

ORIGINAL ARTICLE

Diagnostic Accuracy of Ultrasound in Detecting Ureteric Calculi as Compared to Computed Tomography taken as Gold StandardMIAN AHMED MUSTAFA¹, AHMAD AMMAR ARSHAD², ZAHID HAFEEZ³, RANA SHAHID HAFEEZ⁴, ARSLAN SALEEM CHUGHTAI⁵, SADAF ABDUL QADIR⁶, MEHWISH TAHIR⁷, MUHAMMAD ZAKIR¹Medical Imaging Technologist, Shaukat Khanam Memorial Hospital, Lahore²Assistant Professor and Head Department of Nephrology and Hypertension, Sialkot Medical College, Sialkot/ Imran Idrees Teaching Hospital Sialkot³Assistant Professor of Nephrology, Department of Nephrology and Hypertension, Sialkot Medical College Sialkot/ Imran Idrees Teaching Hospital Sialkot⁴Classified Medical Specialist, PNS Rahat, Karachi.⁵Senior Lecturer (Biostatistics), Shalamar School of Allied health Sciences, Lahore⁶Assistant Professor, University of Management and Technology (UMT), Lahore⁷Associate Professor (Research Supervisor), Shalamar Hospital, Lahore⁸Senior Lecturer University of LahoreCorrespondence to: Mian Ahmed Mustafa, Email: ahmedmustafa90@gmail.com**ABSTRACT****Objective:** To compare the radiological findings for ureteric calculi on Computed Tomography and Ultrasound.**Methodology:** In this cross sectional survey medical records of 51 patients, underwent CT KUB and Ultrasound KUB at Shalimar Hospital, visited during January 1st, 2021 to June 30th, 2021 were considered in the study. A comparison was done between the radiological findings of the USG and CT reports. CT was kept as a gold standard, and the detection of hydro-nephrosis, hydro ureter on USG was checked. Also a comparison was done on the number, size and location of stones detected on both modalities.**Results:** Among the patients 34 were males and 17 were female. The mean age of male patients was 42 whereas mean age of female patients was 40. The specificity and sensitivity of ultrasound for detecting ureteric calculi was 44.12% and 100%, hydronephrosis was 90% and 88% whereas for hydro ureter was 72% and 100% respectively as compared to Computed tomography.**Conclusion:** It can be concluded from this study that there is an agreement between USG and CT finding for ureteric calculi. USG is cost effective than CT and equally effective in detecting hydronephrosis, hydro-ureter and ureteric calculi.**Keywords:** Ureteric Calculi, Hydronephrosis, Hydroureter, Flank Pain, Computed tomography, Ultrasound.**INTRODUCTION**

Urolithiasis is condition in which kidney stone, formed due to imbalance nutrition contains Calcium, Phosphor, Cystine or Uric acid, lodged in the ureters.¹ Ureteral calculi has many risk factors but in Pakistani population ionic calcium oxalate, low pH, reduced inorganic phosphorus, uric acid and sodium extraction were contributory factors^{2,3}. Acute flank pain, also known as renal colic, is most common symptom of ureteral calculi followed by Burning Micturition which is caused due to inflammation or scarring in the urinary tract.⁴

Previously different studies have been conducted to find out the alternative of the computed tomography (CT) scan. A study conducted in Multan Ultrasonography (USG) documented 95% of sensitivity and 100% specificity as compared to CT⁵. Another study showed 73% sensitivity of USG whereas Sensitivity of 98% was yielded by non-enhanced CT scan.⁶ In different studies the sensitivity varies from 41% to 95% and specificity varies from 27.9% to 95%.⁷⁻¹⁰ Whereas recent study has reveals that ureteroscopy is better in detection than CT scan¹¹ but it has its own pros and cons^{12,13}

Mix results have been observed in the literature therefore the study has been conducted to determine the diagnostic accuracy of USG in local setting. Ultrasonography (USG) is a cost effective as well as non-ionizing radiological technique for ureteral calculi detection.

METHODOLOGY

In this retrospective study conducted at Shalamar hospital. The Ultrasound and CT reports of patients were collected from the radiology department of Shalamar hospital, Lahore from January 1st, 2021 to June 30th, 2021 using Purposive Sampling. Patients aged between 20 to 80 years who presented with a complaint of Colic pain, underwent Ultrasound KUB and CT KUB for Ureteric stones confirmation were selected and Patients who had a history of previous nephrolithiasis and abnormal renal anatomy were excluded.

After getting approval from the SMDC-IRB, the data from hospital records will be collected on the special design Performa. The principal investigator recorded patient age, gender, clinical

history including hypertension, flank pain, urinary incontinence, incomplete evacuation of the bladder, vomit, nausea, fever, burning micturition, etc, and compare radiological findings of ultrasonography and computed tomography (CT) on the basis of variables including hydro-ureter, vesicoureteric junction obstruction, ureterolithiasis, hydronephrosis, pelvis-ureteric junction obstruction, vesicoureteric, ureteral lesions,

The data was entered and analyzed on the SPSS version 25. Frequencies were calculated for the qualitative data whereas Means and Standard deviation were computed for quantitative variables t-test was used for comparison of quantitative variables and chi-square test was applied for qualitative variables. 5% level of significance was used for statistical tests.

