

ROLE OF ULTRASOUND IN EVALUATION OF RENAL COLIC AND ASSESSMENT OF RISK FACTOR FOR RENAL CALCULI

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ABSTRACT

Background: This study was conducted to assess the efficacy of ultrasound as instant investigation in out door clinic for patients with renal colic and also to study the risk factors for renal stones.

Material and Methods: It was a descriptive study of patients with renal colic due to obstructive uropathy, from July 2004 to June 2005. Instant abdominal ultrasound was performed in the clinic. Evaluation of metabolic risk factors and analysis of drinking water in the area was also performed.

Results: Three hundred patients, mean age 30.63 ± 3.58 years, presented with renal colic due to obstructive uropathy during the study period. Thirty-four normal persons were taken as controls.

Mean serum calcium of patients was higher 9.56 ± 0.7 mg/dl as compared to 8.8 ± 1.30 mg/dl in controls ($p < 0.05$). Uric acid 5.37 ± 1.66 mg/dl as compared to 5.40 ± 1.52 mg/dl in controls. ($p > 0.05$) Mean urinary calcium excretion of patients was 287.79 ± 181.29 mg/24 hours with 43.33% patients having excretion in excess of 250mg/24 hours as compared to 187.00 ± 88.91 mg/24 hours with only 17.64% having more than 250mg/24hours ($p < 0.05$). Mean 24 hours urinary excretion of uric acid in patients was 424.31 ± 142.16 mg as compared to 314.29 ± 173.49 mg in controls ($p < 0.05$).

Drinking water of three districts of Quetta Division revealed calcium hardness in Quetta 118.63 ± 21.28 mg/L, Pishin 118.75 ± 11.86 mg/L and Chaghi 124.16 ± 7.80 mg/L.

Conclusion: Majority of patients with renal colic can be diagnosed in the clinic with the help of ultrasound. Serum calcium and 24 hours urinary calcium and uric acid excretion are higher in patients with urinary calculi.

Key words: Renal colic, Renal stone, Ultrasound, Risk factors.

INTRODUCTION

Acute renal colic is defined as acute flank pain which may radiate to the groin or testicle with or without nausea, vomiting, dysuria or hematuria. Patients with renal colic present to emergency department or outpatient clinics. It needs quick diagnosis and prompt treatment. It may be a self-limited condition due to spontaneous passage of small calculi of less than 5 mm size and complete recovery in up to 93% of patients with acute urinary tract calculus obstruction.^{1,2} The clinical diagnosis of renal colic can be accurately established by ultrasound in approximately 70% of cases.² Other radiological investigations remain essential as well. Ultrasonography should be performed quickly at presentation to diagnose urinary calculus obstruction and exclude other abdominal emergencies. Acute flank pain is usually caused by acute urinary tract obstruction due to urolithiasis but in rare instances it may be due to

clot colic, renal infarction, acute pyelonephritis, musculoskeletal pain and other abdominal emergencies including diverticulitis, appendicitis and ruptured abdominal aortic aneurysm.

Plain abdominal x-ray for kidney, ureter and bladder (KUB) used alone is of limited diagnostic value with a sensitivity of 53-62% and specificity of 67-69% for the detection of ureteral calculi.^{1,3,6} Intravenous urography (IVU) is the gold standard investigation providing information regarding the site and degree of obstruction, size of stone and the effect of obstruction on the renal excretion. However, it is a semi-invasive technique with potential risks of radiation exposure and contrast material toxic and adverse allergic reactions.

magnitude of the problem of stone disease is large worldwide. In Pakistan it is estimated that approximately 12% of the population develops renal stones by the age of 70 years. 2-3% of the western population overall experience

an attack of acute renal colic sometime during their lifetime.¹

Decision on the appropriate radiologic investigation is usually based on several factors which include the pretest probability of the disease, the prevalence of the disease in the population, the accuracy of the test, the potential risks of the test, the discomfort it causes to the patient and the cost.^{4,17} The ideal test should improve the patient's treatment by providing answers to the clinical questions. Therefore, the value of an imaging examination can be measured along this causal chain: sensitivity/ specificity; to influence decisions/expected value; or to influence health outcomes/quality adjusted life years.⁵

