ORIGINAL ARTICLE

Diagnostic Accuracy of Non-Contrast-Enhanced Helical CT Scan in comparison with Ultrasonography in patients with acute flank pain

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ABSTRACT

Objective: To compare the diagnostic accuracy of non-contrast spiral CT with ultrasound (US) for the diagnosis of ureteral calculi in the evaluation of patients with acute flank pain.

Subject and methods: This study was conducted on 124 patients at Nawaz Sharif social security teaching hospital Lahore (Department of Radiology) from January 2012 to January 2013. One hundred and twenty four patients with flank pain were examined with both Ultrasonography and non contrast enhanced CT scan over a period of 1 year. Both techniques were used to determine the presence and location of ureteric stone, and the presence or absence of secondary signs like ureteral and calyceal dilatation, stranding of perinephric, periureteric fat and soft tissue rim sign.

Results: 86 of the 124 patients were confirmed as having ureteric calculi based on stone recovery or urological intervention. Ultrasound showed 93% sensitivity and 95% specificity in the diagnosis of ureterolithiasis. CT scan showed 91% sensitivity and 95% specificity respectively.

Conclusion: Due to low cost and non invasive modality, we suggest that ultrasound be employed first and CT scan be reserved for when ultrasound is unavailable or non-diagnostic

Keywords: Ultrasonography, CT scan, renal colic

INTRODUCTION

Intravenous urography (IVU) has been the gold standard for the radiological survey of intra renal collecting system, ureter and bladder. Choice of imaging for urinary tract in patients with raised serum Creatinine is limited to noncontrast enhanced studies. These considerations have led to the use of other modalities like combination of plain abdominal radiography (KUB) and gray scale ultrasound (US) kidney, ureter and bladder. More recently use of non-contrast enhanced helical CT (UHCT) and magnetic resonance urography (MRU) in the evaluation of flank pain has received increasing attention[1,2,14,15]. Work in the past decade has shown UHCT to be highly sensitive and specific[1,3,4]. It is highly sensitive for both renal and ureteric stone[3]. The probability of misdiagnosis in distal ureter with multiple phleboliths is still a significant problem. Presences of tissue rim[3,5] and comet tail[5] signs along with secondary signs of obstruction are helpful in these situations. Ultrasound has many inherent advantages[12,13], which includes lack of radiation, universal availability, in expensive and non-invasive. It is useful in the diagnosis of renal and ureteric calculi. Stones on US are characteristically demonstrated as highly echogenic foci with distinct acoustic shadowing. The greatest challenge with regard to US is the identification of ureteral calculi, particularly in its abdominal and upper pelvic course. This limitation of US is due to its inability to scan retroperitoneum due to overlying bowel loop, and bony structures.[4,6] Plain abdominal radiograph also lacks specificity, as phleboliths are not readily differentiated from ureteric calculi. Plain radiographs are also not sensitive to radiolucent calculi and non-calculus obstruction. In the present study we have compared the diagnostic accuracy of UHCT with US with for the diagnosis of ureteric stones in patients with acute flank pain.

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PATIENTS AND METHODS

One hundred and twenty four consecutive patients, seen for suspected renal colic in our emergency department over a 1 year period, were enrolled in a standardized double-blinded protocol that consisted of US examination followed by CT. There were 84 men and 40 women. The age range was 25–90 years.

All imaging studies were conducted within 6 hours of admission to the emergency department. US examination was performed transabdominally, after ingestion of 2 glasses of water, using 3.5 MHz, 5 MHz and 7.5 MHz probes. Examinations were conducted by Professor of radiology. US diagnosis of ureteral calculi required the demonstration of an intraluminal hyperechoic structure causing acoustic

shadowing. The presence of hydronephrosis and perinephric fluid were also noted. Non-enhanced helical CT examinations were performed. CT images were obtained from the upper renal poles to the bladder base. Helical data acquisition consisted of 6.5mm thick sections and a pitch of 1.5:1. No oral or IV contrast medium was administered. The CT examinations were reviewed by a senior radiologist and were evaluated for the presence of ureteral calculi, perinephric or periureteric stranding, and hydronephrosis. CT diagnosis of ureteral calculi was established by visualization of a high attenuation structure (greater than 100 Hounsfield units) within the ureteral lumen. The two sets of studies were reviewed by independent radiologists who were blinded to the patient's identity and who noted all findings including stone demonstration, stone size, and location and signs of obstruction. Findings not related to calculi were also noted.

