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TO EVALUATE THE ROLE OF CT KUB (KIDNEY, URETER, BLADDER) IN THE DETECTION OF UROLITHIASIS IN PATIENTS WITH ACUTE FLANK'S PAIN.

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ABSTRACT:

BACKGROUND: Urolithiasis is the most common urinary tract disease and acute flank's pain is one of the most common symptoms of it. Urolithiasis affects both gender of all age groups but most common affected category was found to be the male. Computed Tomography is a gold standard modality and has great role for urolithiasis detection during KUB (Kidney, Ureter, Bladder) scan. The objectives of this study were to evaluate the role of Computed Tomography KUB (Kidney, Ureter, Bladder) in the detection of Urolithiasis in patients with acute flank's pain and to identify the presence of renal tract calculi in KUB (Kidney, Ureter, Bladder) to confirm that which part is more affected due to calculus presences. **METHOD:** A cross sectional study with consecutive sampling was carried out at Department of Radiology, Medical Teaching Institute Hayatabad Medical Complex Peshawar, Pakistan from October 2022 to March 2023. 150 patients aged between 20-60 years presenting with acute flank's pain were included in the study. Ethical approval was obtained. CT KUB of the patient was performed with 128 slices GE Computed Tomography (CT) scan machine on full urinary bladder in supine position 1 cm above the liver through symphysis pubis, used scan parameters technique 120 kV/Auto mA, 0.5 rotation with Standard Algorithm, 4 mm slice thickness and was taken field of view (FOV) according to the patient size. Axial, coronal and sagittal images are taken and soft-tissue window with 2 mm coronal and sagittal was also reconstructed. **RESULTS:** In total 150 patients presenting with acute flank's pain, 273 stones were detected during CT KUB. The highest number of patients referred by Urologist (60.7%) followed by ER Physician (39.3%). Stones lie in renal calyx (32.7%), renal pelvis (36.7%) and ureter (30.7%). The presence of stones is higher in right kidney (51.4%) as compare to left kidney (38.6%) whereas in right ureter found more stones (17.9%) as compare to left ureter (14.7%). Obstructive Nephrolithiasis was reported to be (27.3%) and non-obstructive (72.7%). According to stone size, majority belongs to 6-10 mm (36.7%). The range of mean attenuation value (HU) was from 301-600 HU having (42.2%) and in most cases single stone were reported (51.3%). Hydronephrosis (65.3%) were the most common secondary signs of obstruction followed by Hydroureter (26.7%) and Perinephric stranding (23.4%). **CONCLUSION:** Computed Tomography KUB (Kidney, Ureter, Bladder) has main role and is key for detection and diagnosis of Urolithiasis. It helps to provide detail information for further treatment plans.

KEYWORDS: CT KUB, Urolithiasis, Obstructive, Non-obstructive, Hydronephrosis, Hydroureter, Perinephric stranding.

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INTRODUCTION

Urolithiasis also called "Kidney stone" is term as the condition in which stones or calculus form along the urinary tracts system, including the kidney, ureter, and bladder. Suspected urolithiasis, acute flank pain is a common reason to visit the hospital, almost 1 million per annum visits in the USA[1]**.** Almost 50% of people having one episode of urolithiasis will have another episode, and out of these 10% will affect a huge number of recurrences[2]**.**

Prevalence of urolithiasis ranges from 1-13% worldwide, with decreasing range from the United states (7-13%) to Europe (5-9%) and Asia (1-5%)[3]**.** According to a cohort study at the University of Wisconsin, the asymptomatic population have almost 8% prevalence of urolithiasis, in which most cases related to obesity, diabetes, and old age[4]**.** The prevalence of urolithiasis has annually $1.83 million significant economic impact in USA alone[5]**.** Risk of kidney stone is lower in an adult population in Asia (1–5%; mostly Pakistan, India, Thailand, Indonesia, the Philippines) than in Europe (5–9%; especially the British Isles, Scandinavian countries, Central Europe, Mediterranean countries), Canada (12%) and USA (13%). Middle Eastern countries have highest number of patients suffering from renal stones (e.g. about 20% in Saudi Arabia and in Sudan, Egypt, the United Arab Emirates, Iran) because of hot weather and high risk of dehydration, which is an important environmental factor of kidney stone formation. Kidney stone disease affects all ages, gender and races but its occurrence rate is increased in aging men (the male and female ratio is 2:1) and in children patients with urinary lithiasis, the rate is only 1–2%. Almost 10% at 1 year and 33%–40% at 5 years are the recurrence rate.

