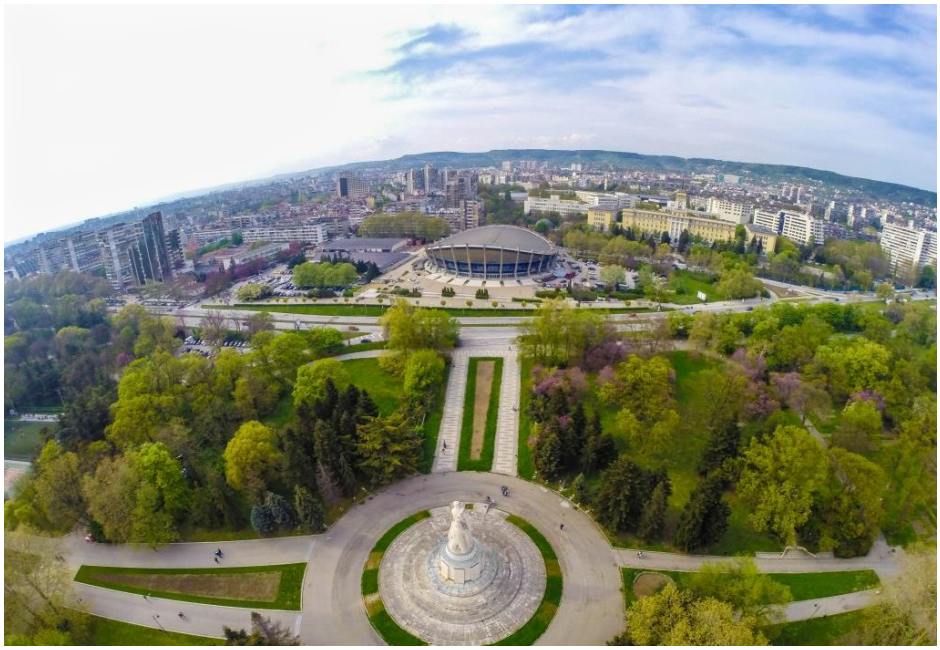
8th EUROSUMMER SCHOOL ON BIORHEOLOGY
and
SYMPOSIUM ON MICRO AND NANOMECHANICS AND MECHANOBIOLOGY OF CELLS, TISSUES AND SYSTEMS

VARNA, BULGARIA
AUGUST 28 - 30, 2024
http://www.biorheo2024.bsb-bg.eu

A meeting organized by the
Bulgarian Society of Biorheology (theoretical, experimental and clinical)
in cooperation with the
European Society of Clinical Hemorheology and Microcirculation
Coorganizers:
Institute of Mechanics to the Bulgarian Academy of Sciences
Section Mechanics to the Union of Scientists in Bulgaria



Avangard Prima, 2024

SCIENTIFIC PROGRAM AND ABSTRACTS of the
8th Eurosummer School on Biorheology and Symposium on Micro and Nanomechanics and Mechanobiology of Cells, Tissues and Systems, Varna, Bulgaria
August 28th - 30th, 2021,
http://www.biorheo2024.bsb-bg.eu

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Dear Participants,

Dear Guests and Friends,

It is our great pleasure to welcome you in Varna, Bulgaria to the 8th **Eurosummer School on Biorheology & Symposium on Micro and Nano Mechanics and Mechanobiology of Cells, Tissues and Systems** from August 28th to 30th, 2024. The Bulgarian Society of Biorheology, in cooperation with the European Society of Clinical Hemorheology and Microcirculation (E.S.C.H.M.) and Department on Biomechanics at the Institute of Mechanics to the Bulgarian Academy of Sciences organize for the seventh time in Bulgaria the European Summer School and Symposium on Biorheology and Symposium on micro- and nano - mechanics and mehanobiology of cells, tissues and systems (Biorheo2024), held at the International Home of Scientists "F. Joliot-Curie" in Varna from August 28 to 30, 2024. The 46 presentations scheduled (18 lectures, 19 communications and 9 posters) will be presented by the invited prominent lecturers from prestigious national and international universities, research institutes and laboratories as well as by young scientists from many countries (Argentina, Belarus, Bulgaria, Georgia, Greece, Hungary, Mexico, Poland, Russia and Serbia).

During the School a competition for the best scientific work of young investigators was organized and young scientists will be awarded. Applications for participation in the competition have been made by four young researchers from Hungary and Russia. The presented at the meeting lectures, communications and posters will be published in J. Series of Biomechanics after reviewing.

Thank you for being part of this scientific event. We wish you all a warm welcome and some fruitful days of scientific collaborations and social contacts! We sincerely hope that you will find the meeting convincing and rewarding. We do hope that this scientific forum will ensure very good conditions for an extensive exchange of experience, views and personal contacts.

More about the Biorheo2024 school and the symposium and its scientific program can be found on http://biorheo2024.bsb-bg.eu

On behalf of the Organizing Committee

Nadia Antonova, Prof., Ph D
President of the Bulgarian Society of Biorheology
and
Past President of the European Society for
Clinical Hemorheology and Microcirculation

Varna, August 28-30th, 2024

The financial support by the Bulgarian National Science Fund: Agreement КП-06-МНФ 11/23.05.2024 is gratefully acknowledged

SCIENTIFIC PROGRAM
Wednesday, August 28th, 2024

9:00-15:30
Registration

9:30-10:00
Opening Ceremony, **Welcome Addresses**

Session 1: Clinical Hemorheology and Hyperviscosity syndromes

Chairperson: **I. Velcheva**

09:30-10:00
L1. Microcirculatory and micro-rheological relations of lymphedema
N. Nemeth
Department of Operative Techniques and Surgical Research,
Institute of Surgery, Faculty of Medicine, University of Debrecen, Debrecen, Hungary

10:00-10:30
L2. Coronary microvascular dysfunction in heart failure: observations from the MICRO Registry
O. Velollari[1], M. Olschweski[1], K-P. Kresoja[1], J. Herzog[1], K. Schnitzler[1], M. Brandt[1], M. Knorr[1], P. Wenzel[1], P. Lurz[1], T. Gori[1]
[1] Department of Cardiology, University Medical Center of the Johannes Gutenberg University Mainz, Germany