RESULTS

A total of 124 patients were included in the study. 86 of the 124 patients were confirmed to have ureteral calculi based on stone recovery or urological interventions. US demonstrated ureterolithiasis in 80 of the 86 patients confirmed to have ureteral calculi (sensitivity 93%, specificity 95%, positive predictive value 98%, negative predictive value 86%) (Table 1,3). 8 calculi were located in the upper third of the ureter, 8 in the middle third and 64 in the distal ureter. Hydronephrosis was noted in 88 cases. The degree of hydronephrosis demonstrated by US examination was graded as minimal in 44 patients, mild in 22 patients and moderate in 22 patients. Perinephric fluid was demonstrated in six patients.

Table.1: Results of imaging with us for detection of ureteric calculi

	Ureteric calculi present	**Ureteric calculi absent**	**Total**
Ultrasound			
Positive for ureteric calculi	80	2	82
Negative for ureteric calculi	6	36	42
Total	86	38	124

Of the 86 patients with calculi, CT detected 78 (sensitivity 91%, specificity 95%, positive predictive value 98%, negative predictive value 82%) (Table 2,3). 10 calculi were demonstrated in the proximal ureter, 8 in the mid ureter and 60 in the distal ureter. Perinephric stranding was seen in 52 cases, and periureteric stranding in 10 cases. Pathology unrelated to urinary stones was demonstrated in 12 patients and included cholelithiasis, cholecystitis, appendicitis and adnexal mass in two patients each, and ovarian cyst (torted) in 4 patients. All of these conditions were detected by US and CT except the appendicitis, which was diagnosed by CT alone.

Table.2: Results of imaging with ct for detection of ureteric calculi

	Ureteric calculi present	**Ureteric calculi absent**	**Total**
CT			
Positive for ureteric calculi	78	2	80
Negative for ureteric calculi	8	36	44
Total	86	38	124

Table.3: Percentage validity of the diagnosis of urolithiasis from us and CT

Validity	**US**	**CT**
Sensitivity	93%	91%
Specificity	95%	95%
Negative predictive value	86%	92%
Positive predictive value	98%	98%

DISCUSSION

Recent studies have shown that non-contrast helical CT is an excellent method for demonstrating ureteral calculi in patients with suspected renal colic[7]. Study conducted by Smith et al[8] showed non-contrast CT to be more effective than IVU in identifying ureteral stones. In another comparative study conducted by Sommer et al[9] 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 124 patients, with comparable results for the two modalities in the demonstration of ureteral calculi. In some cases it was difficult to ascertain on CT whether calcification was within the urinary tract or elsewhere, e.g. calcified phleboliths or a calcified seminal vesicle. In two cases, CT interpretation was false positive for a ureteral calculus, and retrospectively the calcification was shown to be a pelvic phlebolith. 8 patients passed stones (2–5 mm in size), none of which had been seen on CT. Nonvisualization of stones may be explained by volume averaging, small stone size and/or low attenuation value of the stones. US, which is universally available, non-invasive, inexpensive and radiation free, is preferred by some radiologists as the initial method for evaluation of the kidneys and bladder. However, US is considered to be of limited value in demonstrating pathological conditions of the Ureter.[10] All patients with ureterolithiasis described herein 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; we overcame this problem by compressing the area to be examined and changing the patient's position. Dalla Palma[11] evaluated 120 patients with renal colic using US and plain radiographs, and achieved 95% sensitivity but only 67% specificity. US were classified as positive for ureteric colic in the study when calculi or hydronephrosis were present. In the current study, only cases with a definite demonstration of ureteral calculi were classified as positive and our results show a high specificity of 95%. In our study, CT and ultrasound were equally sensitive in detecting ureteral calculi; 91% and 93%, respectively. In the study by Sommer et al, there were false negative US examinations owing to a lack of significant hydronephrosis detectable on the examination[9]. In our patients, US was also accurate in depicting stones in cases of minimal hydronephrosis. Extraurinary causes mimicking renal colic were demonstrated by both modalities except in two cases of appendicitis those were diagnosed by CT only. However, the small number of cases with extraurinary causes precluded statistical analysis.

CONCLUSION

In summary, both helical CT and US were found to be excellent modalities for depicting ureteral stones, but because of high cost, radiation dose and high workload of CT, we suggest that 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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