



## Diagnostic role of ultrasonography and X-RAY combined versus intravenous urography in evaluation of renal colic.

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**ABSTRACT... Objective:** To determine the role of X-Ray and ultrasonography combined versus intravenous urography in diagnosing cause of renal colic. **Study Design:** Experimental study. **Setting:** Urology Department of Margalla Hospital PMO Taxila. **Period:** July to December 2019. **Material & Methods:** Cases presenting with renal colic in urology Out-Patient door Department suspecting renal stone, ureteric or PUJ obstruction were included in this study. Patients below 14 years, hypersensitivity to intravenous contrast media and renal failure or having any condition with deranged blood urea and creatinine level were excluded from the study. X-ray, ultrasonography of abdomen, KUB (kidney, ureter and urinary bladder) and intravenous urography was done in every patient included in the study. **Results:** Sample size was 200. Mean age of patients was  $38.4 \pm 6.8$  years. Right sided renal colic was more common (45%) than left sided (42.5%) and bilateral flank pain (12.5%). On IVU hydronephrosis with obstructing renal stone was found in 45.5% cases, ureteric stone in 40.5% and hydronephrosis with non-obstructing stone was found in 14% cases. On x-ray and ultrasonography KUB, hydronephrosis with obstructing renal stone found in 38.5% cases, ureteric stone in 13.5%, renal stone in 39.5% and hydronephrosis with non-obstructing stone was diagnosed in 6% cases. When results of x-ray ultrasonography compared with IVU, calculi were diagnosed in 53% cases (sensitivity 87% and specificity 100%), hydronephrosis was detected in 98 cases (sensitivity 97%, specificity 95%). **Conclusion:** X-ray KUB and ultrasonography combined have almost equal accuracy as intravenous urography in diagnosing renal colic.

**Key words:** Renal Colic, Renal Stone, Ultrasonography, X-Ray KUB.

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### INTRODUCTION

Renal colic is an acute onset of flank pain usually radiating to the groin and may be associated with hematuria and dysuria. Renal colic is due to obstruction of urinary tract due to stone formation in kidney, ureter, urinary bladder or urethra. It is more common among adult males. It has 50% recurrence rate. Average prevalence of renal colic worldwide is 5-15% which varies according to distribution of disease in different geographical areas.<sup>1</sup> Its incidence varies with seasonal temperature variations but definitive association of temperature variations with renal colic has not been studied worldwide.<sup>2</sup> Acute renal colic is an emergency condition and should be treated immediately. Some studies reported positive role of hydration of patient with intravenous fluid bolus in relieving renal colic due to nephrolithiasis.<sup>3</sup>

Other common mode of treatment is intravenous analgesics such as NSAIDs or opioids like fentanyl etc. Intranasal route of analgesics in spray form has also been proved equally effective as intravenous route by a study conducted on 82 cases in Italy.<sup>4</sup> About 2-5% Asian and 20% population of Saudi Arabia develop renal stone once in life time.<sup>5</sup> When clinical diagnosis is not clear radiological investigations should be done to make the diagnosis. A study done by Lindqvist et al reported that patients presenting in emergency department with renal colic who are relieved by receiving analgesics can be discharged and they should get radiological investigations to rule out the diagnosis 2-3 weeks latter.<sup>6,7</sup> Ultrasonography is very important in diagnosing renal stone as it is non-invasive, easily available, time saving and an economic investigations which is most of the

time conclusive. By this we can see dilatation of pelvicalyceal system due to obstruction with stone.<sup>8</sup> X-ray KUB is also helpful in diagnosing renal stone but its sensitivity (40-50%) and specificity are low. It is not much helpful in making diagnosis alone but it is very helpful along with ultrasonography in making diagnosis. X-ray KUB can be used in observing passage of stone in urinary tract and change in size in response to treatment in comparison to previous x-rays.<sup>9</sup> Intravenous urography can be used to diagnose renal colic due to stone anywhere in urinary tract causing urinary obstruction and hydronephrosis. Dilatation of urinary tract can be seen proximal to obstruction on serial images taken during IVU study. In this procedure intravenous contrast medium is given to the patient and serial x-rays are taken.<sup>10</sup> It has few disadvantages of being costly as compared to ultrasound and simple x-rays, sensitivity to contrast medium and its toxicity is second issue of concern.<sup>11</sup> It is widely used technique in many centers but ultrasound being non-invasive and cost effective technique is still investigation of choice in our health system. Ultrasound combined with x-ray is more sensitive than intravenous urography.<sup>12</sup> CT scan KUB has high sensitivity but due to costly it is not done commonly in renal colic patients.

