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Paper Title: Measurement of Kidney Volume using Multidetector Computed Tomography in Saudi Population

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ABSTRACT

Introduction: In the clinical setting, kidney size determination is crucial since it can help with decision-making regarding the management approach. Multidetector computed tomography (MDCT) has made it possible to estimate the mass or organ volume. When measuring organ volume, the MDCT, which produces 3-D reconstruction images, is especially accurate.

Objectives: This study aimed to measure kidney volume by using MDCT.

Methods: The data used in this study was collected from Dar Alshefa Hospital from June 2024 to July 2024. A total of 50 patients were examined in the CT department with the Geb machine Optima16 slice.

Results: The study is based on measurements of renal dimensions to determine the relationship between age and volume, and renal ellipsoid were the three measuring tools used These were done to obtain: renal length, width, and thickness to estimate the renal volume. These characteristics were utilised to model the renal volume equation with the spss and to compute renal volume using the rotational renal ellipsoid and it became clear to us that the most patients in the age group (36-50) were 21(42%) then the age group (20-35) were 16(32%) then (51-65) were 9 (18%) and at last age group (>65) were 4(8%).there was a statistically significant difference in LT length between males and females(sig=0.033) with mean (95.4(16.8)mm for males and (100.4(8.6)mm for females and in RT volume (sig.=0.035) with mean(133(48.3) cm3 for males and (115.8(32.1) cm3 for females and there was statistically insignificant difference in other kidneys measurements between males and females (sig.>0.05). The mean of Age (43.1(14.3) yrs, LT length (97.3(14.4)mm, LT width (49.1(8.5)mm, LT thickness (50.9(7.5)mm, LT volume (129.8(40.8)cm3, RT length (94.9(17)mm, RT width (46.7(7.2)mm, RT thickness (53.4(9.4)mm and RT volume (126.5(43.4) cm3 there was statistically significant correlation between gender and RT width (p-value = 0.00) and was statistically insignificant correlation between gender and other kidneys measurements (p-value > 0.05), between age and all kidneys measurements (p-value > 0.05

Conclusions: The study concluded that most patients were male in the age group (36-50) the mean LT volume was (129.8-40.8) cm^3 RT volume was (126.5-43.4) cm^3, there was a statistically significant correlation between gender and RT width, there was a statistically significant difference in LT length and RT volume between males and females.

Keywords: MDCT, Kidney volume

INTRODUCTION

The assessment of kidney size is significant in the clinical sector since it can help with management decisions [1]. Since kidney length is easily assessed with ultrasonography (US), it has historically been employed as one of numerous indicators of kidney size. However, kidney length cannot accurately indicate kidney mass due to the complexity of the kidney's form. Furthermore, kidney length as determined by the US has low repeatability and is subject to inter-observer variability [2]. When it comes to identifying renal problems, kidney volume is a more sensitive indicator of kidney size than kidney length [3]. Additionally, it has a strong correlation with body indices and is a great predictor of renal function [4]. Moreover, the prognosis of the graft kidney is independently determined by the pre-transplant renal volume [5]. The US can measure kidney volume, but it requires the use of ellipsoid formulas for the kidney's three-dimensional value [3]. Moreover, the prognosis of the graft kidney is independently determined by the pre-transplant renal volume [6]. It is now possible to quantify the mass or organ volume thanks to the advancement of increasingly complex imaging techniques like magnetic resonance imaging (MRI) and multi-detector computed tomography (MDCT). When it comes to measuring organ volume, the MDCT, which produces 3-D reconstruction pictures, is especially accurate [8]. The most recent advancement in helical CT technology is multi-detector row computed tomography (CT), which acquires interwoven helical sections by simultaneously activating multiple detector rows arranged along the z-axis. When compared to single-detector CT, multidetector CT technology enables faster data acquisition times (2.6 times faster on average for four-detector row CT) without sacrificing image quality. Short gantry rotation intervals and several detectors offering greater coverage allow for quick data collecting times.

Following the administration of a single intravenous contrast bolus, this combination, in conjunction with brief interscan delays, permits the collection of images along the z-axis in various stages of renal contrast material excretion and parenchymal enhancement.

The renal parenchyma and collecting system, as well as the kidney's arterial and venous supply, can thus be optimised for evaluation. Better z-axis spatial resolution is another benefit of multidetector CT. The user does not have to set a specific section thickness beforehand when using multidetector CT; instead, they can choose a specific beam collimation. Once data collection is complete, this option can be used. In addition to producing magnificent 3D images of the renal arteries and veins that are on par with traditional venograms and angiograms, thinner collimation enhances the quality of three-dimensional (3D) data sets. Conventional urography may be avoided with 3D reformations of the collecting system.

OBJECTIVES.

The aim of this study was to measure the kidney volume by using MDCT examinations. To determine the relationship between age and kidney size. To know the differences in kidney size between men and women, calculate the kidney volume by using an ellipsoid formula for patients without renal disease, To monitor changes in kidney size over time.

METHODS

Study Design, Duration, and Study area This is a cross-sectional analytic study focusing on kidney measurement by using a. CT scan. The data used in this study was collected from DarAlshefa Hospital in the Kingdom of Saudi Arabia. This study will be carried out from June 1st to July 15, 2024.

