International Journal Dental and Medical Sciences Research (IJDMSR)
ISSN: 2393-073X Volume 4, Issue 1 (January-2020), PP 18-22
www.ijdmsr.com

Characterization of Renal and Ureteral Stones using Computed Tomography and Ultrasound

Tayseer E. G. Mousa*, E. Mohamed Ahmed, Eman M. Algorashi, Mohamed Elfadil M. Gar-elnabi
Sudan University of Science and Technology, College of Medical Radiological Science, Khartoum, Sudan
Corresponding author: Tayseer Mousa
Email: titaelhadi@yahoo.com

ABSTRACT:- This Study is intended to Classification of Renal Stone Type Using Ultrasound Machine in Elobied in the Sudan. The stone type was measured to 90 patients using CT +U/S, in three centers in Elobied, were the mean stone density in this study was found to be 808 HU, the mean of stone length was found 1.54cm, the mean stone width was found 1.09 cm, while the mean age of patient was 49 years and the mean stone Area was 2.27cm^{2,} 12 patient female and 78males, 61 patient type one and 29 type two. the frequency distribution for stone site and stone type for all patients were the site was right and left with 28 and 62 patients and the type was T1 and T2 with 61 and 29 patients respectively, the relation between the stone density and length for all patients, show that the rate of change for the stone length was 0.0011 for each HU. The relation between the stone density and stone area for all patients, show that the rate of change for the stone area was 0.0027 for each HU

Keywords: Renal Stone, Kidney diseases, Computed Tomography, Ultrasound

I. INTRODUCTION

Ultrasonography (US) is an accessible, relatively inexpensive imaging method that comes without the risks of exposure to ionizing radiation entailed by CT [1]. Kidney diseases are on rise throughout the world and majority people with kidney disease do not notice the disease as it damages the organ slowly before showing symptoms. The increasing number of patients with kidney diseases leads to a high demand of early detection and prevention of kidney diseases. It is well known that ultrasound (US) can be used as an initial evaluation to estimate kidney size and position, and help to diagnose structural abnormalities as well as presence of cysts and stones. However, diagnosis of kidney diseases and abnormalities using ultrasound demands decision from experts as US images suffer from speckle noise. Speckle has variation of gray level intensities. Therefore, to enhance quality of these images, some image processing techniques are usually applied for better understanding of hidden information as well as for extracting some parameters or features that will be useful for diagnosis of the images. Current estimates are that 30 million (1 in 11) Americans will experience a kidney stone within their lifetime, and up to 50% of new stone formers will have a recurrence, within as early as 5 years . The data suggest the incidence of kidney stones will continue to grow with our increasing obesity and diabetes rate, and even climate change.

Detection of urinary stones on ultrasound (US) may be problematic when the stones are obscured by ultrasonic beam-attenuating tissue, such as renal sinus fat, mesenteric fat, and bowel, or when their posterior acoustic shadowing is weak [2-4]. Despite the technical advances of US, radiologists have difficulty confirming or excluding the presence of urinary stones when the gray-scale findings are indeterminate. The twinkling sign is a color-flow US artifact described behind calcifications and presenting as a random color encoding in the region were shadowing would be expected on gray-scale images [5]. Recent studies have reported that the twinkling sign may be useful for detection of urinary stones [6-8].

Classification and pathophysiology: Kidney stones are broadly categorised into calcareous (calcium containing) stones, which are radio-opaque, and non-calcareous stones. On the basis of their composition, stones are classified as shown in the table. The figure shows multiple calcium oxalate stones. Recent evidence indicates that formation of kidney stones is a result of a nanobacterial disease akin to Helicobacter pyloriinfection and peptic ulcer disease [9]. Nanobacteria are small intracellular bacteria that form a calcium phosphate shell (an apatite nucleus) and are present in the central nidus of most (97%) kidney stones and in mineral plaques (Randall's plaques) in the renal papilla. Further crystallisation and growth of stone are influenced by endogenous and dietary factors. Urine volume, solute concentration, and the ratio of stone inhibitors (citrate, pyrophosphate, and urinary glycoproteins) to promoters are the important factors that influence crystal formation. Crystallisation occurs when the concentration of two ions exceeds their saturation point in the solution.

