Diagnostic Accuracy of Transabdominal Ultrasonography in Urolithiasis, Keeping Ct Kub Gold Standard

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ABSTRACT

Background: Every year, around half a million people visit hospitals for flank pain. According to studies, 1 out of 10 individuals have a risk of forming renal stones in their lifetime
Objective: To find diagnostic accuracy of transabdominal ultrasound in urolithiasis, keeping CT KUB gold standard.
Methodology: A cross-sectional analytical study was performed at University of Lahore teaching hospital, Lahore duration of 4 months. 114 patients included in study with flank pain, Ultrasonography was conducted on all patients with full urine bladders using the Transabdominal technique with comparison comprehensive KUB image of non-enhanced CT (Toshiba 64) was conducted from the abdomen to the pelvis.
Results: Age of the study participants ranged between 12 to 85 years with mean age 39.3 + 16.4 years. Out of 114 participants 53 (46.5%) were females and 61 (53.5%) were males. On CT KUB, total 94 (82.5%) participants were positive for urolithiasis and 20 (17.5%) were negative. On ultrasound, 68 (59.6%) participants were found positive for urolithiasis and 46 (40.4%) were found negative. The sensitivity of ultrasound was 71.28%, specificity was 95%, PPV was 98.5%, NPV was 41.3% and diagnostic accuracy was found to be 75.4%.
Conclusion: In present study, ultrasonography showed good diagnostic sensitivity for detecting urolithiasis. Preliminary diagnosis can be made through ultrasonography, as it is safer than other diagnostic modalities in terms of radiation exposure.

Key words: Non-enhanced Computed Tomography, Ultrasound, Ureteric Calculi, Radiation, Computed Tomography

Original Research Article

Introduction:

The urogenital calculi, also known as stones, are these solid structures that form in the urinary system when minerals in urine crystallize. These stones can be present in different areas of the urogenital system and over time have been a recurrent health problem [1]. Studies showed that the prevalence of urinary tract calculi is higher in men 15% than women 8% with the estimated prevalence to be 131 cases per hundred thousand [2]. Researchers have noted diverse prevalence estimates in different populations showing that urolithiasis has higher incidence in some areas. For example, the prevalence is reported as 29.5% in Egyptian, 24.9% in Pakistan, 23.3% in Indians, 20.5% in Yemeni, 17.6% in Sudan, 16.2% in Bangladesh and 7.4% in Saudi Arabia [3]. Symptoms of urolithiasis can include kidney colic, flank pain, dysuria, or the presence of blood in the urine [4]. These symptoms place it among the top causes for people to seek medical help [5]. After a long period of obstruction and infection due to stone disease, the affected kidneys eventually lead to renal failure. Therefore, timely and precise diagnosis, as well as proper treatment of urolithiasis, are vital to avoid complications and maintain renal function [6].

Ultrasound of the urinary tract (USG) is one of the best screening methods because it is non injurious, fast, comfortable to the patients, and the cost is lesser compared to Intravenous Urography IVU and the computed tomography CT scan [7]. The diagnostic sensitivity of ultrasound in the detection of urinary calculi has varied across different studies, largely depending on the location of the stone, its size, and the patient's condition [8]. Ultrasound studies show varied sensitivities in diagnosis, depending on factors such as stone size and position. Smith et al. introduced non-contrast helical CT scan (NCCT) as a modern imaging technique for renal stones, which later on became a successful alternative to Intravenous Urography [9]. Nowadays, in medical practice, NCCT is recognized as the procedure of the first choice for evaluating this clinical condition [10]. However, the NCCT has some downsides. Issues of radiation dosage are of concern since ionizing radiation increases the potential health risks [12]. Furthermore, there may be varying levels of availability of CT scans and the cost associated with them is generally higher than with ultrasound imaging, which may present potential barriers to acceptance [13].

Materials And Methods:

A cross-sectional analytical study was conducted at University of Lahore teaching hospital, Lahore. Sample size was calculated at 95% level of confidence and 8% margin of error. Total 114 participants were included in the study. All

participants underwent ultrasound. Participants were scanned using Toshiba Xario 5 MHz curve-array transducer. Ultrasonography was conducted on all patients with full urinary bladder using the Transabdominal technique. The kidneys were seen from both the axial and coronal planes. For a comprehensive KUB image, a non-enhanced CT (Toshiba 64) was conducted from the abdomen to the pelvis. Reconstruction of images was done at 1mm for reviewing and 5mm for filming. The size of the stone was determined using the long axis of Non-enhanced CT and ultrasound.

Results:

Participants of age 12 to 85 years with mean age + SD of 39.3 + 16.4 years were included in study. Out of 114 participants 53 (46.5%) were females and 61 (53.5%) were males. On CT KUB, total 94 (82.5%) participants were positive for urolithiasis and 20 (17.5%) were negative. On ultrasound, 68 (59.6%) participants were found positive for urolithiasis and 46 (40.4%) were found to be negative (Table 1).

