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URETERIC CALCULI

TO DETERMINE ACCURACY OF ULTRASOUND IN DIAGNOSIS OF URETERIC CALCULI CONFIRMED ON NON CONTRAST COMPUTED TOMOGRAPHY AMONG PATIENTS WITH ACUTE URETERIC COLIC

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ABSTRACT… Objectives: The objective was to determine accuracy of ultrasound in the diagnosis of ureteric calculi confirmed on non-contrast Computed Tomography among patients with acute ureteric colic. **Study Design:** Cross-sectional study. **Setting:** Emergency Department of Nishtar Hospital, Multan. **Period:** 11-07-2012 to 10-01-2013. **Materials and Methods:** 100 consecutive patients presenting with acute severe ureteric colic and fulfilling the inclusion and exclusion criteria were enrolled for the study from the emergency department of Nishtar Hospital Multan. Ultrasonography was done in all patients and USG findings were recorded for the presence or absence of hyperechoic shadows in the ureteric. All the patients underwent CT scan to confirm or refute the findings of Ultrasonography. **Result:** Mean age of the patients was 37.85 $\pm$ 12.60 years. Males were 53 (53%) while females were 47 (47%). Mean duration of pain before presentation was 14.81 $\pm$ 6.20 hours. Mean severity of pain on visual analogue scale was 9.40 $\pm$ 0.8. Overall 79 patients were diagnosed as having ureteric calculi. Ultrasonography detected the ureteric stone in 75 patients and was all found to have stone on CT scan and represented true positives. Among 25 patients in whom ultrasound did not demonstrate any stone, 4 were found to have ureteric stone on CT scan thus representing false negative whereas 21 (84%) were confirmed on CT scan not to have any stone, thus representing True negatives. The sensitivity of USG for detection of ureteric stone was found to be 94.9%, the specificity was 100%, and positive predictive value was 100% while negative predictive value was 84% .There was no significant effect of age or gender on the accuracy of ultrasound. **Conclusion:** Ultrasonography is a readily available, non-invasive and reliable investigation in patients presenting with acute flank pain to diagnose ureteric stones with a specificity of 100% and a sensitivity approaching 95%. Thus it is recommended that it should be used routinely for the evaluation of patients presenting with acute flank pain.

Key words: ureteric calculus, noninvasive, acute ureteric colic, Computed Tomography.

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INTRODUCTION

Renal calculi are very common in human beings with a prevalence rate of up to 10%.[1] Pakistan falls into Afro-Asian stone belt stretching from Egypt, Iran, India, Thailand to Indonesia. Most renal stones become symptomatic when they fall into the ureter causing pain called as ureteric colic.[2] In case of ureteric calculi, establishment of early diagnosis and prompt treatment is essential. Treatment options range from conservative approach to surgical exploration of ureter which will depend upon the size and location of the stone in ureter.[3]

Conventionally, diagnosis of ureteric calculi is established with plain radiography and Intravenous urography among patients with ureteric colic.[4] Intravenous urography (IVU) had been the previous gold standard but its use has now fallen because it involved a lengthy procedure, there was a high risk of contrast toxicity especially in patients with impaired renal function and as better imaging modalities developed over time.[5] Ultrasound (USG) emerged as a widely available, commonly used and safe investigation for diagnosing ureteric calculi. There is no use of intravenous contrast media, no burden of

ionizing radiation and the examination just takes under 30 minutes once the patient's bladder is full.[6] The only problem with USG is that the detection of ureteric stones can in some cases be troublesome when the calculi are obscured by ultrasonic beam-attenuating tissue such as renal sinus fat, mesenteric fat or bowel.[7] Due to these problems, ultrasound has been demonstrated to have a diagnostic accuracy which varies widely in different studies ranging from very low to well above 90% for ureteric calculus detection.[6,8] In one study, the diagnostic accuracy of the USG has been demonstrated to be upto 93%.[8]

A non-contrast computed tomography (CT) scan of the abdomen is recognized as the current gold standard in the diagnosis of ureteric calculi with a sensitivity of 95–98% and a specificity approaching 100%.[7,9] However its routine use is not without risk as there is exposure to high doses of radiation in a single CT scan. Cumulative radiation dose and its drastic consequences can become particularly pertinent in patients with ureteric calculi who may need repetitive CT scans as almost 50% of the patients will suffer from recurrent stone problems within five years of initial occurrence, 50–60% within 10 years and 75% within 20 years.[10] Another major problem with CT scan is that it is not widely available in our country.

