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Research Article

Assessment Fasting Blood Glucose, Serum Electrolyte, RFT and Lipid Profile among Hypertensive Patients at Wolaita Sodo University Hospital, SNNPR, Ethiopia

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ABSTRACT

Background: Hypertension increases the risk of morbidity and mortality and has negative consequences on the cognitive and physical fitness of productivity in adults. Our aim was to assess fasting blood glucose, serum electrolyte, albumin, creatinine, urea, and lipid profile among hypertensive patients at wolaita sodo university hospital.

Methods: A comparative cross-sectional study was conducted from December 2019 to February 2020.The Data were analyzed by using Epi data version 3.1 and SPSS version 21.0 software (IBM Corporation, USA). P-value<0.05 was considered to be significant at 95% confidence level.

Results: Out of 78 cases and 78 controls matched age and gender were involved. The mean age of hypertensive and control study groups were 50 ± 10.0 and 51 ± 11.3 years respectively. The mean ± SD of fasting blood glucose, total cholesterol, LDL-C, TG, and RFT were significantly increased while serum sodium, calcium, albumin, and HDL-Cholesterol significantly decreased in hypertensive and serum potassium was no statistical significance among case and control groups.

Conclusion: In present study, we observed that the hypertensive group was at risk for developing biochemical alteration in lipid profile, electrolytes, RFT, FBG and albumin test parameters over increased period of time.

Keywords: Hypertension; Blood glucose; Serum electrolyte; Albumin

INTRODUCTION

Hypertension or higher pressure in the blood vessels occurs when the heart has to work harder in order to pump blood. If left uncontrolled, hypertension can lead to a heart attack, an enlargement of the heart and eventually heart failure. Blood vessels may develop bulges (aneurysms) and weak spots due to high pressure, making them more likely to clog and burst. The pressure in the blood vessels can also cause blood to leak out into the brain. This can cause a stroke. Hypertension can also lead to kidney failure, blindness, rupture of blood vessels and cognitive impairment [1].

Hypertension, also known as high or raised blood pressure, is a condition in which the blood vessels have persistently raised pressure. Persistent hypertension is one of the risk factors for stroke, myocardial infarction, heart failure and arterial aneurysm, and is a leading cause of chronic kidney failure. Moderate elevation of arterial blood pressure leads to shortened life expectancy. Dietary and lifestyle changes can improve blood pressure control and decrease the risk of associated health complications, although drug treatment may prove necessary in patients for whom lifestyle changes alone prove ineffective or insufficient [1].

Blood pressure is created by the force of blood pushing against the walls of blood vessels (arteries) as it is pumped by the heart. Normal adult blood pressure is defined as a blood pressure of 120 (range 120-140) mm Hg when the heart beats (systolic) and blood pressure of 80 (range 80-90) mm Hg when the heart relaxes (diastolic). However, the cardiovascular benefits of normal blood pressure extend to lower systolic (105 mm Hg) and lower diastolic blood pressure levels (60 mm Hg) [1].

Blood pressure is influenced by various genetic and lifestyle factors including nutrition. In this regard, sodium is an important mineral which, besides its functions in fluid balance, action

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potential generation, digestive secretions and absorption of many nutrients, also play an important role in blood pressure regulation with a reduced sodium intake being associated with a reduction in systolic and diastolic blood pressure. Therefore, independent of body weight, sex and age, too much dietary salt (sodium chloride) is regarded as an established risk factor for hypertension. Concomitant to sodium reduction, higher potassium intake or supplementation has also been repeatedly shown to reduce the blood pressure of especially hypertensive persons [2].

High sodium and low potassium inhibit the sodium pump, increase intracellular sodium, and drive calcium into cells, which ultimately induce vascular smooth muscles contraction and increased peripheral vascular resistance. A new pathway of sodium storage in the human body has been identified. Excess sodium stored in the subcutaneous lymphatic system (on proteoglycans in interstitial space), where it becomes osmotically inactive, can act as a fluid buffering system to blunt the blood pressure increase during excessive salt intake [3].

High blood pressure has been associated with elevated atherogenic blood lipid fractions, but epidemiological surveys often give inconsistent results across population subgroups. A better understanding of the relation between blood pressure and blood lipids may provide insight into the mechanism(s) whereby hypertension is associated with increased risk of coronary heart disease [4].

