Relation of 24-h Ambulatory Blood Pressure With Plasma Potassium in Essential Hypertension

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The established associations between blood pressure (BP) and electrolytes are mostly based on either dietary intake or urinary excretion data. We measured office BP, ambulatory BP (ABP) using the automated oscillometric ABPM-630 device, and plasma electrolytes in 82 essential hypertensive patients to examine the relation between BP and plasma electrolytes. Significant negative correlations were observed between plasma potassium concentration and 24-h systolic BP (r = −0.336) and diastolic BP (r = −0.298) in our patients. Plasma potassium concentration inversely correlated also with both daytime and nighttime systolic and diastolic BPs. There was no relation between office BP and plasma potassium concentration. These findings indicate that in essential hypertensives plasma potassium concentration is inversely related to ABP including daytime and nighttime BPs and suggest that potassium may be a factor determining the whole day BP in essential hypertension.

KEY WORDS: Ambulatory blood pressure monitoring, office blood pressure, sodium, potassium.

The associations between blood pressure (BP) and sodium (Na) and potassium (K) are well established. Modification of Na or K intake offers a potentially effective, nonpharmacologic approach to BP reduction. Epidemiologic studies have demonstrated a positive correlation between Na and BP, and a negative correlation between K and BP. The Na/K ratio is more important than either individual electrolyte alone and Na and K must be considered concomitantly in the investigation of the association of either of these cations with hypertension. Most of the studies used either dietary intake or urinary excretion data to examine the relationships between BP and electrolytes. Few reports have discussed the relationship between BP and plasma electrolytes.

Ambulatory BP (ABP) monitoring has been useful in evaluating BP in an environment that is separate from the stress-filled environment of the physician’s office. ABP monitoring affords an evaluation of BP variability and of its circadian rhythm and gives reliable measure of BP. Several studies have used ABP to examine the relationship between BP and urinary electrolyte excretion. The purpose of the present study is to report our observations on ABP and plasma electrolytes to document their interrelationship.
METHODS

Participants  The study was performed in 82 consecutive hypertensive patients (77 men, 5 women; Table 1) presenting on an outpatient basis. Participants were between the ages of 26 and 59 years (mean, 47 years; Table 1). All hypertensive patients were identified by screening programs and had never been treated. None of the participants had a known history of cardiovascular events, any significant disorder of renal function or liver function, or diabetes mellitus or other metabolic disorders. All participants were on their habitual Na intake during this study.

The diagnosis of hypertension was based on three measurements of BP in the outpatient clinic and measured after 5 min in the seated position. The last measurement was done on the day of ABP monitoring. The average BP levels on three occasions were used as the office BP. The diagnosis of hypertension required that the diastolic readings at all three visits were ≥90 mm Hg.

Procedures  A complete history was taken and physical examination, including fundal evaluation, was performed in each patient to exclude any other concomitant illness or cause of secondary hypertension. Each patient was subjected to 24-h ABP monitoring after the last measurement of office BP. Readings were obtained with the portable automated oscillometric ABPM-630 device (Colin Electronics, Komaki, Japan).11 Readings of BP were obtained each 30 min throughout the 24-h monitoring period. During the monitoring procedure, participants were allowed to follow their routine daily activities. All patients kept a diary to describe their daily activities and were specifically requested to state times of going to sleep and waking. Daytime and nighttime BPs were calculated on the basis of the individual diary.

Fasting blood samples were obtained on the day of ABP monitoring for measurements of plasma Na and K and plasma renin activity (PRA) in the seated position. Electrolytes concentrations were measured by flame photometry. PRA was measured by radioimmunoassay.

Correlation plots were obtained by the method of least squares. Data are given as mean ± SEM.

RESULTS

Table 1 shows the mean values of body height, body weight, body mass index, office BPs, 24-h BPs, daytime BPs, nighttime BPs, PRA, plasma Na and K concentrations, and plasma Na/K ratio in 82 patients.

Plasma K concentration correlated inversely with 24-h systolic BP (r = −0.336, P < .01; Figure 1A) and 24-h diastolic BP (r = −0.298, P < .05) levels. Plasma K concentration correlated inversely with daytime systolic BP (r = −0.312, P < .05), daytime diastolic BP (r = −0.284, P < .05), nighttime systolic BP (r = −0.295, P < .05), and nighttime diastolic BP (r = −0.245, P < .05). There were no relations between plasma K concentration and office systolic BP (r = −0.017, P = NS; Figure 1B) and diastolic BP (r = −0.026, P = NS).

Positive correlations were observed between plasma Na/K ratio and 24-h systolic BP (r = 0.337, P < .01) and diastolic BP (r = 0.301, P < .05). Na/K ratio correlated with daytime and nighttime systolic and diastolic BPs. Because plasma Na concentration alone did not show any relationship to 24-h and office BP levels, the association of plasma Na/K ratio with 24-h BP is mostly attributable to the denominator of the ratio (K concentration). There were no relations between Na/K ratio and office BPs.

No relation was found between any BP parameter and body mass index. PRA correlated inversely with age (r = −0.202, P < .05). PRA also correlated negatively with 24-h systolic BP (r = −0.228, P < .05) and diastolic blood pressure (r = −0.203, P < .05) but not with office BPs.

DISCUSSION

The main finding in this study is that in mild essential hypertensives plasma K concentration is inversely and plasma Na/K ratio is positively related to ABP, but not to office BP. Furthermore, the relation with plasma K concentration or plasma Na/K ratio was applied to both daytime BP and nighttime BP based on ABP.

Although the relationship between plasma electrolyte concentrations and BP has been documented pre-
ABP could increase the sensitivity to detect also an association of PRA with BP. Similar discrepancies between office BP and ABP have been observed under several circumstances.\cite{13}

The significance of our observation is mostly speculative. Because plasma K concentration alone had significant relations with BP, including daytime and nighttime BPs, plasma K might be a factor directly or indirectly determining BP. Decreased extracellular K causes vasoconstriction by enhancing sympathetic nerve activity and by increasing the Na content of vascular smooth muscle.\cite{14} Plasma K may be related to oral K intake, which is associated with the probability of occurrence of hypertension according to epidemiologic evidence.\cite{2} It has been shown that K depletion increases BP in normotensive and essential hypertensive subjects.\cite{15}

In conclusion, K may be a factor directly or indirectly determining daytime and nighttime BP determinants in patients with mild essential hypertension. ABP monitoring may allow the appreciation of the relation between electrolytes and hypertension in a relatively small number of patients.

REFERENCES


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