

# Correlation of Renal Artery Vascular Resistive Index by Renal Doppler Sonography with High Risk Factors in Diabetic Patients

\*Niharika Ved, Rajesh Sharma, Anil K Gupta

Acharya Shri College of Medical Sciences, Bye Pass Road, Sidhra, Jammu, Jammu and Kashmir, 180017, India

Corresponding author: Niharika ved

Acharya Shri College of Medical Sciences, Bye Pass Road, Sidhra, Jammu, Jammu and Kashmir, 180017, India

**Abstract:** *Objective: Renal artery resistive index evaluation of both kidneys in patients with diabetes mellitus and control group along with its correlation with high risk factors in diabetes. Materials and Methods: This study comprised of 50 cases of diabetic mellitus (NIDDM) in age group of (40-60 years) and 50 cases of non-diabetic in age match control. Total 100 cases underwent duplex ultrasonography. Both groups of 50 cases each will be tested for fasting blood sugar, lipid profile, glycosylated haemoglobin along with their complete history regarding duration of diabetes, alcohol consumption, smoking habit. Results: In our study, patients were divided into two groups based on their RI values. group 1 with RI more than 0.7 and group 2 with RI less than 0.7. Mean age of the patients in group 1 is 55.73 years and group 2 is 54.05 years. Mean duration of Diabetes in patients with RI >0.7 is 11.07 years compared to those with normal RI of 4.7 years. There are 40% smokers in group I compared to 30% in group 2. Dyslipidemia is present in 60% of patients of group 1 and 30% in group II patients. Mean fasting blood sugar is 101.4 mg/dl in group 1 patients and 98.2 mg/dl in group 2 patients. 27 patients are within 100-109mg/dl ranges which are 27 in number. Glycosylated haemoglobin is 6.6% in group 1 versus 6.0% in group 2. Mean RI of control group is 0.62 versus mean RI of diabetic group is 0.715, standard deviation 0.01. Conclusion: According to our study high risk factors of diabetes patients such as old age, smoking, dyslipidemia, increased duration of diabetes are found to have significant correlation with RI. No correlation was found between glycosylated hemoglobin, fasting blood sugar. Therefore, RI can be helpful as an additional tool to monitor diabetic patients for detecting complication like diabetic nephropathy. RI demonstrates changes of renal vascular resistance in patients with impaired kidney function. Thus, intrarenal RI could prompt physician to a more tight control of blood sugar in group of diabetics, delaying progression to ESRD.*

**Keywords:** Duplex ultrasonography, RI, Diabetic nephropathy

## 1. Introduction

Diabetes Mellitus is a metabolic disorder of multiple aetiology characterized by chronic hyperglycemia with disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, action or both [1]. Diabetic nephropathy is the single most common cause of end stage renal disease and is also a leading cause of chronic kidney disease in India accounting for about 30% of all chronic kidney disease patients [2].

Diabetic nephropathy is the result of many risk factors-Age, sex, ethnicity, hyperglycemia, dyslipidemia, hyperuricemia, obesity. Hemodynamic factors-Anemia, hypertension, Family history of diabetes, low birth weight, smoking, increased protein intake, physical inactivity, sedentary lifestyle and genetic factors.

In spite of several decades of research since 1940s when several studies linked diabetes to renal disease, there are still large gaps in knowledge and understanding of pathophysiology of diabetic nephropathy [2].

Renal RI value is more closely related to markers of vessel organ damage in patients with cardiovascular disease and diabetes and with stage of renal impairment in nephropathies and almost exclusively with degree of intrarenal changes in acute/advanced chronic kidney disease. Analysis of the Doppler spectrum of the intrarenal arteries in conjunction with careful evaluation of the renal cortical echogenicity might be helpful in sonographic

differentiation of kidneys with preserved function and those with impaired function in patients with diabetes.

## 2. Material and Methods

This case-control study was conducted in the department of Radio diagnosis and imaging, Acharya Shri Chander College of Medical Sciences and Hospital, Sidhra, Jammu. This study comprised of 50 cases of diabetic mellitus (NIDDM) in age group of (40-60 years) and 50 cases of non-diabetic in age match control. Total 100 cases underwent duplex ultrasonography. Both groups of 50 cases each were tested for fasting blood sugar, lipid profile, glycosylated hemoglobin. Complete history was taken regarding duration of diabetes, alcohol consumption, smoking habit. The ultrasound examination of the kidneys will be performed in gray scale and color Doppler modes using, 3.5 MHz frequency, and curvilinear transducer of Logiq GE C5 Premium Ultrasound machine.

