Original Article

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Assessment of Renal Arterial Resistive Index in Type 2 Diabetic Nephropathy Patients

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Abstract

Background: To assess renal arterial resistive index in type 2 diabetic nephropathy patients. **Subjects and Methods:** One hundred thirty type II diabetes mellitus patients with the diabetic nephropathy were selected and parameters such as blood pressure, glycosylated hemoglobin, serum creatinine, albuminuria, and 24-hour urine were recorded. Intrarenal resistive index was measured. **Results:** Stage 1 diabetic nephropathy comprises of 36 patients, stage 2 had 24, stage 3 had 52 and stage 4 had 18 patients. The difference was non- significant (P> 0.05). The mean systolic blood pressure (SBP) in stage 1 was 134.2 mm Hg and diastolic blood pressure (DBP) was 64.8 mm Hg, in stage 2 was 122.6 mm Hg and DBP was 62.4 mm Hg, in stage 3 was 140.8 mm Hg and DBP was 72.0 mm Hg and in stage 4 was 156.2 mm Hg and DBP was 94.6 mm Hg. The difference was significant (P<0.05). The mean RI in stage 1 patients was 0.61±0.02, in stage 2 was 0.68±0.04, in stage 3 was 0.74±0.05 and in stage 4 was 0.87±0.03. The difference was significant (P<0.05). There was positive correlation of RI with SBP (r- 0.52, p- 0.05), GFR (r- -0.02, p- 0.001) and albumin excreted in 24 hours urine (r- 0..03, p- 0.04). **Conclusion:** Increased systolic blood pressure, albumin excretion and severity of disease were capable of increasing RI values in diabetic nephropathy patients.

Keywords: Diabetes mellitus, chronic kidney disease, albumin, systolic blood pressure.

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Introduction

Diabetes mellitus is a group of metabolic diseases consisting of hyperglycaemia due to defects in insulin secretion, insulin action, or both. The long- term chronic hyperglycaemia is linked with damage, dysfunction, and failure of various organs such as kidney.[1] Chronic kidney disease (CKD) is characterized by pathophysiologic processes that are associated with impaired renal function. CKD is thought to be linked with cardiovascular morbidity and mortality. There are various risk factors such as hypertension, type II diabetes mellitus, autoimmune diseases, high age, race, family history of kidney disease, history of acute renal failure and abnormal kidney structure and urinary tract.[2]

It has been found that approximately 20-40% of type 1 and type 2 diabetes have renal involvement.[4] Such patients that progress to frank diabetic nephropathy are called progressors.[3]

Chronic kidney disease is classified based on the eGFR and the level of proteinuria and helps to risk stratify patients. Patients are classified as G1-G5, based on the eGFR. Classification of chronic kidney disease using GFR and ACR categories are as G1 is considered as eGFR ≥90 (ml/min/1.73m^2) (Normal and High), G2 is considered as eGFR 60-89 (ml/min/1.73m^2) (Mild Reduction), G3a is considered as eGFR 45-59 (ml/min/1.73m^2) (Mild-Moderate), G3b is considered as eGFR 30-44 (ml/min/1.73m^2) (Moderate-Severe), G4 is considered as eGFR 15-29 (ml/min/1.73m^2) (Severe Reduction) and G5 is considered as eGFR <15 (ml/min/1.73m^2) (Kidney Failure).[4]

Renal resistive index (RI) is a duplex ultrasound-derived parameter for exhibiting the arterial waveform, where RI is capable of demonstrating dynamic or structural changes of intrarenal vessels and renal dysfunction, and is markedly associated with renal arteriolosclerosis, and adverse cardiovascular events.[5] Patients with diabetes mellitus tend to have significantly higher RI than patients without diabetes mellitus.[6] Considering this we attempted this study to assess renal arterial resistive index in type 2 diabetic nephropathy patients.

Subjects and Methods

One hundred thirty type II diabetes mellitus patients with the diabetic nephropathy were selected for the study. Inclusion criteria was subjects with diabetes mellitus with evidence of reduced renal function irrespective of control of blood sugar, subjects with diabetic nephropathy with stage G1-G5. Exclusion criteria was subjects with known history of renal disease, subject with a single kidney and subjects with a history of renal ultrasound features suggestive of urinary

tract abnormalities.

The study was initiated after obtaining approval from ethical review committee of the institute and valid written consent of all subjects. A thorough clinical and systemic examination was performed. Parameters such as blood pressure (systolic and diastolic), glycosylated hemoglobin, serum creatinine, albuminuria, and 24-hour urine were recorded. Each patient was referred to an ultrasound unit and the value of intrarenal resistive index was measured in 3 poles (upper-middle-lower). The mean in the 3 poles was recorded. The results were compiled and subjected for statistical analysis using Mann Whitney U test. P value less than 0.05 was set significant.

Results

Out of 130 patients, males comprised of 70 (53.8%) and females 60 (46.2%) [Table 1]

Table 1: Patients distribution

Total- 130		
Gender	**Male**	**Female**
Number (%)	70 (53.8%)	60 (46.2%)

Table 2: Stages of diabetic nephropathy

Stages	Number	P value
1	36	0.18
2	24	
3	52	
4	18	

Stage 1 diabetic nephropathy comprises of 36 patients, stage 2 had 24, stage 3 had 52 and stage 4 had 18 patients. The difference was non- significant (P> 0.05) [Table 2].

