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Radio-diagnosis

INTRARENAL ARTERIAL DOPPLER IN EVALUATION OF TYPE 2 DIABETICS

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ABSTRACT Our primary objective was to evaluate the renal volume in diabetic patients of more than one year of duration. We also aimed to evaluate the renal resistive index in diabetic patients of more than one year of duration

KEYWORDS : Renal volume, renal resistive index (R.I), Glomerular filtration rate (G.F.R), Proteinuria

INTRODUCTION

A high proportion of patients with type 2 diabetes are found to have microalbuminuria and evident nephropathy shortly after the diagnosis of diabetes, because diabetes is usually present for many years before the diagnosis and because the presence of albuminuria might be less specific for the presence of diabetic nephropathy, as shown by biopsy studies. Without specific interventions 20% to 40% of type 2 diabetic patients with microalbuminuria progress to evident nephropathy. Recent studies have shown that pharmacologic treatment instituted at a very early stage, i.e before the appearance of the proteinuria, can prevent the onset of nephropathy. Hypertension in type 2 diabetes can be related to underlying diabetic nephropathy, coexisting essential hypertension, or other secondary causes such as renal vascular disease. Both systolic and diastolic hypertension markedly accelerate the progression of diabetic nephropathy, but aggressive management can greatly decrease the speed at which the GFR falls.

Duplex sonography provides an easily applicable, noninvasive, and well-established method for investigating renal morphologic characteristics, diagnosing renal artery stenosis, and measuring vascular resistance in the renal parenchyma.

The renal resistive index (RI), measured by duplex sonography, has been shown to be associated with features of diabetic nephropathy and its progression over time, independent of albuminuria and in a multivariate regression analysis, the RI was an independent predictor of declining renal function. An increased RI was suggested to reflect the renal scarring process, resulting in a reduction of the intrarenal vessel area and a consequent increase in intrarenal vascular resistance. Moreover, serial measurement of the renal volume could be important for evaluating patients with renal disease because changes in renal size could indicate irreversible damage.

RESULTS

Statistical analysis included all 40 patients. Grey scale ultrasound was performed to evaluate renal volume and parenchymal echogenicity. Color Doppler ultrasound was performed to evaluate resistive index in all cases. The clinical and sonographic characteristics of the diabetic patients are summarized below (Table-1). Out of the 40 diabetic patients, 1 patient was normoproteinuric (2.5%), 16 were microproteinuric (40%) and 23 were macroproteinuric (57.5%). The mean renal volume, renal area index and R.I values were stratified for the presence of proteinuria in our diabetic patients (Table-1). Diabetic patients had significantly higher mean renal volume values and R.I values (table-1) which supports the study done by Marcello Mancini et al. All the patients had higher RI values with greater protein urine excretion (>0.3mg/dl) and a lower creatinine clearance. Patients with different degrees of protein excretion had different RI values. The normoalbuminuric and microalbuminuric patients had higher renal volume compared to the macroalbuminuric patients (Table-2). Strong correlations were found between renal volume (Table-1, P<0.001), renal area Index (Table-3, P<0.001) and G.F.R (Table -1, P<0.001), hence duplex ultrasonography can be used to see the changes in the renal volume in type 2 diabetic patients but renal area index is much more significant parameter. No correlation were found between renal area index and resistive index with age, gender, BMI, smoking, serum creatinine, MRD and hypertension.

Table 1: Comparison of study variables of patients studied in relation to Urine Albumin Excretion.

Variables	Urine Albumin Excretion			Total	P value
	Normoalbuminuria (<0.02)	Microalbuminuria (0.02-0.3)	Macroalbuminuria (>0.3)		
Renal volume Right	228.00±0.00	169.94±17.18	122.43±26.14	144.08±35.07	<0.001**
Renal volume Left	263.00±0.00	166.81±23.58	117.64±21.11	141.54±38.13	<0.001**
Resistive Index Right	0.98±0.00	0.89±0.07	0.93±0.06	0.91±0.06	0.123
Resistive Index Left	0.95±0.00	0.88±0.08	0.93±0.05	0.91±0.07	0.085+
Renal Area Index	203.00±0.00	152.28±18.00	111.00±20.96	129.81±30.42	<0.001**

Table 2: Renal Volume distribution of patients studied in relation to Urine Albumin Excretion.

Renal	Volume	Urine Albumin Excretion			Total (n=40)	P value
		Normoalbuminuria (<0.02) (n=1)	Microalbuminuria (0.02-0.3) (n=16)	Macroalbuminuria (>0.3) (n=23)		
Right						
	<120	0(0%)	0(0%)	10(43.5%)	10(25%)	<0.001**
	120-180	0(0%)	10(62.5%)	13(56.5%)	23(57.5%)	
	>180	1(100%)	6(37.5%)	0(0%)	7(17.5%)	
Left						
	<120	0(0%)	0(0%)	10(43.5%)	10(25%)	<0.001**
	120-180	0(0%)	12(75%)	12(52.2%)	24(60%)	
	>180	1(100%)	4(25%)	1(4.3%)	6(15.0%)	

