Asian Journal of Medical Radiological Research Original Article

Doppler Ultrasonography Of The Kidneys In Diabetic Patients

[*1]Ala Mohammed Abd Elgyoum Mohamed Ahmed[1],Abd Allah Mohammed Jaber[2],Amin A. E. Elzaki[3]

[1]National Ribat University, College of Radiological and Nuclear Medicine Sciences,
[2]Consultant Radiologist, Royal Care hospital
[3]Ph.D Rad. Tech. Med. Imaging, Eltayf University

Abstract

This study was conducted with an aim to assess the effect of diabetes on the kidneys using ultrasonography, specifically to assess the vascularty of kidneys by Doppler ultrasound in diabetic patients in Sudan. A total of forty seven samples of Sudanese diabetic patients between the mean of ages was 57.68 years were selected according to the positive evidence of diabetes. Features like patient shape, treatment taken, internal echogenicity, corticomedullary differentiation and renal artery indexes were employed.The examination of Doppler for 47patient showed that 93.6% of patients had ordinary renal artery resistance and 6.4% had high resistance. The study also showed that there were relations between the affection period of diabetic mellitus&changes happening in the kidneys such as renal failure 29.8%, pyelonephritis is 2.1%, renal artery stenosis 6.4%. The study proved that diabetic patients were subject to multiple changes in abdominal organs that can be diagnosed by ultrasound, this supports the use of ultrasound in diabetic treatment units.

Key Words: Renal artery Index (RI), Renal artery pulsatility Index (PI), Corticomedulary differentiation .

INTRODUCTION

Diabetes mellitus is becoming a major out-break in our community affecting both adult and young people and even children. Diabetes mellitus is a destructive disease, causing not only ill-health but affect both the economy, and the psychology of the patient. Hence any tool that can be used in the diagnosis, treatment, and management is very helpful. Ultrasound is one of the modality that can be used in such diseases. Diabetes mellitus is a condition in which the body either does not produce enough, or does not properly respond to, insulin, a hormone produced in the pancreas.[1]

Diabetic nephropathy is kidney disease that is a complication of diabetes. Diabetic nephropathy is caused by damage to the tiniest blood vessels. When small blood vessels begin to develop damage, both kidneys begin to leak proteins into the urine. As damage to the blood vessels continues, the kidneys gradually lose their ability to remove waste products from the blood.[2]

Renal ultrasonography has become the standard imaging modality in the investigation of kidneys. Renal size and location can be determined. Solid tumors can be detected and can be distinguished from renal cysts. Ultrasonography can detect nephrolithiasis and hydronephrosis. Post renal failure can usually be easily differentiated from prerenal or intrarenal acute renal failure. Renal tumors, from a certain size upwards are also readily detectable.[3]

Color Doppler sonography is of value not only for diagnosis of renal artery stenosis, but also gives additional answers in almost all kinds of kidney lesions. Enlarged kidneys with increased resistance index (RI) value in a diabetic patient suggest a diagnosis of diabetic nephropathy. An echo-free lesion in the kidney showing perfusion in colour mode most certainly is not a benign cyst. Hydronephrosis in the presence of unilaterally increased resistance index.[4] Ultrasonography today is an established method for the initial evaluation of kidneys. The ready availability of this method allows rapid diagnosis and therapeutic decisions, which is of extreme importance to keep in hospital time low.[4]

Address for correspondence*

Dr. Ala Mohammed Abd Elgyoum Mohamed Ahmed
National Ribat University, College of Radiological and Nuclear Medicine Sciences, Khartoum, Sudan
Tel: 00249122703063

MATERIALS AND METHODS

Ultrasound Equipment

This study was performed using different ultrasound scanners available at the areas of study such as Aloka prosound SSD 4000 (Aloka holding Europe AG, Switzerland), Toshiba Nemio 20 (Toshiba, Japan), Siemens sonoline G60S (Siemens, USA), and Shimadzu SBU 2200 (Shimadzu Europe GmbH, Germany). All of these scanners drive convex probes produce a frequency of 3.5 MHz; also they were connected with printing facility through digital graphic printer (Mitsubishi Corporation, Japan).

Sample Size

Fort seven samples of Sudanese diabetic patients between the ages of 28 to 96 years were selected according to the positive evidence of diabetes, among the outflow of the patients in two ultrasound departments at National Ribat University Hospital, Renal Transplant Hospital (Khartoum North) at Khartoum State, Sudan.

Testing Procedure (Protocol)

The patients were told to prepare themselves carefully for the scan by abstaining from food for the last 6 hours with continuous taking their drugs, imposing dietary restrictions, walking for 30 min before the examination, water contrast.[5] Usually the examination was carried out with the patient in supine position. Additional scans in the lateral decubitus and prone were useful in some situations.A coupling agent gel was used to ensure good acoustic contact between the transducer and the skin.[5]

After informing the patients about the procedure and obtaining verbal consent from each of them, the area of interest in the abdomen was completely evaluated in at least two scanning planes. Surveys were used to set correct imaging techniques, to rule out pathologies, and to recognize any normal variants.[4]

Statistical Analysis Used

The data was analyzed using STATA8. The associations between the conclusion's different results and the body measurement are tested using chi-square test; level of significant 0.05 was used.

