Asian Pac. J. Health Sci., 2014; 1(4): 496-499 e-ISSN: 2349-0659, p-ISSN: 2350-0964

Acute effect of excess water intake on blood pressure in healthy Individuals

Buchineni Madhavulu[1*], Pathapati Rama Mohan[1], Devaraju SreebhushanRaju[2]

[1]Department of Pharmacology, Narayana Medical College Hospital, Nellore, India
[2]Department of Nephrology, Nizams Institute of Medical sciences, Hyderabad A.P, India

ABSTRACT

Background: It is a common habit in our country to drink excess water presuming that it keeps the kidney clean. The effect of excess water intake on hypertension is poorly known and there is some conflicting data in this regard. Thus we aimed to study the effect of excess water intake in short time on the blood pressure of healthy adult individuals.
Materials and Methods: We conducted an open labeled, randomized, cross over trial with 12 healthy volunteers without any clinically significant disease. Each individual was asked to drink 2000ml of water over a period of 20 minutes after overnight fasting or observed without water intake according to a pre-randomized schedule after a washout period of 3 days.
Results: In healthy adults (mean age 29.2±3.5yrs) after an intake of 2000ml over a period of 16.5±2.6min, there was a significant increase in systolic BP of 113.6±6.2 mmHg at 0 hrs to 127.7±9.6 mmHg at 15 min ($p<0.001$) and 120.7±5.5 mm Hg at 75 min ($p<0.05$). The diastolic BP also increased from 73.6±6.2 mmHg to 85.9±7.4 mmHg at 30 min ($p< 0.01$). There was no significant change in BP during no water intake phase.
Conclusion: Excess water intake increases blood pressure in healthy individuals. The underlying mechanism and the long term effect of excess water intake need to be explored.

Key words: Acute water intake, Blood pressure Melondialdehyde, Osmolality, Hypertension.

Introduction

In general, it is a common cultural impression to drink excess water with the presumption that it keeps the body and kidneys clean. However, the long-term effect of excess water intake on kidney is unknown. It is difficult to answer whether excess water intake is beneficial or harmful to the kidney.Acute water intake was found to increase the blood pressure in patients with orthostatic hypotension due to autonomic failure [1]. This was suspected to be due to water pressor effect. Water drinking elicits a pressor response even if the direct connection between brain stem cardiovascular centers and spinal sympathetic neurons is interrupted.

**Correspondence*
Dr B Madhavulu*
Senior Assocate Professor
Dept. of Pharmacology & Therapeutics
Narayana Medical College & Hospital
Nellore, Pincode: 524 002 (A.P), India
Email: madhavulu@gmail.com

Water drinking activates postganglionic sympathetic neurons either directly or through a spinal reflex mechanism [2].
In patients with renal failure, excessive intake of water is known to increase the blood pressure, which is volume dependent. The effect of acute water intake on blood pressure in healthy group of individuals is not clear. On the contrary, water deprivation was found to be associated with decrease in blood pressure in people with diabetes insipidus [3].
We tested the hypothesis that acute water loading in normal individuals has a pressor effect with increase in blood pressure and hence we intend to study the effect of acute excess water intake on the blood pressure of normal healthy volunteers.

Methods

This open labeled, randomized, controlled, cross over study with 24 healthy adult male volunteers was conducted at Nizams institute of medical sciences,

Hyderabad, India. The study protocol was approved by the Institutional ethical committee. Informed consent was obtained from study participants.

Healthy male volunteers, (subjects having normal clinical, laboratory and ECGs profiles) in the age group of 18-45 years, weighing at least 50kg, who are within 15% of their ideal weights (Table of "Desirable Weights of Adults", Metropolitan Life Insurance Company, 1983) and willing to give consent to participate in the study were included. Exclusion criteria includes subjects with hypertension, diabetes, history of glaucoma, abnormal sodium levels in the blood (i.e. hypo or hypernatremia), abnormal drinking behaviors like adypsia and polydipsia, past history of seizure disorder, stone disease, bladder disturbances, gastro intestinal disturbances, head injury, neurosurgical interventions, On drugs that interfere with water and sodium reabsorption by the kidney e.g. non steroidal anti inflammatory drugs etc, HIV and HbsAg, All the subjects who satisfied the criteria were housed in the ward on the night prior to the study. On the Study day, each individual was asked to drink 2000ml of water over a period of 20 minutes after overnight fasting or observed without water intake according to a pre-randomized schedule after a washout period of 3 days. Biochemical parameters were measured before and at the end of study. Blood pressures and heart rate were measured before and at every 15 min intervals till 120min. The water used in the study was same during the entire study period. The laboratory tests were hematologic (hemoglobin, total and differential count and Platelet count), serum chemistry for hepatic and renal functions (blood urea nitrogen (BUN), serum creatinine, total bilirubin, tlkaline phosphatase, AST, ALT, sodium, potassium, chloride, calcium and osmolality) and urine analysis (pH, specific gravity, protein, glucose, ketones, bilirubin, urobilinogen, Sodium and Osmolality).Adverse events during the study were noted. After three days of wash out period, all subjects were observed in the similar fashion without water. All the biochemical parameters were also repeated in the similar way.