10:30-10:50
Coffee Break

10:50-11:20
L3. Significance of whole blood viscosity in acute ischemic stroke
I.Velcheva
Department of Neurology, Uni Hospital, Panagyurishte, Bulgaria

11:20-11:40
L4. Hemodynamics of BRASH Syndrome Observed in Gerontology
Toru Maruyama, MD., PhD.[1], Michinari Hieda, MD., PhD[2].
[1]Haradoi Hospital and [2]Kyushu University Hospital, Fukuoka, Japan

11:40-12:00
L5. Simultaneous study of coagulation and rheological systems in patients with ischemic stroke
M.Mantskava[1], N. Momtselidze[1], G. Kuchava[1], N. Kharaishvili[1,2], Sh. Ingorokva[2]
[1]Ivane Beritashvili Experimental Center of Biomedicine, Tbilisi, Georgia
[2]High Technology Medical Centre, University Clinic, Tbilisi, Georgia

12:00-13:00
Lunch

Session 2: HEMORHEOLOGY AND MICROCIRCULATION
Chairperson: **N. Antonova**

13:00-13:30
L6. Application of laser-optic techniques in the studies of blood microrheology in norm and pathology
A.V. Priezzhev, A.E. Lugovtsov, P.B. Ermolinskiy
Physics Department of Lomonosov Moscow State University, Moscow, Russia

13:30-14:00
L7. Blood microrheological and microcirculation alterations under age-associated diseases of the cardiovascular system
Lugovtsov A.E. [a], Ermolinsky P.B. [a], Maksimov M.K. [a], Gurfinkel Yu.I. [b], Karanadze N.A. [b], Orlova Ya.A. [b], Dyachuk L.I. [b], Mironov N.A. [b], Priezzhev A.V. [a]

14:00-14:30
L8. Microrheological responses of erythrocytes to gasotransmitters, by inhibiting guanylate cyclase, NO synthase and blocking ATP-dependent and calcium-dependent potassium channels
[1]I. Tikhomirova, [2]A. Priezzhev, [2]A. Lugovtsov, [1]A. Muravyov
[1]Department of Medicine and Biology, State Pedagogical University, Yaroslavl, Russia
[2] Lomonosov Moscow State University, Moscow, Russia

14:30-15:00
Coffee Break

15:00-15:30
L9. Interrelation of blood rheology and hemostasis with metabolism of NO and H_2S in post-COVID period
I. Tikhomirova[a], A. Muravyov[a], E. Petrochenko[a], A. Priezzhev[b], A. Lugovtsov[b]
[a] Yaroslavl State Pedagogical University, 150000 Respublikanskaya, 108/1, Yaroslavl, Russia
[b] Lomonosov Moscow State University, Faculty of Physics, Russia

15:30-16:00
L10. Innovative AC Phase Shift Technique for Rapid and Precise Blood Clotting Time Measurement
Roumen Zlatev[1], Nadia Antonova[2], Margarita Stoytcheva[1], Rogelio Ramos[1]
[1]Universidad Autónoma de Baja California, Instituto de Ingeniería, México; [2]Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., bl. 4, 1113 Sofia, Bulgaria

16:00-16:30
L11. Blood rheology on modified rheometer surfaces
U. Windberger[1], K. Schneider[2], S. Rohringer[2], L. Noirez[3]
[1]Center for Anatomy and Cell Biology, Medical University Vienna, Austria
[2]Center for Biomedical Research, Medical University Vienna, Austria
[3]Laboratoire Léon Brillouin (CEA-CNRS), University Paris-Saclay, France

16:30-17:00
L12. Protective effect of two standard preservation media on irradiated and storage erythrocytes: Rheological comparative evaluation
Alet A I[1,2], Porini S[3], Castellini H V[5], Detarsio G[1], Galassi M[3,5], Aresi A[6], Di Tullio L[1, 6], Acosta A[6], Riquelme B D[1, 2, 3]
[1] Facultad Cs. Bioquímicas y Farmacéuticas (UNR), Suipacha 535, 2000 Rosario, Argentina; [2] Consejo de Investigaciones de la Universidad Nacional de Rosario (CIUNR), Rosario, Argentina; [3] Grupo de Física Biomédica, IFIR (CONICET-UNR), 2000 Rosario, Argentina
[5] Facultad de Ciencias Exactas, Ingeniería y Agrimensura (UNR), Rosario, Argentina
[6] Centro Regional de Hemoterapia de Rosario, Rosario, Argentina

20:00
Welcome Reception

Thursday, August 29th, 2024

Session 3: RED BLOOD CELL AGGREGATION AND DEFORMABILITY
Chairperson: **Sv. Jovtchev**

09:00-09:30
L13. Red blood cell aggregability in hypertension
S. Jovtchev[a], S. Stoeff[a], S. Alexandrov[a], S. Miteva[a], B. Bechev[a], I. Buteva[b], M. Vretenarska[c], V. Iliev [d,e]
[a] Dept. of Medical Physics and Biophysics, Medical Faculty, Medical University – Sofia, Bulgaria, [b] OGW/MHAT "Nadezhda" Sofia, [c] 2nd MHAT Sofia, Nephrology Ward, [d] MC Vitclinic, [e]Military Medical Academy of Sofia

09:30-09:50
Elongation index derivative: a promising hemorheological parameter in Diabetes mellitus erythrocyte analysis
Ivana T. Drvenica[1], Mihajlo D. Radmilović[2], Vesna Lj. Ilić[1], Drenka Trivanović[1], Ana Petakov[3], Katarina Lalić[3,4], Mihailo D. Rabasović[2], Aleksandar J. Krmpot[2]
[1]Institute for Medical Research, National Institute of Republic of Serbia, University of Belgrade, Belgrade, Serbia; [2]Institute of Physics Belgrade, University of Belgrade, Serbia; [3] Clinic for Endocrinology, Diabetes and Metabolic Diseases, University Clinical Center of Serbia, Belgrade, Serbia; [4] Faculty of Medicine, University of Belgrade, Belgrade, Serbia

09:50-10:10
Neutral polymer properties effecting the red blood cell aggregation
S. Miteva, S. Alexandrov, S. Stoeff, N. Avakumova, L. Traikov, S. Jovtchev
Dept. of Medical Physics and Biophysics, Medical Faculty, Medical University – Sofia, Bulgaria

