Original Research Article

Assessment of diabetic nephropathy in type II diabetes mellitus subjects via evaluation of serum creatinine levels, creatinine clearance and microalbuminuria in central indian population

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Abstract

Background: Diabetic nephropathy is also termed diabetic kidney disease which leads to loss of kidney functions chronically in diabetic subjects. Diabetic nephropathy is one of the most common causes of renal replacement and mortality.**Aims:** The present clinical trial was conducted to assess the prevalence of diabetic nephropathy in diabetic subjects via evaluation of serum creatinine levels, creatinine clearance, and microalbuminuria.**Materials and methods:** In randomly selected 80 diabetics, detailed history, comprehensive clinical examination, and relevant laboratory investigations were carried out to assess diabetic nephropathy. 24 hours urine sample was collected for each subject. Serum creatinine, microalbumin, and creatinine clearance were measured. For creatinine clearance, measurement was done by the MDRD formula of e-GFR. The collected data were subjected to the statistical evaluationfor results formulation.**Results:** Diabetic nephropathy was seen in 42.5% of study subjects. However, most severe diabetic nephropathy was only in 1 (1.25%) study subjects. More abnormal Creatinine values were seen in subjects with higher age (60.52%, 23 in subjects older than 51 years) showing that kidney functions decrease with increasing age. On analysis, it was seen that in study subjects only age had a statistically significant correlation with chronic kidney disease (p=0.001).**Conclusion:**The present trial concludes that subjects with diabetes are prone to have diabetic nephropathy affecting kidneys and constituting increased mortality. Renal functions are more compromised in subjects of higher age.

Keywords: Diabetic nephropathy, Type II diabetes, diabetic complications, renal disease.

Introduction

Diabetes mellitus comprises a cluster of metabolic disorders identified by the consistently high level of blood sugar for a long period. Commonly found type of diabetes mellitus is Type II. India is the new diabetic capital in the world with a large increase in subjects with type II diabetes in the last decade and an approximate prevalence of 11.6% and 2% in urban and rural populations respectively with high glucose intolerance in urban subjects[1]. The main risk factors leading to diabetes are obesity, sedentary lifestyle, insulin resistance, and familial aggregation. Prolonged high blood sugar levels in the body can lead to many diabetes-associated complications affecting the eyes, heart, kidney, teeth, blood vessels, nerves, and increase infection risk[2].One such diabetic complication is diabetic nephropathy also termed diabetic kidney disease which leads to loss of kidney functions chronically in diabetic subjects Diabetic nephropathy is one of the most common causes of renal replacement because approximately 40% of subjects undergoing renal replacement are diabetics. Diabetic nephropathy also contributes to mortality in diabetics secondary to cardiovascular complications. Diabetic nephropathy is assessed via increased albumin excretion in the urine of diabetics with the absence of any other renal disorder.

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Two stages of albuminuria identified in diabetic nephropathy are microalbuminuria with Urine Albumin excretion (UAE) between 20>g/min to ≤199 µg/minand macroalbuminuria with UAE ≥200 µg/min[3].Renal damage observed in diabetic nephropathy can be attributed to hypertension, proteinuria, hyperglycemia, and hyperlipidemia with some genetic predilection shown in ethnicity and siblings, which is confirmed by more prevalence of diabetic nephropathy in Type II diabetics compared to type I, independent of their diabetic control[4].The pathophysiology of diabetic nephropathy is attributed to stimulation of renal cells secondary to long-term hyperglycemia leading to the production of cytokines, growth factors, and humeral mediators, which in turn, increase shear stress or permeability of glomerular basement membrane and extracellular matrix deposition[5].High blood glucose levels increase GLUT-1 mRNA expression and GLUT-1 protein mediated by TGF-β in the renal mesangial cells with increased transport of glucose to cells.Glucose uptake by renal cells decreases on adding anti-growth factor (TGF-β). Glucose-related anomalies in the metabolism of the cells are increased by endogenous TGF-β under high glucose influence.Despite its adverse effects, the pathophysiology of diabetic nephropathy is poorly understood and has high mortality rates[6].The present clinical trial was conducted to assess the prevalence of diabetic nephropathy in diabetic subjects via evaluation of serum creatinine levels, creatinine clearance, and microalbuminuria.

