Original Article

USG FOR DETECTING RENAL CALCULI WITH NON-ENHANCED COMPUTED TOMOGRAPHY AS A REFERENCE STANDARD

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Abstract

The aim of this study was comparison of sensitivity and specificity of Computed Tomography and ultrasound, to diagnose ureteral colic in those patients who present with lumbar pain. This study was conducted in Al-Noor Diagnostic Center, between 1st January, 2014 to 31st December, 2014. In this study 250 patients were investigated through imaging modalities i.e. CT and Ultrasound. Renal calculi were confirmed in 220 patients. The sensitivity of NECT was found 98% whereas of U/S was 73%. CT is the best and reliable technique to detect renal calculi however, Ultrasound was found preferred substitute to CT to lessen radiation dose.

Keywords Kidney ureter bladder, Nonenhanced helical computed tomography, Ultrasonography.

Introduction

Computed tomography (NECT) is now considered the prime imaging investigation in patients presenting with complaint of lumbar pain and there is suspicion of renal stone disease. Extraordinary sensitivity (98%) and specificity (99%) of helical NECT for delineating genitourinary calculi is recognized,[1] and NECT is of certain significance for distinguishing ureteral calculi, which as often as possible are not diagnosed with other imaging studies. With enhanced utilization of CT, intravenous pyelography and ultrasound (USG) have now auxiliary part in the assessing genitourinary stones.[2]

However, USG is still being performed in evaluating lumbar pain or for revealing calculi in the renal parenchyma and pelvis. USG is likewise done to identify small pieces of genitourinary stones after Shock Wave Treatment (ESWL). Sensitivity of USG for recognizing nephrolithiasis has been portrayed to be as awesome as 96% calculi in the renal parenchyma and pelvis in comparison to conventional tomography and abdominal KUB radiography.[3] However, the exact sensitivity of USG for renal stones may be considerably not as much of certain proof that radiography is not as accurate as prior assumed.[4]

The sensitivity of USG to recognize genitourinary stones in comparison to NECT is indistinct. Ascertaining the sensitivity of USG for renal calculi will permit valuable choices in regards to which kind of imaging investigation to undergo for a given clinical circumstances.

The dual aim behind current study is, with NECT

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KUB as standard imaging of reference, to carry out retrospective inquiry of the sensitivity and specificity of USG in differentiating genitourinary calculi and determination of USG precision to decide the dimensions and total number of calculi.

Materials and Methods

Our study incorporated 250 patients (165 male and 85 female patients; mean age, 45 years; age range, 14 – 88 years) who have undergone both NECT and USG of kidneys at Al-Noor Diagnostic Center, between 1st January, 2014 to 31st December, 2014. Patients were browsed those having a standardized NECT strategy for suspicion of renal stones and renal USG examination was likewise performed inside 05 days taking after or going before CT.

NECT was done by means of a 16 Slice scanner (Toshiba) and a standard protocol with 5.0 – mm collimation and 1.0 pitch (120 – 140 kVp, 300 mA). NECT Scan 5 mm slices, from top of kidney to end of urinary bladder, with reconstruction at 5 mm intervals. USG was done by using new-generation scanners (Aplio 50 Toshiba) and included of focused renal or abdominal imaging. USG comprised assessment of the kidneys in multiplanar anatomic planes.

USG and NECT studies were assessed in a blinded retrospective way. For every patient, the US images were studied before NECT. Size of stone (longest axis) and number were documented for both USG and NECT images. Site of every stone was verified. Renal calculi were identified on US images due to echogenic shadowing in parenchyma of kidney as well as pelvicalyceal system. Attenuated radio dense structures in genitourinary system were designated as criteria for the decision of renal calculi diagnosis on NECT scan study. Furthermore stone in the ureter and bladder were counted in this study.

Utilizing NECT as a reference, the sensitivity of USG for stones in kidney, ureter and bladder was ascertained. Classification of calculi was ordered on basis of size in sets of 0.0 – 3.0 mm, 3.1 – 7.0 mm, and bigger than 7.0 mm, as demonstrated that patient treatment is influenced by size of stone.[5] Stones were characterized as concordant if estimated size of calculi on both NECT and USG was in same group. And were designated discordant when measurements at USG and NECT images were different. The sensitivity and specificity for every genitourinary stone established by utilizing the retrospective NECT scan results as a reference.

Results

Of total 250 patients included in the study 220 (88%) patients were identified to have calculi on helical NECT scans. 162 (64.8%) patients showed calculi in the correlated ultrasound. 30 (12%) patients turned out to be normal on both non enhanced helical CT scan and ultrasound. The sensitivity of USG to identify calculi in the KUB region turned out to be 73% while the specificity was 93%. The distribution of calculi in different parts of the KUB area is shown in Table 1.

Table 1:

	On Ultrasound	On NECT
Renal Calculi	56	54
Pelviuretric junction Calculi	12	15
Ureteric Calculi	60	106
Vesicoureteric Junction Calculi	33	43
Urethral Calculi	1	2
Vesical Calculi	0	0
Total	162	220

Table 2: The calculus size agreement between NECT and ultrasound.