In recent years, new imaging methods have emerged as a replacement to IVU. Ultrasound (US) is a cheap, noninvasive, safe technique, which can detect acute urinary tract obstruction with a sensitivity of 91-92% and a specificity of 90%.³ US used alone have some limitations. It is an operator dependent technique with variable results capable of detecting ureteric stones in 4-83% of cases.^{7,15} When combined with KUB the sensitivity of US increases to 94-97% at a specificity of 67-90%,^{3,8} with a negative predictive value of 95%, therefore, IVU is not likely to be helpful when the results of KUB and US are negative. The results of the combination of KUB and US can be further improved if the patient is well hydrated prior to the examination which is performed with a full bladder and the addition of color doppler sonography for the study of the differential resistive index values and ureteral jets.^{9,17}

Renal Scintigraphy has not received a widespread acceptance for the initial evaluation of patients with renal colic because it is generally not available for emergency applications. In one study, renal scintigraphy combined with a plain abdominal radiograph yielded a sensitivity of 93% in the detection of acute calculus urinary tract obstruction.¹⁸

MRI urography (MRU) has been shown to be an effective and useful diagnostic tool for the detection of urinary tract dilatation with a sensitivity of 100% and specificity of 96%. It is capable of identifying the cause of obstruction in most patients (88-92%).¹⁹ It can also accurately distinguish between acute and chronic ureteric obstruction based on the degree of peri-renal high signal.^{20,21} However, the exact role of MR urography in the assessment of patients with acute urinary calculus obstruction has not been studied and is yet to be determined.

Un-enhanced spiral CT is a more recent technique that has been used for the initial evaluation

of patients with renal colic. It is a quick and rapid, non-operator dependent technique that has a high sensitivity of 94-97% and specificity of 96-97%.^{22,23} However, it is expensive, not readily available in all hospitals, carries a high radiation dose to the patient equivalent to 3 times that of an IVU,²⁴ and 500 times that of a chest x-ray,²⁵ and hence cannot be used for follow up. It has some diagnostic pitfalls, and cannot differentiate non-opaque uric acid stones from radio-opaque calcium containing stones; an important point for management of stone disease. Because of reduced patient morbidity and, in most cases, reduced hospital costs, there has been a significant increase in the performance of endoscopic stone surgery fueled by consumer preference for a minimally invasive approach. Considering the superiority and high accuracy of other methods like un-enhanced spiral CT scan, its use as a primary method for investigation of renal colic would be ideal but it is expensive and time consuming,^{26,27} providing the issues of a competitive lower cost and application to individuals in the non-reproductive age group, due to radiation exposure hazards could be resolved.

Appropriate selection of the optimal imaging strategy depends largely on local policies, available resources and treatment cost.

This study was designed to assess the efficacy of ultrasound as instant investigation in the out door clinic for patients with acute renal colic and also to study the metabolic risk factors for renal stones.

MATERIAL AND METHODS

It was a descriptive study of patients with obstructive uropathy from July 2004 to June 2005. Ultrasound of the abdomen and pelvis was performed in the clinic for patients who consulted the outdoor clinic with acute flank pain. Patients having no fullness of pelvi-calyceal system and those with complications due to renal stones including renal failure were excluded from the study.

Patient with renal colic and hydronephrosis were subdivided into two groups on the basis of their subsequent management.

Group-1 included patients showing hydronephrosis or fullness of the pelvi-calyceal system and stone more than 5 mm in size on ultrasound. They were advised plain x-ray of abdomen for kidney, ureter and bladder (KUB), after an intramuscular injection of diclofenac sodium to relieve the pain. Site of stone in the urinary tract was confirmed by contrast radiography. Open surgical operation or minimal invasive techniques were performed in these patients.