VARIABLES		FREQUENCY
Age	Minimum Maximum Mean age + SD	12 years 85 years 39.3 + 16.4 years
Gender	Females Males	53 (46.5%) 61 (53.5%)
Site of Pain	B/L Right Left	20 (17.5%) 43 (37.7%) 51 (44.7%)
Hydronephrosis	Absent Mild Moderate Gross	24 (21.1%) 59 (51.8%) 21 (18.4%) 10 (8.8%)
Ultrasound Findings	Stone Present Stone Absent	68 (59.6%) 46 (40.4%)
CT Findings	Stone Present Stone Absent	94 (82.5%) 20 (17.5%)
Size of stone	Minimum Maximum	1.0 mm 8.0 mm

Table 1: Variables

Out of 114 participants, Hydronephrosis was absent in 24(21.05%) participant, Gross hydronephrosis was found in 10(8.77%) participants, Mild in 59(51.75%) and Moderate in 21(18.42%). Out of 114 participants, Calculi was absent in 19(16.67%) participant, 4(3.51%) was found in bladder, 15(13.16%) at distal ureter, 15(13.16%) at lower pole of kidney, 8(7.02%) at mid pole of kidney, 5(4.39) at proximal ureter, 27(23.68%) at PUJ, 7(6.14%) at upper pole of kidney, 14(12.28%) calculi were found at VUJ level. Mean size of stone was found to be 1.28cm. The sensitivity of ultrasound was 71.28%, specificity was 95%, Positive predictive value was 98.5%, Negative predictive value was 41.3% and diagnostic accuracy was found to be 75.4% (Table 2).

STATISTIC	VALUE	95% CI
Sensitivity	71.28%	61.02% to 80.14%
Specificity	95.00%	75.13% to 99.87%
Positive likelihood ratio	14.26	2.10 to 96.72
Negative likelihood ratio	0.30	0.22 to 0.42
Disease prevalence	82.46%	74.21% to 88.94%
Positive predictive value	98.53%	90.80% to 99.78%
Negative predictive value	41.30%	33.51% to 49.56%
Accuracy	75.44%	66.49% to 83.02%

Table 2: Statistical analysis of study

Discussion:

In emergency departments, ureteric calculi are frequently detected in participants who complain of side discomfort, blood in urine, trouble or burning when passing urine. According to American criteria, NECT is highly sensitive imaging modality for detecting ureter calculi, whereas according to European recommendation sonography is the first-choice modality for primary screening of Ureteric calculi [14,15]. In this study, 114 participants were taken. Females accounted for 53 (46.5%) of the 114 patients, while males' patients were 61 (53.5 %). Ultrasound revealed that 68 (59.6%) of the patients had diagnosed urolithiasis, while 46 (40.4%) had no calculus. On computed tomography scan, 94 (82.5%) of the patients had diagnosed urolithiasis, while 20 (17.5%) of the patients had no calculus. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were 71.2%, 95%, 98.5%, 41.3%, and 75% respectively. In comparable research with 80 patients, Wahab et al, (2019) discovered that ultrasonography sensitivity was 69.64 % and specificity was 66.6 % [16]. Our research were consistent with that of Rao et al, (2021) sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy were 65.3%, 72.1%, 79.7%, 55.4%, and 67.9%, respectively[17]. In another research, trans-abdominal ultrasound showed the sensitivity, specificity, positive predictive value and negative predictive value were 92%, 44%, 90% and 50% respectively, in the detection of calculi in ureters using computed tomography as the benchmark [18]. According to Faiq SM et al, (2014) [19] Sensitivity of Computed tomography, ultrasound and X-ray for deterring ureter stones is 100%, 53% and 90% respectively. According to Ahmed F et al, (2018) [20] ultrasound has a sensitivity, specificity, positive predictive value and negative predictive value were 75%, 17%, 97.2%, and 1.7%. According to Xia J et al, (2020) [21] individuals with a positive "ultrasonic ureteral crossing sign" had a sensitivity, specificity, positive predictive value and negative predictive value were of 91%, 97%, 98%, and 87% respectively, all of which are relatively comparable to our findings.

In this study, 51 (44.7%) of the individuals had left kidney calculus, 43 (37.7%) had right, and 20 (17.5%) had bilateral stones. Another research found that 30.0 percent of cases had right ureter stone, 38.8 % had left ureter stone, and 8.3 % had bilateral ureter stones 18. The mean age in years of the participants in this study was 39.3 + 16.4, which was similar to the results of Sasui et al, (2021)18 where the mean age of the participants was 36.6 ± 8.5 and Wahab M et al, (2019)16 where the mean age of the study subjects was 36.5 ±8.3. Javed M et al (2018) [22] discovered that the mean age of the patients was 35.7 ± 6 years. According to a study conducted in Iran, Riaz et al, (2022) [23] discovered that the mean age of study participants were 47.7±15.9 years. Males made up 61 (53.5 percent) of the participants in this study, while females made up 53.5%. (46.5 percent). In the Memon et al (202) [24] research, 31 (51.7 percent) of the participants were men and females were 29, but Altaf N et al, (2019) [25] discovered 64.4% males and 35.6 % females [23]. In general view, ultrasound of abdomen has notable benefit as a screening tool for calculi of ureter, especially in gravid women and new born, and also in follow-up screening. New techniques, advanced equipment, and experience of sonographer can provide better information and diagnostic efficacy of ultrasound in detecting ureter stones can be increased as well.