Statistical analysis

All the data was entered in Microsoft excel spread sheet. Statistical analysis was done by using Graphpad Prism, version-4 USA. Data was described as arithmetic means and standard deviation and "paired test" was applied for any statistical difference. A two tailed p valve of less than 0.05 was considered statistically significant.

Results

Twenty male adults with a mean age of 29.3 $\pm$ 3.5 years, mean weight of (Basal) 61.8 $\pm$ 8.3 kgs and with a mean height of 164.8 $\pm$ 5.9 cms were studied. The average time taken to drink 2L of water was 16.8 $\pm$ 2.6 min. In healthy adults (mean age 29.2±3.5yrs) after an intake of 2L over a period of 16.5±2.6min, there was a significant increase in systolic BP of 113.6±6.2 mmHg at 0 hrs to 127.7±9.6 mmHg at 15 min ($p<0.001$) and 120.7±5.5 mm Hg at 75 min ($p<0.05$). The diastolic BP also increased from 73.6±6.2 mmHg to 85.9±7.4 mmHg at 30 min ($p< 0.01$). There was no significant change in BP during no water intake phase. (Table-2, Fig-1)There was no significant difference in blood sugar, BUN, creatinine, sodium, potassium, calcium, chloride, serum osmolality, MDA levels except urine osmolality which has decreased during water drinking stage of the study (from 335.3+117.6 to 241.4+76.5 mosm/lit; $p<0.01$). (Table-1, Fig-2)

Discussion

Recent studies suggest that water drinking elicits acute changes in human physiology. Water drinking profoundly increases blood pressure in patients with autonomic failure and also increases blood pressure in quadriplegic patients [1], cardiac transplant recipients, and older healthy subjects (4), but to a lesser extent. Blood pressure does not change in healthy young subjects.

Our study showed that the loading with 2L of water is associated with increase in systolic, diastolic as well as mean arterial blood pressures. Rylander *et al* (5) studied effect of magnesium addition in mineral water on blood pressure of healthy individuals. However this study was for a 4 week period and was also not with water loading. In our study we have used the same potable water supplied to the entire city which the sodium and potassium contents were measured.

The sodium level was 10 mg /l in the water which was less than the advocated 20 mg/l. Hence sodium content of drinking water did not contribute to the rise in BP during water loading. There are some conflicting reports of hard water intake associated with excess cardiovascular mortality. However effect on BP was not clearly understood.

Water drinking was shown to increase energy expenditure. Jordan J et al [6] and that the acute changes in cardiovascular regulation and in energy expenditure with water drinking and felt it to be mediated through activation of the sympathetic nervous system. The sympathetic activation may involve a

spinal reflex-like mechanism. The stimulus that causes the sympathetic activation is not known. The acute water pressure response can be exploited in the treatment of patients with impaired orthostatic tolerance caused by autonomic failure, postural tachycardia syndrome, or, perhaps, neurocardiogenic (vasovagal) syncope. The increase in energy expenditure with water drinking should be recognized as an important confounding variable in metabolic studies and may hold some promise as an adjunctive measure in the prevention or treatment of obesity.

We studied the oxidative stress during water loading which we found was not significantly altered. However large number of patients may be required to evaluate this observation. Our study did not evaluate the role of sympathetic activity in the healthy and also did not evaluate the effect of excess water intake in long run. Hence further studies are required to evaluate the effect of excess water intake during a prolonged period and also the effect of sympathetic stimulation during the excess water intake.

Table1: Biochemical parameters

Parameters	Without Water		With Water	
	Basal	120 Minutes	Basal	120 Minutes
Random blood Sugar (mg/dL)	81.82±9.71	77.24±4.74	79.78±6.92	77.30±4.78
Blood urea (mg/dL)	26.12±4.61	23.18±3.40	24.78±3.89	25.25±3.77
Serum Creatinine (mg/dL)	0.95±0.16	0.85±0.15	0.84±0.10	0.89±0.14
Serum sodium (mEq/L)	136.53±6.02	138.94±8.69	136.56±8.11	132.20±12.98
Serum Potassium (mEq/L)	4.39±0.42	4.35±0.46	4.27±0.35	4.51±0.44
Serum Chloride(mEq/L)	93.24±5.15	95.41±4.36	95.72±3.61	91.35±5.54
Serum Calcium (mEq/L)	8.58±0.70	8.89±1.12	8.88±0.64	8.87±0.82
Serum Osmolality (mOsm/L)	309.06±12.98	311.48±18.19	308.04±16.55	298.56±25.34
Urine Osmolality (mOsm/L)	335.54±71.85	335.31±115.38	356.81±117.59	241.36±76.53*
Serum Malondialdehyde (nMol/L)	13.41±3.30	13.71±3.43	13.75±3.00	15.06±3.90
*** p < 0.05**				

