DIAGNOSTIC ACCURACY OF X-RAY KUB IN PATIENTS OF URETERIC COLIC SECONDARY TO URETERIC CALCULI KEEPING CT KUB AS GOLD STANDARD

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ABSTRACT

Objective: To determine diagnostic accuracy of X-Ray KUB in patients of ureteric colic secondary to ureteric calculi keeping CT KUB as gold standard.

Methods: A cross-sectional study was performed in Department of Diagnostic Radiology, Hayatabad Medical Complex, Peshawar from 1st August 2021 to 1st February 2022 (6 months). A total of 167 patients of both genders with suspected ureteric calculi were included in the study. Each participant of the study underwent KUB radiograph followed by CT KUB. Both X-Ray KUB and CT KUB were interpreted by a single consultant radiologist. The participants received no treatment between the X-Ray KUB and CT KUB except analgesics for pain control.

Results: In this study, age range was 20 to 60 years with mean age of 45.437±5.93 years, X-Ray KUB has shown sensitivity of 74.51%, specificity of 87.9% and diagnostic accuracy of 84%, PPV 73% and NPV 88.7% in diagnosis of ureteric calculi.

Conclusion: Plain KUB radiograph is a non-invasive, readily available and reliable investigation in patients presenting with acute flank pain for diagnosis of ureteric stones.

Keywords: Ureteric colic, Ureteric calculi, X-Ray KUB, Diagnostic accuracy

INTRODUCTION

There is global prevalence of ureteric stone disease and a large population is affected throughout the world. No race and culture is spared from this disease. The lifetime prevalence of ureteric calculi is approximately 12%. Its geographic occurrence is equal globally. Obesity and sedentary life style are key factors in causing this disease. Acute lumbar pain due to ureteric calculi is a common presentation in the emergency rooms worldwide.[1–3] A stone blocked within the ureter leads to ureteric colic. It can be extremely painful and requires immediate treatment. Its diagnosis is essential for the early diagnosis of the location and presence of ureteric stones.[4]

Ureteric calculi may cause ureteric and pelvicalyceal system obstruction leading to infection and ultimately renal failure. The ureter is divided into three segments, with the ureter crossing the iliac vessels as the boundary.[5]

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Thus, early accurate diagnosis of ureteric calculi with appropriate treatment is the most important factor for prevention of complications and maintenance of renal function.[6] Signs and symptoms of ureteric stones include severe lumbar pain radiating to groin region, nausea, vomiting, fever, chills and sometimes hematuria.[7] The ureterolithiasis is a common and painful disease having high relapse probability.[8] It is essential to choose correct imaging modality for diagnosing ureterolithiasis . Multiple imaging modalities are present but ultrasound, plain X-Ray KUB and CT are mainly used. CT KUB provides the most accurate one but radiation exposure is a factor. CT scan has become the standard reference in detection of ureteric calculi with its high sensitivity (95-98%) and specificity (98-99%).[9]

Decreased ionizing radiation exposure compared with CT and cost effectiveness are radiography's advantages. If stones are seen on X-Ray, they are also likely to be visible under fluoroscopic studies. Now, 57% and 76% are the sensitivity and specificity respectively of standard KUB X-Ray.[10] CT is best for detailed anatomic evaluation of urinary tract.[11]

Although CT KUB is considered the gold standard for detecting ureteric stones due to its high sensitivity and specificity, it is also more expensive and exposes patients to a higher dose of radiation. By evaluating the accuracy of X-ray KUB, this study aims to assess whether it can reliably identify ureteric calculi and serve as a practical initial imaging choice in settings with limited resources,

potentially reducing the dependency on CT. It could streamline patient management, minimize radiation exposure, and reduce healthcare costs.The results of my study will be shared with radiologists and urologists, which will be a step towards easy diagnosis of the disease & hence betterment of patient care.

