COMPARISON OF PLASMA VISCOSITY AND FIBRINOGEN CONCENTRATION IN HYPERTENSIVE AND NORMOTENSIVE DIABETICS

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Background: Body weight, body mass index, fibrinogen concentration and relative plasma viscosity can contribute to the development of hypertension in diabetics. This study compares body weight, body mass index, fibrinogen concentration and relative plasma viscosity between hypertensive diabetics, normotensive diabetics and healthy controls. **Methods:** The present study was carried out on normotensive and hypertensive diabetics taken from medical OPD of Saidu group of teaching hospitals, Swat. A group of healthy male subjects between 30-60 years of age from the staff members of Saidu Medical College, Swat was also included. Each group comprised of 35 subjects. Systolic and diastolic blood pressures, body weight, height, body mass index, fibrinogen concentration and relative plasma viscosity were measured and compared. **Results:** Body weight, body mass index, fibrinogen concentration and relative plasma viscosity were all significantly more in hypertensive diabetics than normotensive diabetics and healthy control subjects**. Conclusion:** The onset of the complications is different in the two groups of diabetics (hypertensive and normotensive), earlier in hypertensive diabetics and delayed in normotensive diabetics.

Keywords: Plasma viscosity, Fibrinogen, Diabetes, Hypertension

INTRODUCTION

Elevation of plasma viscosity due to corresponding increase in fibrinogen significantly contributes to increase in the blood viscosity in diabetics.[1] Many factors including reduced blood flow due to elevated viscosity of plasma have been implicated in the pathogenesis of hypertension.[2] Elevated plasma viscosity is a feature of diabetic blood, which results in greater flow resistance, and a high incidence of circulatory complications.[3] Various reports suggest that obesity contributes to the development of elevated blood pressure in diabetics.[4] Fibrinogen, a plasma protein, contributes more than other proteins to plasma viscosity in healthy subjects.[5] This contribution is greatly increased in disease states,[6] particularly in hypertension.[7] A significant elevation in plasma fibrinogen concentration was recorded in Nigerian diabetics[8] and its relationship to the increase in plasma viscosity was established in diabetic patients. It is already known that diabetes mellitus is much more common in obese with an increased tendency to hypertension.[9] Elevated plasma viscosity is the feature of diabetic blood, which results in greater flow resistance, and a high incidence of certain complications.[10] Long before the biochemical deviation in carbohydrate metabolism are demonstrable, changes occur in the small blood vessels due to elevated viscosity of plasma that are responsible for some of the complications associated with the disease.[11] These reports suggest that the changes occur in blood components of diabetics, which affect the flow of blood in the vasculatures and may lead to complications that are associated with diabetics.[12]

This study was carried out to compare body weight, body mass index, fibrinogen concentration and relative plasma viscosity between hypertensive diabetics, normotensive diabetics and healthy controls.

MATERIAL AND METHODS

This study was carried out in the Department of Physiology and Department of Medicine, Saidu Medical College, Swat. A total of 105 subjects between 30-60 years of age were selected. Out of these, 35 subjects were normotensive diabetics, 35 were hypertensive diabetics and 35 were healthy control subjects. The control subjects were selected from the staff members of Saidu Medical College and friends while the diabetics were selected from the medical OPD of Saidu Group of Hospitals.

The body weight of the diabetics and healthy subjects was calculated by Marsdan weight machine. Height of the subjects was calculated with metal scale and body-mass index of the subjects was calculated by body weight in kilograms divided by height in meter squares. Seven (7) ml of blood was collected from each subject by venepuncture of antecubital fossa in a routine morning visit to the OPD. Four (4) ml of blood sample was carefully discharged in a 5 ml test tube containing Ethyline diamine tetra acetic acid (EDTA), while the remaining blood sample was carefully discharged in another test-tube containing 0.5 ml 3.8% trisodium citrate solution for the estimation of fibrinogen

concentration. The viscosity was calibrated with distilled water at room temperature and measurements were made on plasma preserved at the same room temperature by a viscometer. The flow ratio of plasma was compared with the flow ratio of distilled water and was expressed as relative plasma viscosity. Fibrinogen concentration was estimated by Ingram's technique.

Blood pressure of the subjects were determined through auscultatory method by mercurial sphygmomanometer in sitting position.

