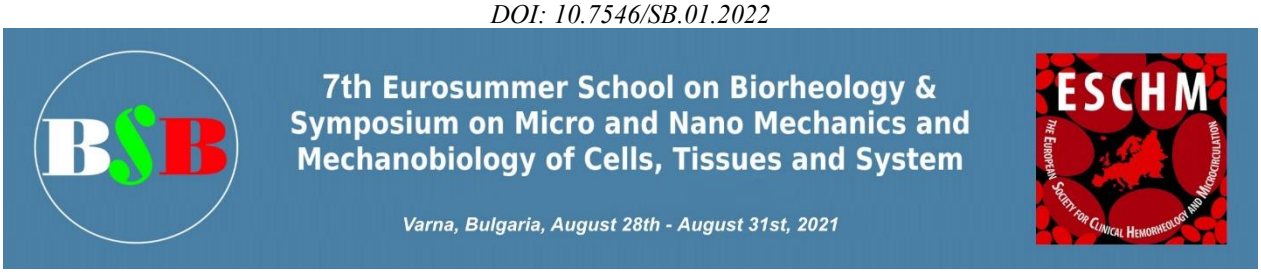
Series on Biomechanics, Vol.36 No.1 (2022), 3-6
DOI: 10.7546/SB.01.2022



The 7th European Summer School on Biorheology and the Symposium on Micro- and Nanomechanics and Mechanobiology of Cells Tissues and Systems (BIORHEO 2021) – (https://biorheo2021.bsb-bg.eu/), have been organized for the seventh time in Bulgaria from August 28th – 31st, 2021. The International scientific forum BIORHEO 2021 was held at the International Home of Scientists "Frederick Joliot-Curie" – in the famous resort "St. Konstantin and Elena", near Varna. The meeting was organized by the Bulgarian Society of Biorheology – in cooperation with the European Society of Clinical Hemorheology and Microcirculation (E.S.C.H.M) and co-organized by the Institute of Mechanics at the Bulgarian Academy of Sciences. The forum was held in person, and for the foreign and some of the Bulgarian participants - remotely, due to the pandemic situation. Biorheo2021 was held two months after the 2nd three society meeting of the European Society of Clinical Hemorheology and Microcirculation, the International Society of Clinical Hemorheology and the International Society of Biorheology (ESCHM-ISCH-ISB2021 Fukuoka) in Fukuoka, Japan. July 2021. The aim of BIORHEO 2021 was to contribute for the international cooperation and contacts of scientists, to attract students, PhD-students, Post Doc-students and young researchers to improve their training and original studies in the field of Biorheology, Micro- and Nano-Mechanics and Mechanobiology of cells, tissues and Biosystems. The forum BIORHEO 2021 brings together specialists in the field of Biorheology and Biomechanics from different countries and continents.

A group of the participants in Biorheo2021, attended in person, Varna

The 39 presentations – 22 plenary lectures, 13 scientific communications and 4 posters, have been presented by the invited scientists from national and international institutes, universities and laboratories from Argentina, Belarus, Bulgaria, France, Georgia, Hungary, Japan, Mexico, Poland, Portugal, Russia and Turkey. The full text of some of the presented lectures is published in the current issue of the Journal "Series on Biomechanics", vol. 36/1, 2022.

Prominent lecturers have delivered their plenary lectures, namely:

L1. Acad. Prof. Yatchko Ivanov (Bulgaria) presented interesting lecture on the importance and usefulness of polymers in the different branches of biomedicine and in many fields of human life.

L2. Prof. Jean-Frederic Brun (France), et al., delivered lecture on the circulating biomolecules involved in the regulation and modulation of red blood cell (RBC-) deformability and aggregation.

L3. Prof. Alexey Muravyov (Russia) and his co-authors discussed the micro-rheological responses of erythrocytes to the gasotransmetters - nitric oxide (NO) and hydrogen sulfide (H2S), in healthy individuals and in patients with type 2 Diabetes mellitus.

L4. Prof. Norbert Nemeth (Hungary) delivered his Review paper summarizing main aspects of physiology & pathology of vascular anastomoses (including experimental – surgical- and microsurgical models, influenced by hemodynamic- and hemorheological conditions).

L5. Prof. B. Grzegorzewski and A. Szolna-Chodor (Poland) examined the influence of glucose and of polymers (poloxamers), on the temporal changes in RBC-aggregability.

L6. Prof. Bibiana Riquelme, et al., (Argentina) presented their own original techniques to evaluate the RBC micromechanics - methods promising to be helpful in Biomedicine and Biorheology.

L7. Prof. Eugene V. Roitman (Russia) discussed main rheological characteristics of blood, treatment of coagulopathies and endothelium dysfunctions in patients with acute severe COVID-19 and the ''post-COVID syndrome".

