

# ULTRASONOGRAPHY, X-RAY AND INTRAVENOUS UROGRAPHY (IVU)

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**ABSTRACT... Objectives:** To know the sensitivity and specificity of ultrasound with plain abdominal film (X-ray KUB) compared to IVU in evaluation of renal colic. To develop a protocol for investigations of renal colic. **Design of study:** Experimental. **Setting:** Department of Urology and Renal Transplantation, Quaid-I-Azam Medical College /Bahawal Victoria Hospital, Bahawalpur. **Period:** From July 2010 to December 2011. **Materials & Methods:** The number of cases for the study were one hundred and fifty. Patients of either sex of age range from 10 to 50 years with suspected urinary tract stone disease, PUJ obstruction and stricture ureterovesical junction were included in this study. While patients of age <10years, renal failure and with history of hypersensitivity to contrast media were excluded from the study. After routine investigations, ultrasonography, plain X-ray KUB and IVU were performed in every patient at radiology department, Bahawal Victoria hospital, Bahawalpur. **Results:** The mean age of patients was  $41.14 \pm 1.30$  years. The ratio of male to female was 2.8:1. Presenting complaints of patients were flank pain. Maximum duration of complaint was 5-6 years. USG + X-ray KUB findings were obstructing renal stone, ureteric stone and PUJO in 97(64.67%), 25(16.67%) and 28(18.67%) patients respectively. While on IVU, obstructing renal stone, PUJO and ureteric stone was found in 87(58%), 31(20.67%) and 32(21.33%) patients respectively. **Conclusions:** This study shows that ultrasonography and plain X-ray abdomen (KUB) is sufficient for the diagnosis of renal disease presenting with renal colic.

**Key words:** Ultrasonography (USG), X-Ray KUB, Intravenous Urography (IVU), Renal Colic.

## INTRODUCTION

Renal colic, defined as acute pain by obstructing ureteral calculus, is possibly the most excruciating pain that a person can endure<sup>1</sup>. Renal colic is one of the most common disease seen in the emergency department<sup>2</sup>. Renal stones are often asymptomatic, having been detected incidentally on imaging for other diseases. Renal stones can, however, cause severe pain when they move or obstruct the drainage of urine<sup>3</sup>.

It is a common condition in North America and worldwide. About 5-15% of the North America and Europeans populations, 2-5% of Asians and 20% of the people in Saudi Arabia pass a urinary calculus in their lifetime<sup>4</sup>. Most authors recommend diagnostic imaging to confirm the diagnosis in first-time episodes of renal colic, when the diagnosis is unclear. Lindqvist et al<sup>5</sup> found that

patients who are pain-free after receiving analgesics could be discharged from the emergency department and can undergo radiologic imaging after 2-3 weeks without increasing morbidity.

Ultrasonography is a safe, noninvasive imaging modality that can be used to study the urinary tract effectively. The diagnosis of obstructive urinary calculi depends on identification of the offending calculus and concomitant dilatation of pelvicalyceal system extending to the site of obstruction<sup>6</sup>.

Multiple studies show that the KUB radiograph has low (40-50%) sensitivity and specificity for the presence of urolithiasis and adds nothing to the emergent clinical impression. At follow-up, the urologist may find the KUB radiograph to be helpful in determining the exact size and

shape of the stone, in establishing a baseline for follow-up, and for visualization of the surgical orientation. KUB radiographs can be used to monitor passage of a previously documented opaque stone<sup>7</sup>.

Intravenous Urography (IVU) has long been accepted as the primary radiological tool for the diagnosis of renal colic<sup>8</sup>. It is, however, associated with significant disadvantages in terms of cost and toxicity. The emergence of newer, cheaper, and less invasive techniques has challenged IVU as the procedure of choice in the investigation of recurrent urinary tract infections (UTI), hematuria and suspected stone disease. There is evidence to support the use of ultrasonography in place of IVU in a wide array of clinical settings. Despite this, IVU remains the primary urinary tract imaging technique at many medical centres<sup>9</sup>.

Sensitivity of ultrasound increases when used along with X-ray KUB. Intravenous urography is not likely to be helpful when the results of plain X-ray and ultrasound are negative<sup>10</sup>.

CT Scan is not readily available in our setup for investigation of patient with renal colic. Therefore, keeping in view all the above facts, this study was conducted to determine the sensitivity, specificity of ultrasound and plain abdominal film (X-Ray KUB) compared to IVU in evaluation of renal colic so that we may be able to develop a protocol for investigations of renal colic.