Study Population and sample size: Fifty patients The sample of this study included a male and female patient of different ages who came to the CT department with an abdomen examination.
Inclusion criteria: All children and adult participants age from 1 to 80 years old.
Exclusion criteria: pregnant women, patients with known hypersensitivity to contrast media, Population below 1 year
The Sample Size Equation: Renal volume is calculated by using the ellipsoid formula:
Volume = length × width × thickness × π/6.
CT machines: In this investigation, data was gathered using CT equipment. The radiological department has this machine installed. Before any data was collected, the machines underwent all quality control checks. The range of the data was acceptable. It's were as follows Manufacturer: Hitachi. Model: Eclos.Installation:2013 No. of Detectors:16slice. made in: Japan.
Technique of Data Collection and Manipulation: After that CT images were stored in computer memory as DICOM images were viewed by the radiant, Ant, DICOM in the computer and then selected the image and uploaded into the radiant, Ant, DICOM in the clearest area to measurement right and left kidney in the three section axial, coronal and sagittal section. In the axial section, we measured the width, in the coronal section we measured the length, in the sagittal section we measured the thickness. We made a standard for two different volumes, summation volume by using the equation equal Volume = length × width × thickness × π/6 as the following table: (All the Data inter and manipulate by use Microsoft Excell such as the following

Pt. No, Age, Gender CT Finding-RT kidney CT Finding-RT kidney M/F, CT length CT width, CT thickness CT length, CT width and CT thickness

RESULTS

Table 1 shows the difference between males and females in kidneys measurement

Table1. Shows descriptive statistics of study variables:

	N	Minimum	Maximum	Mean	Std.Deviation
Age	50	20	77	43.1	14.3
LT length	50	43	125	97.3	14.4
LT width	50	31.9	79.8	49.1	8.5
LT thickness	50	38.5	66	50.9	7.5

Table 2. Shows descriptive statistics of study variables

LT volume	50	40.7	251.9	129.8	40.8
RTlength	50	10.7	122	94.9	17
RTwidth	50	30.6	59	46.7	7.2
RTthickness	50	36.3	72	53.4	9.4
RTvolume	50	13	226.5	126.5	43.4

Table 3: Shows difference between age groups in kidneys measurements

	Gender	N	Mean	Std.Deviation	Sig.
LT length	Male	31	95.4	16.8	0.033
	Female	19	100.4	8.6	
LTwidth	Male	31	50.2	6.7	0.142
	Female	19	47.4	10.9	
LT thickness	Male	31	51.6	6.9	0.086
	Female	19	49.8	8.5	
LT volume	Male	31	132.4	40.2	0.663
	Female	19	125.6	42.4	
RT length	Male	31	92.8	19.4	0.419
	Female	19	98.3	11.8	
RT width	Male	31	49.7	6.7	0.147
	Female	19	41.9	5.1	
RT thickness	Male	31	53.8	10.1	0.269
	Female	19	52.8	8.4	
RT volume	Male	31	133	48.3	0.035
	Female	19	115.8	32.1	

Age		LT.L	LT.W	LT.Th	LT.V
(20-35)	Mean	95.4	47	50.1	120.1
	N	16	16	16	16
	Std.	17.8	6.3	8.3	40.1
(36-50)	Mean	97.9	51.6	52.3	139.5
	N	21	21	21	21
	Std.	12.1	9.9	7.7	40.9
(51-65)	Mean	101.6	51.4	52.3	144.7
	N	9	9	9	9
	Std.	14	6.2	4.8	33.8
(>65)	Mean	92.1	40	43.5	83.6
	N	4	4	4	4
	Std.	13.4	5.8	5.3	15.7
Total	Mean	97.3	49.1	50.9	129.8
	N	50	50	50	50
	Std.	14.4	8.5	7.5	40.8
Sig.		0.7	0.0	0.2	0.0

DISCUSSION

This was a cross-sectional analytical study aimed at measuring kidney volume using multi-detector computed tomography, conducted at Dar Al Shefa Hospital in the Kingdom of Saudi Arabia during the period from June to July 2024, 50 patients with age range 20-77 years were referred to the CT department for examination.

The results found that the most patients were male 31(62%) and female 19(38%).

Also, the results found that the most patients in the age group (36-50) were 21(42%) the age group (20-35) were 16(32%) then (51-65) were 9(18%), and at last age group (> 65) were 4(8%); Table, Figure (3).

The results found that the mean of Age (43.1-14.3)yrs, LT length (97.3-14.4)mm, LT width (49.1-8.5)mm, LT thickness (50.9-7.5)mm, LT volume (129.8-40.8) cm3, RT length (94.9-17)mm, RT width (46.7-7.2) mm, RT thickness (53.4-9.4) mm and RT volume (126.5-43.4) cm3; Table (2).

From correlations between age, gender, and kidney measurements the study found that there was a statistically significant correlation between gender and RT width (p-value = 0.00) and was statistically insignificant correlation between gender and other kidney measurements (p-value > 0.05), between age and all kidneys measurements (p-value > 0.05). Table (1).

The results found that there was a statistically significant difference in LT length between males and females

(sig=0.033) with mean (95.4-16.8)mm for males and (100.4-8.6)mm for females and in RT volume (sig.=0.035) with mean (133-48.3)cm3for males and (115.8-32.1)cm3 for females and there was statistically insignificant difference in other kidneys measurements between males and females (sig. > 0.05); Table (1).

The results found that there was a statistically significant difference in LT width and LT volume between age groups (sigs.=0.0) and there was a statistically insignificant difference in other kidney measurements between age groups (sig.>0.05); Table (4.6).

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