Original Article

# Comparision Between Computed Tomography and Ultrasonography in Detection of Urinary Tract Calculi

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**ABSTRACT**

**Introduction:**In the past decade, developments in CT technology have changed the trend of imaging modalities used in the evaluation of urinary system. The present study was undertaken to compare between Computed Tomography (CT) and Ultrasonography (USG) in detection of urinary tract calculi.

**Methods:** This was a cross-sectional and observational study. The study was conducted in Department of Radiology and Imaging of Tribhuvan University Teaching Hospital from June 2017 to September 2017 in 96 patients. Patients who underwent plain CT abdomen (CT KUB) with suspicion of urolithiasis after performing USG were enrolled in the study. Ultrasound and CT findings were compared on the basis of age, gender, clinical complaints, number of stones and their locaton (site of occurrence). Similarly, specificity, sensitivity, positive predictive value and negative predictive value of USG were calculated using CT as gold standard.

**Results:**A total number of 96 patients were studied from June 2017 to September 2017. Among them 56 were males and 40 were females with male to female ratio of 1.4:1. The mean age of male was 34±14.79 years and female was 38±18.74 years.Flank pain was the commonest complaint recorded in 35.41% of patients. On the CT scan, 127 calculi were detected in 96 patients with 31 (32.2%) patients having calculi at multiple sites. Kidney was the most common site of urinary calculi with 77 (60.62)% calculi located in kidneys. Vesico-ureteric junction (VUJ) was the second commonest site with 15 (11.81.%) calculi. Bilateral calculi were seen in 40 (41.66%) patients. Out of the 22 cases with ureteric calculi, USG detected calculi only in 5 cases and the sensitivity of USG in diagnosing ureteric calculi in comparision to CT was 22.72% with 100 % specificity, 100% PPV and 81% NPV.

**Conclusion:** Ultrasound has lower sensitivity for the detection of ureteric calculi. CT helps in precise detection of calculi during initial evaluation which is critical for clinical decision making and patient counselling.

**Keywords**: Calculi, Computed Tomography, Ultrasonography, Urinary tract

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## INTRODUCTION

Urinary tract stones are common, with a lifetime incidence of 12% and recurrence rate of 50%.[1] As the stone burden is the most important factor for making major clinical decision, accurate measurement of all calculi is crucial.[2] With its high sensitivity and specificity, unenhanced helical computed tomography (CT) has replaced all other modalities and is now regarded as the reference standard in the work-up of renal colic and urinary tract calculi.[3] Unenhanced CT is the most accurate modality for determining the presence of ureteric calculi.[4] Apart from diagnosis of stones, CT can provide detail anatomical information of urinary tract, can identify secondary signs of stone passage, and helps to find out alternate pathologies in diagnostic uncertainty. The main limitation of CT is its exposure to ionizing radiation.

Ultrasound (USG) is also commonly used for the diagnosis of urolithiasis. As there is no risk of radiation in USG it is very useful for the evaluation of urolithiasis particularly in pregnant ladies and pediatric population. Ultrasound is commonly available, inexpensive to operate and poses no risk of radiation exposure.[5] However, ultrasound has lower sensitivity for ureteric calculi, especially when used by an inexperienced radiologist, and in the case of smaller stone size, obese patients and low grade of hydronephrosis.[6]

Many studies were carried out comparing USG and CT for evaluation of urolithiasis.[4,6,7] However, to our knowledge no such literatures are available in Nepal. So, this study was carried out to compare USG and CT for evaluation of urolithiasis.

## MATERIALS AND METHODS

This study was a prospective, cross sectional, observational study conducted in the Department of Radiology and Imaging, Tribhuvan University Teaching Hospital (TUTH),Kathmandu, Nepal during the period from June 2017 to September 2017. TUTH is a multidisceplinary tertiary care hospital. Total 96 patients who had urolithiasis in non contrast computed tomography and had ultrasound reports available were enrolled in the study. Post operative patients, patients with ureteric obstruction by causes other than calculi like retroperitoneal masses and pregnant women were excluded from the study. Patients were interviewed and the demographic data such as age and sex, clinical complaints and history of other illness were obtained and recorded on a predesigned and pretested proforma.

