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Measurement of Diabetic Patient's Kidneys CT Number using Computed Tomography

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ABSTRACT: The study was conducted in Khartoum state on diabetic patients utilizing Computed Tomography. The aim was to assess CT numbers for both kidneys and analyze their correlation with age. A total of 522 participants were examined (138 from the control group and 384 from the diabetic group). The results indicated that the average age of the case group was 58.5, with the mean measurements for the right and left kidneys of the case group being (Rt K Cortical CT number, Rt K Medulla CT number, Lt K Cortical CT number, Lt K Medulla CT number), with means of (36.53), (25.33), (4.91), (36.5), and (25.19), respectively. There were no statistically significant correlations between kidney measurements and the age of the case group (p-values: .214, .620, .865, .806); Whereas, Rt K Medulla CT number decreased with increasing age. Pv (.028). The diabetes did not influence the cortex and medulla CT number pv (0.852, 0.582, 0.872, 0.615).

KEY WORDS: CT number, Computed Tomography, Diabetic patient, Kidneys.

1. INTRODUCTION

Diabetes is a leading factor contributing to chronic kidney disease chronic kidney disease (CKD), impacting the blood vessels and nerves in the kidneys. Traditional biochemical analyses of serum and blood for diagnosing CKD are inadequate and lack sensitivity, necessitating the creation of a more reliable method (1).The incidence of diabetes mellitus (DM) has notably risen in recent years, making it a global health emergency. DM has developed into a significant and widespread chronic condition, causing life-threatening and disabling repercussions. Recent epidemiological studies indicate that the worldwide DM population could exceed 700 million by 2045 (2). The kidneys are vital organs in the body. Anatomically, they are two uniquely shaped organs positioned against the posterior abdominal wall on each side of the vertebral column, featuring a lateral convex edge and a medial side that is convex above and below, but has a central indentation known as the renal hilum, which allows renal vessels and the ureter to pass; they consist of cortex, medulla, sinuses, and pelvis. Physiologically, the kidneys serve to eliminate waste (metabolic end products) from the blood, produce urine, and regulate body fluids, and they also perform other functions (refer to chapter two). The kidney is impacted by numerous diseases, resulting in alterations to its function and structure, with diabetes being one of them. Diabetes is a prevalent chronic illness characterized by elevated blood glucose levels due to the body's inability to utilize it effectively. This condition impacts numerous organs, including the eyes (leading to blurred vision) and blood vessels (causing atherosclerosis). In diabetes, the small blood vessels in the kidneys become damaged, hindering their ability to filter blood effectively. Morphological alterations in diabetic nephropathy impact all four kidney compartments: glomeruli, tubules, and vessels(3).

General Objective: To measure diabetic patient's kidneys CT number using computed tomography.

Specific Objective:

- To measure the CT number for both kidneys.
- To correlate between the CT number for both kidneys and age of patients.
- To compare this measurement between controlled diabetic patients with un controlled diabetic patient.
- To compare this measurments between case and control groups.

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MATERIALS AND METHODS

This case control analytical non investigational study was done to evaluate renal morphology for diabetic Sudanese.

2-1 Materials: 2-1-1 Study sample: This analytical study to evaluate renal changing for diabetic patients by using CT. Total sample of (522) were included in this study (138) control group (normal group), and (384) case group (diabetic group) this case group include (40.4%) males' (155) and (59.6 %) were females'(229) aged from 24-85 years, who underwent CT examination for the abdomen or urinary system (CTU), at the Radiology and Imaging Department

2-1-2 Machine used (CT machine): -Asia hospital: optima 16 slice computed tomography machine., Alzytoona hospital: lightning Aquilion 16 slice computed tomography machine, Aliaa 1 hospital: Toshiba 64 slice computed tomography machine, Aliaa 2 hospital: semen's 32 slice with 64 softwere computed tomography machine,

2-2 Methods: The data collected from patients refer to abdominal computed tomography exam with contrast or CTU. Then CT. number for cortex and medulla were taken from coronal section (without contrast) see figure 2-1, Then measurements of thickness of renal cortex and medulla were taken from contrast-enhanced coronal section scan from arterial phase at level of renal hilum.