MATERIALS AND METHODS

This is a cross-sectional study carried out at Emergency Department of Nishtar Hospital, Multan. 100 consecutive patients presenting with acute severe ureteric colic and fulfilling the inclusion and exclusion criteria were enrolled for the study. Ethical committee of the hospital was obtained prior to conducting the study.

An informed written consent was obtained from every patient. Ultrasonography was done in all patients by me under supervision of a consultant radiologist. USG findings were noted for the presence or absence of hyperechoic shadows in the ureteric area and were recorded in the proforma, in terms of detection of ureteric stones on USG (yes or no). All the patients underwent CT scan to confirm or refute the findings of Ultrasonography. CT protocol included CT abdomen without contrast with axial slices. The hard copies of CT scan were interpreted by me under supervision of a consultant radiologist for presence or absence of ureteric stone appearing as hyper-dense area on film. It was recorded in the proforma in terms of detection of ureteric stones on CT scan (yes or no).

The CT protocol we utilized was that all images were taken with a helical CT scanner without any contrast (I/V or oral). Imaging started from the upper part of the abdomen (this includes entire kidneys and adrenal glands) up till pubic symphysis while patient is in supine position. The slice thickness and interval were same of 5 mm. Images were taken with a 0.8-second gantry rotation by using 140 kVp and 160–180 mAs. CT images were reviewed first by experienced radiologists then patient was released from the CT suite. If required, then additional scanning or reconstruction of sagittal or coronal images were done. It required averaged 10-15 minutes in CT room, including image reconstruction and the experienced radiologist's review.

For the imaging of kidneys, ureters and bladder (KUB examination), USG was done by using curved phased-array transducers (2–5 MHz) and hardcopies of images were obtained. The kidneys were assessed in real time imaging in both longitudinal planes (which includes lateral, middle, and medial portions of kidney) and in transverse planes (which includes superior, middle and inferior portion). If there is any abnormality, additioned images were obtained.

The collected information was entered into SPSS version 10. Statistical analysis was done to calculate mean and standard deviation for quantitative variables like age, severity of pain on visual analog scale and duration of ureteric colic in hours. The qualitative variables like gender were presented as frequency and percentage. Frequencies and percentages were calculated separately for presence or absence of ureteric stones on USG and CT scan. Accuracy of USG

was calculated as percentage of patients who were found to have ureteric stones on USG and were confirmed on CT scan. Percentage was calculated for patients who had no hyper-echoic shadow on USG but were found to have a ureteric calculus on CT scan. Stratification was done with regards to age and gender to see the effects of these on outcomes.

RESULTS

There were 100 patients in total. Mean age of the patients was 37.85 ± 12.60 years ranging from a minimum of 18 to a maximum of 60 years. Male were 53 (53%) while females were 47 (47%). Mean duration of pain before presentation was 14.81 ± 6.20 hours. Mean severity of pain on visual analogue scale was 9.40 ± 0.8 ranging from a minimum of 8 to a maximum of 10 (Table-I). All patients were subjected to ultrasound. CT scan confirmed ureteric stones in 79/100 (79%) pts whereas 21/100 (21%) had no ureteric stone. In USG positive pts, 75 (True Positive) had ureteric stone and Zero patients were diagnosed as false positive. Among 21 patients, in USG negative patients, 4 (False Negative) and 21 (True Negative) were confirmed on CT scan not to have any ureteric stone (Table-II). The sensitivity of USG for detection of ureteric stone was found to be 94.9%, the specificity was 100%, and positive predictive value was 100% while negative predictive value was 84% (Table-III). Fig 1 & 2 have shown the effect of age and gender on accuracy of ultrasonography.

