



## Biochemical Evaluation Of Renal Function And Liver Function In Patients Of Different Types Of Renal Stones

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### ABSTRACT

**Introduction** - Kidney stone disease is a common chronic disorder with male – female ratio of 2:1. It is multi-factorial disorder resulting from combined influence of epidemiological, biochemical and genetic risk factors. These are hardened mineral deposits in kidney and impose much impact on many metabolic processes like liver function and kidney function etc.

**Aim & objective** – Evaluation of renal function and liver function biochemically in patients of renal stone and compare with controls to observe the impact of urinary stones to minimize the complications.

**Method and material** - This, case control study included . 30 cases of Renal stone both male(21) and female(9) and 30 controls. Diagnosis of cases were based on history, clinical examination and KUB x-ray to differentiate radiopaque from radiolucent stones. All the tests are done in Randox chemical auto analyzer by using kit method.

**Result** - Impaired renal function is seen in both type of stone formers. Serum calcium is significantly increased in radio-opaque stones, while serum uric acid level is increased in radiolucent stone formers. In Liver function tests, significant elevation in serum AST, ALT, ALP, while TP is lowered significantly in renal stone patients as compared with control group.

**Conclusion** - Nephrolithiasis is not only a stone disease, but also as a kidney and liver function impairing disease. Stone components were associated with an impaired renal function. Hence, stone analysis is important and should be carefully evaluated to preserve the renal function.

**Keywords:** renal stones, renal function tests, liver function tests

### INTRODUCTION

Kidney stone disease is a common chronic disorder associated with painful stone episodes, lost work days and significant health care costs [1], affecting up to 10–12 % of men and 5–6 % of women [2]. In recent years, kidney stones have been associated with increased risk of chronic kidney disease (CKD) [3], and even end-stage renal disease (ESRD) [4, 5].

Urinary calculi have worldwide distribution but are particularly common in some geographic locals such as United States, South Africa, India and other South East Asian Countries. It is estimated that approximately 2% of the population experiences renal stone disease at sometime in their life with male

– female ratio of 2:1. The peak incidence is observed in 2nd to 3rd decade of life [6]. Renal stone which are solid crystals that form from dissolved minerals in urine, is a multi-factorial disorder resulting from the combined influence of epidemiological, biochemical and genetic risk factors. High dietary intake of animal protein, sodium, refined sugars, fructose, and high cola drinks may increase the risk for developing renal stones [7]. Furthermore, a number of studies have reported an increased prevalence of cardiovascular disease [8], diabetes, hypertension and obesity [9,10,11] in stone formers, suggesting that kidney stone disease may be a systemic disorder linked to the metabolic syndrome

.Previous studies have considered kidney stones as a potential risk factor for chronic kidney disease (CKD), associated with significant morbidity, mortality, and health care cost [12,13,14]. To date, the mechanism accounting for this association is not completely understood. There are several components of urinary stones, such as calcium oxalate, calcium phosphate, uric acid, and struvite [15]. The relationships between stone components and the change of renal function are unclear.

Because the liver has many crucial roles in the maintenance of a healthy body, any level of liver dysfunction can be problematic. The most commonly used serum liver function tests include serum ALT and AST activities that reflect the hepatocellular injury and serum ALP that reflect impaired bile excretion and bile flow and serum albumin that represent the synthetic function of the liver[16]. This study is aimed at the assessment of the changes in liver function and kidney function in patients of different types of kidney stone.

#### **Method and materials :**

This cross sectional, case control study was conducted in Department of Biochemistry, JNMC, Sawangi, Wardha after obtaining clearance from the Institutional Human Ethical committee. Patients were taken from indoor admitted in Acharya Vinobha Bhave Rural Hospital from October 2017 to March 2018. Informed consent was obtained from each participant.

Study group comprises of 60 subjects. 30 cases of Renal stone of age group of 15 – 75 yrs both male(21) and female(9) and 30 controls of normal healthy persons same age and sex, from general population. We reviewed the medical records of patients. The diagnosis of the cases were done in the hospital, based on history, clinical examination followed by KUB x-ray, ultrasonography, and urinalysis

**Stone composition** - Results of stone analysis were obtained from medical records and all available medical imaging reports in order to differentiate radiopaque from radiolucent stones. Stones visualized radiopaque were considered as calcium containing stones and radiolucent stones were considered as uric acid stones. There were 24 cases of radiopaque and 6 cases of radiolucent stones.

**Exclusion criteria** - The exclusion criteria were chronic renal failure, chronic ureteral obstruction in kidneys, congenital renal anomalies, and polycystic kidney disease.

