



A Study to Compare Whole Blood Viscosity Between Diabetics With and Without Retinopathy

KEYWORDS

Whole blood viscosity, Diabetic Retinopathy, Diabetes mellitus, Shear rate.

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ABSTRACT

Blood viscosity is defined as resistance to blood flow in blood vessels. The rheological properties of blood depend on haematocrit value and plasma constituents. As the cellular fraction or plasma constituents increases of blood, blood viscosity increases. Ocular complications of the diabetes are of particular concern to the patients, the physician and the ophthalmologist, because of the increasing incidence of blindness in the world as result of it. Present study aims to find out the etiopathological relationship between whole blood viscosity and diabetic retinopathy. It was seen in this study that whole blood viscosity is significantly higher than the control in both diabetics with and without retinopathy but there is no significant relationship of change of whole blood viscosity between the diabetic without retinopathy and diabetic with retinopathy.

Introduction- Blood viscosity is defined as resistance to blood flow in blood vessels. Early investigators conceptualized blood as a viscous fluid but blood is not a fluid in ordinary sense, it is a fluidized suspension of elastic cells. The rheological properties of blood depend on haematocrit and plasma constituents. As the cellular fraction or plasma constituents of blood increases, blood viscosity increases. Microcirculatory blood flow is governed by perfusion pressure, vessels radius, and vessels length and blood viscosity. Blood viscosity mediates the relationship between blood pressure and blood flow. At fixed driving pressure, blood pressure is inversely proportional to the viscosity of blood. Blood is shear thinning non Newtonian fluid, means its viscosity decreases as the shear rate increases. The shear rate determined by the velocity of blood flow and by the size of blood vessels. High shear rate typically present in large arteries with high blood flow velocity whereas low shear rate typically present in microcirculation where blood flow velocity is low. Thus under normal physiological conditions viscosity of blood with in circulation at any instant or location varies depending on the shear rate with in the particular vessels. Auto regulation of regional blood flow is controlled by neural and metabolic factors that influence vascular resistance by modifying perfusion pressure and vasomotor activity. Under the normal physiological conditions blood viscosity plays a passive role in affecting microcirculatory flow. Blood hyper viscosity caused by disease state can limit the ability of auto regulatory mechanism to augment blood flow resulting in compromised perfusion. Many studies show that micro vascular complications are commonly seen in uncontrolled diabetic patients which lead to retinal and renal damage.

Diabetes mellitus is a complex syndrome characterized by a lack of insulin secretions and/ or increased cellular resistance to insulin resulting in persistent hyperglycemia with or without glycosuria, which result from a derangement in the mechanism of blood sugar homeostasis. With the introduction of insulin and newer hypoglycemic drug although the fatality from the diabetes has been reduced and life span of diabetic individual has been significantly increased, unfortunately the chronic complication of diabetes, vis-a vis diabetic retinopathy poses serious threat to vision of patients who ultimately may become blind.

Ocular complications of the diabetes are of particular concern to the patients, the physician and the ophthalmologist, because of the increasing incidence of blindness in the world as result of it. As the prevalence of diabetes and life expectancy are increasing, incidence of blindness due to diabetes has increased from 4.3% in 1940 to 18.4% in 1962. Retinopathy account for at least 80% of blindness in Diabetics.

In our country diabetes mellitus is as common as other part of world. Surveys have shown that there is a large reservoir of undiagnosed diabetes in India. Pilot survey carried out by the diabetic association of India showed prevalence rate varying from 1% in general populations to 7% in office going adult.

Although multidisciplinary research are underway to prevent and / or combat the diabetic blindness, it is unfortunate that not much attention has paid to this problem in our country, though the incidence of diabetic blindness is equally high in India.

Recently blood viscosity has been implicated in the association of many diseases. There are few reviews on the role of blood viscosity in the etiology of diabetic retinopathy. The high blood viscosity may be the common pathway linking diverse mechanism for the pathogenesis of complications of diabetes.

Objective of Study-

Present study aims to find out the etiopathological relationship between whole blood viscosity and diabetic retinopathy.

Material and Method-

Present study has been done on 100 patients of Diabetes of average duration of treatment more than ten years and 25 healthy normal controls of comparable age group irrespective of sex. Among the 100 Diabetic patients 50 have no evidence of diabetic retinopathy while the remaining 50 have features of Diabetic retinopathy. These patients were randomly selected among the Diabetics referred to the eye clinic for funds examination and were under treatment with insulin and/or oral hypoglycemic agents. This study does not include to patients affected by systemic hypertension, thrombo-embolic disease, patients under treat-

ment with anticoagulant drugs and patients during menstrual cycle.

Three ml of blood from every patient and healthy normal control was collected through venepuncture of anticubital vein in a vial containing 120 I.U. of Heparin. Blood viscosity measurement was done by Brookfield L.V.- ii type of viscometer with C.P. 40 cone, which works on cone and plate principal at different shear rates of 22.5, 45 and 90 respectively. After checking for leveling calibration of viscometer was done by 0.5 ml calibration fluid then 0.5 ml blood was taken in the cup of viscometer with the help of pipette. After adjusting the hit point of cone and cup, speed/shear rate (22.5, 45 and 90) and time (one minute) reading was taken after pressing enter key.

Observation:

Comparisons Whole Blood viscosity (cp) at different shear rates

Shear rate (per second)	Whole blood viscosity (centipoises)		
	Control	Diabetics without Retinopathy	Diabetics with Retinopathy
22.5	6.51±1.23	8.39±1.58	8.53±1.25
45	5.22±1.00	6.49±1.24	6.63±1.03
90	4.07±0.64	5.70±1.15	5.66±1.06

Control / diabetics without retinopathy

P value: $p < 0.001$

Control / diabetics with retinopathy

P value : $p < 0.001$

Diabetic without retinopathy / Diabetic with retinopathy

P value : $p > 0.05$

Result-

Whole blood viscosity is significantly higher than the control in both diabetics with and without retinopathy but there is no significant relationship of change of whole blood viscosity between the diabetic without retinopathy and diabetic with retinopathy.

Discussion and Conclusion –

The average duration of treatment of diabetes is more than ten years in present study; during this period of treatment some of diabetic patients developed diabetic retinopathy while others remaining unaffected. On this basis target patients were divided into two groups, diabetics with retinopathy and diabetics without retinopathy. Whole blood viscosity of patients of diabetes with retinopathy is significantly higher than controls and similar to the patients of diabetes without retinopathy. It has been reported that increase in blood haematocrit is not significant but rise in blood fibrinogen is significant in patients of diabetic retinopathy. The increase in blood viscosity is explained by high fibrinogen level in blood which subsequently increases stickiness of RBC and reduces deformability of RBC.

Diabetic retinopathy is essentially a micro-angiopathy affecting the retinal precapillary arterioles, capillaries and venules. With the resurgence role of blood hemorheology for the etiopathogenesis of many long term complications of diabetes mellitus, the role of high blood viscosity seems to play significant role in causation of diabetic retinopathy. The increase in such important rheological factors might promote stagnation of blood flow in the capillaries and post capillary venules in diabetic patients. Circulatory stagnation is supposed to play an etiological role in capillary non-perfusion, which in turn can act as a stimulus for new vessel formation which represents a major cause of blindness in diabetic people.

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