10:10-10:30
Polymer depletion from biological surfaces – an electrophoretic investigation
S. Alexandrov, S. Stoeff, S. Jovtchev
Dept. of Medical Physics and Biophysics, Medical Faculty, Medical University – Sofia, Bulgaria

10:30-10:50 **Coffee Break**

Session 4: RHEOLOGY, MICRO AND NANO MECHANICS OF BLOOD CELLS
Chairperson: **Eugeni Koytchev**

10:50-11:20
L14. Synthesis and physical characteristics of magnetic nanoparticles coated with albumin and casein for the needs of nanomedicine. A theoretical and experimental study
I. Antonov
Dept. Medical Physics and Biophysics of Medical University Sofia, Bulgaria

11:20-11:40
Impact of albumin and casein modified magnetic nanoparticles on blood hemorheological parameters and the functional state of human neutrophils by evaluating their chemiluminescent response upon stimulation with Zymosan, fMLF and PMA
B. Bechev[1], I. Antonov[1], K. Kavaldzhieva[2], S. Stoeff[1], S. Jovtchev[1], S. Alexandrov[1]
[1]Dept. Medical Physics and Biophysics of Medical University Sofia Bulgaria
[2]Dept Biology of Medical University Sofia Bulgaria

11:40-12:00
Non-Newtonian behavior of complex fluids studied in nano/micro-scale confinements
Plamen Tchoukov
Institute of Physical Chemistry, Bulgarian Academy of Sciences, "Acad. G. Bonchev" Str. bl. 11, 1113 Sofia, Bulgaria

12:00-13:00
Lunch

Session 5: RHEOLOGY, MICRO AND NANO MECHANICS OF BLOOD CELLS AND VASCULAR CELLS
Chairpersons: **Miglena Doneva** and **Eugeni Koytchev**

13:00-13:20
Hematological and hemorheological parameters of blood platelets as biomarkers in diabetes mellitus type 2. A comprehensive review
Elissaveta Zvetkova [1], Ivan Ivanov [2,3], Eugeni Koytchev[3], Nadia Antonova[3], Yordanka Gluhcheva[4], Anika Alexandrova[3], Georgi Kostov[5]
[1]Bulgarian Society of Biorheology, Sofia, Bulgaria; [2]National Sports Academy "V. Levski", Sofia, Bulgaria; [3] Inst. of Mechanics, Bulgarian Academy of Sciences, Sofia, Bulgaria; [4] Instit. of Experimental Morphology, Pathology and Anthropology with Museum, Bulgarian Academy of Sciences, Sofia, Bulgaria;[5] Oncological Hospital, Veliko Turnovo, Bulgaria

13:20-13:50
L15. Overview of the lifespan of plateles (The Relationship Between Stuructural, Functional and Behaviour Properties)
S. Aydogan[1], Burcu Aydogan[2]
[1] Yüksek İhtisas University, Faculty of Medicine, Department of Physiology, Ankara, Turkey
[2] Ufuk University, Faculty of Medicine, Department of Physiology, Ankara, Turkey
13:50-14:10

Influence of blood flow on the mechanical and rheological properties, as well as the activation and adhesion of white blood cells to the endothelium

T. Vukova[1], S. Apostolova[1], I. Georgieva[1], R. Tzoneva[1], N. Antonova[2]
[1]Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences, Laboratory: Transmembrane signaling; [2] Dept. Biomechanics, Institute of Mechanics to the Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria

14:10-14:30

Hematological changes in adult rats in conditions of diabetes mellitus and cadmium exposure

Yordanka Gluhcheva[1], Ekaterina Pavlova[1], Emilia Petrova[1], Rosen Ivanov[1], Ivelin Vladov[1], Anastasija Ilovska[2], Nina Atanassova[1]
[1]Institute of Experimental Morphology, Pathology and Anthropology with Museum, Bulgarian Academy of Sciences, Acad. Georgi Bonchev, Str., Bl. 25, 1113 Sofia, Bulgaria

Session 6. BIOMECHANICS AND CONTROL OF HUMAN MOTION

Chairpersons: **V. Kotev and I. Ivanov**

14:30-14:50

Studying the mass-inertial characteristics in some NASA positions of astronauts: investigation based on improved 3D model of the human body

Gergana S. Nikolova[a], Daniel M. Dantchev[a], Mihail S. Tsveov[a], Vladimir K. Kotev[a,b]
[a]Institute of Mechanics, Bulgarian Academy of Sciences, Department of Biomechanics, Acad., G. Bonchev Str., Building 4, Sofia 1113, Bulgaria; [b] University of National and World Economy, Student Town, UNWE, 1700, Sofia, Bulgaria

14:50-15:10

Girls versus boys' tennis players: Comparison of body composition contents

Gergana S. Nikolova[a], Albena B. Dimitrova [b,c], Daniel M. Dantchev[a]
[a]Institute of Mechanics, Bulgarian Academy of Sciences, Department of Biomechanics, Acad., G. Bonchev Str., Bl. 4, Sofia 1113, Bulgaria; [b] Institute of Experimental Morphology, Pathology and Anthropology with Museum, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 25; [c]National Sports Academy "Vassil Levski", 1700 Sofia, Bulgaria

15:10-15:30

Biomechanical jump performance of adolescent basketball female players after an isometric stretching program

Ivan Ivanov[1,2], Blagovest Glavev[3], Galia Rusimova[1], Sergey Ranchev[2]
[1]Anatomy and biomechanics Department, National Sports Academy "Vassil Levski"
[2]Institute of Mechanics, Bulgarian Academy of Sciences, Sofia, Bulgaria

15:30-16:00

Coffee Break

SESSION OF THE YOUNG SCIENTISTS

16:00-16:20
Changes in microcirculation and tensile strength in small intestine end-to-end anastomoses in experimental model*
Adam Varga, Adam Attila Matrai, Laszlo Adam Fazekas, Erzsebet Vanyolos, Murtadha Qais Muhsin Al-Khafaji, Norbert Nemeth
Department of Operative Techniques and Surgical Research, Faculty of Medicine, University of Debrecen, Hungary

