ACTA XXV CONCILIUM OPHTHALMOLOGICUM

Proceedings of the XXVth International Congress of Ophthalmology, held in Rome, Italy,

May 4-10, 1986

editors

F. Blodi, R. Brancato, G. Cristini, F. d'Ermo, I. Esente, A. Musini, B. Philipson, F. Pintucci, F. Ponte and G. Scuderi

Kugler & Ghedini

Amsterdam - Berkeley - Milano

BRANCH RETINAL VEIN OCCLUSION (BRVO). POSSIBLE ROLE OF HEMORHEOLOGICAL CHANGES IN THE PATHOGENESIS OF RETINAL ISCHEMA*

S. PIERMAROCCHI, A. GIROLAMI, T. SEGATO, E. MIDENA and H. BERTOJA
Centro per lo Studio ed il Trattamento della Retinopatia Diabetica e delle Vasculopatie Oculari, Institute of Ophthalmology, University of Padua, Italy

Introduction

Branch retinal vein occlusion is an important ocular disease and one of the leading causes of visual loss among people over fifty. It is often associated with hypertension, diabetes and other vascular disorders. Nevertheless, precise mechanisms of its pathogenesis and evolution towards different degrees of severity remain as yet obscure. It is well known that the arteriovenous crossing is the site where the occlusion is virtually always observed. Hence, mechanical factors are likely to play an important role in the appearance of retinal vein occlusion. Histologic studies have indicated that the venous lumen is compromised by the swelling of the endothelial cells in the inner venous walls, However, these findings failed to demonstrate that thrombosis is the cause of obstruction. Some authors suggested that an increase in blood viscosity could act as a triggering factor to create a rheological obstruction in a partially occluded lumen. It is well recognized that an increased blood viscosity is associated with various pathological conditions, such as macroglobulinemia or polycythemia, in which thrombosis or vascular occlusion is a feature. The role of blood viscosity in retinal vein occlusion seems to have received little attention apart from a few studies. Two of these, by Ring et al (1) and Trope and Lowe (2), have demonstrated that blood and plasma viscosity are higher in patients with retinal vein occlusion compared with age and sex matched controls. The authors inferred the blood viscosity could be involved in the pathogenesis of retinal vein occlusion.

The aim of the present study was to evaluate the role of viscosity in the etiology of branch retinal vein occlusion and the development of retinal ischemia.

Subjects and methods

Fifty-four unselected patients with long-standing branch retinal vein occlusion were investigated. The group consisted of 32 women and 22 men with a mean age of 61 years (range 38-78). Depending on the extent of the retinal ischemia evaluated with fluorescein angiography, these patients were divided into two groups. The first group included those with extensive areas of capillary non-perfusion, the second group those with only focal, if any, areas of non-perfusion. Thirty-four subjects with a mean age of 61.5 (range 45-80) were used as controls. All the patients underwent a complete ophthalmological examination; fluorescein angiography was performed only in those with thrombosis. The following parameters were evaluated:

- whole blood viscosity at three different shear rates, 230, 115 and 46 inverse second;
- hematocrit and blood viscosity corrected at standard hematocrit of 45%;
- plasma viscosity at three different shear rates;
- erythrocyte deformability.

*This study has been supported by funds from the Italian Ministry of Public Instruction

Acta XXV Concilium Ophthalmologicum
Proceedings of the XXVth International Congress of Ophthalmology, Rome, May 4-10, 1986 pp. 2205-2207.

Samples were collected and prepared according to current methods. determinations of whole blood viscosity were obtained in a platecone Wells-Brookfield viscometer. To measure the erythrocyte deformability, the modified Reid's technique was used. Other chemical determinations included fibrinogen, uric acid, globulins, glycemia and other routine examinations. The 2-tailed Student's t-test was used for comparison of the groups.