Ultrasound findings like anatomical location and size of stones, hydronephrosis were collected [Fig: 1a]. CT scan was performed on 128 slice MDCT scanner (Siemens Somatom Definition AS+). Location of calculi and their size were measured in dedicated work station[Fig: 1b]. Statistical analysis was carried out with the help of SPSS version 23 and Microsoft Excel version 2007. The diagnostic accuracy of USG in comparision to CT was determined by calculating sensitivity, specificity, positive predictive value and negative predictive value. Chi-square test was used to compare the significance between CT and USG in detection of urinary tract calculi.

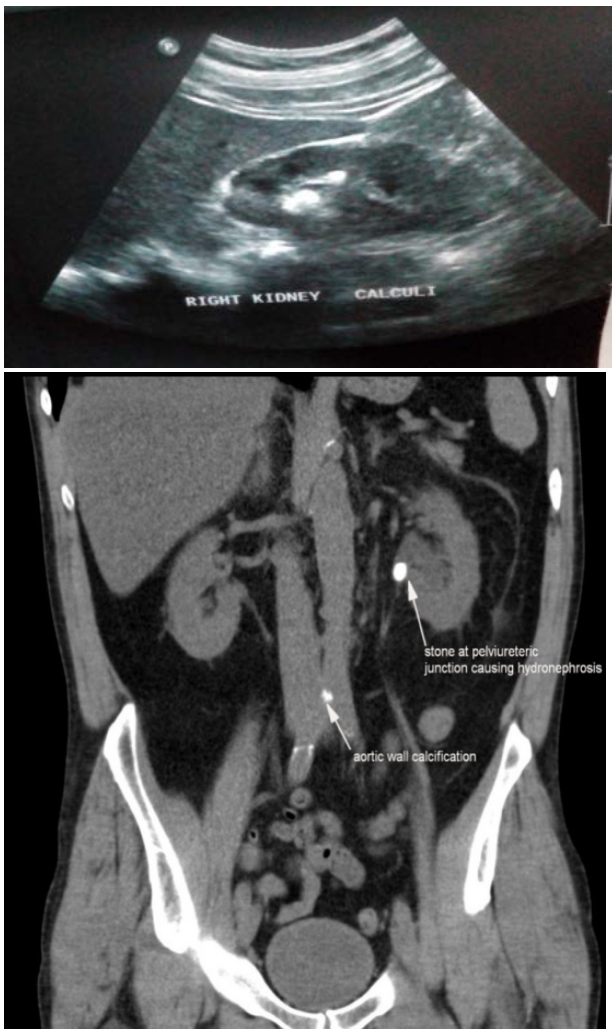


Figure 1: Ultrasound (a) and Coronal reformatted CT image (b) showing hyperechoic calculus in upper calyx of right kidney (a) and hyperdense calculus in left renal pelvis (b).

## RESULTS

A total of 96 patients with urinary tract calculi were evaluated with ultrasound and computed tomography.There were 56 males and 40 females with male:female ratio of 1.4:1. Mean age in male was 34 ± 14.79 years and that in female was 38 ± 18.24 years. Flank pain was the most common complaint reported by 35.41% of patients followed by low back pain in 31.25% of patients [Table 1].

Table 1: Common complaints in patients with urolithiasis

| Complaints | Frequency | Percentage |
|---|---|---|
| Flank pain | 34 | 35.41% |
| Low Back Pain | 30 | 31.25% |
| Burning Micturition | 11 | 11.45% |
| Haematuria | 8 | 8.33% |
| Hydronephrosis | 5 | 5.20% |
| Fever | 4 | 4.16% |
| Non specific | 4 | 4.16% |
| Total | 96 | 100% |

Total of 127 calculi were seen in 96 patients. In CT scans, 77(60.62%) calculi were located in kidneys where as 15(11.81%) calculi were in vesicouretric junction(VUJ) [Table 2]. Most of the stones were seen bilaterally (41.66%), while 38.55% were seen in right side and 19.79% in left side.Thirty one (32.2%) patients had calculi at multiple sites.

Table 2: Basis of location of stone

| Location | Frequency | Percentage |
|---|---|---|
| Renal | 77 | 60.62% |
| PUJ | 11 | 8.66% |
| Upper Ureter | 13 | 10.23% |
| Lower Ureter | 9 | 7.08% |
| VUJ | 15 | 11.81% |
| Bladder | 2 | 1.57% |
| Total Calculi | 127 | 100% |

Correlation of CT and USG diagnosis.

Total number of patients with calculi in CT = 96

Total number of patients with calculi in USG = 67. The correlation between CT and USG finding was 49% ($p<0.001$). Sensitivity and specificity of ultrasound for urinary calculi as compared to CT were 69.79% and 100% respectively.