These disease can even cause chronic kidney disease due to which renal replacement therapy required in 5% of European patients. The use of drugs in the pharmacotherapy of multiple diseases are one of the rare cause of this disease[6]**.** Prevalence of kidney stone in Iran is 5.7%, in which frequency among male is 6.1% and among female is 5.3%[7]**.** In India, life time occurrence of kidney stone is slightly higher about 12% in male and 7% in female[8]**.** Pakistan has variable prevalence of kidney stone in various regions with highest reported prevalence of 12% from Dera Ghazi Khan. Stones are categorized into calcium and non-calcium stones. Calcium stones are most prevalent form of stones ranges from 75% to 85% in various population. Uric acid (UA) stones are less prevalent form and makes almost 10% of the all kidney stones and are mostly observed in men than women and in patients with gout and genetic causes while Less commonly produced in patients with increased serum calcium[9]. According to a study in Pakistan, showing similar statistics of urolithiasis (5%), with the addition that 3% of renal calculi are silent[10]**.**

In 1990s, computed tomography (CT) was first introduced for stone imaging since used as gold standard for the initial detection of patients with suspected kidney stones[11]**.** In 1995 Smith etal**.** first described unenhanced helical CT as an initial imaging technique for the evaluation of urolithiasis in patients with acute flank pain and hematuria[12]**.** Gold standard imaging modality non-contrast CT (NCCT) is reported to have a specificity of 94%–99% and sensitivity of 95%–98%[13]**.** CT KUB can shows the presence of stone's in the Urinary tract stone composition, precise size, accurate location, approximate density, findings of hydronephrosis and also gives guidance about the selection of appropriate therapeutic approach[14]**.** The first choice diagnostic imaging modality for urinary tract obstruction of stones is CT KUB which is mostly considered the initial imaging modality for suspected acute renal colic, dipstick positive or microscopic hematuria, patient with renal failure, obese patient, and initial diagnostic evaluation of upper tract obstruction[15]**.**

Urolithiasis needs more to be evaluated and diagnosed accurately on time for proper management of patients from different renal tract abnormalities and to describe the use and role of Computed Tomography KUB (Kidney, Ureter, Bladder) scan in patients having kidney stone presenting with acute flank's pain, how best to assess for the presence of renal tract calculi. The objectives of this study were to evaluate the role of Computed Tomography KUB (Kidney, Ureter, Bladder) in the detection of Urolithiasis in patients with acute flank's pain and to identify the presence of renal tract calculi in KUB (Kidney, Ureter, Bladder) to confirm that which part is more affected due to calculus presences.

MATERIAL AND METHODS

This was a Cross Sectional study with consecutive sampling undertaken at radiology department, Medical Teaching Institute Hayatabad Medical Complex Peshawar, Pakistan from October 2022 to March 2023. The sample size was calculated on Open-Epi. The approval of the study was taken from ethical review board of Medical Teaching Institute Hayatabad Medical Complex Peshawar, Pakistan. All the Patients (male and female) of age between 20 to 60 years coming to radiology department with symptoms of acute flank's pain and willing to give consent were included in the study. Patient not willing to give consent, age younger than 20 years, Body Mass Index (BMI) >40, single kidney, renal transplantation, undergoing dialysis were excluded.

CT KUB of the patient was performed with 128 slices GE Computed Tomography (CT) scan machine observing the following standard protocol. The scan was performed with full urinary bladder in supine position 1 cm above the liver through symphysis pubis, used scan parameters technique 120 kV/Auto mA, 0.5 rotation with Standard Algorithm, 4 mm slice thickness and was taken field of view (FOV) according to the patient size. Axial, coronal and sagittal images are taken for proper evaluation and soft-tissue window with 2 mm coronal and sagittal was also reconstructed.

Data was noted on a standard Questionnaire, stored and analyzed using SPSS version 22. Mean with standard deviation (SD) was calculated for quantitative variables. Frequency and percentages were calculated for categorical variables. All results were presented in the form of tables and graphs.