### Inclusion criteria for diabetic cases

1. Patients diagnosed with diabetes mellitus as per WHO criteria
2. Random blood glucose more than or equal to 11.1 mmol/L (200 mg/dl)
3. Fasting plasma glucose more than or equal to 7.0 mmol/L (126 mg/dl)
4. Age of patients between 40-60 years
5. Both sexes included

### Inclusion criteria for Control group

1. Age of patients between 40-60 years
2. Both sexes included

### Exclusion criteria

1. Patients of renal artery stenosis
2. Patients with glomerular or tubular interstitial disease
3. Patients with conventional B-mode ultrasound findings of obstructive uropathy
4. Patients with cardiac failure
5. Patients with hypertension
6. Patients with unilateral or bilateral contracted kidney or sonography
7. Patients with urinary tract infection
8. Patients with prior renal surgery
9. Patients with hematuria

## 3. Results

Diabetic cases were further divided into two groups based on their RI value. Group 1 – RI > 0.70 and Group 2 – RI < 0.70. 30% patients are in group 1 and 20% in group 2. [table 1]

In our study, mean age of the patients in group 1 is 55.73 years with standard deviation of 0.82 and group 2 is 54.05 years with standard deviation of 0.75. Maximum distribution is between 55-60 years of age group that is, 57% in group 1 and 45% in group 2. [Table 2]

On multiple linear regression analysis of resistive index with multiple risk factors, resistive index exhibited high dependence on age with a coefficient of 0.00472, p-value of 0.03 (when RI was regressed with age, duration of diabetes, smoking, dyslipidemia).

It was found that patients with higher RI are older in comparison to patients with RI < 0.7.

Hence age is one of the factors on which resistive index is dependent.

In our study 66% patients with diabetes are male and 34% female.

Male: female ratio is 33:17 which is 1.9:1.

There are 40% smokers in group I compared to 30% in group 2.

On multiple regression analysis of resistive index with various risk factors, smoking has coefficient of 0.04 and p value of 0.048. (When RI was regressed with age, duration of diabetes, smoking, dyslipidemia). Resistive index is dependent on smoking with correlation of 23%. Therefore, smoking habit is significantly present in patients with higher RI > 0.7.

As per our study, 56.6% patients in group I are obese, standard deviation of 0.09 and 40% in group 2, standard deviation of 0.1. Average BMI is 27.2 in group 1 patients, standard deviation of 0.34 and 26.87 in group 2 patients, standard deviation of 0.45. BMI is 24 in control with standard deviation of 4.39.

In our study dyslipidemia is present in 60% of patients of group 1 and 30% in group II patients. Multiple regression analysis showed coefficient of 0.032 and p value of 0.04. Therefore, patients with high RI value have dyslipidemia in form of elevated cholesterol levels and LDL levels [table 3].

Mean fasting blood sugar is 101.4 mg/dl in group 1 patients and 98.2 mg/dl in group 2 patients. Maximum numbers of patients are within 100-109mg/dl ranges which are 27 in number. No significant difference is found between two groups [table 6].

According to our study mean duration of diabetes in patients with IRI > 0.70 is 11.07 years with standard deviation of 1.107 compared to those with normal RI of 4.7 years, standard deviation of 0.76. On multiple regression analysis of resistive index with duration of diabetes as one of the factor, the coefficient for duration of diabetes is 0.004 and p value of 0.005. Therefore, RI value is significantly higher in patients with higher duration of diabetes [table 4].

Glycosylated haemoglobin is 6.6% in group 1 with standard deviation of 0.001 versus 6.0% in group 2, standard deviation of 0.002.

No significant correlation is found between RI and glycosylated haemoglobin [table 5].

Mean RI of control group is 0.62 with standard deviation of 0.01 versus mean RI of diabetic group is 0.715, standard deviation 0.0. Hence, RI is higher in diabetic group in comparison with non-diabetic group [table 7].