As CT scan is not easily available in our hospitals so keeping in view of all above facts this study was conducted to determine the role of intravenous urography compared with ultrasonography and plain abdominal x-ray in evaluating cause of renal colic so that in future we may introduce a protocol for investigations of renal colic.

## MATERIAL & METHODS

This is an experimental study conducted in Urology Department of Margalla Hospital PMO Taxila. Study was completed in six months duration. Sample size was calculated using WHO sample size calculator with 95% confidence interval, 0.05 margin of error and prevalence of renal colic 15%.<sup>1</sup> Non probability consecutive sampling technique was done. Patients presenting to the emergency department of study institution with the complaint of renal colic due to renal stone irrespective of gender and above 14

years of age were included in this study. X-ray KUB and ultrasound were done first followed by intravenous urography in all study cases. Patients having chronic renal failure, stricture in ureter or at uretero-vesical junction / PUJ obstruction, hypersensitivity to contrast medium, deranged serum urea and creatinine level and patients below 14 years of age, were excluded from the study. Informed consent was taken from all cases in study group. Those not given consent were excluded from the study. Permission was taken from Ethical Review Committee of the Hospital for conducting the study (458/IERB). Initially detailed history was taken and complete physical examination was done in all study cases. All necessary blood investigations were sent like complete blood examination, renal function tests (urea, creatinine), Liver function tests (ALT, ALP) and urine complete examination were done as well. Sensitivity to contrast medium was tested before doing intravenous urography.

Before doing IVU patient was prepared by stopping food and giving purgatives 6 hours prior to test. Contrast medium was given through intravenous line (22-gauge in children and 18-gauge branula in adults) and serial x-rays KUB were taken at 0, 5, 10, 20 minutes and post micturition. Intra-venous contrast medium used in IVU was Lopamidol 300 and its dose was 0.5-1ml/kg up to maximum 100ml given intravenous injection as a bolus. Extra views of x rays such as oblique view, compression and delayed views were taken in the cases where required. X rays were interpreted by consultant radiologist. Patients were monitored for any hypersensitivity reaction due to contrast medium during and after the procedure has completed. CT scan KUB was taken as reference investigation and results of above mentioned investigations were compared with it. Reporting of X-ray, ultrasonography and CT scan KUB were done by different consultant radiologists to minimize bias.

## RESULT

Total 200 cases were included in this study according to inclusion criteria. Range of their ages was 15-70 years with mean age of  $38.4 \pm 6.8$  years. There were 128(64%) male and 72(36%)

female cases. Maximum cases were between 25-45 years of age (Table-I).

Age of Patients (years)	Number of Patients (N)	%
15-25	37	18.5
26-35	64	32
36-45	51	25.5
46-55	22	11
55-65	16	8
>65	10	5
Total	200	100

**Table-I. Age distribution of patients in study group.**

Duration of symptoms was less than one year in 132(66%), from 1-2 years in 41(20.5%), from 3-4 years in 20(10%) and duration of more than 4 years was reported in 7(3.5%) cases. Mostly cases were having duration of symptoms less than one year (Table-II).