RESULTS

A total of 150 patients with acute flank's pain undergoing CT KUB were included in the study. Patient's age ranged from 20-60 years with a mean age of 37.46 ± 11.63 years while height and weight of the patients ranged from 5.1-5.8 cm and 67-78 kg with a mean height and weight 5.414 ± 0.2232 cm and 71.87 ± 2.796 kg respectively (Table 1).

There were 112 (74.7%) males and 38 (25.3%) females (Table 2, Fig. 2) in which 26 (17.3%) were Single and 124 (82.7%) were married. Patient's Occupation were Business 43 (28.7%), Housewife 35 (23.3%), Labor 32 (21.3%), Student 26 (17.3%) and Other 14 (9.3%) (Table 3, Fig. 3). The residency of the patients was 100 (66.7%) rural and 50 (33.3%) urban whereas 121 (80.7%) from joint family and 29 (19.3%) from nuclear family. Patient's Body Mass Index (BMI) were recorded as underweight 1 (0.7%), healthy weight 72 (48., Overweight 28 (18.7%) and obese (BMI 30.0-40.0) are 49 (32.7%) (Table 4, Fig. 4).

Out of 150 patients, the highest number of patients referred by Urologist 91 (60.7%) followed by ER Physician 59 (39.3%) (Table 5, Fig. 5). Primary signs of Urolithiasis show renal calyx 49 (32.7%), renal pelvis 55 (36.7%) and ureter 46 (30.7%) while in secondary signs, hydronephrosis are (65.3%) in which normal hydronephrosis 52 (34.7%), mild 66 (44.0%), moderate 32 (21.3%), hydroureter are (26.7%) in which normal hydroureter 110 (73.3%), mild 24 (16.0%), moderate 16 (10.7%), whereas perinephric stranding are (23.4%) in which normal Perinephric stranding 115 (76.7%), mild 21 (14.0%), moderate 13 (8.7%) and severe 1 (0.7%) (Table 6).

The presence of stones is higher in right kidney 77 (51.4%) as compare to left kidney 58 (38.6%) where in right kidney upper pole has 5 (3.3%), mid pole 10 (6.7%), lower pole 37 (24.7%), renal pelvis 25 (16.7%), while left kidney upper pole has 11 (7.3%), mid pole 8 (5.3%), lower pole 18 (12.0%), renal pelvis 21 (14.0%), whereas in right ureter there is found more stones 27 (17.9%) as compare to left ureter 22 (14.7%) in which right proximal ureter has 2 (1.3%), mid ureter 8 (5.3%), distal ureter 17 (11.3%) and left proximal ureter 7 (4.7%), mid ureter 5 (3.3%), distal ureter10 (6.7%) (Table 7).

Pelviureteric junction on the right side is 6 (4.0%) and on left side is 5 (3.3%) while vesicoureteric junction on the right side is 15 (10%) and on left side is 7 (4.7%) (Table 8).

Obstructive nephrolithiasis was found in 41 (27.3%) and non-obstructive nephrolithiasis found in 109 (72.7%) (Table 9, Fig. 9). Patient's stone size during CT KUB examination were <3 mm 13 (8.7%), 3-5

mm 27 (18.0%), 6-10 mm 55 (36.7%), 11-15 mm 30 (20.0%), 16-20 mm 19 (12.7%), >20 mm 6 (4.0%) while mean stone attenuation <300 HU 17 (11.3%), 301-600 HU 64 (42.7%), 601-1000 HU 36 (24.0%), >1000 HU 33 (22.0%) and the total sum of the No. of stones were 273 in which No. of One stone77 (51.3%), two stones 46 (30.7%), three stones 14 (9.3%), four stones 3 (2.0%), and ≥5 stones 10 (6.7%) (Table 10).