The occurrence and development of hypertension is a continuous and long-term process. Blood pressure is a sensitive index for diagnosing hypertension, can reflect the progression of hypertension to some extent [5].

A review of current trends shows that the number of adults with hypertension increased from 594 million in 1975 to 1.13 billion in 2015 [6,7]. The main modifiable causes of high blood pressure are diet, especially salt intake, obesity, excessive alcohol intake and smoking status. Globally, hypertension is responsible for 62% of cerebrovascular disease and 49% of ischemic heart disease. High blood pressure is estimated to contribute 7.1 million deaths, about 13% of the total worldwide [8].

The aim of this study was to assess fasting blood glucose, serum electrolyte, albumin, creatinine, urea and lipid profile among hypertensive patients and non-hypertensive participants at Wolaita sodo university teaching and referral hospital.

MATERIALS AND METHODS

Study area

The study was conducted at wolaita sodo university teaching and referral hospital which was situated at southern Ethiopia, wolaita zone, sodo town, 329 kilometers from Addis Ababa, the capital city of Ethiopia.

Study design

A comparative cross-sectional study was conducted to from December 2019 to February 2020 in Wolaita sodo university teaching and referral hospital, SNNPR, Ethiopia.

Sampling method and study groups

Consecutive sampling method was used to include matched age and sex for 162 of 81 Hypertensive outpatients who visiting the hypertensive outpatients department during the study period and 81 were healthy participants voluntarily involved or were they visiting the outpatient department for other illness.

Exclusion criteria

Study groups who had history of renal disease, cardiac heart failure, pregnant women and diabetes were excluded from the study.

Data collection

The data collection was by interview with administered questionnaire mainly consisted of closed and open ended questions and delivered to eligible subjects after consent taken to collect data face to face interview, physical activity of WHO standards and Physical measurements obtained by trained clinical nurses.

Whole blood sample collection and laboratory analysis

About 5 ml of venous blood was collect aseptically from the median cubital vein from each study participant by trained Laboratory Technologists in the morning after nine hours of overnight fast. The fasting blood glucose, serum albumin, serum electrolyte, urea, creatinine, and lipid profiles were analyzed by Siemens Dimension EXL-200 up to date with the regional and national standards.

Data analysis

All questionnaires were checked daily for completeness by the investigator and pre-coded data was entered into computer using Epi data version 3.1, and then data was transferred to SPSS version 21.0 software (IBM Corporation, USA) for further data cleaning to allow consistency and eliminate discrepancies, categorisation of continuous variables and finally analysis. P-value<0.05 was considered statistically significant at 95% of Cl. Any abnormal findings of study groups were reported and communicated to the physician for better management.

RESULTS

Among the total expected 162 study participants, 156 (78 hypertensive patients and 78 non-hypertensive) were included in the study with a response rate of 95.9%. Among Hypertensive patients, 40(51.3%) were females. The age ranges of Cases were from 30-78 years old with mean age 50 ± 10.0 years. The majority of study participants 43(55.1%) from urban areas, 51(65.4%) married, 26(33.3%) no formal education, 35(44.9%) had public/private employed and 50(64.1%) had monthly income below 1000 Ethiopian Birr (Table 1).

Table 1: Socio-demographic characteristics of hypertensive patients and controls at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Variables		Study Participants (n=156)	
		Hypertensive patients	Controls
		n=78 (50%)	n=78 (50%)
Age in years	<50	28(35.9%)	30(38.4%)
	≥ 50	50(64.1%)	48(61.6%)
Gender	Female	40(51.3%)	40(51.3%)
	Male	38(48.7%)	38(48.7%)
Residence	Urban	43(55.1%)	44(56.4%)
	Rural	35(44.9%)	34(43.6%)

Marital status	Married	51(65.4%)	42(53.8%)
	Single	14(17.9%)	11(14.1%)
	Separated	6(7.7%)	10(12.8%)
	Widowed/ widower	7(9.0%)	15(19.3%)
Educational level	No formal education	26(33.3%)	22(28.2%)
	Primary	13(16.6%)	17(21.8%)
	Secondary	16(20.5%)	11(14.1%)
	College or University	23(29.6%)	28(35.9%)
Occupation	Public/Private servant	35(44.9%)	34(43.6%)
	Merchant	11(14.1%)	14(17.9%)
Monthly income level(ETB)	Farmer	20(25.6%)	19(24.4%)
	Unemployed	12(15.4%)	11(14.1%)
	≤ 1000	50(64.1%)	43(55.1%)
	>1000	28(35.9%)	35(44.9%)

Regarding lifestyle factors, anthropometric and salt dietary habits of hypertensive patients; the majority of 39(53.4%) were overweight and 3(4.1%) obese. Similarly, non-hypertensive participants; the majority of 25(34.2%) were overweight and 47(64.4%) normal weight (Table 2).

