ORIGINAL ARTICLE

URINARY ELECTROLYTES IN NON-OBESE, NON-DIABETIC PATIENTS OF ESSENTIAL HYPERTENSION IN RELATION TO AGE AND SEX

Zafar Hussain Tanveer, Sajida Zafar*, Ali Abuzar Raza, Muhammad Naeem*****

Department of Physiology, Sheikh Zayed Medical College, Rahim Yar Khan, *Nishtar Medical University, **Pathology, Nishtar Medical University, ***Institute of Pure & Applied Biology, Bahauddin Zakaria University, Multan, Pakistan

Background: Urinary electrolytes have been under investigation as important parameters for diagnosis of essential hypertension. This study was conducted to determine the urinary electrolytes in non-obese, non-diabetic patients of essential hypertension in relation to age and sex. **Methods:** Five hundred age and sex matched subjects aged 10–60 years having essential hypertension were selected on standard cross-sectional design excluding secondary hypertensives. 24-hours urinary electrolytes of the subjects were compared to those in normotensives. Urinary electrolytes in women were compared to age matched hypertensive men. **Results:** Significantly higher values of electrolytes were found in essential hypertensives compared to normotensives. The electrolytes were significantly higher in men compared to age matched women. **Conclusion:** Increased 24-hour urinary electrolytes indicate that sodium and potassium are contributing factors in pathogenesis of cardiovascular diseases including essential hypertension.

Keywords: Electrolytes, Hypertension, Essential hypertension, Normotensive, Sodium, Potassium

Pak J Physiol 2019;15(3):16−8

INTRODUCTION

The relationship of arterial pressure and sodium consumption has been under investigation for long.[1] Till today no set explanation is given for salt effect owing to vide fluctuations in trials pertaining to specific methods, time period, quantities of sodium consumption and arterial pressure variations.[2–4]

Evidence from many clinical trials shows that decreasing salt consumption gives rise to moderate decrease in arterial pressure in normal and high pressure subjects[5–7] and also low liability of cardiac and vascular events.[8–10]

Jan and colleagues found higher sodium loss, raised molar proportion, and statistically elevated BMI in hypertensives in contrast to normotensives; and decreased potassium loss in hypertensive cases in a study conducted in Kashmir.[11] Cheung and co-workers carried out a research project with hypothesis of a relation between diastolic blood pressure and 24-hour sodium loss. In their subjects, diastolic blood pressure correlated significantly with round-the-clock sodium loss (r=0.41, p<0.001).[12]

Coruzzi *et al* undertook a study to assess the effect of potassium depletion on blood pressure. They found that potassium depletion elevates essential hypertension. That study also suggested that sodium restriction and calcium and potassium supplementation might be especially beneficial in the management of salt sensitive hypertension.[13] The present study was conducted to determine the urinary electrolytes in non-obese, non-diabetic patients of essential hypertension in relation to age and sex in southern Punjab areas of Pakistan.

MATERIAL AND METHODS

This cross-sectional observational study was carried out at Nishtar Hospital Multan and Sheikh Zayed Hospital Rahim Yar Khan from Jan to Dec 2014. The study was conducted on non-obese, non-diabetic population of Southern Punjab, Pakistan. Five hundred age and sex matched cases aged 10–60 years were included in the study. They were further subdivided into subgroups aged <20 years, 21–40 years and 41–60 years. Subjects were known hypertensives for the last one year or more. Secondary hypertensives were excluded from the study.

The 24-hour urinary sodium level of each patient was assessed by taking 24-hour total urinary volume. The undiluted specimen was tested using non-selective electrode technique by haemolytic electrolyte analyzer.[14,15]

RESULTS

Table-1 shows that among 500 (100%) normotensives who had sodium 40–140 mmol/L, 165 (33%) were 10–20 years old, 165 (33%) were 21–40 years old and 170 (34%) were 41–60 years old. The results were statistically significant (p=0.00).

Among 235 (47%) essential hypertensives who had sodium 40–140 mmol/L, 100 (20%) were 10–20 years old, 45 (9%) were 21–40 years old and 90 (18%) were 41–60 years old. Similarly, among 265 (53%) essential hypertensives who had sodium 141–220 mmol/L, 65 (13%) were 10–20 years old, 120 (24%) were 21–40 years old and 80 (16%) were 41–60 years old. The results were statistically significant (p=0.00).

The Table also shows that among 500 (100%) normotensives who had potassium 25–50 mmol/L, 165 (33%) were 10–20 years old, 165 (33%) were 21–40 years old and 170 (34%) were 41–60 years old. The results were statistically significant (p=0.00).