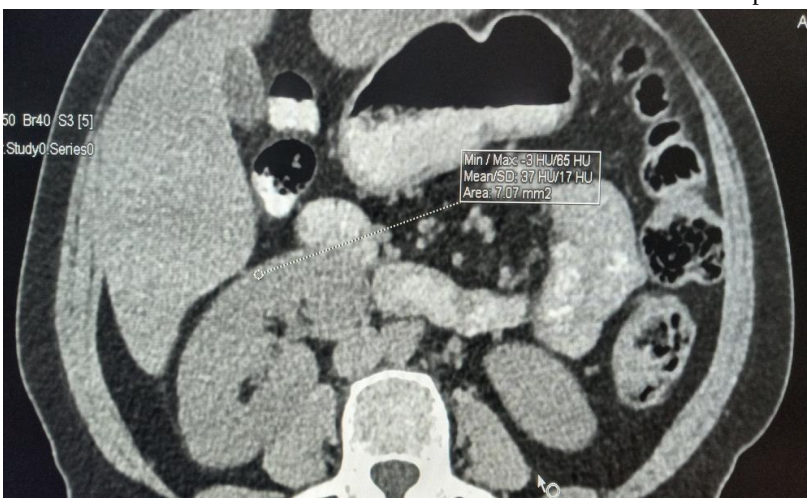

Fig (2-1): explained the way of measuring CT.NO for Rt. renal cortex (Aliaa hospital 2021).

2-2-1 CT Abdomen Technique: Most protocols of the abdomen are performed while the patient lies in a supine position on the scan table with the arms elevated above the head, the feet first entered to the CT gantry. The **Start location:** Just above diaphragm. **End location:** Just below symphysis pubis Patients are asked to hold their breath during scan acquisition to reduce movement and decrease motion artifacts. **Scouts:** AP and lateral , **Scan type:** Helical. **IV contrast:** 125 mL at 3.0 mL/s; 50 mL saline flush. Scan delay = 65 seconds. **Oral contrast:** 675 mL barium sulfate suspension (1.5 bottles Readi-Cat 2). An additional 225 mL (the remainder of the second bottle) given just before scanning. **DFOV:** ~38 cm (optimize for individual). A routine soft-tissue window setting (window width approximately 450; window level approximately 50) will adequately display most abdominal anatomy.

2-2-3 Data Analysis: Analytical statistic using statistic package (SPSS).

3. RESULTS

Table (3.1) frequency distribution of age in DM pts.

Age	Frequency	Percent	Valid Percent	Cumulative Percent
24-40	40	10.4	10.4	10.4
41-60	187	48.7	48.7	59.1
61-80	145	37.8	37.8	96.9
More than 80	12	3.1	3.1	100.0
Total	384	100.0	100.0	
Mean age 58.46±11.9				

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Table (3.2) frequency distribution of gender in DM:

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
Male	155	40.4	40.4	40.4
Female	229	59.6	59.6	100.0
Total	384	100.0	100.0	

Table (3-3): shows frequency distribution of control state of diabetic.

DM control status	Frequency	Percent	Valid Percent	Cumulative Percent
Control	296	77.1	77.1	77.1
Uncontrolled	88	22.9	22.9	100.0
Total	384	100.0	100.0	

Table (3-4) shows descriptive statistics measurements for means of Rt and LT Kidneys of case group:

Variables	N	Minimum	Maximum	Mean	Std. Deviation
Age	384	24	85	58.46	11.977
Rt K Cortical CT number	384	19.0	61.0	36.533	5.7854
Rt K Medulla CT number	384	9	43	25.33	5.262
Lt K Cortical CT number	384	21	58	36.50	6.209
Lt K Medulla CT number	384	11	49	25.19	5.726
Duration of DM	384	1	3	1.99	.805
Valid N (listwise)	384				

Table (3.5) correlation of measurements of kidneys with age and duration in case group:

Variables		Age	Duration of DM
Rt K Cortical CT number	Pearson Correlation	-.064	-.174**
	Sig. (2-tailed)	.214	.001
	N	384	384
Rt K Medulla CT number	Pearson Correlation	-.112*	-.149**
	Sig. (2-tailed)	.028	.003
	N	384	384
Lt K Cortical CT number	Pearson Correlation	-.009	-.216**
	Sig. (2-tailed)	.865	.000
	N	384	384
Lt K Medulla CT number	Pearson Correlation	.013	-.188**
	Sig. (2-tailed)	.806	.000
	N	384	384