The Statistical significance of difference between the mean values of the groups was evaluated by students 't' test. The difference in mean values of two groups was regarded as statistically significant if the P value was less than 0.05 and it was taken as highly significant if P value was less than 0.01.[13]

RESULTS

Table-1 shows comparison of body weight, height, body mass index, systolic and diastolic blood pressures, fibrinogen concentration and relative plasma viscosity of normotensive diabetics with the healthy control subjects. There were no statistically significant differences in these parameters between the two groups except the fibrinogen concentration that was significantly more in normotensive diabetics than healthy subjects (P<0.05).

Table-2 shows comparison of body weight, height, body mass index, systolic and diastolic blood pressures, fibrinogen concentration and relative plasma viscosity of hypertensive diabetics with healthy control subjects. All the parameters were significantly high in the hypertensive diabetics than healthy control subjects (P<0-01), except for height.

Table-3 shows comparison of body weight, height, body mass index, systolic blood pressure, diastolic blood pressure, fibrinogen concentration and relative plasma viscosity between the normotensive and hypertensive diabetics. All the parameters (body weight, body mass index, systolic and diastolic blood pressures and plasma viscosity) were significantly high in hypertensive diabetics than normotensive diabetics (P<0.01), fibrinogen concentration was significantly high (P<0.05) in hypertensive diabetics than normotensive diabetics, while the difference was non significant in height of the hypertensive and normotensive diabetics.

Table-1:Comparison of body weight, height, body mass index, systolic and diastolic blood pressures, fibrinogen and relative plasma viscosity in normotensive diabetics (n=35) and healthy controls (n=35)

	Body weight (kgs)	Height (m)	BMI (kg/m^2)	Systolic BP (mm Hg)	Diastolic BP (mmHg)	Fibrinogen (g/l)	RP Viscosity (cP)
Normotensive diabetics	62.60±1.57	1.68±0.02	23.20±0.58	122.4±4.02	80.02±1.48	3.64±0.18*	1.68±0.04
Control subjects	60.35±2.53	1.69±0.03	22.80±0.52	120.8±3.28	79.68±1.62	2.68±0.08	1.66±0.06

*Values are given as mean±SEM. *: p < 0.05, **: p <0.01 when normotensive diabetics were compared with controls.*

Table-2: Comparison of body weight, height, body mass index, systolic and diastolic blood pressures, fibrinogen and relative plasma viscosity in hypertensive diabetics (n=35) and healthy controls (n=35)

	Body weight (kgs)	Height (m)	BMI ($kg/m^{2)}$	Systolic BP (mmHg)	Diastolic BP (mmHg)	Fibrinogen (g/l)	RP Viscosity (cP)
Hypertensive diabetics	75.30±2.16**	1.69±0.02	27.95±0.66**	170.9±3.20**	96.26±1.86**	4.26±0.18**	2.06±0.02**
Control subjects	60.35±2.53	1.69±0.03	22.80±0.52	120.8±3.28	79.68±1.62	2.68±0.08	1.66±0.06

*Values are given as mean±SEM. *: p < 0.05, **: p <0.01 when hypertensive diabetics were compared with controls*

Table-3: Comparison of body weight, height, body mass index, systolic and diastolic blood pressures, fibrinogen and relative plasma viscosity in normotensive diabetics (n=35) and hypertensive diabetics (n=35)

	Body weight (kgs)	Height (m)	BMI (kg/m^2)	Systolic BP (mmHg)	DiastolicBP (mmHg)	Fibrinogen (g/l)	RP Viscosity (cP)
Normotensive diabetics	62.60±1.57	1.68±0.02	23.20±0.58	122.4±4.02	80.02±1.48	3.64±0.18	1.68±0.04
Hypertensive diabetics	75.3±2.16**	1.69±0.02	27.98±0.66**	170.9±3.20**	96.26±1.86**	4.26±1.8*	2.06±0.02**

*Values are given as mean ±SEM *: p<0.05 **: p <0.01 when normotensive diabetics were compared with hypertensive diabetics.*

