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Characterization of Renal Stones by Computed Tomography and Ultrasound

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Abstract

This study assessed the effectiveness of computed tomography and ultrasound in the diagnosis of renal stone and compared between two images modalities when they are applied for the same cases. It was conducted at radiology departments in Al-amal hospital _ Khartoum. This study was expanded from August 2011 up to December 2011. Random samples of 50 patients, 35males (70%)and 15 females (30%)their ages range from 15 to 72 years old with symptoms of renal stones were chosen, spiral CT and US were done to explain the suitable technique that demonstrate renal stones clearly. The most affected age group from 21-40 years old represent 56 %, most patients were affected in the both sides, with no history of renal stones in their families, kidneys were the most affected area, and Most patients suffer from kidney stones (36%) and ureters 6%). Ultrasound images have a role in the diagnosis of renal stones but CT scan is better and more sensitive. These results are established by account the number of appearances that showing in CT images and compared them with those appeared in ultrasound images It can be said that the two image modalities were performed together and used as essential techniques of renal stones, which help to obtain accurate diagnosis and demonstrate any changes that can affect urinar systems by stones.

Key Words: Renal Stones.CT Scan,Ultrasound.

INTRODUCTION

Urinary tract stones are common, with a lifetime incidence of up to 12% and recurrence rates of up to 50%. In diagnostic and treatment algorithms, stone burden is the most important factor to consider and forms the basis of all clinical decision making (Teichman 2004).Thus, accurate measurement of all calculi is crucial. Since its introduction (Smith et al 1995), unenhanced helical computed tomography (CT) has replaced intravenous urogram and is now regarded as the reference standard in the work-up of renal colic, owing to its high sensitivity and specificity (Smeth, et al1995). Apart from being the diagnostic standard, CT has the advantage of providing detailed anatomical information, can identify secondary signs of stone passage, and is useful for ruling out alternate pathologies in cases of diagnostic uncertainty. Despite the advantages of unenhanced CT, ultrasound (US) is also commonly used as a diagnostic tool in the management of urolithiasis. US is recognized to be both less sensitive and specific than CT; however, it is commonly available, inexpensive to operate and poses no risk of radiation exposure. In many cases, renal and ureteric calculi are incidentally diagnosed in the workup of other conditions. It has been reported that US may detect stones as small as 0.5 mm under optimal conditions. For these reasons, some centers may still use US in the initial work-up of renal colic (Catelano ,et al 2002).Up to date, there has been little direct comparison of the accuracy and reliability of US compared with CT in sudan.Non-contrast spiral CT is presently more extensively used for the diagnosis of urolithiasis, especially in the setting of acute flank pain in adult patients (Sheafor, et al 2000). However, there is little data published over the use of spiral CT in pediatric urolithiasis (Patlas, et al 2001)and (Unal, et al 2003).

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The presenting symptoms of children with stone disease are neither characteristic nor predictable and range from none to sepsis. Thus in pediatric patients with signs and symptoms suggestive of stone disease, radiologic studies are necessary for making an accurate diagnosis.Classically kidney, ureter and bladder plain films (KUB), ultrasound (US) and intravenous urography (IVU) have been utilized for this purpose. However, very little information exists in literature evaluating the accuracy of these modalities in the diagnosis of stones in the pediatric population. Given that the imaging of stones in children with conventional techniques has generally been non-satisfactory due to problems related to intestinal gas and smaller stone size in children, one may expect that spiral CT would be very beneficial for this age group (Unal, et al 2003) and(Hamm, et al 2003). This study aimed to evaluate the role of ultrasound versus spiral CT in the diagnosis of urinary system calculi.

MATERIALS AND METHODS

This study was performed in Department of Radiology in ALamal Hospital in Khartoum state, in period of four months (August 2011- December 2011).

This study included 50 subjects (36 male and 14 female) with age range between from 17 to 70. Study cases were selected from patient referred to CT department in ALamal hospital for CT KUB The variables that collected from each subject include: gender, age, body side, site, U/S finding and CT finding.

CT machine

The CT images were conducted using (TOSHIBA aquilion 64 slices) CT scanner. The scan parameter (3mm slice, 120 kvp, 225 MAS). And with using the electronic caliper within the scanner the following diameters were measured. The features of CT scanner are:256 slices in one rotation with .5mm slice thickness Coverage of 13cm in patient axis direction Advanced Sure Workflow software with PhaseXact Largest couch capacity in the industry – 180cm long by 47cm wide 40% dose reduction compared to previous models.