Table 2: Lifestyle factors, anthropometric, and salt dietary habits of study participants at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Variables	Study participants (n=156)		P-value
	Hypertensive group(n=78)	Non-hypertensive group(n=78)	
Smoking status			
Yes	8(10.2%)	4(5.1%)	0.232
No	70(89.7%)	74(94.9%	
Smoking frequency			
Daily	4(50%)	2(50%)	0.224
Frequently	3(37.5)	1(25%)	
Rarely	1(12.5)	1(25%)	
Alcohol consumption			
Yes	31(39.7%)	27(21.8%)	0.511
No	47(60.3%)	51(78.2%)	
Alcohol drinking frequency			
Daily	9(29.0%)	4(14.8%)	0.587
Frequently	15(48.4%)	6(22.2%)	
Rarely	7(22.6%)	17(63.0%)	
Dietary salt consumption			
Yes	27(34.6%)	62(79.5%)	<0.001
No	51(65.4%)	16(20.5%)	
Physical exercises activity			
Low	36(52.6%)	11(14.1%)	<0.001
Moderate	32(34.6%)	52(66.7%)	
High	10(12.8%)	15(19.2%)	
BMI status			
Normal weight	31(39.8%)	50(64.1%)	0.015
Over weight	42(53.8%)	27(34.6%)	
Obese	5(6.4%)	1(1.3%)	

Comparison of laboratory test parameters among study groups

Hypertensive patients were significantly increased mean ± SD of FBG, RFT, TC, LDL-C, TG ($p<0.001$) respectively; while significantly lower mean ± SD serum albumin, sodium, calcium and HDL-C ($p<0.001$) respectively. When compared with non-hypertensive participants the serum potassium and calcium were not statistically significant among cases and controls (Table 3).

Duration of hypertension with laboratory parameters among hypertensive patients (controlled/non-controlled/ single or combination drugs)

The FBG, RFT, TC, LDL-C and TG of hypertensive patients above five years showed significantly higher when compared with hypertensive patients below five years while serum albumin, sodium, calcium, and HDL-C significantly lower observed on above five years of hypertensive patients. Serum potassium was not statistically significant different within the two groups (Table 4).

Prevalence of abnormal laboratory test parameters among study groups

A total of 78 hypertensive patients were included in this study, where 13(16.7%) hyperglycemia, 12(15.4%) hypoalbuminemia, 14(17.9%) hyponatremia, 8(10.3%) hyperkalemia, 15(19.2%) hypocalcemia,11(14.1%) higher creatinine, 11(14.1%) high urea, 7(8.9%) hypercholesterolemia, 5(6.4%) lower HDL-C, 8(10.3%) high LDL-C, and 10(12.8%) hypertriglyceridemia (Table 5).

Similarly, total of 78 non-hypertensive participants 6(7.7%) hyperglycaemia, 2(2.6%) hypoalbuminemia, 3(3.8%) hyponatremia, 7(8.9%) hyperkalaemia, 4(5.1%) hypocalcaemia, 2(2.6%) higher creatinine, 2(2.6%) high urea, 1(1.3%) hypercholesterolemia, 1(1.3%) lower HDL-C, 2(2.6%) high LDL-C, and 3(3.8%) hypertriglyceridemia (Table 5).