RESULTS

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Patient Age	47	28	96	57.68	13.501
Valid N (listwise)	47				

Patient Height

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	short	8	17.0	17.0	17.0
	medium	17	36.2	36.2	53.2
	taller	22	46.8	46.8	100.0
	Total	47	100.0	100.0	

Patient Shape

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	slim	4	8.5	8.5	8.5
	moderate	19	40.4	40.4	48.9
	obese	24	51.1	51.1	100.0
	Total	47	100.0	100.0	

Treatment taken

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
diet	1	2.1	2.1	2.1
nill	5	10.6	10.6	12.8
irregullar	6	12.8	12.8	25.5
regullar	35	74.5	74.5	100.0
Total	47	100.0	100.0	

Kidney's Echogenicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	hyper echoic	16	34.0	34.0	34.0
	normal	31	66.0	66.0	100.0
	Total	47	100.0	100.0	

Onset of Diabetes Mellitus

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	1	2.1	2.1	2.1
	2	11	23.4	23.4	25.5
	3	3	6.4	6.4	31.9
	4	1	2.1	2.1	34.0
	5	4	8.5	8.5	42.6
	6	3	6.4	6.4	48.9
	7	1	2.1	2.1	51.1
	8	2	4.3	4.3	55.3
	9	2	4.3	4.3	59.6
	10	3	6.4	6.4	66.0
	11	2	4.3	4.3	70.2
	12	1	2.1	2.1	72.3
	13	1	2.1	2.1	74.5
	14	1	2.1	2.1	76.6
	15	1	2.1	2.1	78.7
	16	1	2.1	2.1	80.9
	17	1	2.1	2.1	83.0
	20	3	6.4	6.4	89.4
	21	1	2.1	2.1	91.5
	22	1	2.1	2.1	93.6
	26	1	2.1	2.1	95.7
	27	1	2.1	2.1	97.9
	28	1	2.1	2.1	100.0
	Total	47	100.0	100.0	

Cortico-Mudlary Differentiation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	preserved	32	68.1	68.1	68.1
	lost	1	2.1	2.1	70.2
	worst	14	29.8	29.8	100.0
	Total	47	100.0	100.0	

Patient Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	20	42.6	42.6	42.6
	female	27	57.4	57.4	100.0
	Total	47	100.0	100.0	

Creatinine Level

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid normal	35	74.5	74.5	74.5
high	12	25.5	25.5	100.0
Total	47	100.0	100.0	

Distribution of cross tabulation between variables

Right & left Kidney Renal Artery Pulsatility Index	Frequency	Percent
Optimum	44	93.6%
High	3	6.4%
Total	47	100.0%

Right & Left Kidney Renal Artery Resistance Index	Frequency	Percent
Optimum	44	93.6%
High	3	6.4%
Total	47	100.0%

Variables	Renal Failure	R.F+ R. Parenchymal disease
Creatinine level	<0.000	0.004
Blood Urea Level	<0.000	0.004
Right kidney artery stenosis	0.544	0.544
Left kidney artery stenosis	0.544	0.544
Right kidney length	<0.000	0.167
Left kidney length	<0.000	0.001
Patient shape	0.084	0.149
Onset	<0.000	0.49

Variables	Kidney's Echogenicity	Cortico Medullary differentiation	Right Kidney RI	Left Kidney RI	Right kidney length	Left kidney length
Age	0.012	0.036	0.393	0.393	0.02	0.014
Gender	0.19	0.252	0.567	0.567	0.456	0.884
Patient Shape	0.253	0.066	0.667	0.667	<0.000	0.005
Patient Highest	0.124	0.099	1	1	0.368	0.411
Treatment taken	<0.000	0.001	0.003	0.003	0.012	0.007
Onset of Diabetes	0.001	<0.000	1	1	<0.000	<0.000

Distribution of correlation between variables

Variable	Right kidney length		Left kidney length	
	Correlation factor	sig	Correlation factor	sig
Age	-0.271	<0.000	-0.194	0.005
Patient Shape	0.232	0.001	0.235	0.001
Patient Highest	0.031	0.662	0.137	0.05
Onset of Diabetes	-0.136	0.052	-0.177	0.011

We analyzed the patient according to renal artery resistance index and pulsatility index into four category; the right kidney renal artery pulsatility index, out of 47 patients 44 patients showed optimum pulsatility index, the percentage was (93.6%) and the same percentage for the left kidney while 3 patients showed high pulsatility index for the right kidney, the percentage was (6.4%) and the percentage for the left kidney was the same. For the right kidney renal artery resistance index there were 44 patients showed optimum resistance index, the percentage was (93.6%) the percentage for the left kidney was the same while 3 patients showed high resistance index for the right kidney and the percentage was (6.4%) and the percentage for the left kidney was the same level.

In this study using chi squire test there was association between renal artery resistance index and pulsatility index with diabetic patients who had renal failure and renal artery stenosis (RAS) (P= 0.544 and 0.000), the cross tabulation showed that there was relation and the relation was statistically significant since P<0.05. This was matches with (University Hospital Merkur, 2007) they found that the resistive indices correlated well with renal function, and pathologic values were observed in advanced nephropathy. It also matches with (Ohta, et al. 2005)[7], they found that in univariate analysis, the RI and PI of the main renal arteries and the interlobar arteries were significantly correlated with PWV. Multivariate analyses showed that PWV was independently associated with the RI of the main renal arteries ($P < 0.01$, $R2 = 0.256$).

CONCLUSION

Enlarged kidneys with increased resistance index value in a diabetic patient suggest a diagnosis of diabetic nephropathy also increased RI of the renal arteries is associated with the severity of systemic atherosclerosis. Furthermore, the intrarenal vascular resistance differs depending on the underlying renal disease, and appears to increase to a greater extent in diabetic nephropathy.

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