Characteristic	Patients with ureteric stone	Patients with no ureteric stone
Mean age	38.25 ± 12.81 years	36.33 ± 11.96
Mean duration of pain	14.99 ± 6.16 hours	14.14 ± 6.46
Severity of pain on visual analogue scale	9.37 ± 0.8	9.52 ± 0.81

Table-I. Quantitative variables in patients found to have ureteric stone

	Positive result on USG	Negative result on USG
Positive on CT scan	75 (TP)*	04 (FN)***
Negative on CT scan	0 (FP)**	21(TN)****

Table-II. Summary of Results
*-TP=True positive **-FP=False positive ***-FN=False negative ****-TN=True negative

Sensitivity	94.9%
Specificity	100%
Positive predictive value	100%
Negative predictive value	84%

Table-III. Sensitivity, specificity, positive predictive and negative predictive value of USG

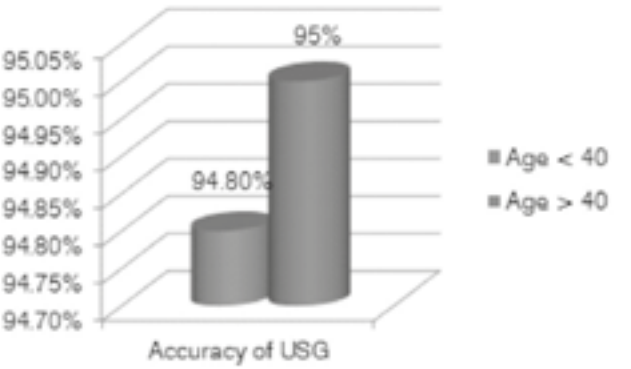

Figure-1. Effect of Age on Accuracy of USG

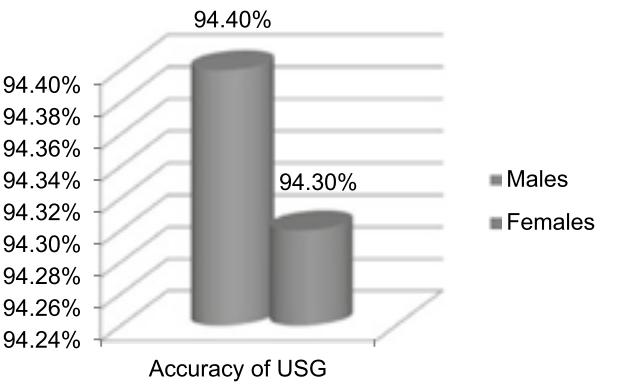

Figure-2. Effect of Gender on the Accuracy of USG

DISCUSSION

Traditionally, suspected nephrolithiasis has been evaluated with X-ray KUB, ultrasound &

intravenous urography. Nowadays, however, non-enhanced helical CT has emerged as investigation of choice for obstructive uropathy because it has high sensitivity and specificity for calculus detection, ability to rule out other non-urinary causes of acute flank pain and even there is no need of contrast medium.

The exact sensitivity of intravenous urography for calculus detection is uncertain. However, in one study[11] 58% of calculi were not detected at intravenous urography in patients with obstruction and non-contrast CT has sensitivity of nearly 100% and can also detect extra urinary abnormalities in 10%-16% of patients. Before helical CT, several investigators considered USG a good option with sensitivities reaching 95%-100% for detection of obstructive uropathy than intravenous urography.[12,13] however, other suggest that sensitivity of USG for calculus detection is 37%-64% and for acute obstruction detection is 74%-85%.[14,15]

