Original Research Paper

Radio-Diagnosis

COMPARATIVE STUDY OF MULTIDETECTOR COMPUTED TOMOGRAPHY (MDCT) WITH ULTRASONOGRAPHY IN ACCURATE DIAGNOSIS OF URETERIC CALCULUS SIZE.

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ABSTRACT **Background** The trend of imaging modalities used in the evaluation of urinary system stones had been changed recently due to the developments in computed tomography (CT) technology. **Objective** The present study was undertaken to find the accuracy of multi-detector computerized tomography in comparison with ultrasonography for an accurate diagnosis of ureteric calculus size. **Methodology** Single centre hospital-based comparative cross-sectional study was conducted at Department of Radio-diagnosis, Sri Venkateshwara Medical College Hospital, and Research Centre, a tertiary care teaching hospital located in Ariyur, Puducherry. A total of 118 patients from February 2021 to September 2022 underwent unenhanced multidetector CT and ultrasound for the diagnosis of ureteric calculus size. **Results** The mean age was 38.8 ± 14.8 years and 74.5% were males and female to male ratio was 1.0:2.9. On CT scans stones were found in the vesicoureteric junction among 12.7% of patients. Ureteric calculi in the upper ureter, mid ureter, and lower ureter were found in 9%, 7%, and 32.2% of patients respectively. Other CT scan findings included hydronephrosis in 6% of patients, hydroureteronephrosis in 60%, and perinephric fat stranding in 3.4% of patients. In ultrasound, 6% of patients had hydronephrosis and 60% of patients had hydroureteronephrosis. Among the 79 cases with ureteric calculi in CT, 35 cases were found on ultrasound. The sensitivity of diagnosing ureteric calculi using ultrasound is compared with CT and was found to be 44.30% with 100% specificity and 100% PPV, and 46.99% NPV **Conclusion** This study concludes that multidetector computerized tomography (MDCT) is more accurate when compared to Ultrasonography in the case of ureteric calculus. However, in positive cases of ureteric calculus in ultrasonography, there is no significant difference in size noted in comparison with computed tomography.

KEYWORDS : CT, USG, Ureteric Calculus, Accuracy.

INTRODUCTION:

Ureteric colic due to ureteric calculi is one among the very common emergencies in urology and in the emergency. The annual incidence of kidney stones in industrialized nations is 0.5% to 1.9%.3,4,5 The prevalence of urinary calculi in the general population is estimated to be 2-3% and is a very common urological disease.

Nearly 10% of the people in the industrialized world are suffering from renal stone disease.

The occurrence of renal tract calculi in India has a wide regional variation of incidence. The southern part of India has a lower incidence of renal calculi compared to the northern part of India.

Ultrasonography (USG) is the best non-invasive and cheap investigation of choice for detection of the urinary system calculi. However it had very low sensisitivity when compared with gold standard Computed Tomography So, this present study was undertaken to assess the accuracy in accurate diagnosis of ureteric calculi in terms of size and location**.**

MATERIALS AND METHODS

Single centre hospital-based comparative cross-sectional study was conducted at Department of Radio-diagnosis, Sri Venkateshwara Medical College Hospital, and Research Centre, a tertiary care teaching hospital located in Ariyur, Puducherry from February 2021 to September 2022. The study was approved by the Institutional Ethics Committee.

Patient's population

The study included patient who has been referred to the Radiology department for CT-abdomen to rule out renal stone / acute abdominal pain for evaluation. Pregnant women were excluded from this study.

Study evaluations

After fulfilling all the eligibility criteria, Written informed consent was taken from the patient or legally accepted representatives were obtained. Patients were explained about the procedure in detail in their own language. Patients were allowed to discontinue the study at any point in time.

Method of diagnosis of ureteric calculus:

A. Computed tomography

Imaging was done on 6 section MDCT scanner (SIEMENS-SOMATOM EMOTION 6).

The patient was asked to fill the urinary bladder prior to evaluation with no additional prerequisite prior to the scan. Computed Tomography of the abdomen was done using a standard protocol in supine position and the images are then reformatted.

Ultrasound

The patients were then examined using ultrasonography with full bladder in various positions (supine position, left lateral, right lateral, and prone positions) using SIEMENS, ACCUSON X300, 2-5 MHz curvilinear array transducer with urology setting.