L8.The aim of prof. Carlota Saldanha`s presentation (Portugal), was to summarize all literature data (2019 – 2021) on the role of erythrocytes in the patients with COVID-19 infection.

L9. Dr. Blagovest Bechev et al., (Bulgaria) discussed the interrelationships between neutrophil activation and microcirculatory problems during COVID-19, and the changes in the neutrophil-to lymphocyte ratio, as critical biomarkers in cases of severe COVID-19.

L10. Assoc. prof. Dr. Elissaveta Zvetkova, prof. Nadia Antonova and co-authors (Dr. A.Alexandrova, Dr. G.Kostov and prof. D. Fuchs), presented literature data on the hematological-, hematometrical- and hemorheological indices (parameters), as prognostic biomarkers during treatment and management of COVID-19 infection: lymphopenia, eosinopenia, thrombocytopenia, elevated neutrophil-to-lymphocyte ratio, elevated RDW (red blood cell distribution width), high IL-6 and neopterin levels, activited C-reactive protein, elevated fibrinogen and D-dimer, etc.).

L11. Prof. Maya Mantskava et al., (Georgia) examined RBC aggregation- and RBC deformation indices in patients with COVID19 and with additional "Covid-toes" complications. Rheological disturbances are related to an increase in erythrocyte aggregation index (EAI). The similar data in a group of patients with Raynaud`s phenomenon were not associated with elevated EAI.

L12. In their plenary lecture, the scientists Dr. Michinary Hieda and Dr. Toru Maruyama (Japan), discussed clinical management of acquired von Willebrand disease in patients with left ventricular assist device (L.V.A.D.). Based on blood rheology data, fundamental causes of clinical complications in patients have been presented and analysed.

L13. Prof. Irina Tikhomirova et al., (Russia) delivered plenary lecture on the clotting (clot formation), in the presence of gasotransmitters. The effects of gasotransmitters - nitric oxide (NO) and hydrogene sulfide (H2S), were estimated in cancer patients and in healthy individuals (controls). The results obtained show that both –

NO and H_2S, improved blood clotting parameters: blood clotting time was moderately prolonged and intensity of coagulation process was lowered.

L14. Prof. Elena Konstantinova and co-authors (Belarus) have performed a comparative study of main hemorheological and microcirculation parameters (indices) in patients with cardiovascular pathology, depending on the presence of Diabetes mellitus type 2. The disorders in the regulation of microcirculation are leading pathophysiological factors (inducing DM2 vascular complications).

L15. The plenary lecture of Dr. Svetoslav Jovtchev et al., (Bulgaria) - "Red blood cell aggregation in hypertension", is of great interest in the routine medical practice. The specific RBC- and plasma factors, controlling the red blood cell (RBC-) aggregability, have been evaluated and characterized *in vitro*, in the experimental model of RBCs exhibiting different (low and/or enhanced) aggregation, in the same culture medium.

L16. In an interesting plenary lecture, assoc. prof. Dr. Irena Velcheva and prof. Dr. Nadia Antonova (Bulgaria) presented their great experience in the field of parallel - hemorheological and neuro-sonographic investigations. Significant increase of hematocrit (Ht) and whole blood viscosity (WBV) in the patients with cerebrovascular diseases (CVDs), as well as elevated plasma viscosity (PV) in patients with risk of CVD-development (in comparison with healthy individuals – controls), were found. The results of investigations revealed relationships and positive correlations between main hemorheological and neurosonographic parameters.

L17. In the plenary lecture of prof. Alexey Muravyov et al., (Russia), presented experimental results related to the effects of gasotransmitter donors (GTDs - NO and H2S), on the RBC rheological properties – in patients with solid non-myeloid malignancies as well as in healthy individuals (controls). A reduced RBC deformability was observed in cancer patients. The positive effects of GTDs on the RBC microrheological characteristics - in the both experimental groups, have been evaluated.

L18. Assoc. Prof. Andrey Lugovtsov et al., (Russia) studied simultaneously interrelationships between blood microrheological- and microcirculation parameters – in healthy individuals and in patients with arterial hypertension (AH) and diabetes mellitus type 2 (DM2). The new techniques of laser diffractometry, laser trapping and capillaroscopy etc., were applied. The results obtained have shown that the ability of erythrocyte to deform is slightly reduced, while the aggregation speed and forces of inter-cellular RBC interactions are significantly increased in the AH- and DM2 patients, relative to the control group healthy persons.

L19. Prof. Alexander Priezzhev and his study group from Moscow state University "Lomonosov", Russia, using special laser optical techniques – applied *in vivo* and *in vitro,* as RBC aggregometry, laser diffractometry, laser trapping, manipulation of single RBC, digital capillaroscopy, etc., well characterized RBC aggregation, deformability and capillary flow properties (microcirculation). The results obtained are important to be applied in the clinical practice.