Although USG has low sensitivity for calculus detection as compared to CT but it is easily available, cheap, no radiation hazards and is the investigation of choice in pregnant patients. Henderson and colleagues[16] reported that US has sensitivity of 97% in comparison with intravenous urography for the detection of "pathology consistent with nephro-ureterolithiasis," Rosen et al reported[17] that bedside US has sensitivity of 72% and specificity of 73% for detection of hydronephrosis in pts with nephrolithiasis when compared with intravenous urography or CT To our knowledge, only one article is available in literature in which the effectiveness of US is compared with that of CT for the detection of upper urinary tract calculi and hydronephrosis. Remer et al[18] reported that after extracorporeal shock wave lithotripsy CT is faster (15 minutes compared with 37 minutes of room time) and more cost-effective ($38 compared with $58 of direct technical cost) than US. However, they measured combined sensitivity of USG and Xray with non-enhanced CT for detection of retained calculus fragments but do not include distal ureters and not even focused on ureteric calculi.

To our knowledge, there are no studies seen in the radiology literature which directly compare the accuracy of US and CT in patients with acute ureteric colic.

In our study mean duration of pain before presentation was 14.81 $\pm$ 6.20 hours. Mean severity of pain on visual analogue scale was 9.40 $\pm$ 0.8 ranging from a minimum of 8 to a maximum of 10. This data is comparable to those seen in other studies. In one study,[19] 45 patients were studied out of which 17 were women and 28 were men. This is similar to that seen in our study with a slight male preponderance. The mean patient age was 44 years (range, 19–68 years) which is also comparable to that seen in our study (37.85 $\pm$ 12.60 years). The slight difference in mean age of our patient population from the above mentioned study was probably due to the inclusion criteria in our study in which only patients with age < 60 were included.

In our study, on ultrasonography, the stone was identified in 75/100 (75%) patients whereas no stone was found on ultrasonography in 25/100 (25%) patients. On CT scan stone was found in 79/100 (79%) patients whereas no stone was found in 21/100 (21%). Overall 79 (79%) patients were diagnosed as having ureteric stone whereas 21(21%) had an alternate diagnosis to their acute flank pain. Ultrasonography detected the ureteric stone in 75 patients which were all found to have stone on CT scan. Whereas among those 25 patients in whom ultrasound did not demonstrate any stone 4 (16%) were found to have ureteric stone on CT scan. The sensitivity of USG for detection of ureteric stone was found to be 94.9%, the specificity was 100%, positive predictive value was 100% while negative predictive value was 84%. This was comparable to that seen in other studies.[8,19]

When the effect of age was noted on the accuracy of USG, it was noted that in age group < 40 years there were 51 patients in total. Males were 22/51 (43.14%) whereas females were 29/51 (56.8%). In age group > 40 years there were 49 patients in total, 31/49 (63.2%) were males and 18/49

(36.7%) were females. In age group < 40, 39/51 (76.4%) were diagnosed to have ureteric calculi and USG was positive in 37/39 (94.8%) patients whereas it did not show ureteric stone in 2/39 (5.1%). In patients with age ≥ 40 years, 40/49 (81.6%) were diagnosed to have ureteric stones and USG was positive in 38/40 (95%) cases while it was negative in 2/40 (5%) patients. However the difference was statistically non-significant with p-value = 0.979.

When the effect of gender was noted on the accuracy of USG, it was noted that there were 36/79 (45.5%) females and 43/79 (54.4%) males who were diagnosed to have ureteric stone. Among females USG was positive in 34/36 (94.4%) patients whereas it was negative in 2/36 (5.5%) patients. Among males USG was positive in 41/43 (95.3%) patients while it was negative in 2/43 (4.65%) patients. However, the difference was clinically non-significant as the p-value was > 0.05.

CONCLUSION

Ultrasonography is a readily available, non-invasive and reliable investigation in patients presenting with acute flank pain to diagnose ureteric stones with a specificity of 100% and a sensitivity approaching 95%. Thus it is recommended that it should be used routinely for the evaluation of patients presenting with acute flank pain.

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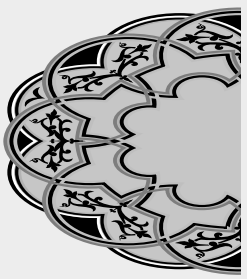

"The hardest prison to escape is your mind."

Motivateron

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