Table (3.6) compares mean measurements in control DM pts.Versus patients with un control DM

Group Statistics						
	DM control status	N	Mean	Std. Deviation	Std. Error Mean	p- value
Rt K Cortical CT number	Control	296	36.219	5.6827	.3303	0.06
	Un control	88	37.591	6.0318	.6430	
Rt K Medulla CT number	Control	296	25.21	5.370	.312	0.38
	Un control	88	25.74	4.891	.521	

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Lt K Cortical CT number	Control	296	36.48	6.564	.382	0.92
	Un control	88	36.55	4.859	.518	
Lt K Medulla CT number	Control	296	25.22	5.885	.342	0.84
	Un control	88	25.09	5.183	.553	

Table (3.7) Comparison between mean of measurements in cases and control groups

Group Statistics

	group	N	Mean	Std. Deviation	Std. Error Mean	P value
Rt K Cortical CT number	Case	384	36.533	5.7854	.2952	0.852
	Control	138	36.420	6.9280	.5898	
Lt K Medulla CT number	Case	384	25.19	5.726	.292	0.582
	Control	138	24.86	6.518	.555	
Rt KMedulla CT number	Case	384	25.33	5.262	.269	0.872
	Control	138	25.41	5.468	.465	
Lt K Cortical CT number	Case	384	36.50	6.209	.317	0.615
	Control	138	36.57	6.162	.525	

4. DISCUSSION

The current study showed that the mean age was 58.5 years, with individuals aged 24-40 years comprising (10.4%) of the case group. The 41-60 age bracket accounted for the largest portion at (48.7%), while those aged 61-80 made up (37.8%), and individuals over 80 years represented (3.1%) table (3-1). A total of (384) patients were included in the study, with females outnumbering males; females represented 229 patients (59.6%), while males accounted for 155 patients (40.4%).as shown in table(3-2).

In the distribution of diabetic control, the controlled DM cases numbered (296), accounting for (77.1%), while uncontrolled DM cases totaled (88) table (3-3), making up (22.9%). The average measurements for the right and left kidneys in the case group were (Rt K Cortical CT number, Rt K Medulla CT number, Lt K Cortical CT number, Lt K Medulla CT number) with averages of (36.53), (25.33), (36.5), and (25.19), respectively table (3-4). Concerning the correlation among kidneys measurements (Rt K Cortical CT number, Lt K Cortical CT number, Lt K Medulla CT number) and the age of the case group, the corresponding Pearson Correlation Coefficients are (.214, .86, .80). This indicates that there is no statistically significant correlation between the kidneys' measurments and the age of the case group, except for a weak reverse correlation noted between Rt K Medulla CT number and age (p-value: .028). This suggests that Rt K Medulla CT number decreases as age increases, as presented in table (3-5) This study by Elbashir, S.A (10) revealed that there was no statistically significant correlation with CT. Numbers and age in diabetes patients $p > .05$.In compression between control and un control DM found there was no deference's in means in the measurements of both kidney between control and un control groups (Rt K Cortical CT number, Rt K Medulla CT number, Lt K Cortical CT number, Lt K Medulla CT number), p v (0.06, 0.38, 0.92, 0.84) respectively. Table (4:6).

comparing mean of measurements between cases and control groups found that there were no difference between case and controle groups in (Rt K Cortical CT number, Lt K Medulla CT number, Rt K Medulla CT number, Lt K Cortical CT number) pv (0.852, 0.582, 0.872, 0.615) table (3-7) implies that the diabetes had no effect on cortex and medulla CT number.). this associated with study of Elbashie, S.H (2016)(10)found in his study there were no statisticallysignificant differences among the two groups in means of (Rt. Medulla CT. number and Lt. Medulla CT. number.) $p > .05$.

5. CONCLUSION

The results indicated that the average CT number measurements for both kidneys revealed no statistically significant correlation between the kidney measurements and the age of the case group, although there was a decrease in the Rt K Medulla CT number as age increased. The diabetes did not influence the CT numbers of the cortex and medulla, so the computed tomography findings can assist in diagnosing renal diabetes.

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