L.20. Prof. Dr. Sami Aydogan (Turkey), in his plenary lecture presented the lifespan of erythrocytes (RBCs): bone marrow erythropoiesis, RBC maturation and aging, RBC senescence, etc. The multiple biomarkers of RBC senescence, appearing in main pathological disorders, were discussed in relationships to the diagnosis and treatment of socially important diseases.

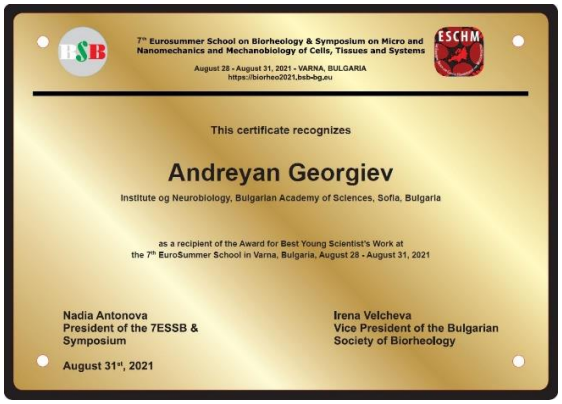
L21. Prof. Dr. Nadia Antonova and co-authors (Bulgaria), proposed in her plenary lecture, a Module for simultaneously measurements of electrical parameters and rheological properties of blood samples – of importance for medical practice.

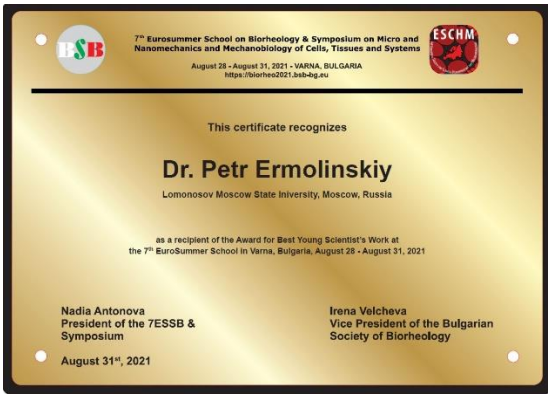
L22. Prof. A. G. Kuchumov et al., (Russia), proposed a new method for simulation of blood flow in the cardiovascular system. The method based on 2D and 3Dmodels to evaluate modified Blalock-Taussig shunt, could improve the efficiency of operative decisions in the children surgery (in cases of congenital heart diseases).

Interesting reports were also presented by Assoc. Prof. Dr. Miglena Kirilova, Assoc. Prof. Dr. G. Nikolova and Prof. D. Dantchev, Chief Assistant Dr. Ivan Ivanov, Chief Assistant Dr. Vasilka Paskova, Chief Assistant

Dr. Elitsa Petrova and Anika Alexandrova from the Department of Biomechanics at the Institute of Mechanics at the Bulgarian Academy of Sciences. The results of a joint study on: Investigation of the rheological properties of blood in patients with type 2 diabetes mellitus have been reported by the research team A. Alexandrova, N. Antonova, A. V. Muravyov, Khr. Khristov, I. Velcheva. Poster presentations were presented by Assoc. Prof. Ekaterina Pavlova and co-authors (IEMPAM-BAS), Peter Ermolinskiy and Alexei Semyonov (Lomonosov Moscow State University, Moscow). The research and teaching experience in the field of hemorheology were presented by Dr. Sv. Alexandrov and Dr. Sv. Miteva and co-authors from the Department of Medical Physics and Biophysics, Medical Faculty, Medical University of Sofia, Bulgaria. During the BIORHEO 2021 Summer School, a competition of young scientists for the best scientific work was organized. Applications for participation in the competition received four young scientists from Bulgaria and Russia. Two of reports presented during the School were awarded with plaques:

- Author: Andreyan Georgiev from the Institute of Neurobiology – Bulgarian Academy of Sciences, Bulgaria; with supervisor assoc. prof. Dr. Maria Antonova; Title: "Experimental estimation and comparison of viscoelastic characteristics of rat aorta *in vitro"*.
- Author: Peter Ermolinskiy from Moscow state University "Lomonosov", Russia; with supervisor prof. Alexander Priezzhev; Title: "Effect of red blood cell aging on their microrheological parameters";





The scientific forum ensured very good conditions for extensive exchanges of news, views, hypotheses, experience in investigations, collaborations, social contacts and activities. The intensive contacts and collaboration between scientists working in fundamental/theoretical and applied/practical biorheology and hemorheology could ensure continuity in investigations and will attract young researchers for best scientific work.

The 7th European Summer School on Biorheology and the Symposium on Micro- and Nanomechanics and Mechanobiology of Cells Tissues and Systems (BIORHEO 2021) was successfully realized with the financial support of the Bulgarian National Science Research Fund: Contract КП-06-МНФ/1, from 18.08.2021

Compliers and Editors:

Ya. Ivanov, N. Antonova, M. Rampling, E. Zvetkova