Fisher Exact test

Table 3: Renal Area Index distribution of patients studied in relation to Urine Albumin Excretion

Renal Area Index (ml/m^2)	Urine Albumin Excretion			Total
	Normoalbuminuria (<0.02)	Microalbuminuria (0.02-0.3)	Macroalbuminuria (>0.3)	
<120	0(0%)	1(6.3%)	15(65.2%)	16(40%)
120-160	0(0%)	10(62.5%)	8(34.8%)	18(45%)
>160	1(100%)	5(31.3%)	0(0%)	6(15%)
Total	1(100%)	16(100%)	23(100%)	40(100%)

P<0.001**, significant, Fisher Exact test

DISCUSSION

Renal enlargement occurs shortly after the induction of hyperglycemia, and it has been shown that the protein content rises in parallel to the kidney weight. Similarly, an increased protein to DNA ratio has been measured after a few days, indicating hypertrophy of the cells [1,2,3]. The increase in renal volume during the early phase of diabetic nephropathy observed in diabetic patients, which could be associated with a reduction in the surface ratio of capillaries to tubules and might cause reduced perfusion and interstitial fibrosis. Hyperfiltration and hypertrophy are the first abnormalities seen in the kidneys in both types of diabetes and can be ideal parameters for intervention because the GFR is well preserved. The structural and functional changes are all reversible and can be decreased by improving metabolic control, strict blood pressure control, and treatment with angiotensin-converting enzyme inhibition or angiotensin 2 receptor blockade. Clinically hyperfiltration is not a parameter of practical value for daily management of patients because it is too problematic to measure, whereas kidney volume measurement could be a potential tool for early identification of diabetic nephropathy. In this study, nephromegaly was the only detectable alteration in the diabetic patients during the albuminuric phase, when renal abnormalities are not detectable by the noninvasive methods normally used and recommended by the scientific community for diabetic nephropathy screening. In this study, higher RI values were observed on Doppler sonography in all the diabetic patients. Major variations were detected at advanced stages of diabetic nephropathy but less so in the early stage. The RI increase in our group of diabetic patients did not depend on the chronologic age but on the duration of diabetes. This finding can be an indication of a disease specific alteration occurring in the kidneys. How much the different renal vascular beds (preglomerular vessels, glomerular capillaries, and postglomerular vessels) contribute to the elevated RI is unclear. In diabetic patients, renal artery disease is more frequent in the intrarenal vessels (interlobar artery, arcuate artery, interlobular artery) than in the main renal artery, and it is possible that during the very early prealbuminuric phase, patients have more pronounced vasoconstriction, even without evident nephropathy. A possible explanation for our study results may be the following: 1. At an early stage of the disease, renal damage is located primarily in the glomeruli, in which case, a normal RI would be expected; and 2. at an advanced stage of the disease, the glomeruli become sclerotic, and tubules become atrophic with increasing interstitial fibrosis. All of these factors can lead to an increase in the RI [4]. Advanced arteriosclerosis in intrarenal arteries at an advanced stage of diabetic nephropathy may contribute to the increase in the RI [5]. Therefore, renal hypertrophy and the increase in the RI represent two different phases: 1. Renal enlargement is a reversible step of renal involvement in diabetes mellitus, 2. The RI increase indicates the progression of disease with renal scarring, which precedes the appearance of albuminuria [6-9]. There is evidence that suggests that the risk of developing diabetic nephropathy begins when urine albumin excretion values are still in the normoalbuminuric level [10,11]. Diabetic nephropathy is a progressive condition that often results increasing creatinine as the final manifestation, and as it progresses , the risk of cardiovascular complications increases. In animal models, prevention of early hypertrophy-hyperfunction has already been shown to avoid the development of diabetic nephropathy [12,13]. At present, treatment during the later stages of the condition is unable to preserve renal function or alter the burden of cardiovascular events. Future research could evaluate whether the progression of nephropathy and cardiovascular morbidity and mortality could be prevented by early treatment in patients with an increased renal volume, a higher RI, or both. Sonography may identify patients with nephropathy at a very early stage and may contribute to early diagnosis and prevention of disease progression. Future studies will need to address the independent role of nephromegaly not only in the evolution of albuminuria but also in the subsequent decline of the GFR and whether it is a marker of glycemic control or has a pathogenetic role in human diabetic nephropathy.

CONCLUSION

Duplex sonography has a potential role in early identification of changes in renal volume, parenchymal echogenicity, morphologic changes and hemodynamic renal changes in type 2 diabetic patients.

SUMMARY

Renal volume and intra renal hemodynamics were studied with duplex sonography in 40 type 2 diabetic patients. The age of the patients ranged from 26 to 80 years. Out of 40 patients, 29 were men and 11 women. The mean renal volume, renal area index and R.I values stratified for the presence of proteinuria in the diabetic group.

29 patients had grade I medical renal disease and 11 had grade II medical renal disease.

The diabetic patients with longer diabetes duration had greater urine protein excretion and reduced G.F.R. The microalbuminuric patients had significant increase in renal volume compared to macroalbuminuric patients. Patients with different degrees of protein excretion had different RI values. Resistive index was increased in all the diabetic patients.

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