Table 2: Blood pressures with and without water intake

Time (min)	With Water		Without Water	
	SBP	DBP	SBP	DBP
0	113.6 ± 6.1	73.3 ± 6.2	114.6 ± 8.2	72.6 ± 6.1
15	127.8 ± 9.6 *	85.7 ± 9.3*	111.7 ± 8.3	71.2 ± 7.9
30	126.4 ± 9.2*	85.9 ± 7.4 *	114.2 ± 9.6	72.0 ± 8.1
45	124.4 ± 8.9*	84.9 ± 7.2*	112.0 ± 7.4	72.6 ± 6.9
60	121.4 ± 6.9 *	82.6 ± 6.4*	113.7 ± 6.7	73.4 ± 7.7
75	120.7 ± 5.6*	81.1 ± 6.0*	113.5 ± 6.0	74.5 ± 7.9
90	116.8 ± 6.1$	77.0 ± 6.5	114.6 ± 5.9	74.7 ± 7.5
105	117.2 ± 6.2	77.4 ± 6.2	116.5 ± 7.1	76.0 ± 7.7
120	118.4 ± 8.4	76.6 ± 5.9	115.4 ± 6.9	76.3 ± 7.9
*** = p < 0.001 ; $ = p < 0.05**				

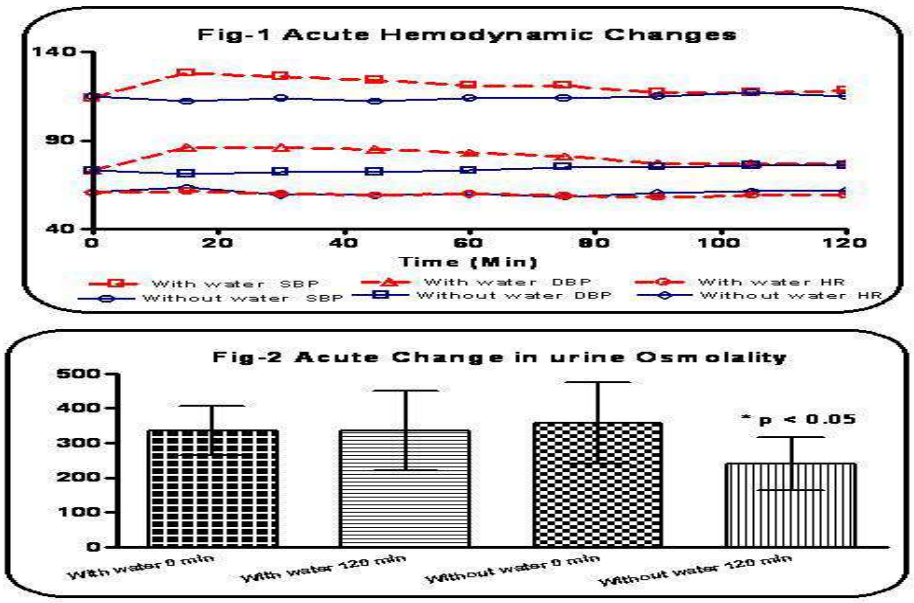

Fig 1: Acute hemodynamic changes during the study &
Fig2: Acute changes in Urine Osmolality during the study

Conclusion

Acute excess water loading significantly elevates systolic and diastolic blood pressures in healthy individuals. The significant increase was noted within 15 minutes of water intake and lasted up to 90 minutes. There was no significant alteration in heart rate. Except for a decrease in urine osmolality, there was no significant change in any other biochemical parameters. Water, should, thus, be recognized as an active substance rather than a placebo, at least where blood pressure is concerned. The pathogenesis and the long-term effect of excess water intake in hypertensive individuals need to be explored.

Acknowledgment

We are extremely thankful to Dr. T Ramesh Kumar Rao, Clinical Pharmacologist Without him the work would have not completed.

References

1. Shannon JR, Diedrich A, Biaggioni I, Tank J, Robertson RM, Robertson D, Jordan J. Water drinking as a treatment for orthostatic syndromes. Am J Med. 2002 1; 112(5): 355-60.
2. Jens Tank; Christoph Schroeder; Mandy Stoffels; André Diedrich; Arya M. Sharma;Friedrich C. Luft; Jens Jordan. Pressor Effect of Water Drinking in Tetraplegic Patients May Be a Spinal Reflex. Hypertension. 2003; 41(6):1234-9.
3. Water intake and 24-hour blood pressure monitoring in a patient with nephrogenic diabetes insipidus caused by a novel mutation of the vasopressin V2R gene.Owada M, Kawamura M, Kimura Y, Fujiwara T, Uchida S, Sasaki S, Hiramori K. Intern Med. 2002; 41(2): 119-23.
4. Haemodynamics of the pressor effect of oral water in human sympathetic denervation due to autonomic failure. Cariga P, Mathias CJ. Clin Sci (Lond). 2001; 101(3): 313-9.
5. Mineral water intake reduces blood pressure among subjects with low urinary magnesium and calcium levels. Rylander R, Arnaud MJ. BMC Public Health. 2004 30; 4(1): 6.
6. Effect of water drinking on sympathetic nervous activity and blood pressure. Jordan J. Curr Hypertens Rep. 2005; 7(1): 17-20.

Source of Support: NIL
Conflict of Interest: None