Clinical Hemorheology and Microcirculation 24 (2001) 117–118
IOS Press

Letter to the Editors-in-Chief

Acute problems of the hemorheological analysis

George Mchedlishvili
Microcirculation Research Center, I. Beritashvili Institute of Physiology, 14 Gotua Str., 380060 Tbilisi, Georgia

Accepted 3 January 2001

Clinical hemorheology is purposefully developing in the recent decades and its active role becomes increasingly significant for the biomedical research and medical practice. The progress in this field is primarily related to the fact that new experimental and clinical data, that are steadily accumulated, prove that hemorheological disorders play a most significant role in development of such pathologies as the arterial hypertension, cardiac and cerebral infarcts, complications of diabetes mellitus, and many others.

In addition to clinical investigations in the field, the specialists are intending to make a careful pathophysiological analysis of the hemorheological disorders and their effects on the blood circulation during development of various pathologies. Leading role in these processes is played by the specialist scientific periodical, the *Clinical Hemorheology and Microcirculation*, which publishes the recent information on all the principal achievements in the field.

Intensive research is also conducted to improve the modern hemorheological methodology. The accumulated experience provided the medical personal with a possibility to formulate certain conclusions on the blood rheological properties and disorders, primarily in the microvessels. Proceeding from the perennial research experience certain progress has been attained for consideration of the following points being essential for further development of clinical hemorheology:

Problem 1. *Which are the blood vessels where the blood rheological phenomena are to be primarily considered*, while blood is persistently circulating in vessels of various caliber – from the aorta to millions of capillaries whose lumina is commensurable with the blood cells. In this latter case, i.e., in the capillaries, the blood is actually not a fluid and its flow does not obey therefore the well-known regularities of hydro-mechanics. It should be also taken into account that in the most narrow microvessels, i.e., in the capillaries and the adjacent arterioles and venules, the resistance to flow should be very high (the Poiseulle's law). Therefore, the hemorheological scientists have to consider the blood flow resistance phenomena primarily related to these most narrow vessels and to take into account the mentioned resistance specificity.

Problem 2. *Which hemorheological variables are to be primarily investigated in the microvessels*. The most reliable experimental results related to the factors disturbing the blood fluidity in capillaries can be obtained under the condition of a constant microvessels diameters and pressure gradient along

their course. Proceeding from the perennial research we came to the following conclusions. It is the RBC aggregation measured with the reliable techniques that is to be taken into account as the most significant hemorheological factor disturbing the blood fluidity up to a full-stop of flow in the narrowest microvessels. Other hemorheological factors that disturb the blood flow in living capillaries are as follows (they are mentioned here in a decreasing degree): the risen local hematocrit, the lowered RBC deformability, and the increased blood plasma viscosity. We are not mentioning some other hemorheological indices whose effects seem to be less pronounced (like the zeta-potential) or those which affect the blood rheological properties in microvessels not directly but via the indices mentioned above (e.g., the plasma fibrinogen contents, etc.).

Problem 3. *What techniques are to be applied for investigation of the hemorheological variables*. There are no problems with investigation of the hematocrit and plasma viscosity in patients blood, since there are direct and quantitative techniques for evaluation of these hemorheological indices. Because of that the results of their investigations, which are obtained in different laboratories, can be considered as sufficiently reliable and comparable (this latter attribute is especially significant). Quite different situation is with investigation of the RBC aggregability and deformability, which are investigated mainly with the indirect techniques. There are already many dozens of techniques proposed by various authors for investigation of the RBC aggregability in the patients' blood, and the number of these techniques is gradually increased every year. Almost similar is the situation with the RBC deformability. This makes the problem of investigation of these two hemorheological indices to such a degree complicated that further progress of the biomedical field is to a great extent dependent on the success of a choice and standardization of the investigation techniques of the both aggregability and deformability of the RBCs.

Especially complex is the problem with investigation of RBC aggregability. Attempts to substantiate the criteria for the best choice of the techniques were made by the present author and published twice in *Clinical Hemorheology and Microcirculation*. The first publication appeared in 1996 (vol. 16, pp. 193–194) and further, the more specified criteria were presented for discussion at the X European (Lisbon, Portugal) and than at the III International (Pecs, Hungary) Conferences. The proposed criteria were published in *Clinical Hemorheology and Microcirculation* (vol. 19, pp. 161–162, 1998). Unfortunately, despite the author's urgent requests, no critical comments and discussion were made either at the sessions nor later, so that the problem remained so far actually unsolved.

The correct choice and standardization of the investigation techniques for the RBC aggregability and deformability in the patients blood were and remain to be the problems of first order. If a clear-cut decision of these problems is not made again, the situation, naturally, will become even more critical, since the number of the proposed techniques steadily increases and chaos in the understanding of the blood rheological properties and disorders in the microcirculation might be raised even more in the world in future.