Group-2 included patients showing hydronephrosis but no visible stone or stone less than 5 mm in size on ultrasound. These patients were managed conservatively.

Other investigations performed in all patients were urine analysis, complete blood picture, blood sugar, blood urea and serum creatinine.

Evaluation of metabolic risk factors was performed which included serum calcium and uric acid and 24 hours urinary calcium, uric acid, pH and volume. Analysis of drinking water of the three districts of encatchment area was also performed. Calcium hardness was defined as the water with a calcium concentration more than 50 ppm or mg/l as described by Thomas Water Authority in UK. Total hardness was determined by the concentration of calcium and magnesium as defined by the US Environmental Pollution Control.²⁸

A proforma was filled which recorded the baseline characteristics of both the groups with regard to age, sex, site of stone, family history, occupation, residence and socio-economic status.

RESULTS

Three hundred patients presented with flank pain during the study period. Instant ultrasound was performed in the clinic for all these patients. The diagnosis of obstructive uropathy was established in 100 (33%) of these patients. Age range of these subjects was 17-65 years with a mean of 30.63 ±3.58 years. Maximum number of patients (41.19%) was between 26 and 35 years of age. (Table-1) Thirty-four normal persons with mean age 28.62 ±2.60 years were taken as controls.

These patients were divided into two subgroups on the basis of their subsequent management.

Table-1: Age distribution of patients with renal stones.

Age in years	Group-1 Percentage	Group-2 Percentage
16-25	11.76	16.66
26-35	41.19	36.66
36-45	35.29	33.33
46-55	5.88	10.02
56-65	5.88	3.33

Table-2: Comparison of serum calcium and uric acid levels of patients and controls.

Parameter	Stone patients (mg/dl)	Normal subjects (mg/dl)	Significance
Calcium (mg/100 ml)	9.56 ±0.7	8.8 ±1.3	p<0.05
Uric Acid (mg/100 ml)	5.37 ±1.66	5.40 ±1.52	p>0.05

Values are Mean ±SD.

Group-1 included 30 (30%) patients showing hydronephrosis and the presence of stone more than 5 mm in size on ultrasound. They were advised KUB and contrast radiography which confirmed the anatomical site of stones in the urinary tract. Open surgical operation was carried out in 20 (66.66%) and minimal invasive techniques in 10 (33.33%) of these patients.

Group-2 included 70 (70%) patients showing hydronephrosis but no visible stone or stone less than 5 mm in size on ultrasound. These patients were managed conservatively. Spontaneous passage of calculi occurred with complete recovery in 65 (92.86%) of these patients.

Mean serum calcium level of patients was 9.56±0.7 mg/dl as compared to 8.8±1.30 mg/dl in controls. The difference between the two groups was significant (p<0.05).

Mean serum uric acid level of patients was 5.37±1.66 mg/dl as compared to 5.40±1.52 mg/dl in controls. Comparison of the means showed non-significant difference statically. (Table-2)

Mean urinary calcium excretion in stone patients was 287.79±181.29 mg /24 hours with 43.33% patients having urinary calcium excretion in excess of 250 mg /24 hours. Controls had lower daily mean excretion 187.00±88.91 mg/24 hours with only 17.64% having urinary excretion more than 250mg/24 hour (p<0.05).

Mean 24 hours urinary excretion of uric acid in patients was 424.31±142.16 mg as compared to 314.29±173.49 mg in controls (p<0.05). (Table-3) 20% of these subjects were having uric acid excretion of more than 750 mg/24 hours.

Urinary volume in 24 hours and pH of a fresh morning specimen of urine was compared in patients and controls. Patients had a mean 24 hours urinary volume of 1336.7±773.83 ml as compared to 1129.41±512.36 ml in controls. Mean pH of urine in stone subjects was 6.24±0.78 as compared to 6.12±0.384 in controls. The difference in

Table-3: Comparison of 24-hours urinary excretion of calcium and uric acid in patients and controls.

