

A Study Regarding Citrus Juices Effect (lemonade & orange juices only) in Urolithiasis When Compared to Plain Drinking Water

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ABSTRACT

Background: Urolithiasis is a common disorder with the estimated prevalence of up to 15% in lifetime. The recurrence rate without treatment for renal stones is 10% at 1 yr, 35% at 5 yrs and 50% at 10 yrs.

Aim: To determine Citrus juices effect (lemonade & orange juices) in urolithiasis when compared with plain drinking water.

Study Design: Experimental Study-Randomized Controlled Trial

Setting: Outdoor Department of Urology, Nishtar Hospital, Multan

Duration of study: This study was done for a period of three months observation after intervention From 1 December 2013 to 28 February 2014

Sample size: 99 patients were included in our study, each group consisting of 33 patients respectively i.e. (lemonade, orange juice and plain water group) .

Sampling technique: non- probability purpose sampling

Results: In our study 99 patients were divided in three equal groups of 33 patients each. Mean age (\pm S.E.M.) of patients was 39.20 ± 4.53 in total patients included in study while it was 39.27 ± 3.84 in group A, 38.57 ± 4.51 in group B and 39.75 ± 5.20 in group C respectively. Efficacy with respect to (increased urinary PH, increased urinary volume and increased urinary citrate) , decreased urinary crystals and decreased size/absent stone was 69.69% ,69.69% and 63.63% respectively in group A(p-value 0.019)while 60.60%,69.69% and 57.57% in group B(p-value 0.121) respectively while 36.36%,48.48% and 42.42% in group C(p-value 0.204). There was no significant difference regarding efficacy in group B & C while significant difference in group A (p-value 0.019) i.e. lemonade group.

Conclusion: The Citrus juices consumption (lemonade) is superior to orange juice & plain drinking water in reducing urolithiasis .

Keywords: Urolithiasis, ULith, Efficacy, EFF, Urinary volume, UV, citrate levels, CL

INTRODUCTION

Most kidney stones are composed of calcium and oxalic acid, substances present in the urine that can crystallize inside the kidneys. *Odvin* (2006) found that consumption of orange juice is associated with lower calculated calcium oxalate super-saturation and lower calculated un-dissociated uric acid suggesting that orange juice consumption could result in biochemical modification of stone risk factor and prevention of recurrent nephrolithiasis.

There is also evidence that citrate blocks the adhesion of calcium oxalate monohydrate crystals to renal epithelial cells (*Penniston et al., 2007*). However, while there is evidence that fluids in the form of coffee, tea, beer, and wine can decrease risk

of kidney stone development, apple juice and grapefruit juice may have the opposite effect (*Curhan et al., 1996*).

Beverages containing high amounts of citrate can be used to decrease the risk of kidney stone formation. . Up to 85% of all stone patients could anticipate lower risk of stone recurrence with elementary reorientation of their lifestyle and dietary habits. Normalizing the major risk factors is easy and cheap (*Straub & Hautmann, 2005*). Studies focusing on the use of lemonade have shown that drinking several glasses of lemonade per day can significantly reduce the risk of future kidney stones. Variable risk factors were found for different genders including citrus fruit, meat, vegetables food, beverages & dairy product (*Dai et al., 2013*). While cranberry juice has significantly less citrate levels than either lemonade or orange juice, citrate is often used as an additive to enhance the flavor of this juice. Therefore, cranberry juice is an excellent beverage to increase urine volume and urinary citrate levels. There are numerous other beverages available to which citrate is used as an additive. Although the amount of citrate

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in these products is highly variable, the vast majority of these beverages would provide benefit in reducing the risk of kidney stones.

Another study showed that orange juice has greater alkalizing and citraturic effects than lemonade. Consumption of orange juice was associated with lower calculated calcium oxalate super saturation and lower calculated un-dissociated uric acid. This short-term study suggests that orange juice consumption could result in biochemical modification of stone risk factors (Odvina, 2006). Indirect evidence suggests that regular use of cranberry concentrate tablets might also increase risk of kidney stones (Terris et al., 2001). In addition, vitamin D affects calcium levels in the body, and prolonged use of extremely excessive doses of vitamin D has been known to cause kidney stones. Strangely, however, high-calcium foods don't seem to increase the risk of calcium oxalate stones.