Calculus Size Agreement Between NECT and Ultrasound			
	Calculus Size at Ultrasound (mm)		
Calculus Size at NECT (mm)	0 – 3.0	3.1 – 7.0	> 7.0
0 – 3.0	6	18	0
3.1 – 7.0	3	36	0
> 7.0	0	27	72
Note: Calculus Size was concordant in 114 (70%) of the 162 cases			

Sensitivity: TP / TP + FN 162 / 220 × 100 = 73%
Specificity: TN / TN + FP 28 / 28 + 2 × 100 = 93%
TP: True positive
TN:True negative
FP: False positive
FN: False negative

Table 3: Validity for diagnosis ureteric calculi by ultra-sonography study.

	CT Scan Positive	CT Scan Negative	Total
Ultrasound positive	TP 160	FP 2	162
Ultrasound Negative	FN 60	TN 28	88
Total	220	30	250

Table 4: Previous published studies that have constantly shown high validity of Helical NECT in the diag-nosis of renal calculi.

Study Group	Patients (n)	Sensitivity (%)	Specificity (%)	Patients with Calculi	
				(%)	(n)
Dalrymple, et al, 1998[4]	417	95	98	45	188/417
Yilmaz, et al, 1998[8]	97	94	97	66	64/97
Kassim A, et al, 2014[1]	100	97	98	98	98/100
Hamm, et al, 2001[16]	125	99	97	73	91/125
Smith, et al, 1996[6]	292	97	96	48	100/210
NA Ahmad, et al, 2003[17]	233	99	98	64	148/233
Present Study	250	98	99	88	220/250

Discussion

The superior sensitivity of helical NECT to detect renal calculi has now been documented,[6] and this technique is perceived by many, as favored modality for describing renal colic and to detect renal calculus disease.[7] Helical NECT appreciates strong superiority over USG or radiography for evaluation of ureteral calculi because of superimposition of gut shadows and contiguous framework of bones. Yilmaz and associates[8] have revealed the advantage of NECT for depiction of ureteral calculi in comparison to intravenous urography as well as USG. They demonstrated sensitivity of US for genitourinary calculi 19% in comparison to 94% for NECT.

Earlier studies[3,9] where radiography and conventional tomography were assessed with USG specified the accuracy of USG for genitourinary calculi was as great as 99%. The previous research results might be confusing, since Dalrymple et al[4] have revealed that most of the calculi identified at helical NECT are overlooked at radiography. Further than in assessment of kidney stone disease, the accuracy of USG for renal stones on the whole is significant since USG images are frequently acquired for additional kidney diseases which have calcium stores in the form of stones.

Our figures specify that USG is of inadequate significance for appreciation of ureteric calculi. Out of the 106 ureteric calculi detected on CT scans, only 62 could illustrated on ultrasonography. The sensitivity of USG for genitourinary stones in this present study is considerably inferior to that documented in past studies[3,9] in which comparison of USG was made to radiography and also with conventional tomography. The result prescribes that by method for both radiography and conventional tomography, a critical figure of genitourinary stones are overlooked which are certainly identified by NECT.

In previous study done by Sommer et al,[10] recommend significant worries in detecting genitourinary stones on USG. They recognized seven kidney stones on NECT images, while a solitary kidney stone was distinguished on USG.

Additionally, NECT is not dependent on aspects, for example, individual body habitus and operator expertise on which USG depends. Calculi may be

overlooked at USG due to a non-existence of acoustic shadowing that can take place due to overriding tissue of changed acoustic impedance. Wrong choice of focal length and transducer power can spoil acoustic shadowing as well.[11] Since US has been presented to be sensitive to non-opaque stones, it is doubtful that chemical configuration shows most important part in the capacity of USG to recognize calculi.[12]

Nevertheless, genuinely extraordinary specificity and positive predictive value of USG advocates that stones detected at USG images dependably relate to stones, as identified by NECT, especially, if radiographs are studied to preclude blood vessel calcifications and instrumentation in the pelvi-calyceal framework.

As described by different authors,[3,11,13] USG sensitivity is dependent upon calculus size, and our realities demonstrate that USG is of little value in recognizing stones of 3.0 mm or lesser than that.

NECT ought to be taken as the standard for detecting the number, dimensions, and location of renal stones. According to Bellin, et al, a supplementary benefit of NECT is capability to calculate stone configuration on base of attenuation having 64% – 81% accuracy.[14] It can also establish urinary disease like infections, congenital abnormalities, and neoplasms.[15] At our establishment, NECT is accepted as the prime methodology for the evaluation of renal calculi.

Conclusion

USG has limited value for accurate detection of renal calculi burden. Any patient presenting with renal colic has to undergo Plain CT (KUB area) because ultrasound is operator dependent and factors like patient compliance or obesity limits the ultrasound investigation of renal calculi.

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