Symptoms (years)	N	%	P-Value
<1	132	66	0.011
1-2	41	20.5	
3-4	20	10	
>4	7	3.5	

**Table-II. Duration of symptoms among patients.**

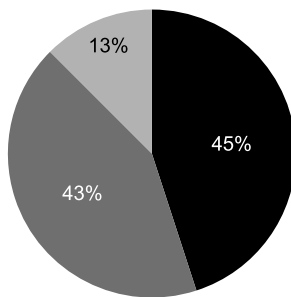
Renal stones were diagnosed in 79(39.5%) cases on X-ray and ultrasonography combines, and on IVU equally, while detected in 83(41.5%) cases on CT scan. Hydronephrosis with obstructing renal stone was diagnosed in 77(38.5%) cases on ultrasonography and x-ray combined showing involvement of both kidneys in 15(21.4%), right kidney in 33(47.1%) and left kidney in 29(41.4%) cases. Similar diagnosis was done in 81(40.5%) cases on IVU examination with both kidneys involved in 16(19.8%), right kidney in 35(43.2%) and left kidney involved in 30(37%) cases. On CT KUB hydronephrosis due to obstructive stone was found in 84(42%) cases. Ureteric stones were found in 27(13.5%) cases on ultrasonography and x-ray combined and in 28(14%) cases detected on IVU and in 30(15%) detected on CT scan. Table-III.

Right sided renal colic was present in 90(45%), left sided in 85(42.5%) and bilateral flank pain in 25(12.5%) cases. Unilateral renal disease was more common than bilateral renal disease (Figure-1). So accuracy of USG combined x-ray was 90% and of IVU 94% in detecting ureteric stones while CT scan KUB was taken as reference investigation.

Findings	USG+X-ray	IVU	CT KUB	P-Value
<b>Renal stone</b>				
Right side	38 (19%)	40 (20%)	42 (21%)	0.011
Left side	33 (16.5%)	29 (14.5%)	31 (15.5%)	
Bilateral	8 (4%)	10 (5%)	10 (5%)	
Total	79 (39.5%)	79 (39.5%)	83 (41.5%)	
<b>Ureteric stone</b>				
Right side	10 (5%)	11 (5.5%)	11 (5.5%)	0.007
Left side	17 (8.5%)	17 (8.5%)	19 (9.5%)	
Bilateral	0 (0%)	0 (0%)	0 (0%)	
Total	27 (13.5%)	28 (14%)	30 (15%)	
<b>Non-obstructive Hydronephrosis</b>				
Right side	5 (2.5%)	9 (4.5%)	8 (4%)	0.004
Left side	4 (2%)	5 (2.5%)	5 (2.5%)	
Bilateral	3 (1.5%)	1 (0.5%)	4 (2%)	
Total	12 (6%)	15 (7.5%)	17 (8.5%)	
<b>Hydronephrosis due to obstructive stone</b>				
Right side	33 (16.5%)	35 (17.5%)	36 (18%)	0.018
Left side	29 (14.5%)	30 (15%)	30 (15%)	
Bilateral	15 (7.5%)	16 (8%)	18 (9%)	
Total	77 (38.5%)	81 (40.5%)	84 (42%)	

