Comparison of individuals consuming natural spring water and tap water in terms of urinary tract stone disease

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DISCUSSION

Several studies have proved that urine becomes diluted with increased fluid intake, and that stone formation is thus obviated by preventing the supersaturation and crystallization of urinary components (5-7). One prospective randomized study investigating the effect of fluid intake on stone recurrence a recurrence of 12% was reported in patients treated for
calcium-oxalate (Ca-Ox) stone and advised to consume high levels of fluids, and of 27% in the group that was given no advice (5). *Pak et al.* reported that increasing fluid intake reduced calcium-oxalate, calcium-phosphate and monosodium urate saturation and reduced the risk of stone formation by raising the Ca-Ox crystallization threshold (16). In another study, Tiselius reported that urine calcium, magnesium, oxalate and citrate levels and urinary volume were factors affecting stone formation and proposed a formula by which Ca-Ox crystallization could be predicted using these parameters (Figure 1) (17).
Although increasing fluid intake is very important in terms of preventing stone recurrence, it may be difficult for patients to follow this advice. In a study of 2877 patients with stone, *Parks et al.* observed that despite plentiful hydration was advised, patients were only able to increase their daily urine output by 0.3 L (7). *Strauss et al.* assessed the factors that might be capable of predicting recurrence of stone disease and identified failure to increase fluid intake as the most important cause of relapse (18). In addition to increasing fluid intake, spreading consumption throughout the day in a circadian manner and drinking water after sport and eating when urine is more saturated are also important items in preventing stone formation (19).
Several studies have investigated the effect of the hardness of water consumed on the risk of stone formation (12-14, 20). The degree of hardness of water depends mainly on the dissolved calcium (Ca) and magnesium (Mg) salts contained in it, and reflects the water's ability to dissolve soap. *Shuster et al.* investigated the relation between water hardness and urinary stone disease. They compared the hardness of the water consumed by patients hospitalized for stone disease with that consumed by a control group with no stone disease and reported no difference between them (12). In another study, *Schwartz et al.* showed that Ca, Mg and citrate levels increased in 24-h urine measurements after consumption of hard water, but that there was no change in urine oxalate, uric acid, pH and volume levels.(20) However, those authors also stated that although hard water consumption affects urinary parameters, it has little effect on clinical outcomes. In addition, *Coen et al.* reported that consumption of carbonated water prevented stone formation by increasing urine citrate levels, and that the consumption of water with a high Ca content and a low intake of water lead to stone formation (21).
Several researchers have investigated the hypothesis that consumption of orange juice and lemonade can prevent stone formation by increasing urine citrate levels and also urine volume (8-11). *Aras et al.* compared the results of lemon juice and potassium citrate therapy in patients with a history of urolithiasis and with hypocitraturia (8). They concluded that the consumption of 85 cc lemon juice a day might be a good alternative to potassium citrate therapy in patients with Ca-Ox stone and hypocitraturia. *Penniston et al.* determined that lemonade had positive effects on urinary citrate levels and urine volume, but that combined use of lemonade and potassium citrate was more effective than lemonade alone (10). In their prospective cross-over study, *Koff et al.* reported that lemonade did not improve urinary citrate and pH levels, but that it might assist potassium citrate therapy by increasing urinary output (9).
Although various studies have investigated the association between fluid consumption and stone formation, to date no scientific studies have been performed on the widespread popular belief that consumption of chlorinated tap water leads to stone disease. In this study we therefore investigated whether there is any association between consumption of tap or natural spring water and

No conflict of interest declared.

Table 1.
Patient demographics.

Variable	Groups Group I	Group II	P value
No. patients (%)	259 (47%)	254 (46%)	
Mean age (years) (range)	52.2 (18-88)	48.6 (18-86)	0.75
Gender (%)			0.274
· Male	49%	45%	
· Female	44%	47%	
Profession (%)			0.397
· Student	10 (3.9%)	13 (5.1%)	
· Housewife	86 (33.2%)	90 (35.4%)	
· Retired/unemployed	89 (34.4%)	71 (28%)	
· Officer	26 (10%)	31 (12.2%)	
· Worker	41 (15.8%)	42 (16.5%)	
· Tradesman	7 (2.7%)	7 (2.8%)	
Mean body mass index (kg/m^2)	25.7	26.2	0.580
· Underweight (< 18.5)	3 (1.1%)	2 (0.8%)	
· Normal weight (18.5-24.9)	96 (37.5%)	86 (33.8%)	
· Overweight (25-29.9)	120 (46.8%)	120 (47.2%)	
· Obesity (30-34.9)	39 (15.2%)	41 (16%)	
· Severely obese (≥ 35)	1 (0.4%)	5 (2%)	
Diabetes mellitus (%)	17%	12%	0.083
Hypertension (%)	22%	16%	0.085

** Statistically significant at p < 0.05.*

Table 2.
Factors potentially associated with urolithiasis.

	Urolithiasis Yes	No	P value
No. patients (%)	137 (26.7%)	376 (73.3%)	
Mean age (range)	52.2 (18-88) yr	48.6 (18-86) yr	0.076
Gender (%)			< 0.001*
· Male	96 (33.5%)	190 (66.5%)	
· Female	41 (18%)	186 (82%)	
Mean body mass index (kg/m^2)	27.2	25.5	0.001*
Groups			
· Group I (Tap Water)	70 (27.1%)	189 (72.9%)	
· Group II (Spring Water)	67 (26.3%)	187 (73.7%)	
Hypertension (%)	42 (30.6%)	58 (15.4%)	< 0.001*

** Statistically significant at p < 0.05.*

urolithiasis in patients receiving US due to abdominal or flank pain. Although we showed that male gender, presence of HT and high BMI affect the risk of stone formation, no difference was determined in terms of presence of stone among patients consuming tap versus natural spring water.

The main limitation of this study was that no metabolic investigation was performed in patients' 24-h urine and that the electrolyte and mineral levels of the waters used were not measured. Nevertheless, this was an ultrasound screening study involving a large number of assessed patients and was the first study on this subject. However, we think that further studies with wider case series examining water and urine specimens are needed in order to more clearly elucidate the relation between tap and spring water consumption and risk of stone formation.

Supplementary references

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