Ureteric calculi were detected in 22 patients in CT. Only 5 ureteric calculi were detected in the USG. The sensitivity of ultrasound in the

diagnosis of ureteric calculi in comparison to CT was 22.72% and specificity was 100%. The positive predictive value was 100% and negative predictive value was 81% [Table 3].

Table 3: Accuracy of USG in comparison to CT for the diagnosis of ureteric calculi

| USG | CT Scan | | Total |
|---|---|---|---|
| | Positive | Negative | |
| Positive | 5 | 0 | 5 |
| Negative | 17 | 74 | 91 |
| Total | 22 | 74 | 96 |
| Sensitivity (%) | Specificity (%) | PPV | NPV |
| 22.72(%) | 100% | 100% | 81% |

## DISSCUSION

Urinary abnormalities, including urolithiasis cause acute low back pain, flank pain, which are common and complex clinical problems. Radiological studies have an important place in the evaluation of flank pain and low back pain. There needs to be a non nephrotoxic and a highly sensitive means of detecting urinary tract stones, as stone pain is extreme and patient needs rapid diagnosis.[8]

The introduction of MDCT allowed more accurate depiction of urinary tract through thin section imaging, faster imaging, improved longitudinal spatial resolution, and the better quality of reformatted images. With these advances, CT has largely replaced plain film radiography, excretory urography and tomography for a variety of urinary tract disorders including urolithiasis.[9] However, the safety and ease of USG examination is surpassed.

In present study, we evaluated 96 patients with urinary tract calculi with ultrasound and non contrast CT scan. The mean age among males was 34±14.79 years and among females was 38±18.74 years. These findings were in agreement with the previous report which postulated that the kidney stones were most common in middle aged people.[3, 8]

In the present study on CT scan, majority of calculi (60.62%) were located in kidneys. Vesicoureteric junction was the second most common site of calculi accounting 11.81%. Most of the stones were seen bilaterally (41. 66%) while 38.55% were seen in right side and 19.79% in left side .

In a study by Gamerddin et al., majority of stones were lodged in kidney than in ureter and bladder.[10] In their study 36% calculi were seen in kidneys and 8% were seen in ureter. We also found more calculi in kidneys; however percentage of renal calculi was much higher than that found in their study.

In this present study 96 cases of urinary tract calculi were detected by CT where as the number of cases was limited to 67 by USG. Overall sensitivity and specificity of ultrasound for urinary calculi as compared to CT were 69.79 % and 100 % respectively. Out of the 22 cases with ureteric calculi, 5 cases were seen in USG and the sensitivity of USG in diagnosing ureteric calculi in comparision to CT was 22.72% with 100 % specificity, PPV 100% and NPV 81%. Previous studies reported sensitivity rates of sonography for detecting urolithiasis of 12 to 93% [7, 11, 12] and a study during last decade reported the sensitivity and specificity of sonography for urolithiasis as 78.6% and 100%.[11,13]

Fisal Ahmed et al.[6] in 2018, studied accuracy of ultrasonography for urinary tract stones using non enhanced CT (NCCT) scan as reference

standard. In 184 patients, NCCT detected 276 (97.2%) stones, while USG could identify 213 (75.5%) stones. Overall USG had a sensitivity of 75.4 % and specificity of 16.7%. Sensitivity of our study was almost similar to their study; however, our specificity was very high as compared to theirs.

Ather et al.[7] in 2004, studied diagonostic accuracy of ultrasonography compared to unenhanced CT for stone and obstruction in 864 patients with renal failure. USG had a sensitivity of 81% for the renal calculi and only 45% for ureteric calculi. When ultrasound was combined with KUB x-ray,the sensitivity was 77% for ureteric calculi. Our sensitivity of ultrasound for detecting ureteric calculi was even much lower as compared to theirs.USG has limited role in the diagnosis and management of urinary tarct calculi. Although USG is readily available, quickly performed and can identify stones located in the kidney, it can not readily detect ureteric stones. This is a significant drawback because ureteric stones are far more likely to be syptomatic than renal calculi.[14] Overall the present study showed the usefulness of MDCT in comparision with USG for the accurate diagnosis of urinary tract calculi. The limitataion of study was smaller sample size.

## CONCLUSION

Ultrasound has low sensitivity and very high specificity as compared to CT scan for the detection of ureteric calculi. CT KUB examination is more accurate and precise in the diagnosis of urinary tract calculi compared to USG especially for ureteric calculi.

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