Conclusion:

In present study, ultrasonography showed good diagnostic sensitivity for detecting urolithiasis. Preliminary diagnosis can

be made through ultrasonography, as it is safer than other diagnostic modalities in terms of radiation exposure.

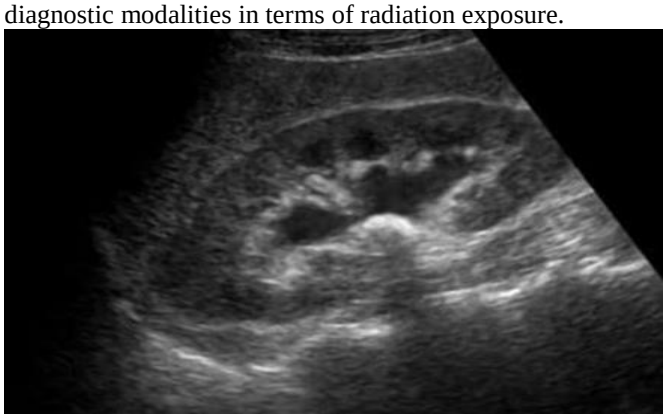

Figure 1: Ultrasound image shows an obstructing Calculus at PUJ

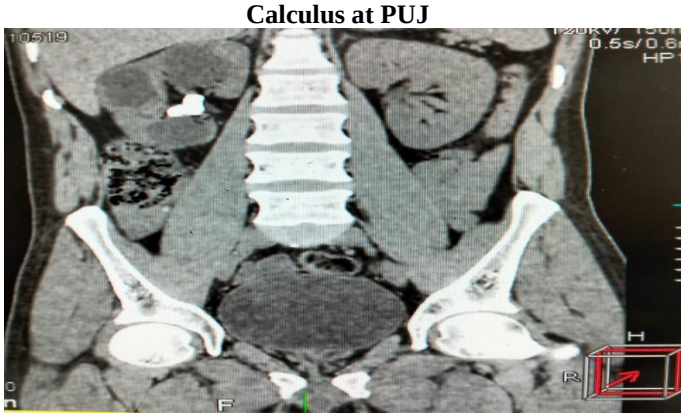

Figure 2: CT coronal image shows a PUJ Calculus

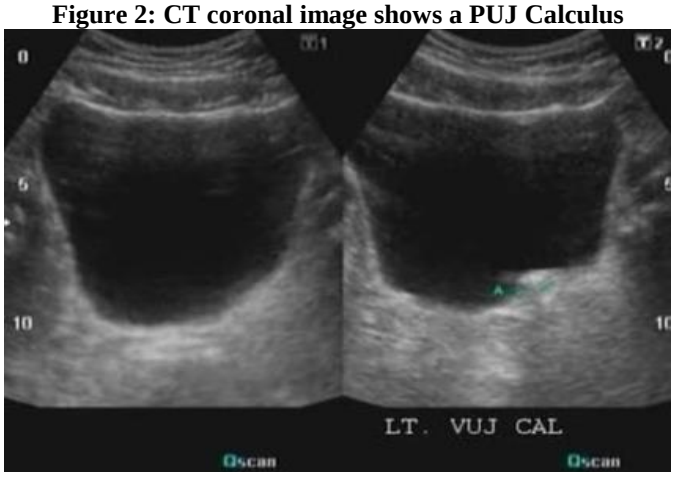

Figure 3: Ultrasound image of calculus at left VUJ

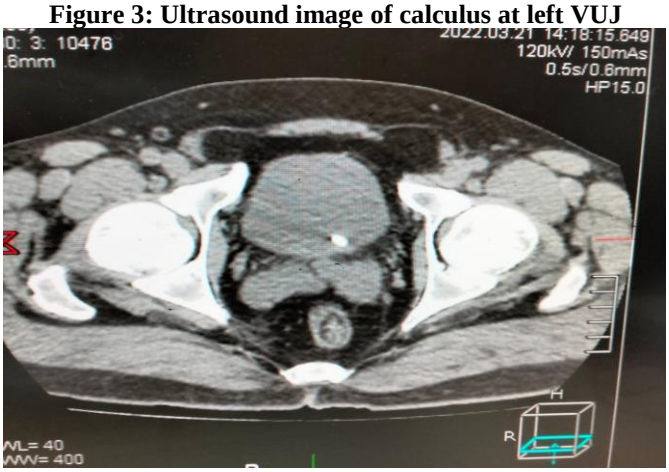

Figure 4: Transverse Plane of CT shows a calculus at left VUJ

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