MATERIALS AND METHODS

A cross-sectional study was performed in Department of Diagnostic Radiology, Hayatabad Medical Complex, Peshawar from 1st August 2021 to 1st February 2022 (6 months). We got ethical approval from the hospital research and ethical committee. A total of 167 patients of both genders of 20-60years age with suspected ureteric calculi (severe lumbar pain radiating to groin region, nausea, vomiting, fever, chills and sometimes hematuria) were included in the study. Pregnant, morbidly obese patients (Men > 129 kg and women > 113 kg), patients with renal failure and having history of abdominal trauma were excluded. After approval, all the patients referred to radiology department for CT KUB for suspected ureteric calculi having fulfilled the inclusion/exclusion criteria were included in the study through an informed written consent. Each participant of the study underwent X-Ray KUB followed by CT KUB. The interpretation was done by a single consultant radiologist, a fellow of CPSP and having at least 3 years of experience in the field of diagnostic radiology. The time between the two tests was a maximum of 2 hours. The participants received no treatment between the X-Ray KUB and CT KUB except anelgesics for pain control. All of the above mentioned information including name, gender, age, height ,weight and BMI was recorded in a proforma. All the information was entered and analyzed in statistical software SPSS (version 21). Frequency and percentage was calculated for categorical variables like gender, findings on X-Ray KUB and CT KUB. Mean±SD was calculated for continuous variables like age, body mass index, weight & height. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) was determined from findings on CT KUB as gold standard and using 2x2 tables. All the results was presented as tables and graphs.

RESULTS

In our study, 20 to 60 years was the age range with mean age of 45.437±5.93 years, mean BMI 28.943±3.90 Kg/m2, mean weight 83.664±6.58 Kg and mean height was 1.706±0.06 meters as shown in Table-I. Frequency and percentage of patients according to gender are shown in Table-II. X-Ray KUB diagnosed 52(31.1%) patients while CT KUB diagnosed 51(30.5%) patients with ureteric calculi as shown in Table-III. X-Ray KUB has shown sensitivity of 74.51%, specificity 87.9% and diagnostic accuracy by 84%, PPV 73% and NPV 88.7% in diagnosis of ureteric calculi as shown in Table-IV and V respectively.

Table 1: Mean±SD of patient's age, BMI, weight and height (n=167)

Demographics		Mean±SD
1	Age (years)	45.437±5.93
2	BMI (Kg/m^2)	28.943±3.90
3	Weight (Kg)	83.664±6.58
4	Height (months)	1.706±0.06

Table 2: Frequency and percentage of patients according to gender (n=167)

Gender	No. of Patients	%age
Male	137	82%
Female	30	18%
Total	**167**	**100%**

Table 3: Overall results of X-ray KUB and CT-KUB in diagnosis ofureteric calculi (n=167)

Ureteric calculi	X-Ray KUB	CT KUB
Positive	52(31.1%)	51(30.5%)
Negative	115(68.9%)	116(69.5%)
Total	**167 (100%)**	**167 (100%)**

Table 4: Comparison of X-Ray KUB versus CT KUB for diagnosing ureterolithiasis (n=167)

KUB radiograph	CT KUB		Total
	Positive	**Negative**	
Positive	38 (TP)	14 (FP)	52
Negative	13 (FN)	102 (TN)	115
Total	**51**	**116**	**167**

Chi-square = 64.41

P value = 0.000

Table 5: PPV ,NPV ,SPECITIVITY,SENSITIVITY ,DIAGNOSTIC ACCURACY OF XRAY KUB

KUB RADIOGRAPH	VALUE
Sensitivity	74.51%
Specificity	87.9%
Positive Predictive value(PPV)	73%
Negative Predictive Value(NPV)	88.7%
Accuracy	84%