RESULTS

In this study medical records of 51 subjects with mean age of 41.47±15.39 years were considered. Among them 34 (66.7%) were male and 17(33.3%) were female. Mean age of male was 42.21±16.28 whereas female was 40.00±13.81 years. Among the patients fever was observed in 14(27.5%), Nausea in 37(72.5%), Hypertension was observed in 6(11.8%), Flank pain in 46(90.2%) among them 25(49.0%) observed in right side and 21(41.2%) observed on the left side. Burning of Micturition was documented in 26(51.0%) Urinary incontinence was reported by 17(33.3%), Dribbling of urine in 10(19.6%) and hematuria was observed in 5(9.8%) patients.

Table 1: Diagnostic comparison of USG and CT

Detection	Ultrasonography Finding	CT Scan Finding		Total
		Yes	No	
Ureteral calculi	Yes	15(100%)	0(0%)	15(29%)
	No	19(52.78%)	17(47.22%)	36(70.59%)
Hydronephrosis	Yes	38(97.40%)	1(2.60%)	39(76.50%)
	No	4(33.30%)	8(66.70%)	12(23.5%)
Hydroureter	Yes	26(100.00%)	0	26(50.98%)
	No	10(40.00%)	15(60.00%)	25(49.02%)

There is statistically significant association between CT and USG in detecting hydronephrosis (p-value <0.001), Hydrourertr (p-value <0.001) and no. of stones detected (p-value 0.011). The specificity was 44.12% and 100% sensitivity of ultrasonography (USG) was observed in detecting ureteric a calculus as compared to CT. USG was found to be 88% Specific and 90% sensitive for the detection of hydronephrosis. The sensitivity and specificity of ultrasound for the detection of hydro ureter was found to be 72% and 100% respectively. (Table 1) Accuracy of USG for detecting Ureteral calculi was 62.75%, Hydronephrosis was 90.20% and Hydrourertr was 80.39% as compared to CT. In CT scan among 9(17.6%) subjects stone was observed in right ureter, in 21(41.2%) it was observed in left ureter and in 4(7.8%) stone were found in both ureters. Whereas in USG, stone in Right Ureter were found in 4(7.8%) patients, in Left Ureter stone were found in 10(19.6%) subjects and in 1(2.0%) patients stone were diagnosed in bilateral ureter. (Figure 1)

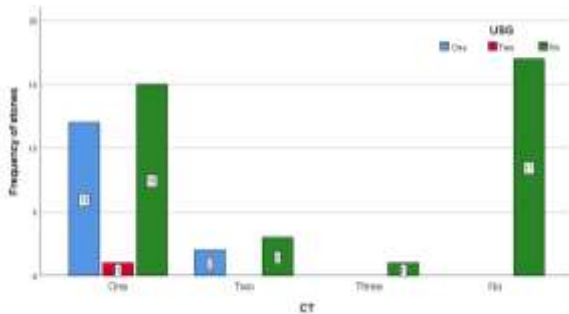


Figure 1: Comparison of ureteric calculi detection on ultrasonography (USG) as compared to computed tomography (CT) Scans

DISCUSSION

In this research, a comparative analysis was carried out of USG and CT reports of 51 patients. Each patient had undergone both scans at Shalimar Hospital, Lahore. Their presenting complaints and clinical history was also taken into account. Burning Micturition was more common than hematuria after renal colic. Literature also documented that has not been found associated with ureteral calculi.¹⁴

The study compared the results of USG and CT on the basis of detecting hydronephrosis, hydro ureter, and stones lodged in the ureters. The aim of this study was to compare the diagnostic results of CT and USG. In this study ultrasound showed specificity and sensitivity of 88% and 90% respectively for detection of Hydro-Nephrosis. For the detection of Hydro-ureter ultrasound showed a specificity of 100% and sensitivity of 72%.

Ultrasound was able to detect 16 stones as compared to CT which detected 41 stones. There were 17 cases found by CT with no stones whereas ultrasound gave 36 findings of no stone. The study revealed that there was strong agreement between both modalities in detecting Hydronephrosis and Hydro ureter. Ultrasound was not able to find all stones detected by CT due to the absence of acoustic shadowing by stones. CT gave a higher number of stone findings due to its ability to locate and differentiate density differences of less than 5%. Small size stones sometimes do not form acoustic shadows which makes it difficult to locate them on ultrasound. Also the choice of transducer, patient positions and bowel gases make it difficult to find stones on ultrasound.

A study conducted at Shiraz University in 2018¹⁵ concluded that ultrasound had a sensitivity of 75.4% for Urinary tract Calculi. In this study 284 stones were detected in 184 patients. Mean patient age was 47.7. USG detected 213 (75.5%) stones. It was also found that there was 73% concordance between stones sizes measured by USG and CT. The stone size measured by USG was almost the same as that detected by CT. The study concluded that ultrasound is a good choice as a first line investigation for Urinary

tract calculi, but it has its limitations. It plays a primary role in the initial diagnosis by detecting clinical signs.

