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The effect of an acute water load on water and electrolyte excretion of renal stone formers

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INTRODUCTION

Urinary volume is a well known risk factor for renal stones. On the contrary the effect of mineral composition of drinking water on risk for stone formation is still questionable.
The present study was undertaken to investigate changes in urine flow rate and electrolytes excretion after administration of waters with different mineral content.

METHODS

A group of six patients with renal calcium stones and four controls voluntereed to take part in this study.
A water load (20 ml/kg body weight over 15-20 min) was administered in the fasting state at 9 A.M.
A blood specimen was drawn before the water load. Urine specimens were collected before (for 60 min) and after the water load (after 60, 120 and 240 min) for determination of creatinine, urea, sodium, potassium, calcium, magnesium, oxalate, phosphate, urate, citrate and pH.
Before and 1 hour after the water load heart rate, blood pressure, cardiac output and extracellular volume were evaluated. Cardiac output and extracellular volume were estimated by an impedenziometric method.
Each subject underwent two water loads with waters with different mineral content (Rocchetta and control).
Rocchetta water content is showed in tab.I.
The calcium content of control water consists of 4 mg/l.

Tab.I - Rocchetta water content

Calcium	57 mg/l	Bicarbonate	180 mg/l
Magnesium	3.7 mg/l	Sulphate	8.5 mg/l
Sodium	4.6 mg/l	Chloride	7.7 mg/l
Potassium	0.4 mg/l	Fluoride	0.14 mg/l

RESULTS

The variations of urinary volume and electrolytes after water load are summarized in table II.
No significant variations of heart rate, blood pressure and estimated cardiac output and extracellular volume (TFI) were observed after water load.

DISCUSSION

After an acute load of water containing little solute, the water is quickly absorbed into the blood from the gastrointestinal tract. The water passes by osmosis into both the extracellular and intracellular water compartments, reducing the osmotic concentration of both compartments to the same level. Since cells contain about 72% of total body water and of the osmotically active solute, about 72% of the water absorbed in the gastrointestinal tract will enter the intracellular space and 28% will remain in the extracellular compartment.

Therefore only a relatively small fraction of the water absorbed remains in the extracellular space. For this reason the increase of the extracellular space after ingestion of 1.5 l of water is not large enough to alter the blood pressure or the colloid osmotic pressure of the plasma, nor to trigger any of the reflex mechanisms controlling the extracellular volume and GFR. On the other hand the drop in the osmotic concentration of the body water is large enough to trigger the osmoreceptors in the hypothalamus causing them to inhibit ADH release. Within 15 to 20 minutes a drop in ADH plasma concentration is observed owing to the continuous metabolism and excretion of circulating ADH. He lack of ADH causes the collecting tubular epithelium to lose its permeability to water, water reabsorption is reduced and urine flow increases with a peak in 60 to 90 minutes. As water is excreted, the osmotic contcentration of the extracellular fluid begins to increase and water leaves the body cells. ADH secretion begins again and in 120 to 150 minutes the urine flow returns to normal value. After 2 hours almost all the ingested water has been excreted.

On the other hand there is little increase in solute excretion. In fact ADH does not affect proximal tubular reabsorption, so solute reabsorption continues and solute-free water is cleared from the extracellular fluid (water diuresis). The marked increase of urea excretion is explained by the fact that the rate of reabsorption of urea by passive diffusion along the renal tubule is highly dependent on the rate of urine flow. On the contrary calcium and magnesium excretion are not influenced by the increased urinary flow.

In this study the increase of diuresis induced by Rocchetta mineral water appeared to be greater than that induced by control water. The increase of urea excretion was higher for Rocchetta water than for control water whereas the increase of calcium and magnesium excretion was not different although the higher calcium content of Rocchetta water.

Owing to its mineral composition Rocchetta water is well absorbed from the gastrointestinal tract and diffused in the intracellular space, so increasing water and urea excretion.

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Tab II - Increase of urinary volume and electrolytes after water load (Rocchetta water = R, control water = C)

	Water	Basal	1h	2h	4h
Volume	R	1	x 5.46	x 9.70	x 2.93
(ml/h)	C	1	x 4.38	x 7.16	x 2.75
Potassium	R	1	x 2.59	x 1.66	x 1.11
(mEq/h)	C	1	x 2.27	x 1.45	x 1.06
Sodium	R	1	x 1.80	x 1.07	x 0.68
(mEq/h)	C	1	x 1.61	x 0.72	x 0.46
Calcium	R	1	x 1.32	x 0.73	x 0.52
(mg/h)	C	1	x 1.52	x 0.53	x 0.28
Magnesium	R	1	x 1.40	x 0.85	x 0.65
(mg/h)	C	1	x 1.50	x 0.60	x 0.42
Oxalate	R	1	x 2.63	x 1.91	x 1.01
(mg/h)	C	1	x 2.40	x 1.52	x 1.14
Citrate	R	1	x 1.74	x 1.09	x 0.77
(mg/h)	C	1	x 2.00	x 1.23	x 0.81
Urate	R	1	x 1.89	x 1.03	x 0.70
(mg/h)	C	1	x 1.82	x 0.79	x 0.67
Urea	R	1	x 2.07	x 1.31	x 0.94
(mg/h)	C	1	x 1.88	x 1.02	x 0.87
Creat	R	1	x 1.80	x 1.16	x 0.87
(mg/h)	C	1	x 1.62	x 0.90	x 0.87