## MATERIALS & METHODS

This study was conducted at the Department of Urology and Renal Transplantation, Bahawal Victoria Hospital / Quaid-e-Azam Medical College, Bahawalpur from July 2010 to December 2011. Patients of either sex of age range from 10 to 50 years with suspected urinary tract stone disease, PUJ obstruction and stricture ureterovesical junction were included in this study. While patients of age <10 years, renal failure and with history of hypersensitivity to contrast media were excluded from the study.

Total number of 150 patients who fulfilled the inclusion

criteria were selected. Detailed history and physical examination of every patient was done. Essential laboratory investigations i.e. Blood Complete examination, Urine routine examination, Serum Creatinine were done in all cases. Then ultrasonography, plain X-ray KUB and IVU were performed in every patient at radiology department, Bahawal Victoria hospital, Bahawalpur.

IVU was performed with patient fully prepared i.e. withhold food for 4-6 hours and advised purgatives night before. To avoid overhydration and diuresis since it dilutes the contrast material and decreases the density of contrast in the renal collecting system, patient is kept nil by mouth overnight. Then IVU was done using a standard technique. A full-length control film was followed by immediate tomogram after injecting the dye, a 5-min spot view of the kidneys, a full-length radiograph of the abdomen after release of compression, and a full-length post-micturation film. The contrast agent used was Iopamidol 300 for all examinations with approximate dose of 0.5-1ml/kg upto 100ml given rapidly intravenously. Supplementary oblique, compression, tomographic or delayed films were performed at the discretion of the radiologist. All examinations were performed and interpreted by two radiologists, both of whom were not aware of the indications.

## RESULTS

Majority 108 (72%) of the patients were 15-45 years of age with mean age of  $41.14 \pm 1.30$  and male to female ratio 2.8:1 as shown in Table-I.

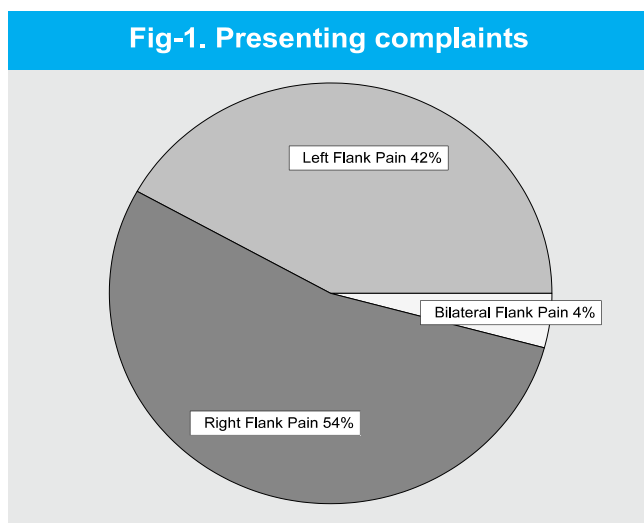
The duration of the presenting complaints was between 1-2 years in 93 (62%), 3-4 years in 15 (10%), 5-6 years in 21 (14%) and more than 6 years in 21 (14%) patients with mean duration was  $36.36 \pm 2.96$ .

Patients presented with Right Flank Pain were 81 (54%), Left Flank Pain 63 (42%) and Bilateral Flank Pain were 06 (4%) as shown in Figure-I.

Hydronephrosis with obstructing renal stone was found in 97 (64.67%) and 87 (58%) patients while hydronephrosis with non-obstructing renal stone (PUJ Obstruction) was found in 25 (16.67%) and 31 (20.67%)

**Table-I: Age and Sex distribution.**

Age (years)	Male		Female		Total	
	No.	%age	No.	%age	No.	%age
15-30	40	26.67	11	7.33	51	34.0
31-45	38	25.33	19	12.66	57	38.0
46-60	25	16.67	11	7.33	36	24.0
61-75	04	2.67	02	1.33	06	4.0
Total	107	71.33	43	28.67	150	100



patients on USG + X-ray KUB and Intravenous urography respectively. USG + X-ray KUB have diagnosed ureteric stone in 28(18.67%) while Intravenous urography in 32(21.33%) patients. Bilateral disease was found in 26(17.33%) while unilateral right or left sided disease was found in 70(46.67%) and 54(36%) patients respectively on USG + X-ray KUB. Intravenous urography have shown bilateral disease in 24(16%) and unilateral right or left sided disease in 70(46.67%) and 56(37.33%) patients respectively. (Table-II)

**DISCUSSION**

There are numerous studies available to the urologist in the diagnosis and management of renal colic. These include radiographic studies, such as the plain X-ray KUB, intravenous urography (IVU) and retrograde urography, ultrasonography (USG), computed tomography (CT), lasix renogram, magnetic resonance