Risk factors for kidney stones: A precise causative factor is not identified in most cases. A family history of kidney stones (increases risk by three times), insulin resistant states, a history of hypertension, primary hyperparathyroidism, a history of gout, chronic metabolic acidosis, and surgical menopause are all associated with increased risk of kidney stones [10–16]. In postmenopausal women, the occurrence of kidney stones is associated with a history of hypertension and a low dietary intake of magnesium and calcium [17]. Incidence of stones is higher in patients with an anatomical abnormality of the urinary tract that may result in urinary stasis (box 1). Most patients (up to 80%) with calcium stones have one or more of the metabolic risk factors shown in box 2, and about 25% of stones are idiopathic in origin. Box 3 shows the various drugs that increase the risk of stone disease.

II. METHODOLOGY:

This Study Intended to classification of renal stone using U/S scan from different soft images of U/S machine during abdomen U/S. The data of this Study was collected from three clinical centers in Elobied.(University of kordufan diagnostic centre, Elsalama clinic Centre and eldaman hospital) and by data sheets, U/S soft image and CT KUB reports , the data has been collected from April 2019 to October 2019.

Patient samples: A total of 90 patients were examined in three centers in Elobied. Table 3.2 (Excel) shows the number of all patients, Data were collected using a data collection sheet for all patients in order to maintain consistency of the information. The following parameters were recorded (Pt code, age, Gender, Stone density, stone size derived from (width* length) cm and Stone site) were recorded.

Imaging technique:-

A kidney ultrasound may be performed on an outpatient basis or as part of your stay in a hospital. Although each facility may have different protocols in place, generally an ultrasound procedure follows this process:

You will be asked to remove any clothing, jewelry, or other objects that may interfere with the scan. If asked to remove clothing, you will be given a gown to wear. You will lie on an examination table on your abdomen. Ultrasound gel is placed on the area of the body that will undergo the ultrasound examination. Using a transducer, a device that sends out the ultrasound waves, the ultrasound wave will be sent through that patient's body. The sound will be reflected off structures inside the body, and the ultrasound machine will analyze the information from the sound waves.

The ultrasound machine will create images of these structures on a monitor. These images will be stored digitally. If the bladder is examined, you will be asked to empty your bladder after scans of the full bladder have been completed. Additional scans will be made of the empty bladder.

There are no confirmed adverse biological effects on patients or instrument operators caused by exposures to ultrasound at the intensity levels used in diagnostic ultrasound. While the kidney ultrasound procedure itself causes no pain, having to lie still for the length of the procedure may cause slight discomfort, and the clear gel will feel cool and wet. The technologist will use all possible comfort measures and complete the procedure as quickly as possible to minimize any discomfort.

In CTKUB You may be asked to change into a patient gown. If so, a gown will be provided for you. A locker will be provided to secure personal belongings. Please remove all 1piercings and leave all jewelry and valuables at home. are most frequently done with and without a contrast media. The contrast media improves the radiologist's ability to view the images of the inside of the body. Some patients should not have an iodine-based contrast media. If you have problems with your kidney function, please inform the access center representative when you schedule the appointment. You may be able to have the scan performed without contrast media or have an alternative imaging exam. The most common type of CT scan with contrast is the double contrast study that will require you to drink a contrast media before your exam begins in addition to the IV contrast. The more contrast you are able to drink, the better the images are for the radiologist to visualize your digestive tract.