CT KUB technique

CT KUB (non contrast enhanced CT of kidney, ureter and bladder) is useful to determine the number and location of urinary tract calculi. It is used in some centers as primary investigation of renal calculi.The patient lies supine on CT scanner table.Scout view was obtained. A low radiation dose technique is used to scan from the top of the kidney to include the bladder base with slice thickness of 5 mm or less as determine by CT saner (no use of i.v. contrast) (France. 2009).

U/S machine

GE medical system LOQIC 5Expert ,made by yocogama medical systems .LTD –JAPAN – model 2302650 ,serial number 1028924,manufactured April 2005 ,Choice of transducer: -Use 3.5 MHz for adults, curvilinear probe, 5 MHz for children and thin adults. Setting the correct gain: -Start by placing the transducer longitudinal central and at the top of the abdomen (the xiphoid angle).Ask the patient to take a deep breath and hold it in. Angle the transducer beam towards the right side of the patient

Abdomen U/S technique

The patient should take nothing by mouth for 8 hours preceding the examination. If fluid is essential to prevent dehydration, only water should be given. Infants should be given nothing by mouth for 3 hours preceding the examination.

RESULTS

This data shows U/S and CT fining included 50 patients analyzed in tables and diagrams which showed below:

Ta ble (1) shows CT finding versus U/S in detection of affected side

Af fec te d side	U /S	C T
Le ft	6	13
R ight	6	4
B oth	10	14
Nil	28	19

Table (2) shows CT finding versus U/S in detection of site of the stone

S ite of the stone	C T	U /S
K idne y	22	18
U r eter	9	4
N ill	19	29

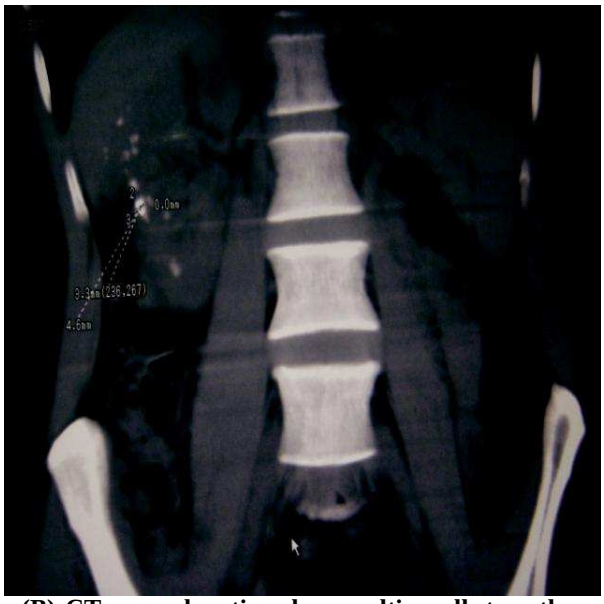
Table(3) shows CT versus US in detection of stone according to size in the kidney

Moda lity	Le ss tha n 5m m	M ore tha n 5m m
U/S	4	14
CT	8	14

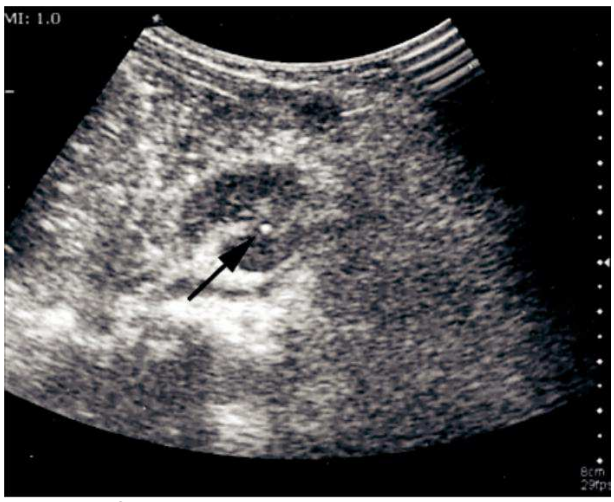
Table(3) shows CT versus US in detection of stone according to size in the in the ureter