DISCUSSION

Patients with ureteric colic initially present to emergency department. Diagnosis can be suspected; however, clinicians must have broad differentials for patients with these symptoms.[12] Highly sensitive imaging modalities describe that symptoms could be due to other causes in the absence of calculi and highly specific imaging modalities demonstrate that a patient's symptoms are linked to calculi when visualized. For disease management, initial imaging is the first step. Imaging modalities that are broadly available include ultrasound, CT, KUB radiograph, IVU and MRI. In 20th century, IVU was the gold standard for ureterolithiasis. Now CT scan has taken its place.[13] No need of pre-imaging fasting , IV contrast along with its reactions, short time span of procedure for diagnosis of ureterolithiasis are the benefits of CT over IVU. CT is highly sensitive and specific for other GUT pathologies too like mass lesions, haematuria and lymphadenopathy.[14] Ultrasonography is a readily available, cost-effective, independant of radiations for diagnosing ureterolithiasis and hence can be used prior to CT Scan CT but limitation is decreased accuracy in mid ureter due to bowel gas shadows and lack of ureter visualization in obese patients.[15] Its benefits are lack of ionizing radiation and its hazards, no need of contrast agent and easy availability.[16]Some studies showed that doppler ultrasound is more useful in detecting renal stones.[17] There is decreased sensitivity and specificity of plain X-Ray KUB as radiolucent calculus is not differentiated from other obstructive causes or phleboliths from calculi.[18] Hence to overcome this hurdle, USG and KUB X-Ray can be performed together adding ultrasound's higher

sensitivity to X-Ray KUB higher specificity.[19] In our study, X-ray KUB demonstrated a sensitivity of 74.5%, a specificity of 87.9%, and an overall diagnostic accuracy of 84% for detecting ureteric calculi. The positive predictive value (PPV) was 73%, and the negative predictive value (NPV) was 88.7%. Given that CT is widely recognized as the gold standard for diagnosing ureterolithiasis, our objective was to compare the performance of X-ray KUB against CT in patients presenting with ureteric colic. This comparison aims to evaluate whether X-ray KUB could serve as a viable initial diagnostic tool, particularly in settings where access to CT may be limited. According to our study, incidence of ureterolithiasis is more in males as compared to females with a ratio of 2.7 to 1, which is higher than previously performed studies, Yan et al (1.55:1), Edmonds et al (1.14:1), and Kobayashi et al (1.68:1).[21–23] In our study, we observed that ureteric calculi were most frequently found in the lower ureter (48.9%), followed by the upper ureter (32.8%), middle ureter (14.6%), and, in 3.5% of cases, multiple sites. The average stone size was 7.6 mm, aligning with findings from previous studies ,Faiq et al found in the lower ureter (47.5%), followed by the upper ureter (40.5%), middle ureter (12%) .[24]

Regarding imaging modalities, ultrasound (US) had a sensitivity of 86.3% and specificity of 87.5%, which, although useful, fell short of CT's higher sensitivity and specificity of 96.9% and 93.6%, respectively. In earlier work by Dalla Palma et al.[25] 120 patients with renal colic underwent evaluation with both ultrasound and X-ray, resulting in a sensitivity of 95% and specificity of 67% for ultrasound. Notably, their study classified ultrasound as positive if either a ureteric stone or hydronephrosis was detected. In contrast, we only classified cases as positive if ureterolithiasis was directly visualized, which likely contributed to our study's higher specificity of 87.9% as compared to Dalla Palma et al.'s 67%.

According to study conducted by Miller et al, unenhanced CT has sensitivity and specificity of 96% and 100% respectively.[26] Limitations of this study include the lower sensitivity and specificity of X-ray KUB compared to CT KUB, especially for detecting small or radiolucent stones, which may lead to false negatives. Additionally, patient factors such as obesity or overlying bowel gas can obscure stone visualization on X-ray, further impacting diagnostic accuracy. This study may also be limited by its reliance on a specific patient population, which might restrict the generalizability of findings to broader clinical settings

CONCLUSION

Plain KUB radiograph is a non-invasive, readily available and reliable imaging investigation in patients presenting with renal colic to diagnose ureteric stones with a specificity of 87.9%. Hence, it is recommended that it should be used routinely for the evaluation of patients presenting with acute flank pain.

AUTHORS' CONTRIBUTIONS

MK: Contributed to the idea, design, analysis, and interpretation of data, and drafting, and final approval of the manuscript.
GW,MM: Contributed to the design and interpretation of data, and drafting and final approval of the manuscript.
UB,SI,SF: Contributed to the design, and acquisition of data, and drafting and final approval of the manuscript.
All authors approved the final version of the manuscript to be published and agreed to be accountable for all aspects of the work.

CONFLICTS OF INTERESTS

The authors declared no conflict of interest.

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