Table 3: Comparison of laboratory test parameters among study groups at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Test parameters	Study Participants (n=156)		t-test for Equality of Means		
	Hypertensives (n=78)	Non-hypertensives (n=78)	p-value	95% CI	
	Mean ± SD	Mean ± SD		Lower	Upper
FBG (mg/dL)	122.93 ± 9.10	109.68 ± 10.31	<0.001	12.04	14.64
Albumin (g/dL)	4.27 ± 0.59	5.09 ± 0.96	<0.001	0.45	1.19
Sodium (mmol/L)	135.82 ± 4.05	138.90 ± 3.23	<0.001	2.26	3.9
Potassium(mmol/L)	4.05 ± 0.46	4.12 ± 0.64	0.403	0.11	0.25
Calcium(mmol/L)	2.12 ± 0.37	2.24 ± 0.23	0.299	0.02	0.26

Creatinine(mg/dL)	1.14 ± 0.46	0.85 ± 0.15	<0.001	0.16565	0.4005
Urea (mg/dL)	44.65 ± 18.56	33.21 ± 11.43	<0.001	5.8032	15.3506
Total Cholesterol (mg/dL)	172.10 ± 33.33	154.53 ± 26.24	<0.001	22.877	40.379
HDL-C (mg/dL)	43.36 ± 7.20	48.92 ± 6.54	<0.001	4.9	6.22
LDL-C (mg/dL)	105.55 ± 29.35	84.19 ± 23.29	<0.001	16.025	33
Triglyceride (mg/dL)	123.19 ± 27.77	107.14 ± 21.48	<0.001	20.559	37.493

Table 4: Duration of hypertension with laboratory test parameters among hypertensive patients at WSUTRH, SNNPR, Ethiopia, from December 2019 to February 2020.

Test parameters	Below 5 years (n=45)	Above 5 years (n=33)	t-test for Equality of Means		
			p-value	95% CI	
	Mean ± SD	Mean ± SD		Lower	Upper
FBG (mg/dL)	114.90 ± 15.95	122.56 ± 9.19	0.03	6.76	14.558
Albumin (g/dL)	5.32 ± 1.04	4.19 ± 0.58	0.001	0.457	1.801
Sodium (mmol/L)	140.70 ± 7.16	135.34 ± 2.86	0.001	1.06	9.661
Potassium (mmol/L	4.02 ± 0.63	4.04 ± 0.44	0.929	0.302	0.331
Calcium (mmol/L)	2.43 ± 0.91	2.08 ± 0.16	0.004	0.113	0.582
Creatinine (mg/dL)	1.00 ± 0.32	1.24 ± 0.58	0.035	0.018	0.463
Urea (mg/dL)	39.26 ± 12.42	48.34 ± 20.64	0.026	1.093	7.059
T.Cholestrol (mg/dL)	160.86 ± 25.30	178.10 ± 28.90	0.039	3.851	18.76
HDL-C (mg/dL)	43.04 ± 5.27	39.83 ± 8.30	0.022	0.479	5.956
LDL-C (mg/dL)	86.81 ± 22.03	99.07 ± 30.60	0.018	2.112	11.406
Triglyceride (mg/dL)	127.03 ± 30.43	134.51 ± 31.19	0.046	1.241	8.715

Table 5: Prevalence of abnormal laboratory test parameters among study groups at WSUTRH, Ethiopia, from December 2019 to February 2020.

Abnormal parameters	Prevalence in HTN (n=78)	Prevalence in Non-HTN (n=78)	P-value
Hyperglycaemia	13(16.7%)	6(7.7%)	<0.001
Hypoalbuminemia	12(15.4%)	2(2.6%)	0.003
Hyponatremia	14(17.9%)	3(3.8%)	0.001
Hyperkalemia	8(10.3%)	7(8.9%)	0.659
Hypocalcaemia	15(19.2%)	4(5.1%)	0.001
Elevated creatinine	11(14.1%)	2(2.6%)	0.002
Elevated urea	11(14.1%)	2(2.6%)	0.001
Hypercholesterolemia	7(8.9%)	1(1.3%)	0.001
Lower HDL-C	5(6.4%)	2(2.6%)	0.003
High LDL-C	8(10.3%)	1(1.3%)	0.001
Hyperglycaemia	10(12.8%)	3(3.8%)	0.003

DISCUSSION

The current study assessed fasting blood glucose, serum albumin, electrolytes, and creatinine, urea, and lipid profiles among hypertensive and non-hypertensive participants. The fasting blood glucose, creatinine, urea, total cholesterol, LDL-cholesterol, and triglyceride are significantly higher among hypertensive study participants when compared to the non-hypertensive study group. Sodium, calcium, albumin, and HDL-Cholesterol concentration was significantly lower among hypertensive study participants when compared to the non-hypertensive study group.