Table 1: Mean ± Standard deviation among Age, Height and Weight

Scale Variables	Mean	Std. Deviation
Age	37.46	11.632
Height	5.414	.2232
Weight	71.87	2.796

Table 2: Frequency and Percentage of Gender

Gender	Frequency	P rcent
Male	112	74.7
Female	38	25.3

Figure 2: Gender of patients

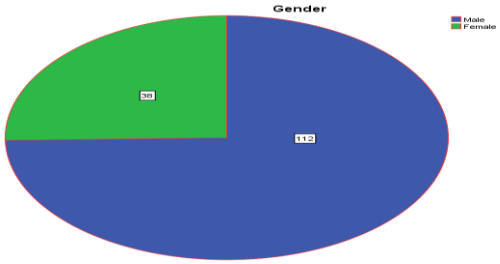


Table 3: Frequency and Percentage of Occupation

Occupation	Frequency	Percent
Housewife	35	23.3
Student	26	17.3
Labor	32	21.3
Business	43	28.7
Other	14	9.3

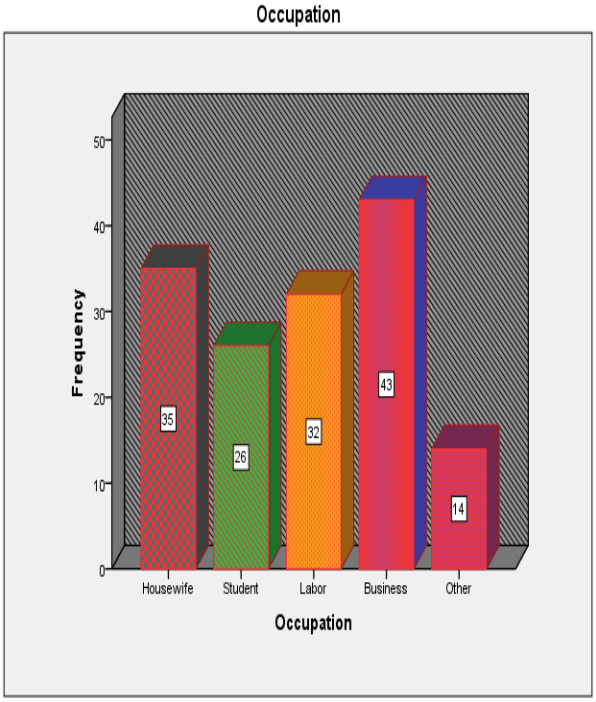


Figure 3: Occupation of patients

Table 4: Frequency and Percentage of Body Mass Index (BMI)

Body Mass Index	Frequency	Percent
Underweight		
Healthyweight		
Overweight	1	0.7
Obese		
	72	48.0
	28	18.7
	49	32.7

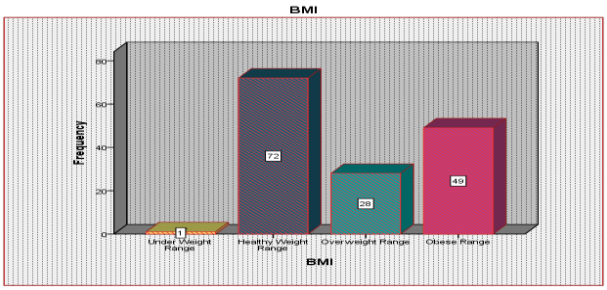


Figure 4: Body Mass Index of patient

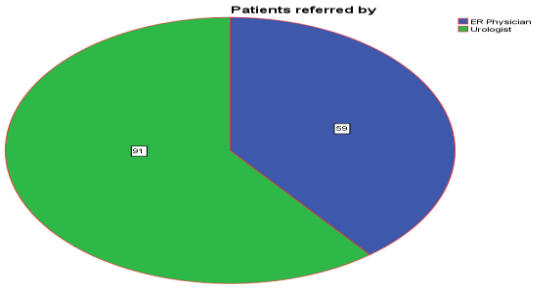


Figure 5: Patients referred by doctors

Table 5: Frequency and Percentage of patients referred by doctors

Patient referred by	Frequency	Percent
ER Physician	59	39.3
Urologist	91	60.7

Table 6: Primary and Secondary signs of Urolithiasis

Primary Signs		
Stone location	Frequency	Percent
Renal Calyx	49	32.7
Renal Pelvis	55	36.7
Ureter	46	30.7

Hydronephrosis	Frequency	Percent
Normal	52	34.7
Mild	66	44.0
Moderate	32	21.3
Hydroureter	**Frequency**	**Percent**
Normal	110	73.3
Mild	24	16.0
Moderate	16	10.7
Perinephric stranding	**Frequency**	**Percent**
Normal	115	76.7
Mild	21	14.0
Moderate	13	8.7
Severe	1	0.7
Secondary Signs		