Table 1. show statistical parameters for all patients:

Variables	Age	density	Stone length	Stone Width	Stone area
Mean	49.26	808.41	1.548	1.094	2.272
Median	50.00	727	1.300	1.065	1.43
Std. Deviation	23.82	411.44	0.927	0.671	3.395
Minimum	6	139	.4	0.3	0.16

Maximum	80	1460	5.3	3.6	19.08

Table 2. show frequency distribution for stone site and stone type:

	Stone Site	Frequency	Percent	Stone type	Frequency	Percent
	Right	28	30.1	T1	61	67.8
	Left	62	68.9	T2	29	32.2
	Total	90	100.0	Total	90	100.0

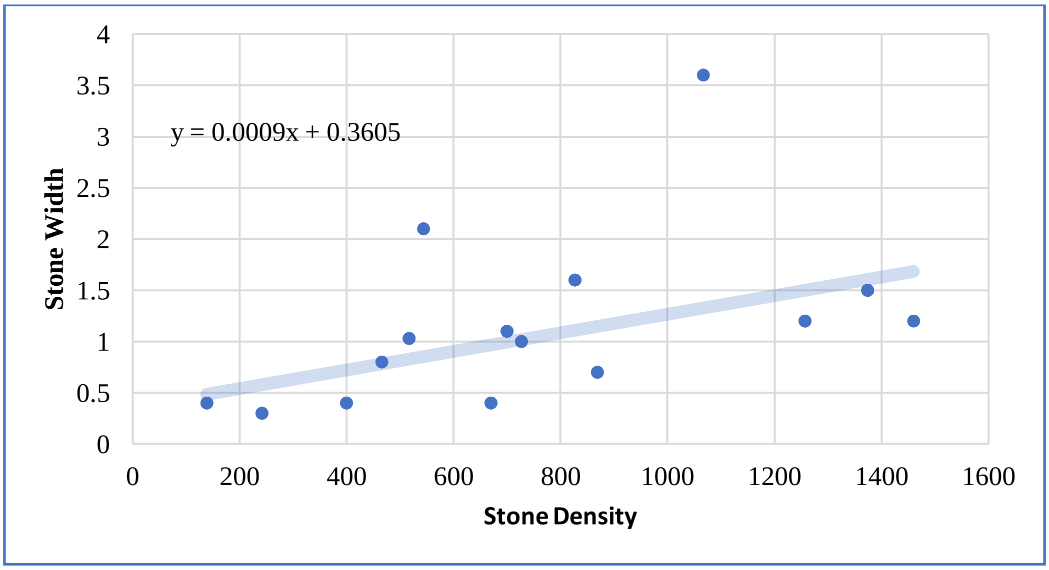

Figure 1. correlation between the stone density and with for all patients

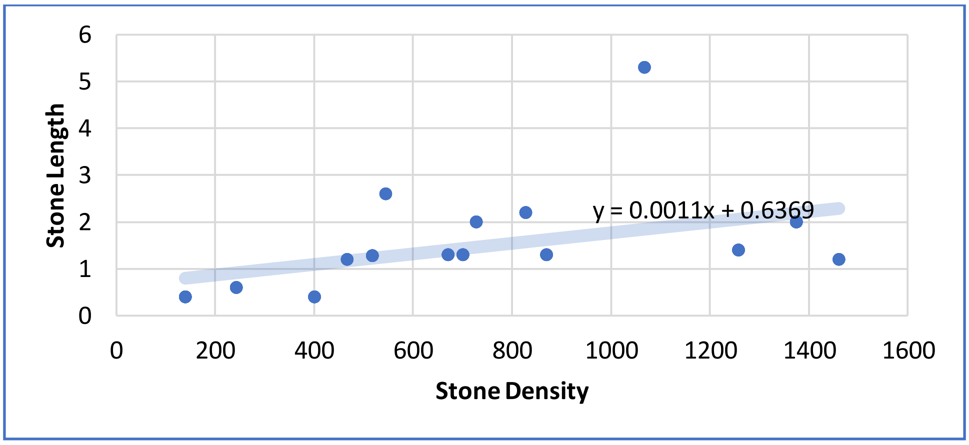

Figure 2. correlation between the stone density and length for all patients

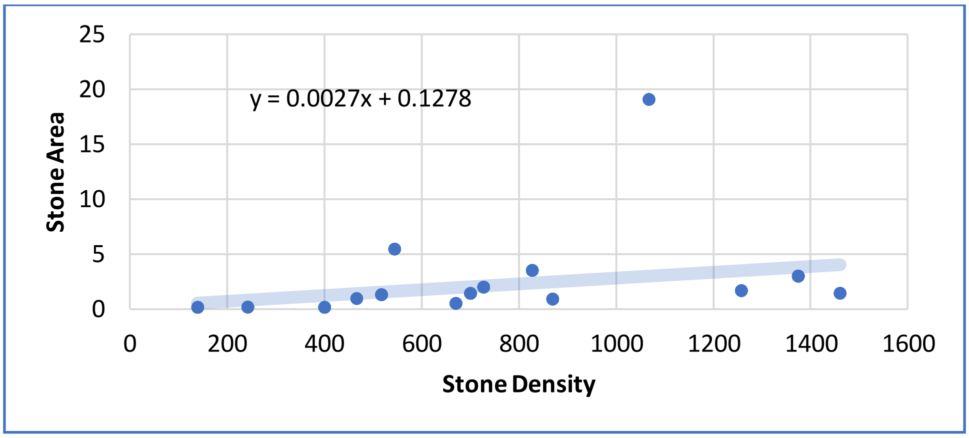

Figure 3. correlation between the stone density and area for all patients

Table 3. show analysis of variance for patients ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
density	Between Groups	12189119.789	11	1108101.799	30.040	.000
	Within Groups	2877200.000	78	36887.179		
	Total	15066319.789	89			
Stone length	Between Groups	41.422	11	3.766	8.381	.000
	Within Groups	35.045	78	.449		
	Total	76.467	89			
Stone Width	Between Groups	25.291	11	2.299	12.162	.000
	Within Groups	14.746	78	.189		
	Total	40.036	89			
Stone area	Between Groups	391.168	11	35.561	4.369	.000
	Within Groups	634.839	78	8.139		
	Total	1026.007	89			

III. DISCUSSIONS:

This Study is intended to Classification of Renal Stone Type Using Ultrasound Machine in Elobied N.K.S in the Sudan. The stone type was measured to 90 patients (CT +U/S) in three centers in Elobied,

Statistical parameters presented as mean, median. Standard deviation, minimum and maximum for the stone density, stone length, width and area. Were the mean ± STD for the age 49.26 ± 23.82 years, for stone density 808.41 ± 411.44 HU, for stone length, width and area was 1.548 ± 0.927 cm, 1.094 ± 0.671 cm and 2.272 ± 3.395 respectively. As shown in table 1.

