable marker of internal changes and can be used as a noninvasive, easily available parameter for the detection and evolution of diabetic nephropathy. Intrarenal resistance resistive index can be of value in detecting early diabetic nephropathy even before albumin is present in the urine. Renal Doppler is a non-invasive modality that can be used in association with biochemical parameters in the follow up of patients with diabetic nephropathy.

Thus, an increasing intra-renal resistance index value could prompt the physician to a more tight control of blood sugars and hypertension in the group of diabetic patients, delaying the progression to end stage renal failure.

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Fig. 1: Spectral waveform and resistance index recorded from interlobar artery of middle pole of right kidney in a group II patient shows a raised intrarenal resistive index of 0.72.

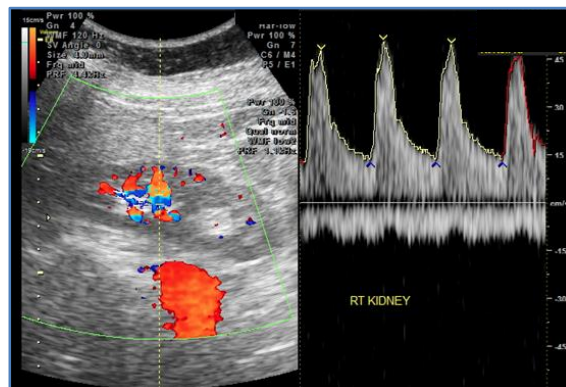


Fig. 1

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Fig. 2: Spectral waveform and resistance index recorded from interlobar artery of lower pole of left kidney in a group IV patient shows raised intrarenal resistive index of 0.80.

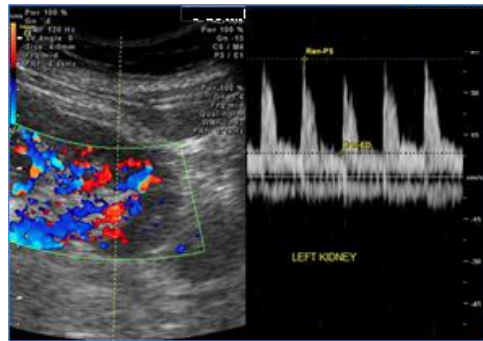


Fig. 2

Fig. 3: Spectral waveform and resistance index recorded from interlobar artery of middle pole of left kidney in a group IV patient shows a raised intrarenal resistive index of 0.85.

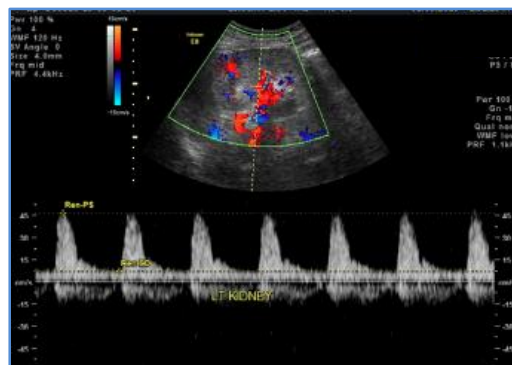


Fig. 3

Fig. 4: Spectral waveform and resistance index recorded from interlobar artery of middle pole of left kidney in a control subject shows normal intrarenal resistive index of 0.65.

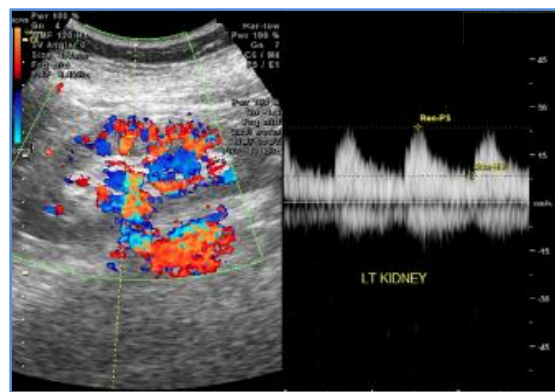


Fig. 4

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GROUP	N	MEAN	S.D.	MINIMUM	MAXIMUM	P VALUE
I	66	0.7	.0120	0.65	0.73	<0.0001
II	47	0.74	.0130	0.66	0.77	
III	41	0.78	.0206	0.68	0.82	
IV	46	0.82	.0400	0.67	0.84	
TOTAL	200	0.76	.0467	0.65	0.84	

TABLE 1: MEAN RESISTANCE INDEX IN STUDY GROUP

GROUP	N	MEAN	S.D.	MINIMUM	MAXIMUM	P VALUE
STUDY	200	0.74	0.0467	0.65	0.84	<0.0002
CONTROL	30	0.63	0.027	0.55	0.67	

TABLE 2: COMPARISON OF MEAN RESISTANCE INDEX BETWEEN STUDY AND CONTROL GROUP

GROUP	RESISTANCE INDEX		TOTAL
	NORMAL (<0.7)	HIGH (>0.7)	
I	40 60.6%	26 39.3%	66 100%
II	17 36.1%	30 63.8%	47 100%
III	11 26.8%	30 73.1%	41 100%
IV	8 17.3%	38 82.6%	46 100%
TOTAL	76 38%	124 62%	

TABLE 3: RELATIVE PERCENTAGES OF NORMAL AND HIGH RESISTIVITY VALUES IN STUDY GROUPS

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