16:20-16:40
Investigating vascularization of mesenchymal mesoblastic nephroma: hemorheology, microcirculation and histomorphology*
Adam Attila Matrai[1], Alexandra Barkoczi[2], Adam Varga[1], Laszlo Adam Fazekas[1], Ho Quang Tri Vinh[1], Gyorgy Trencsenyi[3], Judit Peline Szabo[3], Tamas Nagy[3], Brigitta Orlik[4], Norbert Nemeth[1], Adam Deak[1]
[1]Department of Operative Techniques and Surgical Research, Faculty of Medicine, University of Debrecen, Hungary
[2]Department of Urology, Faculty of Medicine, University of Debrecen, Hungary
[3]Department of Nuclear Medicine and Translational Imaging, Faculty of Medicine, University of Debrecen, Hungary
[4]Department of Pathology, Faculty of Medicine, University of Debrecen, Hungary

16:40-17:00
The impact of interferon-alpha on RBC-endothelium interaction: optical tweezers study
Matvei Maksimov[a], Petr Ermolinskiy[a], Danila Umerenkov[a], Olga Scheglovitova[b], Andrei Lugovtsov[a], Alexander Priezzhev[a]
[a] Faculty of Physics, Lomonosov Moscow State University, 119991 Moscow, Russia; [b] The Gamaleya National center, Moscow, Russia

17:00-17:20
Assessing the microcirculation and microrheology of blood in patients with type 2 diabetes mellitus by different optical techniques*
Danila Umerenkov, Petr Ermolinskiy, Yury Gurfinkel, Andrei Lugovtsov, Alexander Priezzhev
Faculty of Physics, Lomonosov Moscow State University, 119991 Moscow, Russia

(The studies participate in the competition for best work of a young scientist)

17:20-17:40
Awarding

20:00-23:00
Official Dinner

Friday, August 30th, 2024

9:00-9:30

L 16. Estimation of IHD patients' parameters of oxygen transfer for creation of binary classification models of functional state of the microcirculation system

E.E. Konstantinova[a], O.S. Spiridonova[b], N.L. Tsapaeva[a], E.N. Hubar[c]
[a] Belorussian State Medical University, Minsk, Belarus; [b] Company "HiQo Solutions", Minsk, Belarus; [c]Multifunctional Medical Centre "Mercy", Minsk, Belarus

9:30-10:00

L 17. Biomechanics of aortic valve: numerical simulation and additive manufacturing

Alex G. Kuchumov, Nikita Pil, Andrey Drozdov, Polina Kilina
Perm National Research Polytechnic University, Perm, Russia

10:00-10:20

Selective laser melting technology development for coronary stents

Polina Kilina[1], Alex G. Kuchumov[2,3]
[1] Department of Innovative Engineering Technologies, Perm National Research Polytechnic University, Perm, Russia; [2] Biofluids Laboratory, Perm National Research Polytechnic University, Perm, Russia; [3] Department of Computational Mathematics, Perm National Research Polytechnic University, Perm, Russia

10:20-10:40

Biomaterials for treating consequences of periimplantitis. Strategies for development and application

Eugeni Koytchev, Nadia Antonova
Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 4, 1113 Sofia, Bulgaria

10:40-11:00

Coffee Break

11:00-11:20

Long COVID and Microcirculation

Aristotle G. Koutsiaris
Medical Informatics and Biomedical Imaging (MIBI) Laboratory, Faculty of Medicine, School of Health Sciences, University of Thessaly, Biopolis Campus, Larissa, Greece

11:20-11:40

Biopsychosocial Determinants of Metabolic Control and Microvascular Health: An Interdisciplinary Approach.

Polimira Miteva[1], Anna Alexandrova-Karamanova[1], Nadia Antonova[2], Ekaterina Dimitrova[1]
[1]Institute for Population and Human Studies, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 6, 1113 Sofia, Bulgaria; [2]Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 4, 1113 Sofia, Bulgaria

11:40-12:00

Training High School Students in First Aid: A Peer-Led Initiative by Medical Students

Natia Jojua, Tinatin Gognadze, Lasha Dolidze
European University, Tbilisi, Georgia

12:00-13:00
Lunch

13:00-13:30
N. Antonova
Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 4, 1113 Sofia, Bulgaria
L18. Methodological Aspects in Blood Rheology - From Experiments to Numerical Simulations and Instrument Development

13:30-14:30
POSTER SESSION
Chairpersons: **N. Antonova** and **I. Velcheva**

P1. Characterization of explanted hernia meshes
M. Doneva[1,2], D.Pashkouleva[1], S. Sopotenski[3]
[1]Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 4, 1113 Sofia, Bulgaria; [2]Faculty of Pharmacy, Medical University of Sofia, 2 Dunav Str., 1000 Sofia, Bulgaria; [3]St. Sofia Hospital, Sofia, Bulgaria

P2. Clinically relevant experiments with hernia meshes
D.Pashkouleva[1], S. Karastanev[1], M. Doneva[1,2]
[1]Institute of Mechanics, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 4, 1113 Sofia, Bulgaria; [2]Faculty of Pharmacy, Medical University of Sofia, Sofia, Bulgaria

P3. Changes in red blood cell deformability at the beginning of the winter swimming season and at the end of another, in females and males: preliminary reports
Aneta Teległów[1], Marta Frankiewicz[2], Jakub Marchewka[3]
[1, 2, 3,] University of Physical Education in Krakow,31-571 Krakow, Poland

P4. Erythrocytes' Membranes' Fatty Acid Profiles Post Laparoscopic Sleeve Gastrectomy for Obesity Management
Jan Bylica[1,2,3], Joanna Gdula-Argasińska[4], Piotr Major[5], Tomasz Grodzicki[1], Maria Fornal[1]
[1] Department of Internal Medicine and Gerontology, Jagiellonian University Medical College, Kraków, Poland; [2] Doctoral School of Medical and Health Sciences, Jagiellonian University Medical College, Kraków, Poland; [3] Department of Rheumatology, Immunology and Internal Medicine, University Hospital in Krakow, Poland; [4] Department of Radioligands, Faculty of Pharmacy, Jagiellonian University Medical College, Kraków, Poland; [5] 2nd Department of General Surgery, Faculty of Medicine, Jagiellonian University Medical College, Kraków, Poland