The significantly increased fasting blood glucose level of the hypertensive study participants, when compared to the non-hypertensive study group in our study, was consistent with the findings in previous studies conducted in Korean, Chinese, Cameroon, and India [9-12]. Hypertension induced micro vascular dysfunction, which may contribute to the pathophysiology of diabetes development [13,14]. Endothelial dysfunction which is related to insulin resistance is also closely associated with hypertension, and biomarkers of endothelial dysfunction were found to be independent predictors of hyperglycemia [15].

Serum creatinine and urea level were significantly higher in the hypertensive study participants when compared to the non-hypertensive study group in this study. This finding was similar to previous studies conducted in India, and Cameroon [16-20]. This may be a result of a progressive glomerular damage, endothelial dysfunction and renal micro vascular disease [20,21].

The serum albumin was significantly decreased in hypertensive study patients when compared to the non-hypertensive. This study's findings were similar to previous studies conducted in Japan and USA [18,19]. Hypertension is associated with endothelial dysfunction, insulin resistance, inflammation and oxidative stress, while albumin possesses both anti-inflammatory and antioxidant properties [22-25]. Albumin inhibits copper-stimulated peroxidation and hemolysis as well as the production of free hydroxyl radicals from systems containing copper ions and H2O2. It may also inhibit endothelial apoptosis [26,27].

Serum sodium and calcium were significantly decreased in hypertensive participants when compared to the non-hypertensive participants while serum potassium was no significant difference between studies groups with the findings in previous studies conducted in Nigeria [28].

The total cholesterol, LDL-cholesterol, and triglyceride were significantly elevated while HDL-cholesterol level was lower in hypertensive study participants when compared with non-hypertensive participants findings in previous studies conducted in India, and Bangladesh [29,30].

The duration of hypertension on fasting blood glucose, potassium, creatinine, urea, total cholesterol, LDL-Cholesterol, and Triglyceride concentration of hypertensive patients above five years showed significantly higher when compared with hypertensive patients for below two years. Hypertensive patients had significantly lower levels of serum albumin, sodium, calcium, and HDL-Cholesterol if the duration of hypertension was above five years.

Prevalence of hyperglycemia, hypoalbuminemia, hyponatremia, hypokalaemia, elevated serum creatinine, elevated serum urea, hypercholesterolemia, lower HDL-C, high LDL-C, and hypertriglyceridemia in hypertensive patients were increased when compared with non-hypertensive subjects.

CONCLUSION

Hypertensive participants showed a significantly elevated level of fasting blood glucose, TC, TG, LDL-C, creatinine, and urea test parameters. In this study, we observed that the hypertensive group was at risk for developing biochemical abnormality in creatinine, urea, fasting blood glucose, total cholesterol, triglyceride, LDL-cholesterol, electrolytes, and albumin test parameters. The fasting blood glucose, total cholesterol, triglyceride, LDL-C, creatinine, and urea tests were significantly higher while serum albumin, sodium, calcium, HDL-C significantly decreased in the hypertensive patients with an increased period of time.

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DECLARATION OF INTEREST

We the undersigned declare no Conflict of interest.

AUTHOR CONTRIBUTIONS

Manuscript Preparation: Berhanu Haile, Mistire Wolde, Tatek G/Egzeabeher, Laboratory Analysis: Berhanu Haile, Data analysis: Berhanu Haile, Mistire Wolde, Funding acquisition: Berhanu Haile, Investigation: Berhanu Haile, Mistire Wolde, Methodology: Berhanu Haile, Mistire Wolde, Manuscript administration: Mistire Wolde, Writing-review and editing: Berhanu Haile, Mistire Wolde, Tatek G/Egzeabeher.

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ETHICS

The study was approved by Addis Ababa University College of health sciences department of medical laboratory sciences Ethical review committee and due permission granted to the Wolaita Sodo University Teaching and Referral hospital. All participants were stated to be appropriately consented and for privacy purposes all data was kept confidential. Anonymity of result records were maintained by using unique IDs of the client registration number and unique hospital code numbers used at Wolaita Sodo University Teaching and Referral hospital laboratory. The abnormal laboratory findings of study subjects were dispatched and communicated only with managing physicians.

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