**Table 1:** Distribution of patients according to RI

| Group name | No. of patients | % of total patients |
|------------|-----------------|---------------------|
| Group 1    | 30              | 60%                 |
| Group 2    | 20              | 40%                 |

**Table 2:** Distribution of Age

| Age         | Group 1 | Group 2 | Control |
|-------------|---------|---------|---------|
| 40-44 years | 1       | 0       | 0       |
| 45-49 years | 0       | 0       | 10      |
| 50-54 years | 1       | 3       | 5       |
| 55-59 years | 11      | 8       | 10      |
| 59-60 years | 17      | 9       | 25      |

**Table 3:** Frequency of risk factors in diabetics

| Risk factor  | Group 1 | Group 2 |
|--------------|---------|---------|
| Smokers      | 40%     | 30%     |
| Dyslipidemia | 60%     | 30%     |
| Obesity      | 57%     | 30%     |
| Alcoholic    | 33%     | 30%     |

**Table 4:** Mean duration of diabetics according to RI

| Group name | Mean duration in years |
|------------|------------------------|
| Group 1    | 11.47                  |
| Group 2    | 4.7                    |

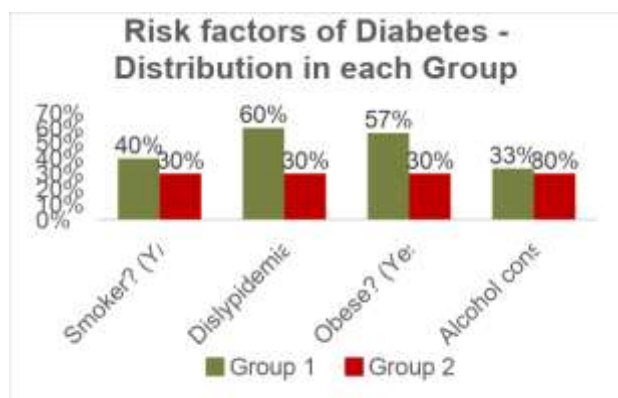
**Table 5:** Glycosylated haemoglobin in diabetic patients and control group

| Group name | Glycosylated Haemoglobin |
|------------|--------------------------|
| Group 1    | 7%                       |
| Group 2    | 6%                       |
| Control    | 5%                       |

**Table 6:** Distribution of fasting blood sugar

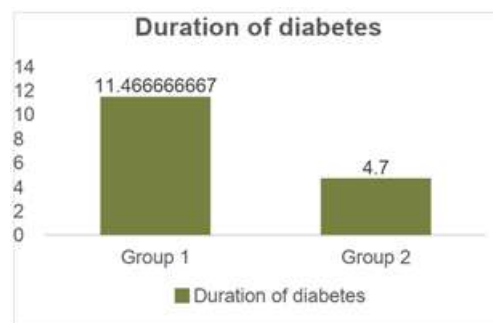
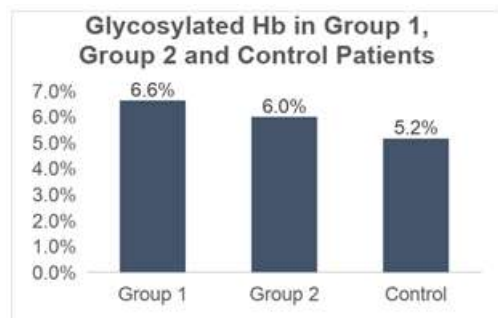
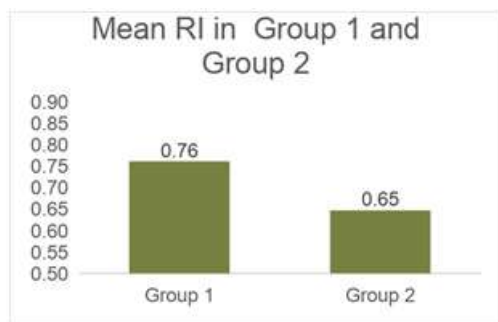
| Blood sugar | Frequency |
|-------------|-----------|
| 90 - 99     | 3         |
| 100 - 109   | 27        |
| 110 - 119   | 14        |
| 119 - 120   | 6         |

#### Graphs



**Table 7:** Mean RI in various groups

| Group Name        | Resistive Index |
|-------------------|-----------------|
| Group 1           | 0.76            |
| Group 2           | 0.65            |
| OVERALL DIABETICS | 0.72            |
| CONTROL           | 0.62            |



