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CT KUB evaluation of suspected urolithiasis

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Abstract

Introduction: Non-contrasted computed tomography scan for kidney, ureter, and bladder (CT KUB) for the diagnosis of urolithiasis is important for accurate diagnosis, followup, and management. Unlike USG, CT KUB has more diagnostic yield in urolithiasis and other incidental findings. This study aims to evaluate the use of the CT KUB in suspected urolithiasis, which is presented with severe flank pain.

Method: A retrospective observational study was carried out in the Department of Radiology and Imaging, Patan Hospital, Nepal. The CT KUB reports of patients with suspected urolithiasis from a period of 3 years from Jan 2017 to Jan 2020 were analyzed for evidence of urolithiasis and secondary signs of obstruction as 'diagnostic' of CT KUB. Other incidental radiological findings were further analysed and categorized into urinary and extra-urinary. Ethical approval was obtained. The association between USG and CT KUB was analysed using the Chi-square test, with a p value of 0.05 considered statistically significant.

Result: A total of 414 CT KUB reports were analysed, 230(55.6%) males, 314 patients had USG before CT KUB. Considering CT KUB as a gold standard for the diagnosis of urolithiasis, the accuracy of ultrasound was found to be 85.03%, and sensitivity is 94.09% and specificity of 27.9%.

Conclusion: The majority of the patients included in the study had ultrasound done before CT KUB. The sensitivity of ultrasound was significant considering CT KUB as a gold standard in the diagnosis of urolithiasis.

Keywords: Urolithiasis, CT KUB, incidental findings, USG scan

Introduction

Urolithiasis is a common cause of severe flank pain with a lifetime incidence of 12%¹ and a recurrence rate of up to 50% in the subsequent 10 years.^{2,3} Imaging plays an important role in establishing an accurate diagnosis, follow-up, and management of urinary tract stones. A non-contrast computed tomography scan of the kidney, ureter, and bladder (CT KUB) is the imaging investigation of choice for patients with suspected urolithiasis and is recommended by the European Association of Urology and the American Urological Association.^{4,5} The CT KUB reveals the presence of stone/s, size, location, density, and presence of hydronephrosis; it gives information for selecting the appropriate therapeutic approach.⁶ Advantages include high sensitivity and specificity and the ability to detect alternative abdominal pathology.⁷ One of the major demerits is the radiation dose.^{8,9}

Ultrasound is the first-line imaging technique that can detect about 50-60% of ureteral stones and is mainly used for imaging the kidneys and the proximal parts of the ureter.¹⁰ But, CT KUB provides a higher diagnostic yield in the detection of urinary stones, particularly the distal parts of the ureter.²

Unlike ultrasound, has high levels of ionizing radiation with consequent long-term cancer risk.¹¹ Approximately 14000 additional cancers overall may be attributable due to unnecessary abdominopelvic CT scans.¹² These avoidable scans can also lead to increased incidental findings, often not significant resulting in unnecessary patient anxiety and inappropriate follow-up.¹³

The purpose of this study was to evaluate the CT KUB findings in suspected cases of urolithiasis and USG findings before CT KUB.

Method

This is a retrospective observational study done in the Department of Radiology and

Imaging, Patan Hospital, Patan Academy of Health Sciences (PAHS). Ethical approval was obtained from the Institutional Review Committee-Patan Academy of Health Sciences (IRC-PAHS). Electronic data of CT KUB were reviewed for a period of 3 years from January 2017 to January 2020. CTKUB reports of the patients with clinical suspicion of urolithiasis were identified and retrieved from the CT section of the radiology department. For all the patients who had USG done before coming for CT KUB, USG reports were attached.

The reports were retrospectively reviewed for evidence of urinary tract calculi, as well as other incidental radiological findings. Reports were interpreted as 'diagnostic' for urolithiasis, with the presence of a urinary tract stone/s or secondary signs of obstruction such as hydronephrosis and/or hydroureter, ureteric stricture. All above mentioned urinary tract findings on CT KUB were compared with available USG reports findings. All USGs were done in Philips Affinity 50/70 G machines with 3.5 MH convex probe; performed by the radiologists (MD Radio-Diagnosis and Imaging). All USG were done through the transabdominal approach with full urinary bladder. The kidneys were visualized in both sagittal and coronal planes. Ureters were also traced down up to the urinary bladder with emphasis to the ureterovesical junction.