MATERIAL AND METHODS

This experimental study-randomized controlled trial was conducted in the OPD of Urology, Nishtar Hospital, Multan from December 2013 to February 2014. Sample technique non probability purposive sampling

Sample size was using formula

$$n = \{z_{1-\alpha/2} \sqrt{[2\bar{P}(1-\bar{P})]} + z_{1-\beta} \sqrt{[P_1(1-P_1) + P_2(1-P_2)]}\}^2 / (P_1 - P_2)^2$$

$P_1 = .30$, $P_2 = .69$ (Odvina, 2006). With level of significance = 5% & power of test = 90%

Sample size would be 33 in each group. (Total sample size 99)

All adult above 20 years old male and female patients with nephrolithiasis and with renal stone less than 1 cm in size were included in study were included in the study

Exclusion criteria

- Patients with renal tubular acidosis, primary hyperparathyroidism, hyperkalemia, Any diseases or medications that potentially could affect acid base status, gouty diathesis, gastrointestinal disease, renal insufficiency, chronic diarrhea,
- Patients with hypercalcemia, calcium phosphate stones with secondary etiology, struvite, and uric acid stones also were excluded
- Patients having urinary tract infection (burning micturation and pus cells on urine analysis) at the time of study.
- Patients with impaired renal function (S. creatinine >1.5)
- Patients using diuretics

- Patients using drugs for stone prevention e.g. potassium citrate, thiazide diuretics
- Pregnant mothers

Data Collection: All patients fulfilling inclusion criteria presenting at urology OPD Nishtar Hospital, Multan were included in the study. Patients were explained about the research protocol, the study was conducted after informed consent. Previous dietary history of different food items was taken (Semi-quantitative Food Frequency Questionnaire attached) from all groups before including into study & frequency and amount of each food item consumed during last three month were measured. All the patients were divided into three groups randomly (two experimental groups i.e. group A & B each consisting of 33 patients) & (one control group C consisting of 33 patients too) by lottery method. Group A was advised to take lemonade juice 85 ml in 1 litres plain water /day while group B was advised to take fresh orange juice (250 ml fresh juice twice times daily) while group C was advised to take plain water 3 litres per 24 hours with normal diet according to food guide for this study (USDA's guide 2011). All the patients had abdominal Ultrasound before taking lemonade juice, orange juice & plain drinking water. All three groups were followed after 3 month period with repeated abdominal ultrasound. The efficacy was determined by either absence or decreased in renal stone size & was documented in attached proforma. All the patients had their urine complete (urinary PH, urinary crystals, urinary volume & urinary citrate levels) at least 24 hours before taking lemonade juice & orange juice & plain drinking water. Then patients were followed after 3 month for urinary chemical examination for urinary crystals, PH, volume, citrate levels (24 hour). Decreased urinary crystals or increased urinary citrate/volume/PH was considered efficacious. All data was collected in attached proforma.

Data Analysis: All the collected data was entered into SPSS version 16 analysis. Frequency and amount of each food item consumed during last three month were measured. Mean and standard deviation were computed for quantitative variables like age. Frequency and percentage was computed for gender & efficacy (Increased PH, Urinary volume, urinary citrate levels & decreased urinary crystals, no of patients with absent or decreased stone size) for each group. Effect modifier like age & sex were controlled by stratification. Comparison of the each group was made by Chi-Square test to see the effect of these on outcome variable. $P < 0.05$ was considered significant.

RESULTS

Among fruits, citric acid is most concentrated in lemons and limes (Pak, 1994) comprising as much as 8% of the dry fruit weight. Up to 85% of all stone patients could anticipate lower risk of stone recurrence with elementary reorientation of their lifestyle and dietary habits. Normalizing the major risk factors is easy and cheap (Straub & Hautmann, 2005). In present study, there were 99 patients divided in three equal groups of 33 patients each. Mean age (\pm S.E.M.) of patients was 39.20 ± 4.53 in total patients included in our study while it was 39.27 ± 3.84 in group A, (lemonade group) 38.57 ± 4.51 in group B (orange group) and 39.75 ± 5.20 in group C (plain water group) respectively.

There were 25(25.25%) , 23(23.23%) and 23 (23.23%) patients in group A ,group B and group C respectively between the age of 30–40 years and 8(8.08%) , 10(10.10%) and 10 (10.10%) patients between 41–50 years in group A , group B and group C respectively (Table 1).

The males were 22 (22.22%), 26 (26.26%) and 23 (23.23%) while females were 11(11.11%), 7(7.07%) and 10(10.10%) in group A, group B and group C respectively (Table 2). There were 23(69.69%) , 20(60.60%) and 12 (36.36%)patients having increased urinary PH, Increased urinary Volume and increased urinary Citrate levels after three month intervention in group A ,group B and group C respectively (Table 3.) Before intervention, average urinary citrate levels were 260mg/day in our study reaching 320mg/day after intervention with citrus juices (lemonade and orange juices). Average PH was 5.6 before intervention and increased to 7.2 after intervention. On average Urinary volume increased from 1.5 litre/day to 2.7 litres/day before and after intervention respectively.

There were 10(30.30%), 10(30.30%) and 17(51.51%)patients who showed urinary Crystals levels in urine analysis even after three month intervention in group A, group B and group C respectively (Table 4).

