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Original Article

Evaluating Unenhanced Multidetector Computed Tomography of Kidneys, Ureters and Bladder (CT KUB) as the Initial Imaging Service in Suspected Acute Renal Colic Patients

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ABSTRACT

Objective: To assess the role of unenhanced multidetector computed tomography (CT) of kidneys, ureters and bladder (KUB) in the initial imaging of suspected acute renal colic.

Study Design: Retrospective longitudinal study.

Place and Duration of Study: Combined Military Hospital, Kharian Pakistan, from Jan 2020 to Jan 2021.

Methodology: One hundred and thirty-eight cases of suspected acute renal colic underwent CT-KUB. The demographic, radiological, clinical, and follow-up data were recorded for each patient.

Results: There were 88(51.8%) males and 82(48.2%) females in the present study, with a mean age of 50.86±18.57 years. Out of 170 patients, only 138(81.17%) were indicated with acute findings, whereas 32(18.82%) individuals showed no acute findings. The mean stone size was found to be 4.77±0.98mm. Most of the stones had a location near the pelvic brim (n=47; 34.15%).

Conclusion: The use of CT KUB should be encouraged for the evaluation of renal colic.

Keywords: Acute renal colic, Computed tomography (CT), Computed tomography of Kidneys, ureter and bladder (CT-KUB).

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INTRODUCTION

An acute renal colic is an extreme form of pain caused by acute hindrance in the urinary tract due to calculus. Apart from kidney stones, there can be many other causes of flank pain.[1] However, the number and severity of kidney stones are responsible for nephrolithiasis, the most common diagnosis, along with flank pain.[2] Nephrolithiasis affects about 5% to 15% of the population at a certain time.[3] Unenhanced computed tomography (CT) has been recognized as a gold standard for assessing suspected acute renal colic.[4] Previous research has extensively emphasized that CT has a negative predictive value of 97%, high specificity of 100% and sensitivity of 98% for diagnosing renal and ureteral calculi.[5] Another technique called abdominal x-ray (KUB) is used to identify renal stones. However, its use is limited due to the little information rendered by radiolucent calculi. In addition, other factors such as abdominal organs, bowel gas and pelvis bone also hinder proper visualization through KUB.[6] Thus, KUB is used mostly when the CT scan is positive, and the location of the stone is already known.[7]

Several researchers have put forward a similar effort of combining CT with KUB.[8,9] A recent study claimed high specificity & sensitivity of CT KUB in the diagnosis of renal colic. However, some limitations of radiation, cost and availability were also pointed out.[10] Thus, the use of CT KUB for renal colic is still debatable & requires extensive research. The present work is an effort towards the literature devoted to understanding the applicability of CT KUB for renal coli.

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METHODOLOGY

The retrospective observational was conducted at Combined Military Hospital, Kharian Pakistan, from January 2020 to January 2021. The study was approved by the affiliated Ethical Committee (approval certificate number 347). The sample size was estimated with a prevalence range of 5-19.1%,[11] using Power Analysis and Sample Size software (PASS). In total, 138 cases of suspected acute renal colic were identified from records and included in the study through non-randomized consecutive sampling.

Inclusion Criteria: The patients of either gender, suspected of renal colic and who underwent CT KUB were included in the study.

Exclusion Criteria: Patients with urinary tract abnormalities or recent history of abdominal surgery were excluded from the study.

After explaining the purpose of the study, written consent was taken from the participants. All the patients underwent CT KUB as part of their examination for acute renal colic.

The demographic, radiological, clinical, & follow-up data were recorded for each patient. Radiologists reviewed the reports. The case was declared positive when high attenuation calculi were detected in the kidneys, ureter or bladder. The maxi-mal axial measurement of calculus and timing of CT KUB examination were also noted. Moreover, any abnormalities associated with the pain of the patient found on CT KUB were also recorded.

The statistical package for social sciences (SPSS) version 20 was used to perform statistical analysis. The frequencies and percentages were used to show categorical data, whereas Mean±SD deviations were used to depict continuous data. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

Out of 170 patients, only 138(81.17%) were indicated with acute findings, whereas 32(18.82%) individuals showed no acute findings. The characteristics of patients with acute findings and no findings have been compared. (Table-I).