Among 380 (76%) essential hypertensives who had potassium 25–50 mmol/L, 135 (27%) were 10–20 years old, 145 (29%) were 21–40 years old and 100 (20%) were 41–60 years old. Likewise, among 120 (24%) essential hypertensives who had potassium 51–100 mmol/L, 30 (6%) were 10–20 years old, 20 (4%) were 21–40 years old and 70 (14%) were 41–60 years old. The results were statistically significant (p=0.00).

Table-2 demonstrates that among 500 (100%) normotensives who had sodium 40–140 mmol/L, 250 (50%) were males and 250 (50%) were females. The results were statistically significant (p=0.00).

Among 235 (47%) essential hypertensives who had sodium 40–140 mmol/L, 135 (27%) were male and 100 (20%) were females. Similarly, among 265 (53%) essential hypertensives who had sodium 141–220 mmol/L, 115 (23%) were males and 150 (30%) were females. The results were statistically significant (p=0.00).

The Table also describes that among 500 (100%) normotensives who had potassium 25–50 mmol/L, 250 (50%) were males and 250 (50%) were females. The results were statistically significant (p=0.00).

Among 380 (76%) essential hypertensives who had potassium 25–50 mmol/L, 190 (38%) were males and 190 (38%) were females. Likewise, among 120 (24%) essential hypertensives who had potassium 51–100 mmol/L, 60 (12%) were males and 60 (12%) were females. The results were statistically significant (p=0.00).

Table-1: 24-hour urinary electrolytes in normotensives and essential hypertensives according to age [n (%)]

24-Hour Urinary Electrolytes	Normotensives				Essential Hypertensives			
	10–20 Yrs	21–40 Yrs	41–60 Yrs	Total	10–20 Yrs	21–40 Yrs	41–60 Yrs	Total
Sodium (mmol/L)								
<40	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
40–140	165 (33)	165 (33)	170 (34)	500 (100)	100 (20)	45 (9)	90 (18)	235 (47)
141–220	0 (0)	0 (0)	0 (0)	0 (0)	65 (13)	120 (4)	80 (16)	265 (3)
>220	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	165 (33)	165 (33)	170 (34)	500 (100)	165 (33)	165 (33)	170 (34)	500 (100)
	Chi square=95.80, df=22, p=0.00				Chi square=3.51, df=42, p=0.00			
Potassium (mmol/L)								
<25	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
25–50	165 (33)	165 (33)	170 (34)	500 (100)	135 (27)	145 (29)	100 (20)	380 (76)
51–100	0 (0)	0 (0)	0 (0)	0 (0)	30 (6)	20 (4)	70 (14)	120 (4)
>100	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	165 (33)	165 (33)	170 (34)	500 (100)	165 (33)	165 (33)	170 (34)	500 (100)
	Chi square=84.38, df=24, p=0.00				Chi square=3.71, df=38, p=0.00			

Table-2: 24-hour urinary electrolytes in normotensives and essential hypertensives according to sex [n (%)]

24-Hour Urinary Electrolytes	Normotensives			Essential Hypertensives		
	Male	Female	Total	Male	Female	Total
Sodium (mmol/L)						
<40	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
40–140	250 (50)	250 (50)	500 (100)	135 (27)	100 (20)	235 (47)
141–220	0 (0)	0 (0)	0 (0)	115 (23)	150 (30)	265 (53)
>220	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	250 (50)	250 (50)	500 (100)	250 (50)	250 (50)	500 (100)
	Chi square=58.25, df=11, p=0.00			Chi square=1.05, df=21, p=0.00		
Potassium (mmol/L)						
<25	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
25–50	250 (50)	250 (50)	500 (100)	190 (38)	190 (38)	380 (76)
51–100	0 (0)	0 (0)	0 (0)	60 (12)	60 (12)	120 (24)
>100	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Total	250 (50)	250 (50)	500 (100)	250 (50)	250 (50)	500 (100)
	Chi square=43.31, df=12, p=0.00			Chi square=96.69, df=19, p=0.00		

DISCUSSION

Sodium and potassium play substantial role and help in investigating hypertension among patients. It is worth mentioning here that urinary sodium was found normal among both groups but was higher in essential hypertensives because 100% normotensives and 47% essential hypertensives had sodium range of 40-140 mmol/L, while the remaining proportion (53%) of essential hypertensives had sodium ranging from141–220 mmol/L. The mean value of sodium of normotensives was 126.08 and the mean sodium level of essential hypertensives was 144.68. Another study

conducted by Jan *et al*[11] showed almost comparable results to the present study (mean sodium value of normotensives to be 138.5 mmol/L and mean sodium level of essential hypertensives to be 140.4 mmol/L).