P5. Investigation of skin temperature oscillations during local heating and cold test in patients with type 2 diabetes mellitus
V. Paskova[a], N. Antonova[a], I. Velcheva[b], N. Chaushev[c], H. Chalakov[d]
[a] Dept. of Biomechanics, Institute of Mechanics, Bulgarian Academy of Sciences, Sofia, Bulgaria; [b]Dept. of Neurology, "Uni Hospital", Panagyurishte, Bulgaria; [c]Dept. of Neurology, University Hospital of Neurology and Psychiatry "St. Naum", Medical University. Sofia,

Bulgaria; [d]Dept. Endocrinology and Metabolic Diseases, "Uni Hospital", Panagyurishte, Bulgaria

P6. Comparative in vitro investigation of viscoelasticity in aging of healthy/melatonin deficient rat aorta

Andreyan Georgiev[1], Maria Kaneva[2], Jana Tchekalarova[3], Mariya Antonova[4]
Department of Behavioural Neurobiology, Institute of Neurobiology,
Bulgarian Academy of Sciences, Acad. Georgi Bonchev Str., bl.23, Sofia, 1113, Bulgaria

P7. Properties of Lecithin Stabilized Water-in-Oil Thin Films and the Role of Interfacial Rheology

Hristina Petkova, Dimitrinka Arabadzhieva, Khristo Khristov, Plamen Tchoukov
Institute of Physical Chemistry, Bulgarian Academy of Sciences, "Acad. G. Bonchev" Str. bl. 11, 1113 Sofia, Bulgaria, *Coresponding author

P8. An Application of the Method of Simplest Equation for Exact Real Solutions for Advection-Diffusion Interaction

Radoslav G. Nikolov[1], Ivan P. Jordanov[1,2], Elena V. Nikolova[2]
[1]University of National and World Economy, Fac. Applied Informatics and Statistics, Department of Mathematics, Sofia, Bulgaria,
[2]Institute of Mechanics, Bulgarian Academy of Sciences, Sofia, Bulgaria

P9. Semantic priming as modulator of saccade directions and pupil diameter in glaucoma patients

Milena Staneva[1], Mario T. Iliev[2], Tanya Dimitrova[3], Iliyana Sazdova[4], Elitsa Ivanova[5], Tzvetomir Dimitrov[6], Hristo S. Gagov[4]
[1]Institute of Neurobiology, Bulgarian Academy of Sciences, Acad. G. Bonchev str., Bl. 23, Sofia, Bulgaria; [2]Faculty of Physics, University of Sofia "St. Kliment Ohridski", Sofia, Bulgaria; [3] Vistamed Medical Center, Sofia, Bulgaria; [4]Faculty of Biology, University of Sofia "St. Kliment Ohridski", Sofia, Bulgaria; [5]VMware Bulgaria, Sofia, Bulgaria; [6]First Municipal Hospital, Sofia, Bulgaria

14:30-14:40
Closing

PLENARY LECTURES

L1. Microcirculatory and micro-rheological relations of lymphedema

N. Nemeth
Department of Operative Techniques and Surgical Research, Institute of Surgery, Faculty of Medicine, University of Debrecen, Debrecen, Hungary, E-mail: nemeth@med.unideb.hu

Hemorheology deals with macro- and micro-dimensions of blood flow properties, including its cellular and plasmatic components and the vessel wall with which the flowing blood comes into direct contact, as A.L. Copley defined this discipline. The major hemorheological parameters are whole blood and plasma viscosity, red blood cell aggregation and red blood cell deformability. These factors play an important role in tissue perfusion and microcirculation, and they can alter in numerous pathophysiological processes. Interestingly, very few data are known in the literature that relates to another major actor of circulation: the lymphatic system. In the past, there were certain investigations related to peri-hemorheology: the flow properties of the interstitial fluid and the lymph. Thanking the modern investigative methods in micro-rheology and the visualisation techniques of microcirculation, new perspectives could be opened related to lymphedema, which has great clinical significance. Concerning the pathophysiology and the therapeutic approaches of the lymphedema several animal models had been established on large and small animal species, using various techniques to induce lymphedema (e.g., ligation and/or cauterization of larger lymphatic routes, removal of lymph nodes and lymphatic vessels together with the surrounding tissues, extensive lymph node dissection with circumferential soft tissue resection, irradiation, even in combination). However, a kind of “gold standard” of experimental lymphedema model cannot be clearly declared yet. In this review-type presentation we give a brief overview of hemorheology and microcirculation, including data on lymphatic rheology and related experimental models together with preliminary data on micro-rheological and microcirculatory alterations in a rodent lymphedema model. (Grant: NKFI-1 „OTKA" K-139184)

L2. Coronary microvascular dysfunction in heart failure: observations from the MICRO Registry

O. Velollari[1], M. Olschweski[1], K-P. Kresoja[1], J. Herzog[1], K. Schnitzler[1], M. Brandt[1], M. Knorr[1], P. Wenzel[1], P. Lurz[1], T. Gori[1]
[1] Department of Cardiology, University Medical Center of the Johannes Gutenberg University Mainz, Germany

Background. Heart failure (HF) is one of the leading causes of hospitalization in the elderly. Coronary microvascular dysfunction (CMD), among other risk factors, is linked to the pathogenesis and clinical manifestations of HF.

Purpose. The abstract aims to summarize key findings from a comprehensive analysis of CMD in subgroups of HF, shedding light on its association with hemodynamic parameters.

Methods. Patients experiencing recurrent angina (CCS II-IV) and no relevant epicardial stenosis were enrolled in a prospective registry. Epicardial and microvascular responses (pressure, resistance and flow) were assessed at rest and during adenosine and acetylcholine testing. The impact of an elevated left ventricular end-diastolic pressure (LVEDP) (Group A HF - /LVEDP -, Group B HF +/ LVEDP +, Group C HF -/LVEDP +, Group D HF +/LVEDP) in the absence of clinical signs of HF was also investigated.

