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Research Article

A STUDY TO CORRELATE URINARY OUTPUT AND TOTAL ORGANIC ACIDS OF URINE IN CALCIUM OXALATE RENAL STONE FORMERS AND CONTROLS

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ABSTRACT

The objective of current study is to evaluate the urinary output and total organic acids in the urine of calcium oxalate stone formers and compare it with that of non stone formers i.e. controls, to investigate whether the difference between the two properties in two groups really exists or not. Further, correlation between the two properties is also evaluated. The study was conducted on 50 patients divided into two groups- Group I consist of 25 idiopathic patients having calcium oxalate renal stone i.e. stone formers (SF) and Group II consists of 25 controls i.e. non stone formers (NSF) having no clinical evidence of renal stones. Each patient and control was asked to collect a 24-hour urine, which was kept unrefrigerated, using thymol as preservative. It was concluded from the studies that urinary output and total organic acids can be used as a tool to separate a SF from NSF. There was no correlation between the properties studied.

Keywords: Renal Stone, stone former, non stone former, control, urinary output, organic acids.

1. INTRODUCTION

Urine is a complex polyionic solution and consists of large amount of water in which urea and other organic and inorganic moieties are dissolved. Urine contains lot of inhibitors and promoters of crystallization [1]. Important ions and molecules present in urine in relation to renal stone formation are Ca^{2+}, Na^{+}, K^{+}, Mg^{2+}, oxalate, phosphate, H^{+}, OH^{-}, SO_4^{2-} citrate, amino acids, various ketone bodies, urea, uric acid, glycosaminoglycans etc [2]. The loss of balance between the urinary promoters and inhibitors and super saturation of urine with these stone forming ions increase the risk of stone formation more than disturbance in any single substance [3].

Each year, thousands of people are diagnosed with renal stone disease, a condition that develops when the urine becomes overly saturated with certain microscopic substances. They form crystals that bind into hardened mineral deposits known as renal stones [4]. Renal stones can develop anywhere in urinary tract. They are formed due to imbalance between fluid and certain wastes in urine causing a high concentration of stone forming salts i.e. calcium oxalate, calcium phosphate, uric acid and struvite [5]. Renal stones may grow over months and even years before causing problem. Normally the stone will move through the urinary tract and pass out in the urine.

Large stones do not always pass through and may require a procedure or surgery to remove them. These stones can result in extreme pain, burning sensation during urination, blood in urine, can stop the flow of urine and in some cases may lead to high blood pressure and increase the risk for coronary artery disease and diabetes mellitus [6]. The renal stone formation is a recurrent problem and around half of all people who previously had a kidney stone will develop another one within five years. The recurrence rate without preventive treatment is approximately 10% at 1 year, 33% at 5 years and 50% at 10 years [7]. Another visible change was the variation in the gender of the affected people. Although in the beginning the disease was limited to men, nowadays it also affects the women. Peak age of renal stone found in men is 30 years and women are 35-55 years [8]. Further, renal stones develop more frequently in people with a family history of stones than in those without a family history [9].

In the previous study, specific gravity, pH [10] and surface tension and viscosity [11] and organic acids [12] were evaluated in urine of SF and NSF. In the current paper, urinary output and total organic acids of urine of calcium oxalate stone formers were determined and these properties were compared with that of non stone formers, to investigate whether the difference between two groups really exists or not so that a new simple

method may be developed to distinguish the stone formers from non stone formers rather than the various imaging techniques used now-a-days [13] and correlation between the two properties were also find out. The study was conducted on 50 patients. Group I consist of 25 idiopathic patients of various ages and both sexes having calcium oxalate renal stone disease i.e. stone formers (SF) and Group II consists of 25 controls i.e. non stone formers (NSF) with matched age and sex having no family history of kidney stone.

2. EXPERIMENTAL

Patients and controls were put on equal calorific diet/kg body weight and equal amount of water for 2 days. On third day, they were asked to collect 24- hour urinary sample.

Each patient was provided with two 2.5 litre collecting bottles and for urine preservation 10 ml of 5% thymol in isopropyl alcohol is added into each bottle. On the day of urine collection, subjects were asked to empty the bladder completely upon awakening and discard this urine. This is the start date and time. Write it on the collection container. After that, all urine should be collected in the bottle (also during the night) for the next 24 hours. Always store the collecting bottles in a cool place. The last urine collected should be that voided upon awakening the second day, at the same time as the start time [14].