When the association between normotensives and essential hypertension was assessed according to age and 24-hour urinary electrolytes, sodium and potassium were normal in both groups but most of essential hypertensives aged 21–40 years had sodium 141–220 mmol/L and potassium 25–50 mmol/L. The result was found statistical significant.

Association between normotensives and essential hypertension according to diastolic blood pressure and 24-hour urinary electrolytes, showed normal sodium and potassium in both groups, but most of the essential hypertensives with DPB 100–110 mmHg had sodium 141–220 mmol/L and potassium 25–50 mmol/L. The result was found statistically significant.

CONCLUSION

Higher level of 24-hour urinary electrolytes in essential hypertensives indicates that sodium and potassium are contributing factor in pathogenesis of cardiovascular diseases including essential hypertension. Further investigations into possible role of dietary salt content in causation of essential hypertension are suggested.

REFERENCES

1. Nguyen H, Odelola OA, Rangaswami J, Amanullah A. A review of nutritional factors in hypertension management. Int J Hypertens 2013; 2013:698940. doi: 10.1155/2013/698940.
2. Adrogue HJ, Madias NE. Sodium and potassium in the pathogenesis of hypertension, New Engl J Med 2007;56:1966–78.
3. Johnson AG, Nguyen TV, Davis D. Blood pressure is linked to salt intake and modulated by the angiotensinogen gene in normotensive and hypertensive elderly subjects. J Hypertens 2001;19:1053–60.
4. Sacks FM, Svetkey LP, Vollmer WM, Appel LJ, Bray GA, Harsha D, *et al*. Effects of blood pressure of reduced dietary sodium and the Dietary Approaches to Stop Hypertension (DASH) diet. N Engl J Med 2001;344(1):3–10.
5. Kumar NL, Deepthi J, Rao YN, Deedi MK. Study of lipid profile, serum magnesium and blood glucose in hypertension. Biol Med 2010;2:6–16.
6. He FJ, MacGregor GA. Effect of modest salt reduction on blood pressure: a meta-analysis of randomized trials. Implications for public health. J Human Hypertens 2002;16:761–70.
7. Bray GA, Vollmer WM, Sacks FM, Obarzanek E, Svetkey LP, Appel LJ. A further subgroup analysis of the effects of the DASH diet and three dietary sodium levels on blood pressure: Results of the DASH-sodium trial. Am J Cardiol 2004;94:222–7.
8. Tuomilehto J, Jousilahti P, Rastenyte D, Moltchanov V, Tanskanen A, Pietinen P, *et al*. Urinary sodium excretion and cardiovascular mortality in Finland: A prospective study. Lancet 2001;357:848–51.
9. Cook NR, Cutler JA, Obarzanek E, Buring JE, Rexrode KM, Kumanyika SK, *et al*. Long term effects of dietary sodium reduction on cardiovascular disease outcomes: Observational follow-up of the trials of hypertension prevention (TOHP). BMJ 2007;334:885–8.
10. Strazzullo P, D'Elia L, Kandala NB, Cappuccio FP. Salt intake, stroke, and cardiovascular disease: meta-analysis of prospective studies. BMJ 2009;339:b4567.
11. Jan RA, Shah S, Saleem SM, Waheed A, Mufti S, Lone MA, *et al*. Sodium and potassium excretion in normotensive and hypertensive population in Kashmir. J Assoc Physicians India 2006;54:22–6.
12. Cheung BM, Ho SP, Cheung AH, Lau CP. Diastolic blood pressure is related to urinary sodium excretion in hypertensive Chinese patients. QJM 2000;93:163–8.
13. Coruzzi P, Brambilla L, Brambilla V, Gualerzi M, Rossi M, Parati G, *et al*. Potassium depletion and salt sensitivity in essential hypertension. J Clin Endocrinol Metab 2001;86:2857–62.
14. Elliott P, Stamler R. Manual of operations for 'INTERSALT', an international cooperative study on the relation of sodium and potassium to blood pressure. Control Clin Trials 1988;9(2 Suppl):1–117S. PubMed PMID: 3396367.
15. Dyer AR, Elliot P, Shipley M. Urinary electrolyte excretion in 24 hours and blood pressure in the INTERSALT study. II. Estimates of electrolyte blood pressure associations corrected for regression dilution bias. Am J Epidemiol 1994;139:940–51.

Address for Correspondence:

Dr. Zafar Hussain Tanveer, Professor of Physiology and Principal, Sheikh Zayed Medical College, Rahim Yar Khan, Pakistan. **Cell:** +92-300-6305788

Email: zhtanveer@gmail.com

Received: 11 Sep 2018 **Reviewed: 15 Aug 2019** **Accepted: 18 Aug 2019**