ORIGINAL ARTICLE

HYPERURICEMIA AND RAISED ATHEROGENIC INDEX OF PLASMA IS ASSOCIATED WITH HYPERTENSION

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ABSTRACT

Among the non-communicable diseases, CVD is the number one cause of mortality all over the world. Hypertension is an important contributor to cardiovascular diseases, stroke and kidney diseases. The study was done to evaluate the association of serum uric acid and atherogenic index of plasma with hypertension. A total of 100 individuals were selected as study subjects based on predefined enrollment criteria. Among them 50 diagnosed cases of hypertension were selected as cases and 50 normotensive healthy individuals as controls. Serum uric acid and serum lipid profile were measured in all study subjects. Atherogenic index of plasma was calculated by the formula log (TG/HDL-C). The study population mostly belonged to 36 to 45 years of age group. The mean age of hypertensive patients was 40.78 ± 4.00 years and that of controls was 39.58 ± 4.12 years. The study found that the mean levels of serum TG (205.24 ± 56.74 mg/dl), TC (225.44 ± 60.67 mg/dl), LDL-C (134.34 ± 49.58 mg/dl) in hypertensive patients were significantly higher than those of controls. The mean AIP in the hypertensive patients was (0.68 ± 0.19) significantly higher ($p < 0.001$) than that of controls (0.43 ± 0.22). The mean serum uric acid level in hypertensive patients (7.05 ± 1.31 mg/dl) was found to be significantly higher ($p < 0.001$) than that of controls (4.84 ± 1.27 mg/dl). The study shows a positive linear correlation of serum uric acid with TG ($r = 0.455$, $p = 0.001$), TC ($r = 0.504$, $p = 0.001$), LDL-C ($r = 0.425$, $p = 0.002$) and negative correlation with HDL-C ($r = -0.158$, $p = 0.274$) in hypertensives. The hypertensive subjects showed a positive significant ($r = 0.437$, $p = 0.002$) correlation between AIP and serum uric acid. From the study it seems that hyperuricemia and high AIP are associated with hypertension.

Key Words: Hypertension, Serum Uric Acid, Atherogenic Index Plasma

Introduction

Cardiovascular diseases (CVDs) are the number one cause of global mortality and these are serious health problems in developed as well as in developing countries. In Bangladesh, deaths due to non-communicable diseases (NCDs), especially chronic diseases are increasing at an alarming rate. Among them CVDs, cancers, chronic respiratory diseases, and diabetes are responsible for an increasing number of deaths[1]. CVDs, has become a significant burden on the health care service in Bangladesh. World Health Organization (WHO) reported that, 27% of total

deaths in Bangladesh were due to CVD[2]. CVD is the highest among all causes of death followed by diseases of the respiratory system[3].

Several risk factors have been identified for the development of CVDs such as smoking, high blood pressure, high blood cholesterol, serum uric acid (SUA)[4], diabetes mellitus[5] and family history of CVD[6]. Among various risk factors, hypertension (HTN) is identified as one of the modifiable risk factors for cardiovascular and kidney diseases[7]. HTN increases the risk for a variety of cardiovascular diseases including stroke, coronary artery disease, heart failure and peripheral vascular disease[8]. Among individuals aged 40 to 90 years, each 20/10 mmHg rise in blood pressure doubles the risk of fatal coronary events[9]. HTN accounts for an estimated 54 percent of all strokes and 47 percent of all ischemic heart diseases globally[10].

Atherogenic Index of Plasma (AIP) is being used to assess the cardiovascular risk. People with high AIP have a higher risk for coronary heart disease (CHD) than those with low AIP[11]. TG and HDL-C in AIP reflect the balance between the atherogenic and anti-atherogenic lipoproteins. It has been suggested that AIP values of - 0.3 to 0.1 are associated with low, >0.1 to 0.24 with medium and above 0.24 with high CVD risk[11].

Uric acid is another important risk factor for CVDs. The increase in the SUA level was identified as an independent factor for the cardiovascular death[12]. Uric acid is a major factor for the development of CVD in hypertensive patients[4,13]. It has been reported that 25-40% of patients with untreated HTN have high SUA levels. In the Framingham Heart Study, each increase in SUA by 1.3 mg/dl was found to be associated with the development of HTN with an odds ratio of 1.17[14]. SUA has been shown to aggravate both dyslipidemia and hyperglycaemia[13,15]. A study conducted in India, showed that the SUA level is positively associated with TC, LDL-C[16] and with AIP[17]. The aim of this study was to explore the association of SUA and AIP with HTN.

Method

This case-control analytical study was carried out in the Department of Biochemistry, Sir Salimullah Medical College (SSMC), Dhaka during the period of July 2012 to May 2014. Fifty hypertensive patients of both sexes and above 30 years old attending the Medicine OPD of Bangabandhu Sheikh Mujib Medical University (BSMMU) and SSMC were included in this study as cases. Fifty age- and sex-matched normotensive subjects were also taken from medical, paramedical staff, attendants of patients, persons coming to hospital for fitness purpose and outdoor patients of minor illness. Patients with diabetes mellitus, thyroid disorder, heart disease, renal impairment and liver disease were excluded from the study population. Patients taking drug therapy such as thiazide and loop diuretics, cytotoxic drug, antitubercular drug, low dose aspirin, antioxidant as well as taking medications targeted to reduce uric acid and lipid levels were also excluded from study. Smokers and alcohol abusers were also excluded.