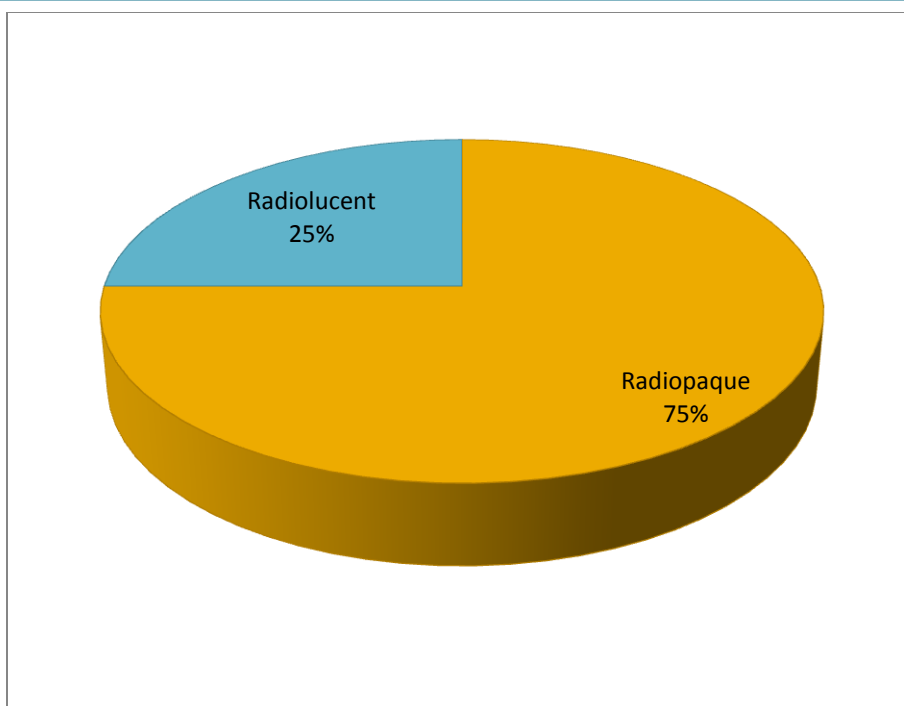
**Collection of blood samples** - Five mL of venous blood samples was withdrawn in plain bulb. After centrifugation, we got clear serum. The serum samples were isolated with proper labeling, and used for biochemical measurements

**Biochemical measurement** - For liver function test, we measured serum AST, ALT,ALP, total bilirubin, and total protein. For renal function test we measured serum urea, creatinine. We also measured serum calcium and uric acid. All the tests are done in Randox auto analyzer by using kit method.

**Statistical analysis** - Statistical analysis was done by using descriptive and inferential statistics using one way ANOVA, Multiple Comparison: Tukey Test and z-test for difference between two means and software used in the analysis were SPSS 22.0 version and EPI-INFO 6.0 version and  $p < 0.05$  is considered as level of significance.

#### **Result**

This case control study included 60 participants, 30 cases of renal stones, and 30 healthy controls with age group 15-75 years, and the male : female ratio was 2.33 : 1. A total of 24 patients (80%) had radiopaque (calcified) stones and in 6 patients (20%) the stones were radiolucent.(Fig:1)



**Renal function tests** - Results showed (Table – 1) impaired renal function in both type of stone formers. Increased mean serum urea (radio-opaque- 55.04 )(radiolucent- 52.00) and increased mean serum creatinine (radio-opaque- 2.63)(radiolucent-2.39 )is seen when compared with control(mean serum urea-22.23, mean serum creatinine-0.92). Serum calcium is significantly increased in radio-opaque stones, while serum uric acid level is increased in radiolucent stone formers.

Table – 1 Comparison of kidney function tests in cases and conrols

	Group	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
Urea mg/dl	Control	30	22.23	5.73	1.04	-	-
	Opaque	24	55.04	13.83	2.82	11.80	0.0001,S
	Radiolucent	6	52.00	11.09	4.53	9.79	0.0001,S
Creatinine mg/dl	Control	30	0.92	0.21	0.03	-	-
	Opaque	24	2.63	0.81	0.16	10.98	0.0001,S
	Radiolucent	6	2.39	0.63	0.26	10.38	0.0001,S
Sr. Calcium mg/dl	Control	30	8.21	0.51	0.09	-	-
	Opaque	24	10.17	0.72	0.14	11.60	0.0001,S
	Radiolucent	6	8.93	0.48	0.19	3.16	0.003,S
Uric Acid mg/dl	Control	30	3.90	1.25	0.22	-	-
	Opaque	24	3.82	0.98	0.20	0.25	0.80,NS
	Radiolucent	6	8.41	1.35	0.55	7.95	0.0001,S

**Liver function tests** - The result of the current study showed significant elevation (  $P < 0.05$ ) in serum AST, ALT, ALP, concentrations ( mean 31.96, 36.73 & 319.13 respectively)in renal stone former patients when compared with concentrations in the control group, while TP (mean 5.91)is lowered significantly ( $P < 0.05$ ) in renal stone former patients as compared with control group. Farther more results showed non significant differences (  $P < 0.05$ ) in the serum bilirubin concentrations between renal stone former patients and controls groups as shown in (Table – 2).