Materials and methods

The present clinical trial was conducted to assess the prevalence of diabetic nephropathy in diabetic subjects via evaluation of serum creatinine levels, creatinine clearance, and microalbuminuria. The

study subjects were recruited from the subjects visiting the Out-Patient Department of endocrinology and were confirmed diabetics. The subjects were finally recruited after obtaining informed consent from them. The study randomly selected 80 diabetics from the institutionwho were more than 18 years of age and were confirmed Type II diabetics for at least 1 year before the commencement of the study. The exclusion criteria for the study were Type I diabetics, subjects with other associated systemic diseases such as thyroid dysfunction, carcinoma, and hypertension, and diabetics diagnosed and confirmed for less than one year. For confirmatory diabetes diagnosis, criteria by World Health Organisation (WHO) and American Diabetes Association (ADA) were used where subjects with fasting blood sugar of ≥126mg/dl and post-prandial blood sugar of more than 200 mg/dl were considered diabetics.In each included subjects, detailed history, comprehensive clinical examination, and relevant laboratory investigations were carried out to assess diabetic nephropathy. 24 hours urine sample was collected for each subject. Serum creatinine, microalbumin, and creatinine clearance were measured. For creatinine clearance, measurement was done by the MDRD (Modification of Diet in Renal Disease) formula of e-GFR. The collected data were subjected to the statistical evaluation using SPSS software 24.0 for Windows (SPSS Inc., Chicago, IL, USA) and one-way ANOVA (analysis of variance), and the results were formulated. The values were expressed in terms of mean and standard deviation. The level of statistical significance was kept at the level of $p < 0.05$.

Results

The present clinical trial was conducted to assess the prevalence of diabetic nephropathy in diabetic subjects via evaluation of serum creatinine levels, creatinine clearance, and microalbuminuria.The 80 subjects were within the age range of 18 years to 67 years with a mean age of 32.6 years. The demographic characteristics of the study subjects are listed in Table 1. The study comprised of 45% (n=36) females and 55% (n=44) males. The study had 20% (n=16) subjects within the age of 18-30 years, 32.5% (n=26) from 31-50 years, and 47.5% (n=38) older than 51 years. Concerning diabetes duration 30% (n=24) subjects had diabetes for 1 year, 32.5% (n=26) for 1-3 years, and 47.5% (n=38) were diabetics for more than 3 years. 27.5% (n=22) study subjects were unemployed. For associated conditions, 21.25% (n=17) subjects were smokers, 23.75% (n=-19) had obesity, and 26.25% (n=21) had hypertension. On assessing the GFR (Glomerular Filtration rate) using MDRD formula in ml/min/1.73m^2, it was seen that 57.5% (n=46) subjects had GFR of more than 90ml/min/1.73 $m^{2,}$ 18.75% (n=15) had GFR of 60-89 ml/min/1.73 m^2, 16.25% (n=13) had GFR between 30-59ml/min/1.73 m^2, 6.25% (n=5) subjects were with GFR of 15-29ml/min/1.73 m^2, and only in one subject GFR wasless than 15ml/min/1.73 m^2as shown in Table 2. These results interpreted that diabetic nephropathy was seen in 42.5% study subjects. However, most severe diabetic nephropathy was only in 1 (1.25%) study subjects.

The present trial also assessed the Creatinine values in study subjects and denoted them as normal and abnormal (Table 3). The results showed that more abnormal Creatinine values were seen in subjects with higher age (60.52%, 23 in subjects older than 51 years) showing that kidney functions decrease with increasing age. In subjects of 18-30 years, only 3 subjects and in 31-50 years age 7 (26.92%) subjects had abnormal Creatinine vales. Concerning diabetes duration, theabnormal Creatinine values were 4.16% (n=1), 53.84% (n=14), and66.6% (n=20)respectively for duration of 1 year, 1-3 years, and more than 3 years. For gender, no difference was seen. Table 3 also summarizes levels of Creatinine in diabetic nephropathy and non-diabetic nephropathy. It was seen that for the age of 18-30 years the abnormal Creatinine values had a mean of 1.03±0.19, and in other age groups, the abnormal values had a mean of 0.95±0.19. For the diabetic duration, the mean was 0.95±0.19 for all the duration groups. On analysis, it was seen that in study subjects only age had a statistically significant correlation with chronic kidney disease (p=0.001), whereas, employment status and gender had no significant correlation with chronic kidney disease.

Table 1: Demographic characteristics of the study subjects

Characteristics		Percentage	Number
Mean Age (years)	32.6		
Age Range (years)	18-67		
Gender	Females	45	36
	Males	55	44
Age Distribution (years)	18-30 years	20	16
	31-50 years	32.5	26
	>51 years	47.5	38
Diabetes duration	Up to 1 year	30	24
	1-3 years	32.5	26
	>3 years	37.5	30
Employment status	Unemployed	27.5	22
	Employed	72.5	58
Associated systemic diseases	Smoking	21.25	17
	Obesity	23.75	19
	Hypertension	26.25%	21

Table 2: GFR in study subjects

GFR stages (ml/min/1.73m^2)	MDRD	
	%	(n)
Stage I (more than 90)	57.5	46
Stage II (60-89)	18.75	15
Stage III (30-59)	16.25	13
Stage IV (15-29)	6.25	5
Stage V (less than 15)	1.25	1