Results. Overall, 188 patients (63% (118) women, mean age 65±11 years) with angina and no epicardial stenosis were enrolled. Patients with HF (n=26) displayed lower hyperemic flow in response to (endothelium-independent) adenosine (5.2±3.1 vs. 7.3±4.4; p=0.004), lower coronary flow reserve (2.9±1.5 vs. 4.4±1.1; p<0.001) and microvascular resistance reserve (3.3±2.1 vs. 5.2±2.7; p<0.001), and increased hyperemic microvascular resistance (25±21 vs. 17±11; p=0.045) as compared to those without HF. Subgroup analysis based on left ventricular end-diastolic pressure (LVEDP) (n=52) revealed that group A patients exhibited favorable cardiovascular parameters, including the highest coronary flow reserve (CFR), and microvascular resistance reserve (Table 1). Group B patients had the lowest coronary flow reserve and microvascular resistance reserve. An increased LVEDP without clinical signs of HF was not associated with a lower coronary flow reserve or microvascular resistance reserve. Microvascular resistance during acetylcholine (endothelium-dependent)-induced hyperemia was lower in HF patients.

Conclusion(s). Patients with heart failure displayed signs of impaired microvascular endothelium-independent responses while endothelium-dependent reactivity appears to be maintained. In the subgroup analysis, an elevated LVEDP with HF was associated with impaired coronary microvascular function.

Hemodynamic parameters	Group A (n=14) HF - /LVEDP -	Group B (n=13) HF + /LVEDP +	Group C (n=25) HF - /LVEDP +	P-value
LVEDP	9.3±4.3	20.7±3.8	24.9±13.1	**<0.001***
Rest-MR	94±37.7	64.5±41.4	67.9±30.9	0.058
Adenosine-MR	20.5±9.5	25.9±22	18.4±14.7	0.391
Adenosine-flow	4.2±1.7	5.0±2.8	7.4±5.0	**0.035***
CFR	4.29±1.2	2.6±1.2	4.26±1.9	**0.006***
MRR	5.1±1.7	2.8±1.7	4.9±2.1	**0.004***
Ach-MR	57.4±37.8	36.2±23.5	32.8±16.5	**0.018***
Ach-CFR	2.2±1.3	2.0±1.2	2.2±1.0	0.855
Ach-MRR	2.4±1.5	2.1±1.6	2.4±1.1	0.786

Table 1: *Subgroup analysis of microvascular function parameters as measured with offline Coroventis system*

L3. Significance of whole blood viscosity in acute ischemic stroke

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Previous studies presented the relationship of whole blood viscosity (WBV) with different aspects of stroke. Elevated WBV was found to be associated with a higher incidence of ischemic stroke. It was reported as an independent risk factor for stroke and it also correlated with other stroke risk factors like arterial hypertension, diabetes mellitus, atrial fibrillation, obesity, dyslipidemia and smoking. It takes part in the development of atherosclerosis and thrombogenesis in the cerebral blood vessels.

Higher values of WBV were established in patients with cerebral small vessel disease and they predominated in acute and chronic lacunar infarctions. The increased WBV at low shear rates showed positive correlations with the number of chronic lacunes on MRI. In acute stroke WBV was related to infarction growth, to its possible recurrence or its hematological transformation. It was discussed to play a role in reducing cerebral collateral circulation, thrombus propagation or arterial reocclusion in progressive lacunar stroke. So, the increased WBV was associated with neurological deterioration and poor outcome in lacunar infarctions. In these cases, elevated WBV contributes to the pathophysiology of ischemic stroke through its influence on cerebral microcirculation, vessel endothelial function, the promotion of thrombotic events and reduction of cerebral tissue perfusion.

Over the years the effect of different medications on WBV in stroke patients was studied and different methods to estimate WBV have been used. The significance of prior antithrombotic treatment and hydration therapy during the acute phase of stroke are discussed.

Nowadays special attention is paid to the role of WBV in the cases with an adverse effect of the contemporary ischemic stroke therapeutic approaches: thrombolysis and mechanical thrombectomy and this effect is supposed to be due to the impaired cerebral microcirculation.

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L4. Hemodynamics of BRASH Syndrome Observed in Gerontology

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BRASH syndrome is characterized by bradycardia, renal failure, atrioventricular (AV) nodal blockade, shock, and hyperkalemia. Patients with this syndrome show profound bradycardia and/or hypotension based on the combined effects of atrioventricular nodal blocking agents (calcium channel blockers and β-blockers) and hyperkalemia. Such poor hemodynamics reduce renal perfusion and deteriorate renal function, which accelerates hyperkalemia and delays the urinary excretion of atrioventricular nodal blocking agents, thus forming a positive feedback loop. We present two cases of BRASH syndrome in senile patients under the prescription of calcium channel blockers and β-blockers. The triggers of this syndrome were gastric bleeding and urinary tract infection, respectively. Hypermagnesemia also likely involved this syndrome in a case. This syndrome is not rare, because many triggers such as dehydration, hyperviscosity, infection, and up-titration of atrioventricular nodal blocking agents are usual in daily geriatric practice. It is important to be aware of BRASH syndrome for early diagnosis and correct management, because this syndrome is partially iatrogenic in gerontology.

L5. Simultaneous study of coagulation and rheological systems in patients with ischemic stroke

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Introduction. Stroke is one of the most serious health and social problems worldwide. Mortality from the disease ranks second and is 8% among men and 16% among women. The hemostatic system of elderly patients in the acute period has features that have not been sufficiently studied. Understanding the mechanisms of interaction between coagulation and rheological systems makes it possible to influence processes, improving the outcome of the disease. **Aim.** The purpose of this study is to conduct a comparative analysis of the state of the anticoagulant systems and the blood rheology system in elderly patients in the acute period and in the control group. **Materials and methods**. The state of the hemostatic system was studied in 36 men and women (65–79 years old) with stroke. The methodology used in this study is was based on modern examination standards patients with acute cerebrovascular accident. All patients underwent a comprehensive clinical neurological examination. The degree of neurological deficit and severity of stroke was assessed using the NIHSS (National Institutes of Health Stroke Scale), activity in daily life - using the Barthel and Rivermid index, intellectual-mnestic impairment - using the MMSE (Mini) scale -mental State Examination), functional capacity - according to the Rankin scale on the day of admission and upon discharge from the hospital. We studied antithrombin III and erythrocyte aggregation as the main markers of anticoagulation and blood rheology.