The physical properties of urine viz. urinary output and total organic acids in urine sample were determined in both the groups. Urinary output and total organic acids of 24-hour urinary sample of both the groups was determined. The individual values of each observation of each subject in the two groups were shown in Table 1.

Table 1: Experimental values of Urinary Output & Organic acids of Stone Formers and Controls

Subject (Stone formers)	Urinary output (litres)	Organic acids (meq/L)	Subject (Controls)	Urinary output (litres)	Organic acids (meq/L)
1.	2.100	16.50	26.	1.240	34.75
2.	1.800	17.34	27	1.000	25.57
3.	1.080	42.34	28.	1.200	52.5
4.	1.180	28.40	29.	1.650	39.75
5.	1.450	34.95	30.	0.940	56.20
6.	1.020	38.05	31.	0.920	48.40
7.	2.300	13.08	32.	1.280	76.24
8.	1.400	29.70	33.	1.200	72.7
9.	1.260	42.35	34.	1.150	44.40
10.	1.450	47.65	35.	0.900	29.60
11.	1.230	46.70	36.	1.240	22.40
12.	1.680	45.95	37.	0.900	39.84
13.	1.700	35.65	38.	1.340	52.56
14.	1.200	49.61	39.	1.280	35.89
15.	1.820	40.29	40.	1.080	49.78
16.	1.630	38.39	41.	0.960	47.33
17.	1.450	39.98	42.	1.320	60.78
18.	1.200	50.20	43.	0.980	44.20
19.	2.250	36.45	44.	1.060	46.7
20.	1.480	52.5	45.	0.920	65.54
21.	1.320	47.05	46.	0.960	72.31
22.	2.100	38.39	47.	0.950	67.55
23.	1.580	18.85	48.	1.220	75.2
24.	1.220	39.95	49.	0.880	62.7
25.	1.640	36.70	50.	1.020	54.55

2.1. Statistical Methods

Significance of mean value differences between the two groups i.e. stone formers (Group-I) and controls (Group-II) were tested using student t-test and correlation coefficient was also calculated. The results are tabulated and shown graphically.

3. RESULTS AND DISCUSSION

The present study was conducted on 50 patients divided into two groups- Group I consist of 25 patients having calcium oxalate renal stone i.e. stone formers (SF) and Group II consists of 25 controls i.e. non stone formers (NSF). 24-hour urine was collected from each patient and control. It was found during study that:

a. **Urinary output** of Group I (fig. 1) ranges from 1.020 to 2.300 litres with a mean value of 1.542 ± 0.354. Corresponding value in Group II (fig. 2) ranges from 0.880 to 1.650 litres with a mean value of 1.103 ± 0.185 as shown in Table 2. Comparison of urinary output in both the groups is shown in fig 3. By applying student t-test, t value comes out to be 5.34 which is statistically highly significant.

Table 2: Results of Urinary output of 24-hour Urinary Sample in the Two Groups

Subjects	Evaluated Range	Evaluated Mean	Evaluated Standard Deviation
Stone Formers (Group-I)	1.020 to 2.300	1.542	± 0.354
Non Stone Formers (Group-II)	0.880 to 1.650	1.103	± 0.186