Table 7: Detection of stones by CT scan during examination of CT KUB based on location

Right Kidney	Frequency	Percent
Upper pole	5	3.3
Mid pole	10	6.7
Lower pole	37	24.7
Renal pelvis	25	16.7
Left Kidney	**Frequency**	**Percent**
Upper pole	11	7.3
Mid pole	8	5.3
Lower pole	18	12.0
Renal Pelvis	21	14.0
Right Ureter	**Frequency**	**Percent**
Proximal Ureter	2	1.3
Mid Ureter		
Distal Ureter	8	5.3
	17	11.3
Left Ureter	**Frequency**	**Percent**
Proximal Ureter	7	4.7
Mid Ureter	5	3.3
Distal Ureter	10	6.7

Table 8: Detection of Junctions during KUB Examination

Pelviureteric junction	Frequency	Percent
Right	6	4.0
Left	5	3.3
Vesicoureteric junction	**Frequency**	**Percent**
Right	15	10.0
Left	7	4.7

Table 9: Detection of Obstructive and Non-obstructive Nephrolithiasis

Nephrolithiasis	Frequency	Percent
Obstructive	41	27.3
Nonobstructive	109	72.7

Figure 9: Obstructive and Non-obstructive Nephrolithiasis

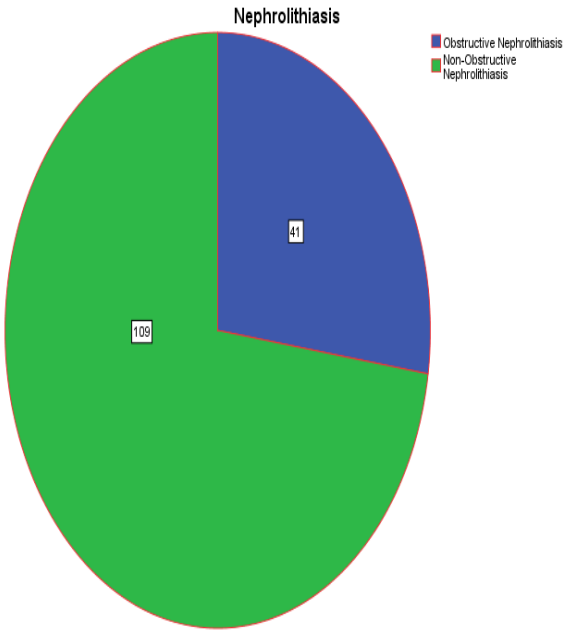
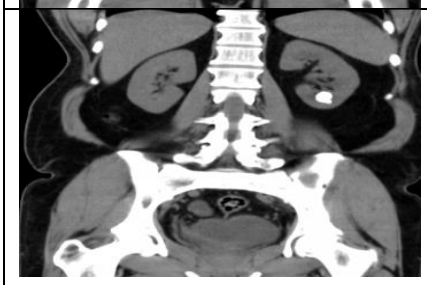


Table 10: Overall detected Stones No. its size and mean attenuation (HU value)

Stone size (mm)	Frequency	Percent
<3	13	8.7
3-5	27	18.0
6-10	55	36.7
11-15	30	20.0
16-20	19	12.7
>20	6	4.0
Mean Attenuation value (HU)	**Frequency**	**Percent**
<300	17	11.3
301-600	64	42.7
601-1000	36	24.0
>1000	33	22.0
No. of stones	**Frequency**	**Percent**
One	77	51.3
Two	46	30.7
Three	14	9.3
Four	3	2.0
≥5	10	6.7

Figure 1: CT KUB of a 45Y/F patient with Right flank pain showing Bilateral Obstructive Nephrolithiasis at the Pelviureteric junction as given in the Coronal and Axial Images.

Figure 2: Coronal Image of a 52Y/M patient undergoing CT KUB presenting with Flank pain shows findings are of distal bilateral ureteric calculi just above the vesicoureteric junction resulting in moderate upstream Hydronephroureter and bilateral Nephrolithiasis.