#### 4. Discussion

Diabetic nephropathy is the single most common cause of end stage renal disease and a leading cause of chronic kidney disease in India. There has been paradigm shift in understanding of factors held responsible for this discrepancy in natural history of these two sets of patients with balance tilt towards hemodynamic factors rather than towards metabolic factors. Since 1980s, Colour Doppler USG has allowed evaluation of alteration of renal perfusion non-invasively by evaluating intrarenal artery or showing general renal perfusion. Among parameters measured by Doppler USG, RI is the most frequently used index in clinical practice. It is hypothesized that RI demonstrates changes of renal vascular resistance in patients with impaired kidney function. Histopathological changes mainly affect vascular compartment in kidney of diabetic patients which results in elevation of renovascular resistance. Therefore, RI is valuable in detecting early diabetic nephropathy.

Renal Doppler is a non-invasive modality that can be used in association with biochemical parameters in follow up of patients with diabetic nephropathy. Intrarenal RI could prompt physician to a more tight control of blood sugar in group of diabetics, delaying progression to ESRD.

In our study, mean age of the patients in group 1 is 55.73 years with standard deviation of 0.82 and group 2 is 54.05 years with standard deviation of 0.75. It was found that patients with higher RI are older in comparison to patients with RI < 0.7. Hence age is one of the factors on which resistive index is dependent. Mean duration of Diabetes in patients with RI > 0.7 is 11.07 years with standard deviation of 1.107 compared to those with normal RI of 4.7 years and standard deviation of 0.76. Therefore, RI value is significantly higher in patients with higher duration of diabetes. There are 40% smokers in group I compared to 30% in group 2. Smoking habit is significantly present in patients with higher RI > 0.7. In our study dyslipidemia is present in 60% of patients of group 1 and 30% in group II patients. Patients with high RI value have dyslipidemia in form of elevated cholesterol levels and LDL levels. 56.6% patients in group I are obese, standard deviation of 0.09 and 40% in group 2, standard deviation of 0.11. Mean fasting blood sugar is 101.4 mg/dl in group 1 patients and 98.2 mg/dl in group 2 patients. Maximum numbers of patients are within 100-109mg/dl ranges which are 27 in number. No significant difference is found between two groups. Glycosylated haemoglobin is 6.6% in group 1 with standard deviation of 0.001 versus

6.0% in group 2, standard deviation of 0.002. No significant correlation is found between RI and glycosylated haemoglobin. Mean RI of control group is 0.62 with standard deviation of 0.01 versus mean RI of diabetic group is 0.715, standard deviation 0.01. Hence RI is higher in diabetic group in comparison with non-diabetic group.

According to our study high risk factors of diabetes patients such as old age, smoking, dyslipidemia, increased duration of diabetes are found to have significant correlation with RI. No correlation was found between glycosylated hemoglobin, fasting blood sugar. Therefore, RI can be helpful as an additional tool to monitor diabetic patients for detecting complication like diabetic nephropathy. RI demonstrates changes of renal vascular resistance in patients with impaired kidney function. Thus, intrarenal RI could prompt physician to a more tight control of blood sugar in group of diabetics, delaying progression to ESRD.

## 5. Conclusion

Renal doppler is a non-invasive modality that demonstrates changes of renal vascular resistive index in patients with impaired kidney function. Histopathological changes mainly affect vascular compartment which results in elevation of renovascular hypertension. High risk factors of diabetes patients such as old age, smoking, dyslipidemia, increased duration of diabetes are found to have significant correlation with RI. Therefore, RI can be helpful as an additional tool to monitor diabetic patients for detecting complication like diabetic nephropathy and could prompt physician to a more tight control of blood sugar in group of diabetics, delaying progression to ESRD.

## List of Abbreviations

USG-Ultrasonography  
RI- Resistive index  
ESRD-End stage renal disease

## References

- [1] Alberti KG, Zimmet P Z. Definition, diagnosis and classification of diabetes mellitus and its complications part1:diagnosis and classification of diabetes mellitus provisional report of WHO consultation. Diabetic Med 1998;15(7):539-53
- [2] Mani MK. Patterns of renal disease in indigenous populations in India. Nephrology 1998; 4:4-7
- [3] Zatz R, Meyer TW, Rennke HG et al. Predominance of hemodynamic rather than metabolic factors in the pathogenesis of diabetic glomerulopathy. Proc Natl Acad Sci USA 1985; 82(17):5963-67