Table 1: Age distribution of the patients

Age (Yrs)	Group A	Group B	Group C
30-40	25(25.25%)	23(23.23%)	23(23.23%)
41-50	8(8.08%)	10(10.10%)	10(10.10%)

Mean \pm S.E.M. of patients in Group A= 39.27 ± 3.84
 Mean \pm S.E.M. of patients in Group B= 38.57 ± 4.51
 Mean \pm S.E.M. of patients in Group C= 39.75 ± 5.20

Table 2: Gender distribution of the patients

Gender	Group A	Group B	Group C
Male	22(22.22%)	26(26.26%)	23(23.23%)
Female	11(11.11%)	7(7.07%)	10(10.10%)

Table 3: Frequency of increased urinary PH, Volume, Citrate levels after 3 month of intervention

Urinary PH, Volume, Citrate levels	Group A	Group B	Group C
Increased Levels	23 (69.69%)	20 (60.60%)	12 (36.36%)
NOT increased	10 (30.31%)	13 (39.40%)	21 (63.64%)

Table 4: Frequency of urinary Crystals After 3 month of intervention

Urinary Crystals levels	Group A	Group B	Group C
Urinary crystals present	10 (30.30%)	10 (30.30%)	17 (51.51%)
No urinary Crystals	23 (69.70%)	23 (69.70%)	16(48.49%)

DISCUSSION

Countries in the Afro-Asian stone belt falling within the tropical and subtropical regions have consistently reported a high incidence of urolithiasis (Rizvi et al., 2002). The recurrence rate without treatment for calcium oxalate renal stones is 10% at 1 year, 35% at 5 years and 50% at 10 years (Uribarri et al.,1989). Several studies indicate that urinary stone disease has a high prevalence in our country. But unfortunately the epidemiology of urolithiasis remains poorly investigated in the region. Prevalence rates are mostly based on hospital admissions. The etiology of stone formation in a given population is reflected in the composition of calculi, metabolic studies, and dietary habits (Rizvi et al., 2002).

There are various extrinsic and intrinsic factors for renal stones in the different population groups in different provinces of Pakistani population. More than half the people live in rural areas and the climate is moderate to hot(UNDP, 1997). Poor nutritional status and inadequate health facilities are common in the region. However, there are few published studies objectively comparing the risk factors for urinary stone disease and its recurrence in local population. The most common type of urinary stone in our local population is calcium oxalate (60-65%), confirming that the composition of urinary stones in Sind, lower Punjab and Balochistan is inconsistent with international findings.

Metabolic studies from the region show that the major risk factors are low urinary volume (20-30%), hyperuricosuria (20-60%), hyperoxaluria (50-60%), hypomagnesuria (20- 30%) and hypocitraturia (30-40%).¹ These results suggest that dietary and environmental factors are more important in this region, as oxalate-rich and calcium-poor diets prevail with low intake of proteins. Furthermore, chronic diarrhea and malabsorption in the tropics could be a

major causative factor for hyperoxaluria (Haghighi & Wolf, 1997). Despite advances in treatment methods, urinary stone disease remains a major source of morbidity. The understanding of pathophysiology of stone disease remains limited and stone recurrence continues to be a significant clinical problem. The rates of stone recurrence are reportedly 22.6-51% at a mean follow-up of 2-7.1 years (Laminski et al., 1990).

Our present study demonstrated the effect of lemonade juice, orange juice and plain water in stone prevention as well as its therapeutic effect over a period of 3 month in patients with renal stones less than 1cm in size. The efficacy of each juice was judged by absence or decrease in kidney stone size on Ultrasound Abdomen after period of three month follow up along with urinary chemical examination for urinary PH, urinary crystals, urinary volume & urinary citrate levels (24 hour). Absence/decreased stone size or decreased urinary crystals or increased urinary citrate/volume/PH was considered efficacious. The patients were placed on almost similar diet according to MY plate food plan 2011.

Efficacy with respect to (increased urinary PH, increased urinary volume and increased urinary citrate) , decreased urinary crystals and decreased size/absent stone was 69.69% ,69.69% and 63.63% respectively in group A (p-value 0.019) while 60.60%, 69.69% and 57.57% in group B (p-value 0.121) respectively while 36.36%,48.48% and 42.42% in group C (p-value 0.204). There was no significant difference regarding efficacy between the groups. These results showed that lemonade juice has superior to orange juice and plain water in prevention as well as regression of small stone(less than 1cm in size).

The study done by Wabner and Pak showed that orange juice significantly increased urinary citrate levels and PH which is similar to results in our study.

Seltzer et al, studied the effect of lemonade juice on urinary parameters. He demonstrated increased urinary citrate levels but unchanged urinary oxalates & uric acid levels. PH was not studied in his study. His results are quite similar to our results.

CONCLUSION

The Citrus juices consumption (lemonade) is superior to orange juice & plain drinking water in reducing urolithiasis. The dietary use of red meat, soda water and green vegetables is associated with

increased risk of kidneys stones formations. The citrus juices addition to normal daily diet with abstinence from above diet and plenty use of plain drinking water can dramatically be prophylaxis against renal stones formation as well as can eradicate small stones up to 1 cm in size.

RECOMMENDATION

There should be health education to promote health strategy regarding benefits of citrus fruits in prevention of kidney stones. Promotion through nutrition programmes will only be possible through research in community health programmes.

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