Table – 2 Comparison of Liver function test in cases and contro

	Group	N	Mean	Std. Deviation	Std. Error Mean	t-value	p-value
AST IU/L	Control	30	15.86	4.21	0.76	11.76	0.0001,S
	Study	30	31.96	6.19	1.13		
ALT IU/L	Control	30	15.50	4.29	0.78	14.22	0.0001,S
	Study	30	36.73	6.95	1.26		
ALP IU/L	Control	30	155.46	40.08	7.31	11.20	0.0001,S
	Study	30	319.13	69.20	12.63		
TP g/dl	Control	30	7.24	0.69	0.12	8.16	0.0001,S
	Study	30	5.91	0.56	0.10		
TB mg/dl	Control	30	0.73	0.17	0.03	0.37	0.71,NS
	Study	30	0.74	0.14	0.02		

**Discussion**

Stone formation in the urinary tract has been recognized for thousands of years, but during the last few decades the pattern and incidence of the disease have changed markedly. Urinary stone affect 10-12% of the population in industrialized countries. The average lifetime risk of stone formation has been reported in the range of 5-10%. .The incidence of Urinary stones has been increasing recently. With a prevalence of >10% and an expected recurrence rate of nearly 50%, stone disease has an important effect on the health care system.

In our study the male female ratio was 2.3:1.Our study revealed that nephrolithiasis is more common in men (12%) than in women (6%) and is more prevalent between the ages of 20 to 45 in both sexes.

Urolithiasis may result in loss of function by two general mechanisms, the first mechanism include episodic events, such as urethral obstruction during stone passage, or because of procedures needed for stone removal, and their attendant complications, and the second mechanism include continuous events, as

a result of a disordered physiology that underlies stone formation[17].

**Kidney function test** - In the present study, we found a significantly lower level of kidney function in patients with kidney stone disease than in age- and gender-matched control subjects and it is more deteriorated in radiopaque subset.

In a study by Yii-Her Chou et al [18] they found better renal function in calcium containing stones compared with those with non-calcium containing stones (struvite and uric acid,  $p < 0.01$ )

In another study by Vaka K. Sigurjonsdottir et al [19] they found the prevalence of CKD was significantly higher among the patients with radiolucent stones compared with calcium stone formers ( $p < 0.001$ ).

The pathogenesis of CKD in patients with kidney stone disease likely involves multiple different pathways [3, 20]. Obstruction to urine flow caused by stones has the potential to inflict kidney injury. In fact, unilateral ureteral obstruction has been shown to cause intense renal vasoconstriction and renal blood

flow reduction, can lead to significant ischemia and permanent renal parenchymal damage [21]. Renal parenchymal crystal deposition and the associated inflammation and fibrosis have been well described in patients with primary hyperoxaluria and APRT deficiency [22] and similar histological changes have also been observed in patients with uric acid and struvite stones [23].

Furthermore, Evan et al. [24] shown that obstruction of the ducts of Bellini, commonly seen in stone formers, is strongly associated with tubular atrophy, interstitial fibrosis and glomerulosclerosis [25]. While crystal nephropathies can cause inflammation and fibrosis leading to severe kidney damage, the underlying pathobiological mechanisms of CKD in ordinary human kidney stone disease remain elusive. In animal models, however, the best characterized pathway of calcium oxalate crystal-induced inflammation involves NLRP3 inflammasome-mediated mechanisms, leading to direct injury to tubular cells, neutrophil recruitment, tubulo-interstitial inflammation and progressive renal failure [12, 26].

This study indicated the presence of impaired renal function more in calcium containing stones rather than non calcium containing stones. This finding suggests that the stone component is another risk factor for the progression of functional impairment in CKD. The most common component of non-calcium stone was uric acid. Uric acid stone formers are commonly associated with diabetes and gout, diseases that are known to result in renal function impairment [27,28,29].

**Liver function tests** - The result of the current study showed significant elevation ( $P < 0.05$ ) in serum ALP, AST, ALT concentrations in renal stone former patients when compared with concentrations in the control group of both sex groups, while total protein is lowered significantly.

In a study by Ismail Saliha –Kakay et al., [16] they found increased level of serum AST and ALP while no significant difference found in serum ALT levels.

In other study by Azoury, et al. [30] in 1982, it has been found that calcium oxalate stone formers have low ALT and AST activity compared to healthy individuals. As ALT and AST convert alanine and aspartic acid respectively into glutamic acid, a

possible mechanism of retardation of kidney stone formation involving enzyme steps via glutamic acid creation in situ is suggested.

## Conclusions

Our results indicate that nephrolithiasis is not only a stone disease, but also as a kidney and liver function impairing disease. Stone components were associated with an impaired renal function. Hence, stone analysis is important and should be carefully evaluated to preserve the renal function

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