DISCUSSION

The present study recorded an association between body weight, body mass index, fibrinogen concentration, plasma viscosity and blood pressure in diabetics. The observation is consistent with similar reports in Caucasians non diabetics.[14,15] This means that hypertensive diabetics develop characteristic increase in body weight, body mass index, fibrinogen concentration and relative plasma viscosity. This early increase in viscosity in hypertensive diabetics compared to normotensive diabetics have been reported by a number of investigators.[8,15,16] Hypertensive diabetics tend to develop vascular complications earlier than normotensive diabetics[17] and increase in viscosity is linked with microvascular diseases in hypertensive diabetics.[3] Many factors including reduced blood flow due to elevated viscosity of plasma have been implicated in the pathogenesis of vascular disease in diabetics.[2] This is in line with our findings that hypertensive diabetics are predisposed to vascular abnormalities due to increased body weight, body mass index, fibrinogen concentration and increased plasma viscosity. Elevated plasma viscosity is a feature of diabetic blood, which results in a greater flow resistance and a high incidence of circulatory complication.[18] In conclusion, body weight, body mass index, fibrinogen concentration and plasma viscosity are elevated earlier in hypertensive diabetics than normotensive diabetics, suggesting that onset of the complications may be different in both types of diabetics, earlier in hypertensive diabetics and delayed in normotensive diabetics.

Acknowledgement

We are thankful to Professor Dr. Shaukat Ali Orakzai, Vice principal Academics/Head Department of Biochemistry, Saidu Medical College, Swat for his cooperation and his valuable guideline through out this study.

REFERENCES

1. Memeh CU, Reid HL. Plasma and serum viscosity in Nigerian diabetics. Acta Diabetol Lat 1988;25:101-8.
2. McMillan DE. The microcirculation: Changes in diabetes mellitus (Editorial). Mayo Clinic Proct 1988;63:517-20.
3. McMillan DE. Physical factors in the development of atherosclerosis in diabetes. Diabetic Care 1981;30(2):97-104.
4. Anonymous: Diabetes and hypertension [editorial] Lancet 1978;ii:138-9.
5. Harkness J, Whittington RB. Blood plasma viscosity, an approximate temprature invariant arising from generalized concepts. Biorheology 1970;6:169-71.
6. Dormandy JA. Clinical importance of blood viscosity. Viscostas 1979;I:5-8.
7. Zannad F, Voisin P, Brunnote F, Bruntz JF, Stoiz JF, Gilgenkrantz JM. Haemoreological abnormalities in arterial hypertension and their relation to cardiac hypertrophy. J Hypertension 1988;6:293-7.
8. Reid HL, Obi GO, Oli JM. Reduced erythrocyte deformability and hyperfibrinogenemia in Nigerian diabetics with hemoglobin genotype HbAA. Acta Diabetol Lat 1984;21:105-14.
9. Oli JM, Iken VO. Diabetes mellitus and hypertension in an African population. J R Coll Phys Lond 1986;20:32-5.
10. Memeh CU. Differences between plasma viscosity and proteins of type-1 and type-2 diabetic Africans in early phase of diabetes. Horm Metab Res 1990;25:21-3.
11. Phillips MJ. Plasma and whole blood viscosity . Br J Hematol 1976;34:347-52.
12. Foster DW. Diabetes mellitus. In: Harrisons principles of Internal Medicine. 14th ed. Newyork. McGraw-Hill Health Professions Division, 1998; p 2060-81.
13. Steel RG, Torrie. Principles and Procedures of Statistics. 2nd ed. NewYork, McGraw-Hill Book Co. Inc. 1980; p 90-3.
14. Reisin E, Abel R, Modan M, Silverbag DS, Eliahou HE, Modan B. Effect of weight loss without salt restriction on the reduction of blood pressure in overweight hypertensive patients. N Engl J Med 1978;298:1-6.
15. Earnst E, Koenig W, Matrae A, Keel U. Plasma viscosity and hemoglobin in the presence of cardiovascular risk factors.Clin. Hemorheol 1988;8:507-15.
16. Sherma S. Platelet adhesiveness, Plasma fibrinogen in juvenile-onset and maturity-onset diabetes mellitus. J Clin Path 1981;34:501-3.
17. Klein Rbek, Klein SE, Moss MD, Davis DL, DeMets. Glycosylated hemoglobin predicts the incidance and progession of diabetes retinopathy. JAMA 1988;260:2864-71.
18. Chidi U, Memeh U. The relationship between body weight and plasma viscosity in hypertensive diabetics. Nigerian J Hypertension 1990;8:711-4.

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