Another retrospective study conducted in 2019¹⁶ recruited 90 patients having a mean age of 45.6 years and compared the radiological findings for urinary tract stones of USG, Radiography and CT. The study concluded that USG is a useful primary investigation for the evaluation of urinary tract obstruction. USG has a sensitivity of 75% - 90% for hydronephrosis detection. The study suggests that USG can be combined with X-ray KUB (Ureteric stone sensitivity of 29%- 59%) for the diagnosis of ureteric stones.

Another study conducted in 2019⁷ recruited 80 patients with mean age of 36.47 years. On ultrasound 47 were positive for ureteric stone while 33 were negative. On CT 56 were positive for ureteric stone while 24 were negative. The sensitivity and specificity of USG for ureteric calculi was found to be 69.64% and 66.6% respectively. The study concluded that USG is a good choice for a primary investigation; it can accurately detect clinical signs of hydronephrosis and hydrourertr. USG can detect large stones but sometimes miss stones of size less than 3mm. CT can detect stones of all sizes due to its ability to distinguish even the minimal density differences. Due to being a retrospective study the researcher was unable to compare the radiological findings for stones sizes less than 3mm. There was also a large time interval between the scans of many patients, as the patients did not have CT KUB done at the same date of USG examination

CONCLUSION

It can be concluded from this study that there is an agreement between USG and CT finding for ureteric calculi. USG is cost effective than CT and equally effective in detecting hydronephrosis, hydro-ureter and ureteric calculi.

REFERENCES

1. Coe FL, Evan AP, Worcester EM, Lingeman JE. Three pathways for human kidney stone formation. *Urological research*. 2010;38(3):147-60.
2. Rafique M, R B, A R, I C. Chemical composition of upper renal tract calculi in Multan. *J Pak Med Assoc*. 2000;50(5):145-8.
3. Khan S, Shahjahan S. Role of different etiological factors in renal calculus disease. *Pak J Med Res*. 2000;39(4):146-50.
4. Oliver R, Bell K, Rashid T. Painful and Frequent Micturition. Context, Principles and Practice of TransGynecology: Managing Transgender Patients in ObGyn Practice. 2022:97.
5. Noreen A, Javed A, Zahoor M, Shakir A, Bodla M, Saleem N. Ureteric calculi to determine accuracy of ultrasound in diagnosis of ureteric calculi confirmed on non contrast computed tomography among patients with acute ureteric colic. *Professional Med J*. 2016;23(12):1531-6.
6. Malik S, Malik S, Iqbal A. Usg for detecting renal calculi with non-enhanced computed tomography as a reference standard. *Ann King Edward Med Uni*. 2015;21(2):74-7.
7. Wahab M, Tariq K, Ishtiaq M, Ahmad K, Aslam M, Khan S. Diagnostic accuracy of ultrasound in detecting ureteric stone keeping non-enhanced CT as gold standard. *Annals of Punjab Medical College (APMC)*. 2019;13(3):223-5.
8. Roberson NP, Dillman JR, Reddy PO, DeFoor W, Trout AT. Ultrasound versus computed tomography for the detection of ureteral calculi in the pediatric population: a clinical effectiveness study. *Abdominal Radiology*. 2019;44(5):1858-66.
9. Akram F, Khan W, Fayyaz M, Siraj SK, Banaras F. The Validity of Ultrasound KUB; in the Diagnosis of Ureteric Calculus. *Pakistan Journal of Medical & Health Sciences*. 2022;16(07):689-.
10. Jaiswal P, Shrestha S, Dwa Y, Maharjan D, Sherpa NT. CT KUB evaluation of suspected urolithiasis. *Journal of Patan Academy of Health Sciences*. 2022;9(1):58-64.
11. Rashid N, Rehman Z, Dogar I, Hashmi K, Nawaz F. Predictability of Computerized Tomography as Compared to Ureteroscopy in Detection of Ureteric Stone in patients with Indwelling Stents. *Ann King Edward Med Uni*. 2022;28(2):175-9.
12. Jafri S, Haidry M. Lower ureteric stones; to find out the treatment results & complications of removal of lower ureteric stones with or without stenting the ureter. *Professional Med J*. 2016;23(03):262-7.
13. Awan S, Bhatti A, Awan A. Ureterorenoscopy, a review of first three years of experience for ureteric stone disease. *Professional Med J*. 2019;26(10):1712-8.
14. Mirza M, Zubair M, Saria M, Habib L, Jaleel F, Channa M. Validity of microscopic hematuria as a predictor of urinary calculi. *J Surg Pak*. 2009;14(3):108-11.
15. Ahmed F, Askarpour M-R, Eslahi A, Nikbakht H-A, Jafari S-H, Hassanpour A, et al. The role of ultrasonography in detecting urinary tract calculi compared to CT scan. *Research and reports in urology*. 2018;10:199.
16. Thungkatikajonkit P, Wongwaisayawan S, Wibulpolprasert A, Viseshsindh W, Kaewlai R. Is combined ultrasound with radiography sufficient for the diagnosis of obstructive ureteric stone in patients with acute flank pain? *Journal of Medical Ultrasound*. 2020;28(2):86.