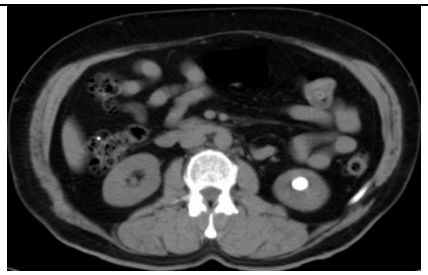


Figure 3: CT KUB of a 52Y/M patient with flank pain showing non-obstructive left sided Nephrolithiasis as shown in the given Coronal and Axial Images.

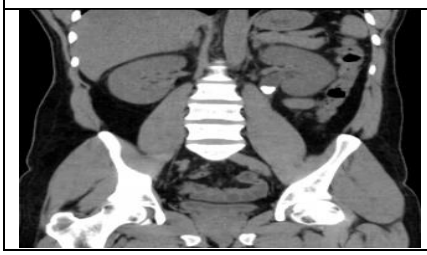


Figure 4: A 29Y/M patient with flank pain having Left sided proximal ureteric calculus resulting in moderate upstream hydronephroureter as shown on Coronal Image.

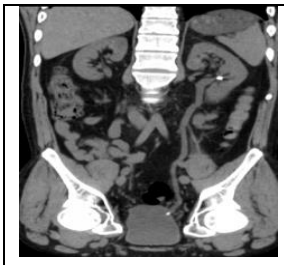


Figure 5: A 34Y/M patient with flank pain resulted in Left sided distal ureteric calculus at the vesicoureteric junction resulting in mild upstream hydronephroureter as shown in Both Coronal and Axial Image.

Figure 6: A 28Y/M patient presenting with flank pain, findings are Right sided proximal ureteric calculus resulting in mild to moderate upstream hydronephroureter as shown in the Coronal Image.

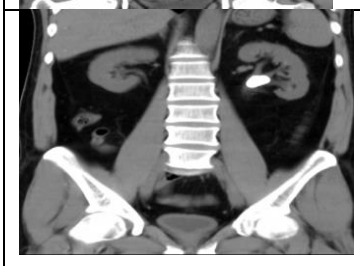


Figure 7: CT KUB of a 40Y/M patient with Left flank pain resulted in Left sided obstructive nephrolithiasis at the Pelviureteric junction as given in the Coronal and Axial Images.

DISCUSSION

CT KUB is gold standard for detection of Urolithiasis in patients presenting with flank's pain. In our study patient's age ranged from 20-60 years and mean age (37.46 ± 11.63) years with mean height and weight (5.414 ± 0.2232) cm and (71.87 ± 2.796) kg respectively similar to a study reported in Pakistan by M. Nadeem et al. in 2012 recorded mean age (37.1 ± 12.4) years [5]. In 2017 Saerah Iffat Zafar et al. reported patient's age ranged from 12-70 years with a mean age of (38.8 ± 13.3) years[10]. In other study conducted by Mostaque Ahmed Bhuiyan et al. in 2020 also shows the mean age (44.2 ± 7.3)[16].

Male individuals are more likely to be affected by urolithiasis as compare to female. In the present study there are (74.7%) males and (25.3%) females just like the study conducted in 2022 by Akram H et al. in which 75.9% were males and 24.1% were females[17]. In 2012 M. Nadeem et al. study had (70%) males and (30%) females[5] while the study reported by Saerah Iffat Zafar et al. in 2017 had (72%) males and (28%) females[10].

During flank's pain mostly doctor advice for an examination of Computed Tomography KUB. According to our study, (60.7%) patients for CT KUB examination were ordered by Urologists while (39.3%) by ER physician. Other study in 2021 by Muhammad Farhan et al. shows (59.4%) urologists and (22.9%) ER physician[18]. Another study reported by M Nadeem et al. in 2012 shows (57.2%) urologists and (29.6%) ER physician[5].

Primary signs of Urolithiasis in the present study shows renal calyx (32.7%), renal pelvis (36.7%) and ureter (30.7%) while secondary signs show hydronephrosis (65.3%) where normal hydronephrosis (34.7%), mild (44.0%), moderate (21.3%), hydroureter are (26.7%) in which normal hydroureter (73.3%), mild (16.0%), moderate (10.7%), while perinephric stranding are (23.4%) in which normal perinephric stranding (76.7%), mild (14.0%), moderate (8.7%) and severe (0.7%.)