t value = 5.34

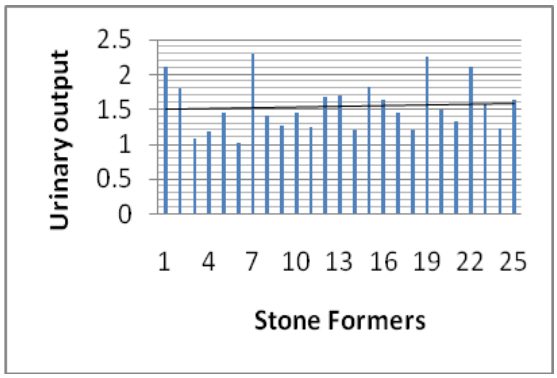

Fig.1: Graph showing Urinary output of Stone Formers

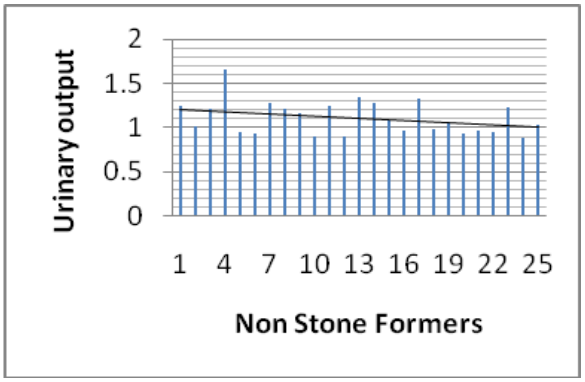

Fig. 2: Graph showing Urinary output of Non Stone Formers

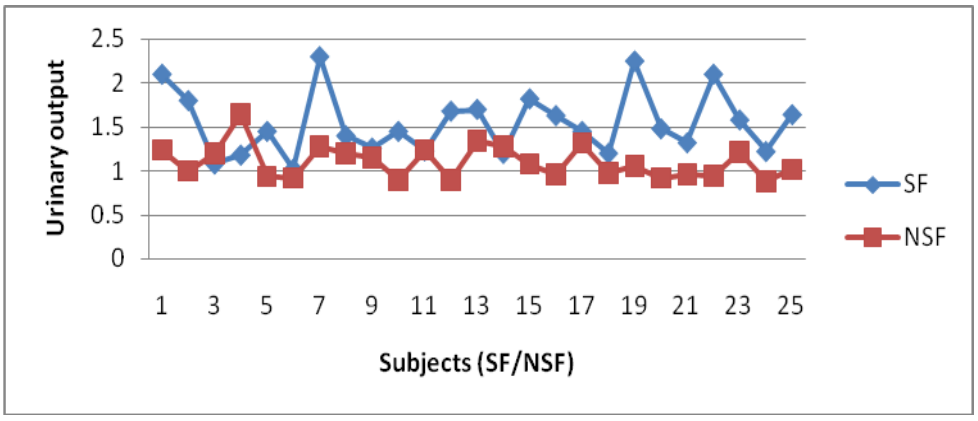

Fig.3: Graph showing comparison between Urinary output stone formers & non stone formers

b. **Total Organic Acids** of Group I range from 16.50 to 50.20 with a mean value of 37.081 ± 10.760 as shown in fig 4. Corresponding value in Group II (fig 5) ranges from 22.40 to 76.24 with a mean value of 51.097±15.107 as shown in Table 3. Comparison of total organic acids in both the groups is shown in fig 6. By applying student t-test, t value comes out to be 3.70 which is statistically highly significant.

Table 3: Results of Total Organic Acids of 24-hour Urinary Sample in the Two Groups

Subjects	Evaluated Range	Evaluated Mean	Evaluated Standard Deviation
Stone Formers (Group-I)	13.08- 52.5	33.481	± 9.306
Non Stone Formers (Group-II)	22.40 - 76.24	51.097	± 15.107