**Table-II. Results of USG + X-ray KUB versus IVU.**

Finding	USG + X-ray KUB		IVU	
	No. of patients	%age	No. of patients	%age
<b>Hydronephrosis e obstructing renal stone</b>				
Bilateral	15	10.0	12	8.0
Right	45	30.0	40	26.67
Left	37	24.67	35	23.33
<b>Ureteric stone</b>				
Bilateral	07	4.67	07	4.67
Right	13	8.67	15	10.0
Left	08	5.33	10	6.67
<b>Hydronephrosis e non-obstructing stone (PUJ obstruction)</b>				
Bilateral	04	2.67	05	3.33
Right	12	8.0	15	10.0
Left	09	6.0	11	7.33

urogram (MRU) and the Whitaker test<sup>11</sup>. Selection of a specific test over another depends on the severity of obstruction and the patients age and renal function. Consideration must also be made for availability, cost, reliability and feasibility of the test for long term follow up by repeated examination<sup>11</sup>.

What is to be done if helical CT is not available? Plain abdominal film plus ultrasonography should be considered. This approach does not solve all the problems; in unresolved cases urography is indicated. It should also be noted that ultrasonography has a good sensitivity in detecting other intra-abdominal conditions which are responsible for pain that mimics renal colic<sup>12</sup>. Intravenous urography should not have priority in investigating the patients with renal colic. Helical CT should be the first choice. If this technique is not available, plain abdominal film and ultrasonography should be considered adding urography in unresolved cases<sup>13</sup>.

Urography is indicated only if a plain abdominal film and ultrasonography findings are equivocal or if intervention is necessary. If we have used X-ray KUB and Ultrasonography alone as the first test in our patients,

urography would have been unnecessary in approximately 60% of patients. Twenty percent of our patient passed a stone in the first 48 hours following the onset of pain and symptoms<sup>14</sup>.

When the results of both diagnostic modalities (X-ray KUB+USG and IVU) were combined, calculi were identified in 59 patients (sensitivity 85%, specificity 100%) and hydronephrosis was seen in 66 patients (sensitivity 95%, specificity 94%)<sup>13</sup>. Our study shows that the diagnostic ability of these tests is equal in the detection of renal calculi.

Intravenous urography proved better in midureteric calculi (100%), 88.2% of all congenital lesions including the major as well as minor variations. Both modalities were not helpful in diffuse parenchymal diseases (IVU-40% and USG-50%) and renal tuberculosis (IVU-18.2% and USG-45.5%)<sup>15,16</sup>. Sonography was able to delineate the cause of obstruction to pelvicalyceal system in only 72.3% of cases as compared to 88% by IVU<sup>14,15,16</sup>.

Ultrasonography is safe, quick, reliable and most effective diagnostic tool in majority of cases. Intravenous urogram should be reserved for cases which need surgical intervention<sup>6</sup>.

Our data indicates that combining USG with X-ray KUB provides the best diagnostic modalities that approaches the yield of IVU in excluding the presence of a calculus in the urinary tract in patients who present with intractable flank pain<sup>8</sup>.

The bedside USG + KUB has a high sensitivity and can be performed rapidly at the bedside by the emergency physician as compared to IVU. This combined modality is an effective screening tool in the initial evaluation of ureteral colic<sup>12</sup>. Emergency IVU is useful in the evaluation of patients with suspected renal colic. This rule out ureteral obstruction and allow consideration of alternative diagnosis<sup>17</sup>.

Our study shows that in patients with negative X-ray KUB and ultrasonography, the yield of IVU is very low and may not be necessary. This is important, as an IVU

examination is not without risks. A combination of X-ray KUB with ultrasonography and careful evaluation of clinical symptoms will improve the cost effectiveness in patient management<sup>10,18,19</sup>.

In settings where plain abdominal film, ultrasound and uncontrast spiral CT are available on a 24 hours basis, the approach consisting of KUB plus US and UHCT in unsolved cases can be preferred in view of its own lower cost and lower X-ray dose to patients as compared to UHCT as the sole investigation<sup>14</sup>.

In conclusion, IVU should not have priority in investigating the patients with renal colic, helical CT scan should be the first choice. If helical CT is not available, then a plain film and ultrasonography should be considered adding urography in unresolved cases<sup>1,11,20</sup>.

## CONCLUSIONS

This study shows that ultrasonography and plain X-Ray abdomen (KUB) is sufficient for the diagnosis of renal disease presenting with renal colic because of results of USG and X-ray KUB are equal to IVU. Moreover, X-ray KUB plus USG can be preferred in view of its lower cost and radiation dose to patient as compared to IVU. But in unequivocal cases, we advise noncontrast helical CT scan.

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