Table-I: Demographics of patients (n=170)

Characteristics	Acute Findings	No Findings
Gender(%)		
Male	74(53.6)	14(43.8)
Female	64(46.4)	18(56.3)
Age (Mean±SD)	50.48±18.58	52.5±18.74
Analog pain scale on admission	7.26±0.82	6.43±0.50
Dysuria n(%)		
Yes	17(12.3)	3(9.4)
No	121(87.7)	29(90.6)
Heart rate (mean±SD)	80.57±1.18	82.09 ± 1.22
Flank pain		
Both sides	49(35.5)	0(0)
Right	76(55.1)	2(6.3)
Left	49(35.5)	30(93.8)
Temperature (^{o}C) (mean±SD)	36.61±0.48	36.59±0.49
Creatinine (µmol/l) (mean±SD)	82.65±2.45	68.12±1.49
Renal clearance (ml/min)	87.90±1.81	102.96±1.35
Leukocytes (10^9/l)	10.70±0.23	8.84±0.16
C-reactive protein (mg/l)	13.77±0.14	6.72±0.15

The analogue pain scale for patients with acute findings (7.26±0.82) was more than that for individuals with no findings (6.43±0.50). In addition, the patients with acute findings had a higher frequency of dysuria (n=17;12.3%) compared to individuals with no findings (n=3;9.4%). The temperature, creatinine, leukocytes and c-reactive protein for patients with acute findings (36.61±0.48^{o}C; 82.65±2.45µmol/l; 10.70±0.23 10^9/l; 13.77 ±0.14mg/l)were found to be higher as compared to the individuals with no findings(36.59±0.49^{o}C; 68.12±1.49 µmol/l;8.84±0.16 10^9/l;6.72±0.15mg/l). However, heart rate and renal clearance for individuals with no findings (82.09±1.22; 102.96±1.35ml/min) were greater than the patients with acute findings (80.57±1.18; 87.90± 1.81). The mean stone size was found to be 4.77± 0.98mm. Most of the stones had a location near the pelvic brim (n=47; 34.15%) (Table-II).

Table-II: Findings on Computed Tomography of Kidneys, Ureters and Bladder (CT KUB) (n=170)

Findings	Values
Stone size (mm) (Mean±SD)	4.77±0.98
Stone Location (n, %)	
Ureteropelvic junction	46(33.3)
Near the pelvic brim	47(34.1)
Ureterovesical junction	45(32.6)

DISCUSSION

Radiological imaging has wide acceptance for assisting in managing individuals with acute renal colic. The traditional approach to imaging involves plain radiography, IVU and ultrasound.[11] In the last several years, CT KUB has emerged as the preferred imaging method due to its better accuracy supported by tremendous research works. Sometimes, abdominal abnormalities are responsible for causing flank pain. Thus, it is important to identify the real cause of acute flank pain.[12] Unenhanced CT renders the benefit of reliably differentiating between the causes of abdominal pain. The patients with no previous history of nephrolithiasis undergo CT for better management.[13]

Despite the benefits associated with CT, several demerits also occur with the modality. The CT has been found to underestimate the stone size compared to abdominal x-ray and intravenous pyelograms.[14,15] On the other hand, CT exposes patients to radiation, which can be harmful. This study found that CT KUB has many merits over other imaging protocols. There is no requirement for intravenous contrast, high sensitivity for detecting ureteral calculi, less examination time and differentiating ability between various causes of flank pain, as stated by Sen *et al.*[14] We found that CT-KUB also enables the classification of stones in accordance with their diameter, density and volume. This classification helps adopt appropriate and effective management strategies, as stated by Ghoshal *et al.*[5]

In the present study, several signs were recorded as secondary indicators of renal stone. This included hydroureter, renal enlargement, decreased renal atten-

uation, hydronephrosis, periureteral stranding, asymmetric perinephric stranding and tissue rim sign, as stated by Desai *et al*.[16] A stone size less than 5mm is highly likely to resolve or pass out of the ureter. However, the stones with greater size and perplexing locations need to be removed through intervention.[17]

In this study, we found that CT-KUB is extremely helpful in diagnosing causes of acute flank pain, whether it is renal stone or any other reason. For example, the renal stone is thought to cause 33% of cases with acute flank pain. On the other hand, about 45% of cases of flank pain occur due to other reasons, such as genitourinary, gynaecological or gastrointestinal issues, as described by Chi *et al*.[18] The findings of the present research work have illustrated adequate differential detection of renal stone and other causes of flank pain.

The stone location in the present study included 33.3% in the ureteropelvic junction, 34.1% near the pelvic brim and 32.6% in the ureterovesical junction. The study by Rana *et al*.[19] found the stone location to be lower for 47% of patients and upper for 53% of patients. The mean stone size was 4.77±0.98 mm in the present study.

CT KUB can bring about positive outcomes for radiology workflow and budgets.[6] CT KUB is recommended to be cost-effective compared to other diagnostic methods due to reduced time required for assessment, lack of administration of intravenous contrast and radiographic equipment.

CONCLUSION

The present study shows the feasibility and applicability of CT KUB in the evaluation of acute renal colic. Besides diagnosing renal stones, CT KUB can also diagnose other unexpected causes. Therefore, using CT KUB can be beneficial in managing the cases of renal colic with high efficiency and less cost and time.

Conflict of Interest: None.

Author's Contribution:

Following authors have made substantial contributions to the manuscript as under:

NS & SB: Study design, drafting the manuscript, critical review, approval of the final version to be published.

AQ & TA: Data acquisition, data analysis, data interpretation, critical review, approval of the final version to be published.

NSN & RA: Conception, study design, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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