Parameter	Patients			Controls			Significance
	Mean	SD	SEM	Mean	SD	SEM	
Calcium (mg/24hours)	187.69	88.91	21.58	278.79	181.29	33.14	p<0.05
Uric Acid (mg/24hours)	314.29	173.49	42.9	423.31	142.16	25.98	p<0.05

Table-4: Comparison of 24 hours urinary volume and pH in stone-formers and normal controls.

Parameter	Stone patients		Normal controls		p-value
	Mean \pm SD	SEM	Mean \pm SD	SEM	
Urinary Volume (ml /24 hr)	1336.7 \pm 773.83	134.15	1129.41 \pm 512.36	124.35	p>0.05
pH	6.24 \pm 0.781	0.142	6.12 \pm 0.385	0.093	p>0.05

Table 5: Comparison of drinking water between districts of Quetta division.

Variable	Quetta	Pishin	Chaghi
Calcium as Ca ⁺²	54.92 \pm 5.90	47.50 \pm 4.2	99.40 \pm 11.58
Total hardness	240.42 \pm 17.55	349.50 \pm 114.51	357.4 \pm 33.87
Calcium hardness as CaCO ₃	118.63 \pm 121.28	118.75 \pm 11.86	124.16 \pm 7.80
Magnesium hardness	101.42 \pm 9.59	230.75 \pm 68.42	233.33 \pm 22.85
Magnesium as Mg ⁺²	24.12 \pm 2.43	35.56 \pm 1475	56.69 \pm 5.55
pH	7.81 \pm 0.12	7.82 \pm 0.15	8.36 \pm 7.50
Silica	1.40 \pm 0.36	1.30 \pm 11.06	9.40 \pm 11.58

Values are Mean \pm Standard Error of the mean.

24 hours urinary volume and pH was statistically not significant (p>0.05). (Table-5)

Analysis of drinking water of three districts of Quetta Division revealed calcium hardness in Quetta district as 118.63 \pm 21.28 mg/L, Pishin district 118.75 \pm 11.86 mg/L and Chaghi district 124.16 \pm 7.80 mg/L. (Table-5)

DISCUSSION

The prevalence of ureteral calculi in patients presenting with acute flank pain in the region is comparable to that worldwide which ranges from

67-95%.² In regions with hot climate urolithiasis is common, for example in the Riyadh Armed Forces Hospital, some 28% of urological patients had stone disease and 29% of these were ureteric. In addition, 16-29% of patients with stone disease will have repeated attacks of renal colic so-called stone formers.⁴

In the present study, ultrasound proved to be a non-invasive, safe technique, which efficiently detected acute urinary tract obstruction. Ultrasound used alone had some limitations. It is an operator dependent technique. When combined

with X-Ray KUB, the sensitivity of US increases. IVU is not likely to be helpful when the results of plain X-Ray and US were negative.

Arif (1992) carried out another study from the Quetta division, which showed the numbers of stones removed at operations was high.³ In that study the incidence per 100,000 population was reported as 28 in Quetta, 4 in Pishin and 5 in Chaghi districts during 1989-1991.

In another study by Arif the approximate incidence of urinary stone operations in the population was estimated as 28 per 100,000 in Quetta district, 5 in Pishin and 4 in Chaghi district.³ It is noteworthy that the incidence of stone operations is highest in Quetta district as opposed to the lowest water hardness and equal concentration of calcium of drinking water compared to other districts of the Quetta division in the present study. In contrast Chaghi district comprises both mountains and desert plains with scattered population having the highest calcium and total hardness of drinking water but the incidence of stone operations was lowest as reported in that study.³

CONCLUSION

Majority of patients with renal colic can be early diagnosed in the clinic with the help of ultrasound. Serum calcium and 24 hours urinary calcium and uric acid excretion are higher in patients with urinary calculi.

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