t value = 4.86

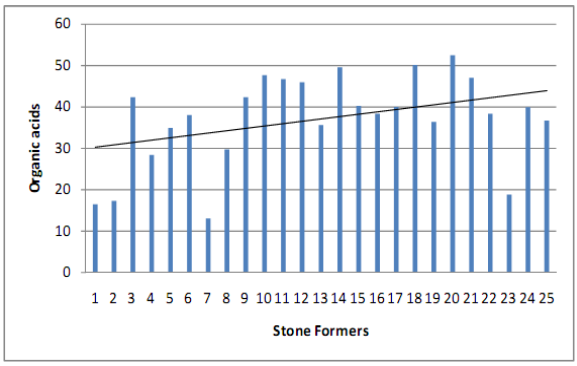

Fig.4: Graph showing Organic acids of Stone Formers

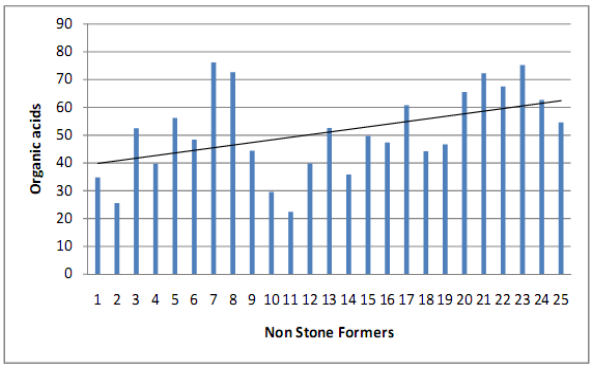

Fig. 5: Graph showing Organic acids of Non Stone Formers

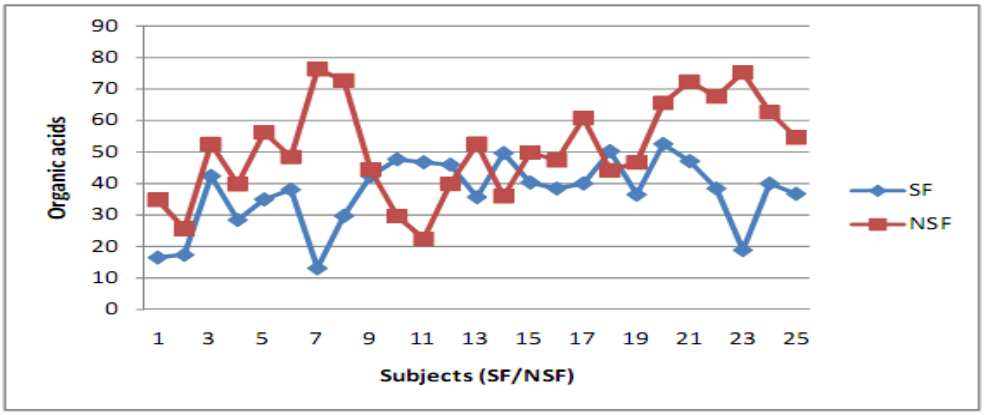

Fig. 6: Graph showing comparison between Organic acids of stone formers & non stone formers

Further, to find dependence of one property over another, correlation coefficient (r) were calculated, the values of which are shown in Table 4. The correlation coefficient between urinary output and organic Acids in Group-I comes out to be - 0.428 and the correlation coefficient between urinary output and organic acids in Group-II comes out to be - 0.056. From correlation coefficient, we found that no positive or negative perfect correlation is found between the properties studied. The graphs showing correlation between urinary output and organic acids in Group-I and Group-II is shown in Fig 7 and 8 respectively.

The following conclusions have been drawn from the analysis of data obtained in the study.

- Urinary output in Group-I is significantly more than in Group-II. Stone formers may have increased output so as to flush excessive complexes present in urine as a result of stone forming process thus trying to prevent aggregation of these complexes in urine. Urinary output alone cannot separate a stone former from a non stone former on individual basis because 20-25% cases of non stone former fall in the region of stone former but can give clue to the some extent that there are possibility of developing renal stones or not.
- Total organic acids of Group-I is significantly lower than Group-II but there is overlap of values in approximately 10% to 20 % cases. Therefore, no line of separation is possible. But, total organic acid content in urine to some extent can be used to distinguish a stone former from non stone former.

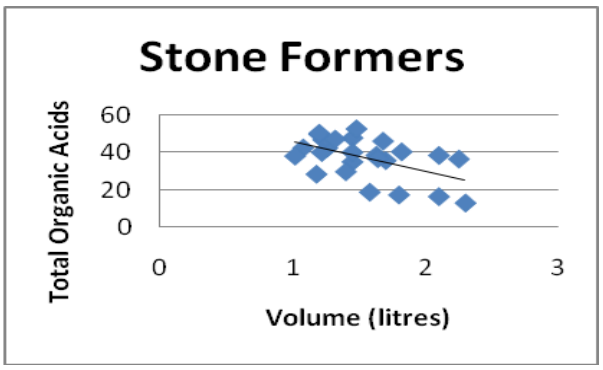

Fig.7: Correlation between Organic acids & Urinary output for Group-I

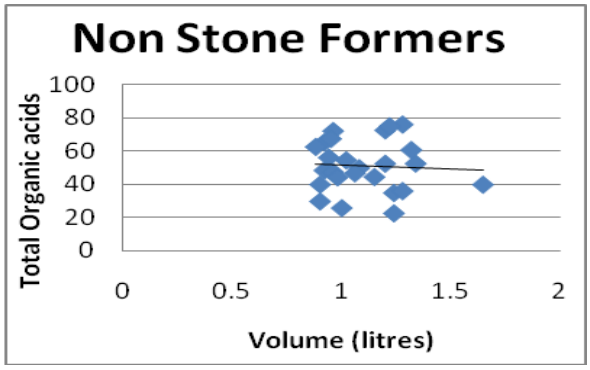

Fig.8: Correlation between Organic acids & Urinary output for Group-II

Table 4: Correlation Table showing correlation coefficients among different properties studied

Variables	Subjects	Correlation coefficient (r)
Organic acids vs urinary output	Stone Formers	- 0.428
Organic acids vs urinary output	Non Stone Formers	- 0.056

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