A study in 2020 by Mostaque Ahmed Bhuiyan et al. reported Ureter (10.8%), Renal pelvis (7.6%), Upper calyx (13.9%), Lower calyx (28%), Middle calyx (39.7%) and Hydronephrosis (70%), Hydroureter (60%), Fat stranding (53.33%)[16]. M. Nadeem et al. in 2012 recorded Renal (38.77%), Ureteric (40.61%) and Hydronephrosis (1.22%), Hydroureter (0.81%), Perinephric stranding (1.63%)[5] while Renal (26.5%) and Ureteric (44.1%) were reported by Saerah Iffat Zafar in 2017[10].

Computed Tomography scan has significant role in the detection of stones during KUB scan. Our study reveals the location of the stones in right kidney upper pole (3.3%), mid pole (6.7%), lower pole (24.7%), renal pelvis (16.7%), multiple (48.7%) while left kidney upper pole (7.3%), mid pole (5.3%), lower pole (12.0%), renal pelvis (14.0%), multiple (61.3%) whereas right proximal ureter (1.3%), mid ureter (5.3%), distal ureter (11.3%) and left proximal ureter (4.7%), mid ureter (3.3%), distal ureter (6.7%). The results of the study conducted by Ravishankar T.H.S et al. in 2020 shows Upper Ureter (32.8%), Middle Ureter (14.6%), Lower Ureter (48.9%) and Multiple (3.5%)[19]**.** Other study in 2022 by Akram H et al. reported Kidney (46.6%), Proximal ureter (16.0%), Mid ureter (9.6%), Distal ureter (23.3%), Urinary bladder (4.6%)[17]. Syed Muhammad Faiq et al. in 2014 also reported Proximal 40.5%, Mid 12%, Distal 47.5%[20] while in 2004 M Hammad Ather et al. recorded the results as

Upper ureter (33%), Middle ureter (64%), Distal ureter (50%)[21]**.**

The Identification of stone's size is essential for proper management and treatment decisions. Results of present study reveals patient's stone size during CT KUB examination which were <3 mm (8.7%), 3-5 mm (18.0%), 6-10 mm (36.7%), 11-15 mm (20.0%), 16-20 mm (12.7%), >20 mm (4.0%). Other study by Mostaque Ahmed Bhuiyan et al. in 2020 reported <3 (11.9%), 3-5 (35.4%), 6-10 (34.5%), 11-15 (12.9%), 16-20 (3.2%) and >20 (2.1%)[16]. Another Study in 2017 by Saerah Iffat Zafar et al. recorded <3 mm (20.6%), 3-5 mm (44.1%) and >5 mm **(**35.3%)[10]**.**

Mean stone attenuation value is also significance in further investigation and treatment plans of the patients. In present study <300 HU (11.3%), 301-600 HU (42.7%), 601-1000 HU (24.0%), >1000 HU (22.0%) were noted. A study in 2020 by Mostaque Ahmed Bhuiyan et al. shows <300 (38.70%), 301-600 (35.48%), 601-700 (15.05%) and >1000 (10.75%)[16]**.**

In our study 150 patients presenting with flank's pain is performed during which 273 stones is detected. Other study in 2018 by Fisal Ahmed et al. reported 284 stones in 184 patients[13]. The current study has One stone (51.3%), two stones (30.7%), three stones (9.3%), four stones (2.0%), and ≥5 stones (6.7%). Another Study conducted by Mostaque Ahmed Bhuiyan et al. in 2020 reveals No. of One stones (73.4%), two stones (11.6%), and three stones (5%) Four stones (6.6%) and ≥5 stones (3.4%)[16].

CONCLUSION

Computed Tomography KUB (Kidney, Ureter, and Bladder) has a great role in the detection of stones during scan because of its higher sensitivity and specificity. Nowadays Computed Tomography is the preferred Imaging modality for diagnosis and detection of stones because it is non-invasive, highly available, better imaging quality and less time taken with more valuable and significance details about the scans to give idea about further treatment planning on the time. Urolithiasis is the condition which affect both gender (male and female) but most commonly male individuals. Most CT KUB examination was ordered by Urologist followed by ER physician to rule out abnormality and pathology during the scan.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

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CONFLICT OF INTEREST: No competing interest declared.

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