The CT KUBs were done with 128 slice Multi-Detector Computed Tomography (Injenuity, Philips) without any contrast. The exposure factors were 130 KVP and 200 mAS, with the patient in a supine position, anteroposterior topogram from the lower chest to thighs. The scans were extending from the dome of the liver to the ischial tuberosity.

The obtained data were analyzed using SPSS software. The chi-square test and analysis of variance comparison were done to compare rates of positive, negative, and incidental findings as well as to compare yield across different imaging modalities.

Result

There were 414 CT KUB reports retrieved between Jan 2017 to Jan 2020. A total of 230(55.6%)males and 184(44.4%) females had CT KUB done for suspected ureteric colic in the Radiology Department with a mean age of 37.0±15.9, Table 1. Male to Female ratio was 1.25:1.

Out of 340 CT KUB 'diagnostics', 313(92%) showed renal, ureteric, or both stones, while 27(7.9%) had no stones but showed only secondary signs of obstruction. Out of 313 urolithiasis cases in CT KUB, 223(71.2%) showed secondary signs and 90(26.4%) cases showed no secondary signs.

Incidental findings of CT KUB in this study were 86(20.7%) out of which 61(14.7%) were urinary, and 25(6.0%) were extra urinary, Table 2. Among urinary most common was a renal cyst, 20(32.8%), and among extra urinary, it was cholelithiasis, 6(24.0%).

The patients without renal or ureteric calculi but incidental findings were 30(7.1%). Such incidental findings were further categorized into clinically significant as the cause of flank pain, 14(3.3%), and clinically insignificant 16(3.8%).

Out of 414 CT KUB reports, 314(75.8%) had an ultrasound done. Only 44(10.6%) had X-ray KUB done before CT KUB was ordered.

Those who underwent ultrasound showed urolithiasis and/or only secondary signs in 286(69.4%). Out of those patients, 255(89.2%) had urolithiasis and/or secondary sign on CT KUB, Table 3.

Considering CT KUB as a gold standard for diagnosis of urolithiasis, the accuracy of ultrasound was found to be 85.03% and sensitivity is 94.09%, and specificity of 27.9%, Table 3.

Table 1. Demographic details of patients undergoing CT KUB N=414

Variables	N	%
Male	230	55.6
Diagnostic for urolithiasis and/or obstruction	340	75.6
Urolithiasis	313	92.1
Only features of obstruction	27	7.9

Table 2. Urinary and extra-urinary incidental findings in CT KUB of the patients, N=86

Incidental findings	N(%)
Urinary	61(70.9)
Renal cyst	20(32.8)
Extra-renal pelvis	15(24.6)
Atrophic kidney	9(14.8)
Ureteric stricture	9(14.8)
Horseshoe kidney	4(6.6)
Duplex collecting system	3(4.9)
Renal mass	1(1.6)
Extra-urinary	25(29.1)
Cholelithiasis	6(24.0)
Hepatic cyst	5(20.0)
Ovarian cyst	4(16.0)
Fibroid	4(16.0)
Ovarian mass	3(12.0)
Cholecystitis	2(8.0)
Appendicitis	1(4.0)

Table 3. Comparison between USG and CT KUB Findings for urolithiasis and secondary signs of obstruction

		CT-KUB Positive	CT-KUB Negative
USG Positive	286(100%)	255(89.2%)	31(10.8%)
USG Negative	28(100%)	16(57.1%)	12(42.9%)

Discussion

CT KUB in our study in the overall population showed stones and/or secondary sign/s of obstruction in the majority of the patients, 340(82.1%), which was clinically significant. Incidental findings describing the cause of flank pain such as cholecystitis, cholelithiasis, appendicitis, the ovarian cyst was seen only in 14(3.3%) patients. In a study done in Hamburg, Germany which included 125 patients with suspected renal colic, the clinically significant incidental findings were found to be 6(5%).¹⁴ This is almost the same as our study. Amongst similar previous studies, clinically significant incidental findings ranged from 10 to 15% with a comparable spectrum of pathology involving the GU tract and EGU tract, liver, gall bladder, and appendix.^{7,15} The difference in detection rate across studies is partially accounted for by the 'clinically significant' versus 'clinically insignificant' pathology. Perhaps one of the important components in the detection of incidental findings is the clinical judgment of ordering authority in suspicion of underlying urolithiasis.⁷

In this study, the females were less commonly affected than males, 184(44.4%) vs 230(55.6%), and the mean age of presentation was 37y. These findings are supported by another study done in Toronto, Canada where renal stones were three times less common in females with the common age of presentation between 30 and 60 y.¹⁶ With low incidence of urolithiasis in females as compared to male patients (27.5% vs. 57.5%) presented with flank pain in the emergency department.¹⁷ In our study we observed the rate of the female population was slightly higher than mentioned in the above studies, another study could be done to evaluate the same.