Table 3: Assessment of blood pressure based on stages of diabetic nephropathy

Stages	SBP (mm Hg)	DBP (mm Hg)
1	134.2	64.8
2	122.6	62.4
3	140.8	72.0
4	156.2	94.6

The mean systolic blood pressure (SBP) in stage 1 was 134.2 mm Hg and diastolic blood pressure (DBP) was 64.8 mm Hg, in stage 2 was 122.6 mm Hg and DBP was 62.4 mm Hg, in stage 3 was 140.8 mm Hg and DBP was 72.0 mm Hg and in stage 4 was 156.2 mm Hg and DBP was 94.6 mm Hg. The difference was significant (P<0.05) [Table 3].

Table 4: Assessment of RI in different stages of diabetic nephropathy

Stages	Mean± SD	P value
1	0.61±0.02	0.02
2	0.68±0.04	
3	0.74±0.05	
4	0.87±0.03	

The mean RI in stage 1 patients was 0.61±0.02, in stage 2 was 0.68±0.04, in stage 3 was 0.74±0.05 and in stage 4 was 0.87±0.03. The difference was significant (P<0.05) [Table 4].

Table 5: Relationship between variables with RI

Parameters	R value	P value
SBP	0.52	0.05
DBP	0.34	0.48
HbA1C	0.54	0.45
GFR	-0.02	0.001
Albumin excreted in 24 hours urine	0.03	0.04

There was positive correlation of RI with SBP (r- 0.52, p- 0.05), GFR (r- -0.02, p- 0.001) and albumin excreted in 24 hours urine (r- 0..03, p- 0.04).

Discussion

Renal resistive index (RI) may be able to detect earlier changes of vascular damages preceding elevated eGFR and a few studies have demonstrated higher values of RI in diabetic patients with renal impairment, even with early involvement.[7,8] Some suggested have also suggested its usefulness in determining severity and staging of renal disease.[9,10] The structural abnormalities include hypertrophy of the kidney, increase in glomerular basement membrane thickness, nodular and diffuse glomerulosclerosis, tubular atrophy, and interstitial fibrosis.[11] These findings occur both in type 1 and type 2, although more common in the latter.[12] Functional alterations include an early increase in glomerular filtration rate with intraglomerular hypertension, subsequent proteinuria, systemic hypertension, and eventually culminates in loss of renal function. Renal dysfunction is typically identified in the macro albuminuria stage, which over time can progress to ESRD.[13,14] We attempted this study to assess renal arterial resistive index in type 2 diabetic nephropathy patients.

Our results showed that out of 130 patients, males comprised of 70 (53.8%) and females 60 (46.2%). Stage 1 diabetic nephropathy comprises of 36 patients, stage 2 had 24, stage 3 had 52 and stage 4 had 18 patients. Ohta et al,[15] in their study on 245 patients with or without renal impairment who underwent ultrasonographic assessment of the renal artery found that the RI and PI of the main renal arteries and the interlobar arteries were significantly higher in patients with diabetic nephropathy. These results suggest that the increased RI of the renal arteries is associated with the severity of systemic atherosclerosis.

Our results showed that the mean systolic blood pressure (SBP) in stage 1 was 134.2 mm Hg and diastolic blood pressure (DBP) was 64.8 mm Hg, in stage 2 was 122.6 mm Hg and DBP was 62.4 mm Hg, in stage 3 was 140.8 mm Hg and DBP was 72.0 mm Hg and in stage 4 was 156.2 mm Hg and DBP was 94.6 mm Hg. Afsar and Elsurer16 in their study observed that 24-h creatinine clearance was related to increased renal resistive index levels. Renal resistive index levels were highest in patients with type II diabetes with both decreased 24-hours creatinine clearance and increased 24-hours urinary albumin excretion, whereas they were lowest in patients with normal creatinine clearance and normal

urinary albumin excretion.[16]

Our results showed that the mean RI in stage 1 patients was 0.61±0.02, in stage 2 was 0.68±0.04, in stage 3 was 0.74±0.05 and in stage 4 was 0.87±0.03. There was positive correlation of RI with SBP (r- 0.52, p- 0.05), GFR (r- -0.02, p- 0.001) and albumin excreted in 24 hours urine (r- 0.03, p- 0.04). Hanamura et al,[17] evaluated the significance of the renal resistive index in 202 chronic kidney disease (CKD) patients and found that patients with RI ≥0.7 had significantly poorer renal survival than those with RI>0.65 and 0.65 ≤RI<0.7. The patients in the high-normal RI group showed good response to steroids. However, in the high RI group, steroid therapy did not significantly improve renal survival. Of the clinical indices studied, RI≥0.7, hypertension, proteinuria, and low eGFR at diagnosis were independent risk factors for worsening renal dysfunction.

Conclusion

Increased systolic blood pressure, albumin excretion and severity of disease were capable of increasing RI values in diabetic nephropathy patients.

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