Results. We obtained statistically significant differences in the level of antithrombin III activity in patients who suffered an ischemic stroke both at the time of admission and also on the day of discharge. As for erythrocyte aggregation, if it was increased by more than 200% compared to the control, then the future course of the disease was not encouraging. But in the case of patients in whom the change in aggregation ranged from 50% to 100% relative to the control, the improvement in erythrocyte aggregation occurred simultaneously with an improvement in the clinical condition. **Conclusion**. Simultaneous study of coagulation and rheological systems in patients with stroke is very important for effective treatment, personification of patients, and can also become a prognostic marker of stroke.

Keywords: RBC aggregation, ischemic stroke

L6. Application of laser-optic techniques in the studies of blood microrheology in norm and pathology

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The composition of the blood, as well as parameters characterizing the structure and dynamics of the blood and tissues surrounding the blood microvessels, are factors that determine the fluidity of the blood and the efficiency of transport and delivery of gases (oxygen and carbon dioxide) and nutrients throughout the entire volume of the human body.

In modern hemorheological studies, laser and optical methods are widely used, which allow a comprehensive study of deviations from the norm of various parameters related to the structure and dynamics of blood through visualization and measurement. In particular, the following are used: diffuse light scattering (DLS); laser diffractometry (LD); optical tweezers (OT), video capillaroscopy, speckle contrast spectroscopy, two-photon tomography and fluorescence imaging.

The first three methods are used for in vitro measurements using fresh EDTA-stabilized blood samples taken from healthy donors or patients suffering from various diseases such as diabetes and hypertension. The last four methods are used for in vivo measurements and imaging. In addition, parameters related to red blood cell aggregation are measured in model solutions of certain plasma proteins known as aggregation agonists or inhibitors to study the mechanisms of aggregation.

In particular, the aggregation and disaggregation forces of individual red blood cells are measured using OD, aggregation index is measured, characteristic aggregation time and critical shear stress are measured in whole blood samples using an aggregometer by DLS method.
In our work, the traditional LD (ectacytometry) method, used to measure the average value of the deformability of erythrocytes in a sample, is improved in such a way that it becomes possible to measure the parameters of cell distribution by deformability, which is important for the clinical application of the method. Blood flow in the capillaries is visualized using digital capillaroscopy methods, which makes it possible to determine several parameters of the flow in the capillaries of the human nail bed. Also, in vivo visualization of blood flow over large areas of the microcirculatory system in laboratory animals is performed using laser speckle-contrast spectroscopy.

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L7. Blood microrheological and microcirculation alterations under age-associated diseases of the cardiovascular system

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Red blood cells (RBCs) are the primary cellular elements of blood performing several important functions in the body. RBCs can reversibly aggregate form 2D or 3D structures (aggregates), which significantly influence the blood circulation in the body. Studying the aggregation properties of erythrocytes is an essential task because it can provide insight into the state of blood and its ability to effectively transport oxygen. Aggregation properties of erythrocytes can change due to various factors, such as alterations in the protein composition of blood and diseases. Investigating age-related changes in RBCs aggregation properties is an important task in assessing blood microcirculation.

The main goal of this work is to study the aggregation properties of erythrocytes in patients of different age groups suffering from arterial hypertension (AH) and atrial fibrillation (AF).

Measurements of RBCs microrheological parameters were conducted using the erythrocyte aggregometer RheoScan. The following parameters were determined based on the signal of diffuse light scattering from blood samples: the critical shear stress (CSS) - the minimum shear stress that must be applied to the flow of aggregates to break them down, and the aggregation index (AI) - the fraction of cells that aggregate within the first 10 seconds of the process of spontaneous aggregation.

The results of the conducted research showed that the aggregation parameters, including the aggregation index and the critical shear stress, vary depending on the age of donors in all groups of participants, and these differences are statistically significant ($p < 0.05$).

Acknowledgements. The study was completed with financial support within the framework of the Development Program of the Interdisciplinary Scientific and Educational School of

Moscow University “Photon and Quantum Technologies. Digital medicine". Digital medicine" (project No. 23-ШI06-03).

L8. Microrheological responses of erythrocytes to gasotransmitters, by inhibiting guanylate cyclase, NO synthase and blocking ATP-dependent and calcium-dependent potassium channels

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The positive effect of gasotransmitters (GT), nitric oxide (NO) and hydrogen sulfide (H_2S) on the microrheology of blood cells is known. However, the mechanisms of microrheological changes in red blood cells (RBCs) remain poorly understood.

The **purpose** of this study was to investigate RBC microrheological responses to GT donors and to analyze the intracellular signaling pathways.

Materials and Methods. RBCs were washed, resuspended in Ringer's solution, and aliquoted. Cells were incubated: with sodium nitroprusside (SNP, 100 μM), with sodium hydrosulfide (NaHS, 100 μM), with an inhibitor of soluble guanylate cyclase (sGC) – 1H-[1,2,4]-oxadiazolo[4,3-a][quinoxalin-l-one (ODQ, 0.5 μM), with NO-synthase (NOS) inhibitor, N-nitroarginine methyl ester (L-NAME, 200 μM), ATP-dependent K^+ channel blocker glibenclamide (GK, 100 μM), a blocker of Ca^{2+} dependent K^+ channels (KCa) tetraethylammonium (TEA, 1.0 mM). The RBC elongation index (EI) and their aggregation (RBCA) were recorded after cell incubation.

Results. After RBC incubation with SNP, an increase in EI by 9% was detected. Under these conditions, RBCA decreased by 32%. An increase in EI and a decrease in RBCA were observed after NaHS, by 10 and 28%, respectively. When s-GC was inhibited with ODQ and NOS with L-NAME, the microrheological effects of SNP and NaHS did not appear. However, blocking KATP channels did not eliminate the increase in EI and the decrease in aggregation under the influence of NaHS. While blocking KCa channels with TEA almost completely eliminated the effects of NaHS.

Conclusion. Thus, the results of the study allow us to conclude that the effects of NO and H_2S can be realized in red blood cells using the s-GC-cGMP signaling pathway and, perhaps through activation of KCa channels.