Table 2. show the frequency distribution for stone site and stone type for all patients were the site was right and left with 28 and 62 patients and the type was T1 and T2 with 61 and 29 patients respectively. The relation in fig 1. between the stone density and with for all patients, show that the rate of change for the stone width was 0.0009 for each HU.

The relation between the stone density and length for all patients, show that the rate of change for the stone length was 0.0011 for each HU. As shown in fig 2. The relation between the stone density and stone area for all patients, show that the rate of change for the stone area was 0.0027 for each HU, as shown in fig 3. Table 3. show analysis of variance for patients were the p. value show that there is a significant difference between the patients age with the stone parameters 0.00.

IV. CONCLUSION:

This Study is intended to Classification of Renal Stone Type Using Ultrasound Machine in Elobied N.K.S in the Sudan. The stone type was measured to 90 patients (CT +U/S) in three centers in Elobied, the mean stone density in this study was found to be 808HU, the mean of stone length was found 1.54cm, the mean stone width was found 1.09cm, while the mean age of patient was 49 years and the mean stone Area was 2.27cm^{2,} 12 patient female and 78males, 61 patient type one and 29 type two. the frequency distribution for stone site and stone type for all patients were the site was right and left with 28 and 62 patients and the type was T1 and T2 with 61 and 29 patients respectively, the relation between the stone density and length for all patients, show that the rate of change for the stone length was 0.0011 for each HU. The relation between the stone density and stone area for all patients, show that the rate of change for the stone area was 0.0027 for each HU.