M oda lity	L ess tha n 5mm	M ore than 5mm
U /S	0	2
C T	1	8

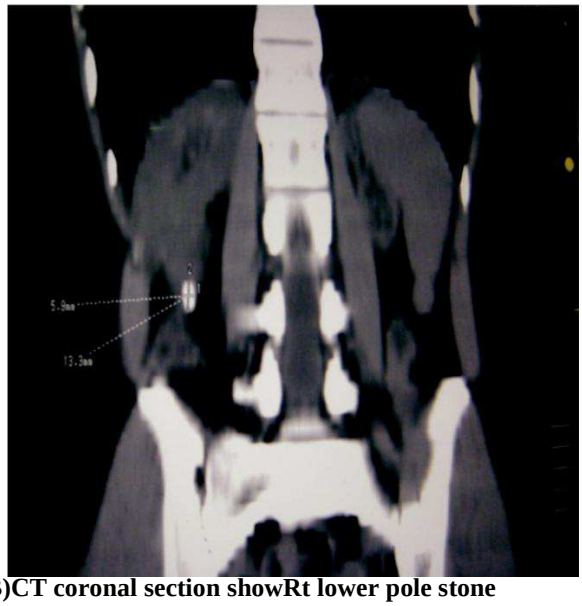
(A)U/S finding normal renal appearance no stone notice



(B) CT coronal section show multi small stone the largest one is 3.3 X 4.6



(A) U/S finding Rt kidney lower pole stone



(B)CT coronal section showRt lower pole stone

DISCUSSION

Recent studies have shown that non-contrast spiral CT is an excellent method for demonstrating renal stones in patients with suspected renal colic (Vieweg J., et al 1998) showed non-contrast CT to be more effective than IVU in identifying ureteral stones. In another comparative study, (Smergel E., et al 2001) noted that reformatted, noncontrast spiral CT images were superior to a combination of US and plain abdominal radiography for imaging ureteral calculi. In the current study, a comparison was made between spiral CT and US in 50 patients, with comparable results for the two modalities in the demonstration of renal calculi. In some cases it was difficult to measure stone size by CT and US . The visualization of renal stone with CT and US technique was obtained ,The consecutive CT and US scans from 50 patients were separated into urinary system and were evaluated; each image was analyzed separately. The present results agree with studied done by (Yilamz et al, 1997), PATLAS et al, 2001) and Oner et al 2004). 56% of patients in studied sample are aged from 21-41 years old and they are mostly affected by renal stone, while 34% of patients are over 40 years . US shows that both sides are affected equally ,While CT findings shows that left, sides were more affected , US shows that both 36% of total cases are affected in the Kidney, while Ureter obtained a lower proportion (8%) respectively.Those above present results were confirmed and agree with previous studies done by (Ronan et al, 2007) and Andrew et al,2010)) US, which is universally available, non-invasive, inexpensive and radiation free, is preferred by some radiologists as the initial method for evaluation of the renal stones. However, US is considered to be of limited value in demonstrating pathological conditions of the ureter (Myers et al 2001) . All patients with ureterolithiasis described had some degree of ureterohydronephrosis, hence US was able to follow the ureter to the level of the stone and demonstrate the exact nature of the obstructing lesion. An intraluminal echogenic focus with acoustic shadowing was clearly depicted in all cases. Technical problems might occur in assessing the ureter when the stone is in the middle third, an area often obscured by bowel gas so this problem solved by compressing the area to be examined and changing the patient's position. Dalla Palma (Strouse., 2002) evaluated 120 patients with renal colic using US and plain radiographs, and achieved 95% sensitivity but only 67% specificity.US was classified as positive for ureteric colic in the study when calculi or hydronephrosis were present. In this study, CT and US were equally sensitive in detecting renal calculi. In the study by Sommer et al, there were false negative US examinations owing to a lack of significant hydronephrosis detectable on the examination (Niall , et al 1999). In this study US was also accurate in depicting stones in cases of minimal hydronephrosis.

CONCLUSION

CT is the image modality to evaluate the renal stones, as the provides 'a road map , and excellent detail is available regarding to the anatomy, pathology and early diagnosis of urinary system so its very import factor in the disease management. both spiral CT and US were found to be excellent modalities for depicting renal stones, but because of high cost, radiation dose and high workload of CT, U/S is the first line of choice in diagnosis of renal calculi. US should be performed first in all cases and CT should be reserved for cases where US is unavailable or fails to provide diagnostic information.

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