Results

Whole blood viscosity at higher shear rates was significantly increased in the thrombotic patients compared to controls. The difference still exists when group 1 or 2 are separately taken versus controls. At lower shear rates, differences remain between controls and all the thrombotic patients and between controls and group 1 (Figs. 1,2,3). The hematocrit does not show significant differences between our groups, apart from a slight difference between group 1 and group 2 (Fig. 4). Blood viscosity, once corrected at standard hematocrit of 45%, gives the same results of the basal whole blood viscosity, with a clear increase in patients with thrombosis which is more evident in those with larger ischemia (Figs. 5,6,7). Plasma viscosity is significantly increased, at higher shear rates, in all patients with branch retinal vein occlusion; but the difference is more striking between group 1 and controls. Similar correlations exist at lower shear rates of 115 inverse seconds. No difference has been observed at the lowest shear rate (Figs. 8,9,10). Erythrocyte deformability shows remarkable differences only when controls are compared with all the thrombotic patients. Only slight differences exist in the other groups (Fig. 11). Means of fibrinogen are increased in patients with thrombosis even when groups 1 and 2 are considered separately versus controls (Fig. 12). Other chemical determinations do not show statistically significant differences.

Discussion

These results confirm some previous studies, i.e., that blood viscosity is significantly increased in patients with branch retinal vein occlusion, where the larger the ischemia the higher the viscosity. In order to eliminate the determinant influence of hematocrit, blood viscosity has been regressed to standard hematocrit of 45%, although no difference has been observed between the occlusion groups and controls as far as hematocrit is concerned. Corrected mean values of blood viscosity confirm those obtained at basal hematocrit. Plasma viscosity and fibrinogen are also increased in patients with retinal vein occlusion with special regard to those with more severe capillary non-perfusion. Some authors observed reduced erythrocyte deformability in subjects with retinal thrombosis[3]. In our patients only a slight reduction in the occlusion group was observed. However, we think that these results give limited information because of possible influence of artefacts. Further studies are required to assess the role of erythrocyte deformability in the pathogenesis and evolution of retinal vein occlusions. Pathological changes in the vasculature of the retinal circulation are almost certainly a factor involved in the development of branch retinal vein occlusion. Actually, because of either pressure on the vein or a thickened venous wall due to arterial disease or endothelial proliferation, or both, an impedance to the circulation at arteriovenous crossings is observed. In this partial occlusion, the venous flow rate may fall, resulting in low shear rates which allow local increase in blood viscosity, due to red cell aggregation. This increase in viscosity is strongly favored by increases of hematocrit and fibrinogen and might be the cause of a rheological obstruction which may complete a partial anatomical occlusion.

Though the precise mechanism of capillary non-perfusion still remains obscure, it is generally accepted that the capillary may not in fact be closed, but that a state of relatively circulatory stagnation may exist. This hypothesis seems to be plausible when we consider that the most striking differences in blood viscosity were observed in those patients with severer ischemia. Therefore, an increase of blood viscosity is likely to be a determinant factor in the appearance of non-perfusion areas. This fact can eventually have some clinical consequences, because it is well established that retinal ischemia is frequently associated with neovascularization, a dreadful cause of vitreous hemorrhages, tractional retinal detachment and neovascular glaucoma.

These findings underline the role of blood viscosity in the pathogenesis and evolution of branch

retinal vein occlusion. Studies devoted to find new therapies aimed at obtaining a reduction in blood viscosity are of overwhelming interest, such a reduction being the key to a better perfusion and a way to prevent late dramatic complications of branch retinal vein occlusion.

References

1. Ring CP, Pearson TC, Sanders MD, Wetherley-Mein G: Viscosity and retinal vein thrombosis. Brit J Ophthalmol 69:397, 1976
2. Trope GE, Lowe GDO: Abnormal blood viscosity and haemostasis in long-standing retinal vein occlusion. Brit J Ophthalmol 67:137, 1983
3. Peduzzi M, Codeluppi L, Poggi M, Baraldi P: Abnormal blood viscosity and erythrocyte deformability in retinal vein occlusion. Am J Ophthalmol 96:399, 1983