Outcome measures

Primary outcome:
• Accuracy in detection of ureteric calculus Location and Size using Computed Tomography compared with ultrasonography.

Secondary outcomes:
• Specificity, Sensitivity, Positive predictive value, and Negative predictive value of CT (Computed Tomography) vs USG (Ultrasonography) in ureteric calculus size and location determination.

STATISTICAL ANALYSIS

Patient demographics were represented by Descriptive statistics. Continuous data was stated as mean ± SD based on distribution The categorical data are expressed as ratios, rates, and proportions. Shapiro Wilk test was used to check the Normality. The accuracy of diagnosing the ureteric calculus size using CT was compared with USG to determine the specificity, sensitivity, Positive predictive value, and Negative predictive values using cross-tabulations. $p \le 0.05$ was considered statistically significant. Statistical analysis was done by using SPSS version 22.

RESULTS

A total of 118 patients were enrolled in the study. According to this

study 74.5% were males and male (sex) to female (sex) ratio was 2.9:1.0. The mean age of presentation was 38.8 ± 14.8 years. 80.5% of patients presented with flank pain and it was the commonest complaint. On CT scan stones were found in the vesicoureteric junction among 12.7% of patients. Calculi in upper ureter, mid ureter, and lower ureter were found in 9%, 7%, and 32.2% of patients respectively. Additional CT scan findings included hydronephrosis in 6% of patients, hydroureteronephrosis in 60%, and perinephric fat stranding in 3.4% of patients. Ultrasound (USG) findings revealed hydronephrosis in 6% of patients and hydroureteronephrosis in 60% of patients. Out of the 79 patients detected with ureteric calculi from CT, 35 patients were detected on ultrasound (USG). The ultrasonography (USG) sensitivity in diagnosing ureteric calculi when compared to CT was 44.30% with 100% specificity and 100% PPV, and 46.99% NPV.

DISCUSSION

This cross-sectional comparative study was undertaken to assess the accuracy of multidetector-CT in comparison with Ultrasonography (USG) for the accurately diagnosing the size of ureteric calculi.

The multi-detector computed tomography (MDCT) introduction in the evaluation of the collecting system of the kidney more precisely using the thinner image sections, reducing the scan time, improvement in spatial resolution longitudinally, and obtaining better coronal sections images.

However, Ultrasonography is much safer without any radiation exposure as well. In the case of resource-limited settings where CT is not available and affordable.

The present study was done for the assessment of accuracy in the detection of ureteric calculus size using multi-detector computed (MDCT) in comparison with ultrasonography.

In the present study, 74.5% were of the male sex and 25.5% were of the female sex with male gender to female gender ratio was 2.9:1.0 suggesting the male preponderance of renal stones.

This study suggest that renal stones disease was commonest in the middle-aged male gender, with the peak incidence in the fourth decade. These findings were in correlation with the previous study.

In this study, the commonest complaint of the presentation was found to be flank pain accounting for 80.5% of patients followed by backache in 47.1%, burning micturation in 37.9%, headache in 29.9%, and hematuria in 28.7% and fever in 10.3%.

Since the introduction of NCCT (Non-contrast-enhanced computed tomography) by Smith et al 1995, it has been widely accepted as the standard imaging modality of choice. CT had the following advantages like, simplicity of the performance, no intravenous contrast agents are needed in the study, and the scan time very less. Even extrarenal abnormality can be detected using CT. The calculi having attenuation value of 1000 HU and above will have a poor response to ESWL.

In this study on CT scans, Stones were found in the vesicoureteric junction among 12.7% of patients. Calculus in the upper, mid, and lower ureter was found in 9%, 7%, and 32.2% of patients respectively. In this present study, additional CT findings include hydronephrosis in 6% of patients, hydroureteronephrosis in 60%, and perinephric fat stranding in 3.4% of patients.

CT has its limitations: it is having radiation and can't be used in pregnancy and needs to be limited in younger patients and it won't be available outside the hospital facilities and is costly compared to other cheaper modalities.

Ultrasound has its advantages such as being inexpensive compared to CT, zero radiation and being mobile & can be done at the bedside. However, it has lower sensitivity for smaller renal stones size.