REFERENCES:

[1]. Brenner DJ, Hall EJ. Computed tomography–an increasing source of radiation exposure.N Engl J Med2007; 357: 2277–84
[2]. McConnell JD: Ultrasonography of the kidney. Semin Urol. 1994; 12: 333-40.
[3]. King W 3rd, Kimme-Smith C, Winter J: Renal stone shadowing: an investigation of contributing factors. Radiology. 1985; 154: 191-6.
[4]. Kimme-Smith C, Perrella RR, Kaveggia LP, Cochran S, Grant EG: Detection of renal stones with real-time sonography: effect of transducers and scanning param eters. AJR Am J Roentgenol. 1991; 157: 975-80.
[5]. Rahmouni A, Bargoin R, Herment A, Bargoin N, Vasile N: Color Doppler twinkling artifact in hyperechoic regions. Radiology. 1996; 199: 269-71.
[6]. Chelfouh N, Grenier N, Higueret D, Trillaud H, Levan tal O, Pariente JL, et al.: Characterization of urinary calculi: in vitro study of “twinkling artifact” revealed by color-flow sonography. AJR Am J Roentgenol. 1998; 171: 1055-60.
[7]. Aytaç SK, Ozcan H: Effect of color Doppler system on the twinkling sign associated with urinary tract calculi. J Clin Ultrasound. 1999; 27: 433-9.
[8]. Lee JY, Kim SH, Cho JY, Han D: Color and power Doppler twinkling artifacts from urinary stones: clinical observations and phantom studies. AJR Am J Roentgenol. 2001; 176: 1441-5
[9]. Ciftcioglu N, Bjorklund M, Kuorikoski K, Bergstrom K, Kajander EO. Nanobacteria: an infectious cause for kidney stone formation.Kidney Int 1999;56:1893-8.
[10]. Curhan GC, Willett WC, Rimm EB, Stampfer MJ. Family history and risk of kidney stones.J Am Soc Nephrol1997;8:1568-73.
[11]. Sakhaee L, Adams-Huet B, Moe OW, Pak CYC. Pathophysiologic basis for normouricosuric uric acid nephrolithiasis.Kidney Int2002;62: 971-9.
[12]. Cappuccio FP, Siani A, Barba G, Mellone MC, Russo L, Farinaro E, et al./A prospective study of hypertension and the incidence of kidney stones in men.J Hypertens1999;17:1017-22.
[13]. Mollerup CL, Vestergaard P, Frokjaer VG, Mosekilde L, Christiansen P, Blichert-Toft M. Risk of renal stone events in primary hyperparathy roidism before and after arathyroid surgery: controlled retrospective follow up study.BMJ2002;325:807.
[14]. Kramer HJ, Choi HK, Atkinson K, Stampfer M, Curhan GC. The associa tion between gout and nephrolithiasis in men: the health professionals’ follow-up study.Kidney Int2003;64:1022-6.
[15]. Baldwin DN, Spencer JL, Jeffries-Stokes CA. Carbohydrate intolerance and kidney stones in children in the Goldfields.J Paediatr Child Health 2003;39:381-5.
[16]. Mattix Kramer HJ, Grodstein F, Stampfer MJ, Curhan GC. Menopause and postmenopausal hormone use and risk of incident kidney stones.J Am Soc Nephrol2003;14:1272-7.
[17]. Hall WD, Pettinger M, Oberman A, Watts NB, Johnson KC, Paskett ED, et al. Risk factors for kidney stones in older women in Southern United States.Am J Med Sci2001;322:12-8.

Corresponding author: Tayseer Mousa
Sudan University of Science and Technology, College of Medical Radiological Science, Khartoum, Sudan