A complete physical and relevant clinical examinations were performed. Blood pressure was measured in a sitting position after resting for at least 15 minutes. Average of two measurements at 15 minute interval was taken. Hypertension was defined as a DBP $\geqslant 90$ mmHg and or SBP $\geqslant 140$ mmHg. Estimation of serum lipid profile and uric acid were done. AIP of all study subjects was calculated. Collected data were checked, edited, processed and statistical analysis were performed using Statistical Package for Social Science (SPSS) version 12.0.

Numerical data were represented as Mean $\pm$ SD

and unpaired t- test was done to measure the level of significance. Categorical data were represented as frequency and percentage and Chi-square test was done to measure the level of significance.

Results

In the hypertensive group, 26 (52.0%) were males and 24 (48.0%) were females and in the control group 29 (58.0%) were males and 21 (42.0%) were females. The mean age of hypertensive patients was 40.78±4.00 years and that of controls was 39.58±4.12 years (Table-I). There was no statistical significant difference between groups in respect to sex and age. The mean systolic BP were 145±10 mmHg and 115±9 mmHg in hypertensive and control subjects respectively; the mean diastolic BP were 87±6 mmHg and 77±6 mmHg in hypertensive and control subjects respectively. Both systolic and diastolic BP were significantly higher in the hypertensive group than that of control group (Table- II). Serum TG, TC and LDL-C were significantly higher in cases compared with those of controls. Serum HDL-C was significantly lower in the hypertensive subjects compared to that of controls (Table-III). Atherogenic index of plasma in the hypertensive patients was significantly higher when compared that of controls (Table III). Serum uric acid level in hypertensive patients was found to be significantly higher when compared with that of controls. Of all, 70% of the hypertensive subjects were hyperuricemic whereas 08% of the normotensive subjects were hyperuricemic and the difference was statistically significant (Table IV). As shown in Table V, SUA shows a positive and significant linear correlation with serum TG, TC and LDL-C and AIP. It also shows a significant negative correlation with HDL-C.

Table-I: Distribution of study subjects according to sex and age (yrs)

Sex	Group		p value
	Hypertensive patients	Controls	
Male n(%)	26 (52.0)	29 (58.0)	0.546*
Female n(%)	24 (48.0)	21 (42.0)	
Age (Mean±SD) (yrs)	40.78 ± 4.00	39.58 ± 4.12	0.142

Table-II: Comparison of blood pressure between cases and controls

Blood pressure	Group		p value
	Hypertensive patients	Controls	
Systolic BP (mm Hg)	145±10	115±9.0	0.001
Diastolic BP (mm Hg)	87±6.0	77±6.0	0.001

Table-III: Comparison of lipid profile between cases and controls

Biochemical findings	Group		p value
	Hypertensive patients	Controls	
TG (mg/dl)	205.24±56.74	136.84±52.81	0.001
TC (mg/dl)	225.44±60.67	175.72±45.54	0.001
HDL-C (mg/dl)	42.10±12.27	48.10±12.43	0.017
LDL-C (mg/dl)	134.34±49.58	101.74±38.83	0.001
AIP	0.68±0.19	0.43±0.22	0.001

Table-IV: Distribution of the study population according to Hyperuricemia

Hyperuricemia	Group		p value
	Hypertensive patients n(%)	Controls n(%)	
	35 (70.0)	4 (8.0)	0.001
	15 (30.0)		
	50 (100.0)		

Odds Ratio is 26.83 (8.18 - 87.96)

Table-V: Correlation of SUA with lipid profile and AIP in hypertensive patients

Parameters	r value	p value
TG	0.455	0.001
TC	0.504	0.001
HDL-C	-0.158	0.274
LDL-C	0.425	0.002
AIP	0.437	0.002

Discussion

The present study shows that serum TG, TC, LDL-C were significantly higher in hypertensive patients than those of normotensive controls. Shah *et al.*[18] revealed similar findings of elevated serum TG, TC and LDL-C in the hypertensive subjects when compared to that of controls. Similar observation was also reported in the study carried out by Sarkar *et al.*[19]. Present study shows that serum HDL-C was significantly lower ($p=0.017$) in cases than controls and this finding agrees with the finding of the study done by Al-Baldawi and Taqi[20]. The multiple risk factor intervention trial in USA showed that for each decrease in HDL cholesterol of 1 mg/dL (0.03 mmol/L) was associated with an increase in the risk of CHD of 2% in men and 3% in women[21]. The mean serum uric acid level in cases of the present study was 7.05 ± 1.31 mg/dl which was close to that found by Feig et al.[22], where they found mean uric acid level to be 6.9 mg/dl in their study patients. In this study, 70% had elevated level of SUA in cases. Garrick *et al.*[23] observed that 31% of their study patients with hypertension had hyperuricemia. In some studies hyperuricemia was found to be present in 40 to 60% of subjects with untreated hypertension[24,25]. The present study showed a close association of hyperuricemia with hypertension with an Odds Ratio of 26.83. A positive association between hypertension and serum uric acid has been shown by some other authors[26,27].

Our study shows a positive linear correlation between SUA and TG, TC & LDL-C. This finding is consistent with the findings of Nakanishi *et al.*[28]. The present study shows a negative correlation of SUA with HDL-C in hypertensives. This finding also agrees with the findings of Ishizaka *et al.*[29]. The present study observed significantly higher AIP ratio in cases than that of controls ($p=0.001$). Calin and Maria[30] in their study observed moderately increased AIP in hypertensive patients. Marwan *et al.*[31] also found that atherogenic index of plasma to be higher in hypertensive than normotensive subjects. From this study it can be concluded than hyperuricemia and raised atherogenic index of plasma is associated with hypertension.

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