In this study, USG has detected upper ureteric calculi, mid ureteric calculi, and lower ureter calculi were found in 4%, 0%, and 7% with the presence of hydronephrosis in 6% of patients and hydroureteronephrosis in 60%.

Subedi et al found that CT-KUB is the best modality for identification of ureteric calculi with higher sensitivity and sensitivity up to 98.1%.

Ultrasonography has a very limited role in evaluation of mid and distal ureteric stones. This is the greatest drawback of using ultrasonography.

However, ultrasonography can identify some secondary signs of ureteral obstructions. And it also needs special training for the detection of ureteric calculus.

Sharad Kondekar and Iqbal Minne compared USG and CT for identification of calculi and found that sensitivity and specificity of ultrasonography in the diagnosis of renal calculi were found to be 53% and 85% respectively.

Hasan Shamset.al. Conducted a study to identify the diagnostic accuracy of USG in renal stone disease and ureteric calculus and found that the diagnostic accuracy is 86.27% and 33.33% respectively.

Vijayakumar Met.al. conducted a study on technical review for ultrasonic renal stone size detection and found that the sensitivity of USG decreases with a smaller stone size of less than 3 mm.

Conclusion:
It is concluded that multidetector computerized tomography (MDCT) is more accurate for diagnosing the ureteric calculi when compared to Ultrasonography. However, in positive cases of ureteric calculus in ultrasonography, there is no significant difference in size noted in comparison with computed tomography.

TABLE - 1: MEAN AGE OF PRESENTATION

Age of patients in years	Number of patients	Percent of patients
≤10	4	3.4
11-20	10	8.5
21-30	20	17
31-40	33	27.8
41-50	24	20.4
51-60	19	16.1
>60	8	6.8
Total	118	100

Descriptive Statistics	Min	Max	Mean	SD
AGE(YRS)	7	82	38.8	14.8

In this study, the mean age was estimated to be 38.8 ± 14.8 years of age.

TABLE - 2: SEX DISTRIBUTION

Sex of patient	No of patients	Percent of patients
Male	88	74.5
Female	30	25.5
Total	118	100

In the present study, 74.5% were males and 25.5% were females. The male-to-female ratio was 2.9:1.0

TABLE- 3: COMPUTED TOMOGRAPHY SCAN FINDINGS

	N	Percent
Location		
Pelviureteric junction	7	6
Upper ureter	11	9
Mid ureter	8	7
Lower ureter	38	32.2
Vesicoureteric junction	15	12.7
No calculus	39	33.1
OTHER CT FINDINGS		
Hydronephrosis	7	6
Hydroureteronephrosis	72	60
Perinephric fat stranding	4	3.4

TABLE -4: DISTRIBUTION OF CASES ACCORDING TO ULTRASONOGRAPHY FINDINGS

USG FINDINGS	N	Percent
LOCATION		
Pelviureteric junction	7	6
Upper ureter	5	4

Mid ureter	0	0
Distal ureter	8	7
Vesicoureteric junction	15	12.7
No calculus	83	70.3
OTHER USG FINDINGS		
Hydronephrosis	7	6
Hydroureternephrosis	72	60

TABLE - 5: ACCURACY OF USG (ULTRASONOGRAPHY) IN COMPARISON TO CT(COMPUTED TOMOGRAPHY) FOR URETERIC CALCULUS DIAGNOSIS

USG DIAGNOSIS	CT DIAGNOSIS		Total
	POSITIVE	NEGATIVE	
POSITIVE	35	0	35
NEGATIVE	44	39	83
Total	79	39	118

Sensitivity-44.30% Specificity-100%   PPV-100% NPV-46.9%

ANNEXURE/ IMAGES
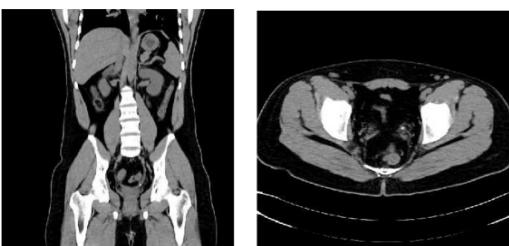
Photograph 1. Coronal and axial CT showing lower ureteric calculus resulting in hydronephrosis and hydroureter on the left side

Photograph 1. C. USG showing only hydronephrosis and hydroureter on the left side

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