**Table-III. Comparison of findings on USG + x-ray, IVU and CT-KUB (%=N/200).**

■ Right renal colic ■ Left renal colic ■ bilateral renal colic

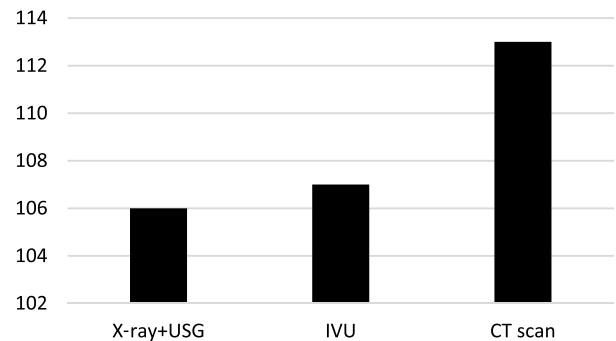


**Figure-1. Frequency of presenting complaints among study group.**

## DISCUSSION

Stone in urinary tract anywhere is called urolithiasis. It should be treated on emergency bases. Its prevalence is different in different countries as in Egypt 29.5%, in India 23.3%, in Bangladesh 16.2%, in Saudi Arabia 7.4% and in Pakistan prevalence is 24.9%.<sup>13</sup> Various radiological investigations can be used to diagnose the stone. Ultrasonography is excellent for detecting hydronephrosis but low sensitivity for stone detection rather radiographs are more sensitive than ultrasound for detecting stone but can't assess hydronephrosis, that is why ultrasound and x-ray combined have good sensitivity and specificity for detecting stone and hydronephrosis. In our study as well, combination of both x-ray combined with ultrasound versus intravenous urography has been studied. According to a study conducted in Thailand accuracy of x-ray KUB combined ultrasound KUB was higher than x-ray or USG alone and detected ureteric stone with 90% and this is same as in our study, 90% accuracy with x-ray and USG while 94% with IVU.<sup>14</sup> A Pakistani study was conducted in Bahawalpur on diagnostic accuracy of ultrasound combined x-ray versus intravenous urography in which x-ray + USG diagnosed ureteric stone in 28 (87.5%) cases out of 32 cases diagnosed on IVU, as compared to our study where ureteric stone was detected in 27 (13.5%) cases on x-ray+ USG as compared to 28 (14%) diagnosed on IVU. They diagnosed hydronephrosis with obstructing stone in 97 (30.7%) cases on x-ray + USG as compared to 87 (27.5%) diagnosed on IVU, this was comparable to our study in which same

## Urinary tract stones



**Figure-2. Frequency of urinary tract stones diagnosed on various radiological.**

diagnosis was made in 77 (38.5%) cases on x-ray + USG as compared to 81 (40.5%) cases diagnosed on IVU.<sup>17</sup> According to our study results x-ray combined with USG were equal to IVU. Another study conducted in Iraq on comparison of USG to IVU in detecting hematuria, concluded that USG is more sensitive to IVU in detecting renal stone, renal neoplasm, and lower ureteric stone, but its sensitivity is equal to IVU in detecting middle and upper ureteric stone. Retrograde urography, CT scan and MRI are other investigations which can be used to detect renal or ureteric stone and hydronephrosis with high sensitivity and specificity but CT and MRI are costly and not easily available in peripheral areas in Pakistan. If findings on plain x-ray KUB and ultrasonography are equivocal then IVU is indicated. According to previous studies IVU is better in diagnosing calculi in middle of ureter (100%), major and minor congenital lesions (88.2%). USG and IVU are not good in diagnosing diffuse renal parenchymal disease and renal tuberculosis (IVU 40%, USG 50%). USG successfully diagnosed pelvicalyceal obstruction in 72.3% patients while IVU diagnosed in 88% patients.<sup>17,18</sup> A study conducted in India on comparison of magnetic resonance urography versus IVP in diagnosing hydronephrosis concluded that MRU is better than IVP and can replace it. MRU is an ideal investigation among patients which are at risk of exposure to radiations or sensitive to iodinated intravenous contrast medium. It can find renal function as well as PUJ obstruction but this technique needs expertise and resources.<sup>19</sup> A study previously conducted

in Pakistan on comparison of IVU and CT KUB suggested that CT KUB is more sensitive and specific to IVU in detecting renal and ureteric stone and its accuracy is 100% as compared to IVU+USG 85%. Plain CT KUB has high radiation exposure and indicated in only selective cases where IVU and USG are non-conclusive; it is non-invasive as compared to IVU.<sup>20</sup>

## CONCLUSION

Results of ultrasonography and x-ray plain abdomen (KUB) combined are equal to results of intravenous urography and sufficient to diagnose the disease among patients presenting with renal colic. Plain x-ray and ultrasonography are cost effective, easily available in hospitals and non-invasive procedures that's why better than IVU. In those cases where IVU and x-ray, Ultrasonography are not conclusive, CT scan KUB should be done to diagnose the disease.



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### AUTHORSHIP AND CONTRIBUTION DECLARATION

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1	Raheel Sheikh	Topic selection, Data collection, Final approval of the article.	
2	Qazi Taqweem ul Haq	Data collection, Drafting and revising the article.	
3	Uzma Abdullah	Data analysis, Data interpretation found additional resources of information.	