Table 3: Serum Creatinine levels in subjects with diabetic nephropathy and non-diabetic nephropathy

S. No	Parameter	Serum Creatinine		Serum Creatinine	
		Abnormal % (n)	Normal % (n)	Abnormal Mean±S.D	Normal Mean±S.D
Gender	Females (n=36)	41.66% (n=15)	58.33% (n=21)	0.95±0.19	1.08 ± 0.19
A	Males (n=44)	38.63% (n=17)	61.36% (n=27)	0.95±0.19	1.08 ± 0.19
Age Distribution (years)	18-30 years (n=16)	18.75% (n=3)	81.25% (n=13)	1.03±0.19	1.48±0.13
	31-50 years (n=26)	26.92% (n=7)	73.07% (n=19)	0.95±0.19	1.08 ± 0.19
	>51 years (n=38)	60.52% (n=23)	39.47% (n=15)	0.95±0.19	1.08 ± 0.19
Diabetes duration	Up to 1 year (n=24)	4.16% (n=1)	95.83% (n=23)	0.95±0.19	1.08 ± 0.19
	1-3 years (n=26)	53.84% (n=14)	46.15% (n=12)	0.95±0.19	1.08 ± 0.19
	More than 3 years (n=30)	66.6% (n=20)	33.3% (n=10)	0.95±0.19	1.08 ± 0.19

Discussion

The present clinical trial was conducted to assess the prevalence of diabetic nephropathy in diabetic subjects via evaluation of serum creatinine levels, creatinine clearance, and microalbuminuria. The 80 subjects were within the age range of 18 years to 67 years with a mean age of 32.6 years.GFR (Glomerular Filtration rate) using MDRD formula in ml/min/1.73m^2 was assessed and it was seen that 57.5% (n=46) subjects had GFR of more than 90ml/min/1.73 m^2, 18.75% (n=15) had GFR of 60-89 ml/min/1.73 m^2, 16.25% (n=13) had GFR between 30-59ml/min/1.73 m^2, 6.25% (n=5) subjects were with GFR of 15-29ml/min/1.73 m^2, and only in one subject GFR was less than 15ml/min/1.73 m^2. These results interpreted that diabetic nephropathy was seen in 42.5% of study subjects. However, most severe diabetic nephropathy was only in 1 (1.25%) study subjects. These findings were consistent with the studies by Patel V et al[7] in 2018 and Wong TY et al[8] in 2002 where authors depicted similar results concerning GFR values. The study comprised of 45% (n=36) females and 55% (n=44) males. The study had 20% (n=16) subjects within the age of 18-30 years, 32.5% (n=26) from 31-50 years, and 47.5% (n=38) older than 51 years. Concerning diabetes duration 30% (n=24) subjects had diabetes for 1 year, 32.5% (n=26) for 1-3 years, and 47.5% (n=38) were diabetics for more than 3 years. 27.5% (n=22) study subjects were unemployed. For associated conditions, 21.25% (n=17) subjects were smokers, 23.75% (n=-19) had obesity, and 26.25% (n=21) had hypertension. These demographic characteristics were similar to the demographics used in the previous studies by Adler et al[9] in 2003 and Agarwal N et al[10] in 2003. Abnormal Creatinine values were seen in subjects with higher age (60.52%, 23 in subjects older than 51 years) showing that kidney functions decrease with increasing age. In subjects of 18-30 years, only 3 subjects and in 31-50 years age 7 (26.92%) subjects had abnormal Creatinine vales. Concerning diabetes duration, the abnormal Creatinine values were 4.16% (n=1), 53.84% (n=14), and 66.6% (n=20) respectively for duration of 1 year, 1-3 years, and more than 3 years. For gender, no difference was seen. It was seen that for the age of 18-30 years the abnormal Creatinine values had a mean of 1.03±0.19, and in other age groups, the abnormal values had a mean of 0.95±0.19. For the diabetic duration, the mean was 0.95±0.19 for all the duration groups. On analysis, it was seen that in study subjects only age had a statistically significant correlation with chronic kidney disease (p=0.001), whereas, employment status and gender had no significant correlation with chronic kidney disease. These findings coincided with the findings of Russo GT et al[11] in 2018 and Inassi J et al[12] in 2013 where comparable Creatinine levels and their associations were reported by the authors.

Conclusion

Within its limitations, the present trial concludes that subjects with diabetes are prone to have diabetic nephropathy affecting kidneys and constituting increased mortality. Renal functions are more compromised in subjects of higher age.Hence, early screening of renal function in diabetics should be done to prevent renal failure, transplant, and mortality. However, the study had few limitations including a smaller sample size, geographical area bias, and cross-sectional nature. Hence, more longitudinal studies with larger sample size and longer monitoring periods are required to reach a definitive conclusion.

Conflict of Interest: Nil
Source of support:Nil

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