Our study also indicates that female patients are likely to have gynecological pathologies such as ovarian cysts, adnexal masses, and fibroids as a cause of flank pain (5.9%) which is similar as reported in other literature (6%).¹⁸ On the contrary, another study, in 776 patients showed a higher incidence of gynecological pathology in 38.3% of cases.⁷ Most of such gynecological findings require additional imaging further increasing the radiation exposure and economic burden on patients. The incidental findings detected on CT KUB can be diagnosed with careful clinical evaluation, urinalysis, appropriate and cost-effective radiation-free investigations. Another study concluded that when there is even the slightest doubt regarding a female patient's symptoms and signs, she should be initially evaluated by other means (e.g., using a combination of plain X-ray and ultrasound), thus avoiding the unnecessary use of CT.¹⁹

The CT KUB has added value over ultrasound and X-ray KUB because this offers the additional advantage of more precise anatomic localization of stones specifically in the ureters where stones are usually obscured by colon gases.²⁰ CT KUB is the best imaging modality as it has high sensitivity (98%) and specificity (97%) in detecting ureteric stones.²¹ In our study we found ureteric calculi in 30.7% of patients in CT KUB which is almost similar to the study where the rate of ureteric calculi was 33.7%.²²

In our study, the overall PPV of USG and X-ray KUB is fairly high considering CT KUB as a gold standard. A study done in Pakistan noted that ultrasound has a sensitivity of over 80% and specificity of 100% for renal stone but the sensitivity to pick ureteral stone is less than 50%. However, the use of plain X-ray increases the sensitivity up to 77% in picking up the ureter stones.¹⁰ In our study the sensitivity of the ultrasound is almost similar to the above

study (94.09%), however, the specificity is low (27.9%), This could be because most of the cases were ureteral calculi. It is therefore suggested that if there is incomplete information on both USG and X-ray, CT could then be performed.

In this study, the sensitivity and specificity of ultrasonography in cases of urolithiasis were 43% and 89% respectively. The findings in our study are closely in agreement with most studies performed in this regard. A study from Cleveland, the USA with a sample size of 552 patients, showed that USG had a sensitivity of 54% and specificity of 91% for urolithiasis, confirmed by non-enhanced CT.²³ Other studies comparing USG with CT KUB have shown low sensitivity ranging from 24-69% and high specificity of 82-90% for USG.²⁴ Another study from the USA conducted on 2759 patients showed that USG is the first-line investigation and used effectively to detect calculi in kidneys, proximal ureter, and vesicoureteric junction or urinary bladder.²⁶ In this regard, findings of USG may be combined with findings of x-ray KUB to give better diagnostic accuracy.

The use of CT KUB beyond the specific evaluation of urinary tract calculi, so-called 'indication creep', has been demonstrated with alternative pathology detection rates as high as 45% in a study done in Australia in 215 patients.²⁷ In our study group 100 (24.2%) patients did not undergo USG and came directly for CT KUB which might have increased the so-called indication creep more than mentioned above. To reduce indication creep, an algorithm has been proposed for ordering CT KUB in patients presenting with flank pain.²⁸

limitations of the current work were the retrospective nature of data collection, the department/authority who ordered the tests, and details of clinical indications could not be analyzed.

Conclusion

The majority of the patients included in the study had an ultrasound done before CT KUB. The sensitivity of ultrasound was significant considering CT KUB as a gold standard in the diagnosis of urolithiasis.

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Conflict of Interest

None

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Author Contribution

Concept, design, planning: All; Literature review: PJ; Data collection: PJ; Data analysis: All; Draft manuscript: PJ; Revision of draft: All; Final manuscript: PJ; Accountability of the work: All.

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