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L9. Interrelation of blood rheology and hemostasis with metabolism of NO and H_2S in post-COVID period

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Aim: to study the interrelations between metabolism of gasotransmitters (NO and H_2S) and blood rheology and hemostasis parameters in post-COVID period in healthy volunteers and in patients with cardiovascular disorders.

Material and Methods. Blood was drawn from healthy volunteers (n=20), patients with cardiovascular disorders (CVD) (n=25), healthy people in post-COVID period (n=20) and CVD patients in post post-COVID period (n=27). Whole blood clotting process was analyzed by low frequency piezothromboelastography using "ARP-01M Mednord" complex (Russia). Characteristics of platelet hemostasis were evaluated by using of aser platelet aggregation analyzer Biola ALAT-2 (Russia). Brookfield viscometer DV2T (USA) was used for blood and plasma viscosity measurements. RBC deformability and aggregation were estimated by means of RheoScan-D300 system (South Korea) and aggregometer Myrenne MA-1(Germany). The content of H_2S and the total concentration of (NOx) were determined in blood plasma.

Results. In healthy individuals, a stable balance of NO and H_2S in the blood plasma was noted, even after COVID-19. Numerous correlations between rheological indicators and hemostasis parameters with the content of NO and H_2S in all healthy individuals (including those who have had COVID-19) pointed the participation of gasotransmitters in the regulation of blood rheology and hemostasis.

Discussion. An increase in circulating NOx in CVD may be the result of adaptation processes that compensate for the pathological lack of bioactive NO in the body. Increased consumption of this gasotransmitter in immune reactions (during COVID-19) contributes to a decrease in NOx levels in patients with CVD in post-COVID period.

Conclusion. An imbalance of NO and H_2S in CVD patients is manifested in a decrease in their regulatory effects on the rheological properties of the blood and the hemostatic system, which persists after COVID-19, despite a decrease in NO levels to normal values.

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L10. Innovative AC Phase Shift Technique for Rapid and Precise Blood Clotting Time Measurement

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The phase shift of alternating current (AC) resulting from the applied AC potential is significant in electrochemical impedance spectroscopy (EIS) studies. Conventional EIS analysis mainly uses Nyquist and Bode diagrams, often overlooking the phase shift as a standalone parameter for characterizing sample properties.

Aim. This study explores a novel EIS application in a narrow frequency range to measure the AC phase shift and accurately determine blood clotting time, a crucial parameter for diagnosing and monitoring various diseases.

Materials and methods. We introduced an innovative approach utilizing AC phase shift measurement as a self-sufficient parameter for characterizing blood properties. The phase shift in the frequency range from 100 Hz to 1000 Hz was used to rapidly and precisely determine blood coagulation time. A specially developed LabVIEW-based virtual instrument provided results with a relative standard deviation not exceeding 1.9%.

Results. The LabVIEW-based virtual instrument successfully measured the AC phase shift, yielding results with a relative standard deviation of less than 1.9% in the frequency range from 100 Hz to 1000 Hz.

Discussion. The findings highlight the novelty of using AC phase shift as a standalone parameter for characterizing blood properties. The narrow frequency ranges from 100 Hz to 1000 Hz optimized the precision and speed of blood clotting time determination. The high reproducibility and reliability of the measurements are crucial for clinical applications.

This innovative method offers a non-invasive, efficient, and unbiased alternative to traditional blood coagulation tests, which can be time-consuming and less precise. By focusing on the AC phase shift, a more nuanced understanding of blood properties can be achieved, potentially improving diagnostic and monitoring capabilities for various diseases.

Conclusion. We proposed a novel, fast, accurate, and unbiased method for determining blood clotting time based on measuring the AC phase shift at a specific frequency. This innovative approach demonstrates a reliable and efficient technique for characterizing blood properties, particularly for diagnosing and monitoring blood coagulation-related diseases.

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L11. Blood rheology on modified rheometer surfaces

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Background. Rheology of a bulk sample is a collective phenomenon based on the force transmission through the sample. Conventional rheometry uses steel plates, however, steel is not a physiological contact surface for blood. Blood viscosity and shear moduli might be underestimated in these tests, because the force transmission through the gap is strongly influenced by the contact of the sample to the test surfaces. It was shown that shear moduli are higher when high wetting substrates are used (E. Kume et al.; L. Noirez; U. Windberger et al.).
Method. To test blood under near-physiological condition, we modified the test plates by coatings with (1) endothelial cells (HUVECs) grown on a collagen hydrogel, (2) collagen hydrogel without HUVECs, (3) glass that was the substrate for the hydrogel coating, and (4) steel. We tested blood and plasma from healthy human volunteers in oscillating shear flow to assess the blood behavior at near-equilibrium conditions.
Results. A linear elastic property was identified by a G´-plateau in both coatings and on glass, but not if both surfaces were made of steel. The highest linear G´-value was obtained on glass and hydrogel surfaces followed by HUVECs, and steel. Yield points were assessed by extrapolating the end of the G´-plateau to the applied shear stress and revealed the highest values for glass and hydrogel coating, followed by HUVEC seeding. An extended yielding was observed for the modified surfaces, which culminated in a second linear phase until the shear elasticity was finally lost at shear stresses of over 300 mPa. With steel surfaces, elasticity was lost already at 5mPa, demonstrating that the viscoelastic response highly depends on the substrate interaction.
Our data indicate that a modification of the boundary surface has deep consequences for flow. To model the flow through biomedical devices, controlled interfacial conditions that reflect the planned application are key parameters.

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L12. Protective effect of two standard preservation media on irradiated and storage erythrocytes: Rheological comparative evaluation

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Transfusion units are regularly irradiated in hemotherapy centres to prevent graft-versus-host disease by inactivating donor lymphocytes. High-energy photon radiation damages the DNA of nucleated blood cells, shortening the lifespan of red blood cells from 35 (CPDA) or 45 (CPD-Optisol®) to 28 days (according to Argentine regulations). The mean corpuscular volume and levels of free sodium and potassium are the most affected biochemical parameters. The preservation media commonly used during red blood cell storage are designed to protect them from this damage. In this study, the hemorheological properties of gamma-irradiated red blood cell concentrates and their storage in two typical storage solutions were examined.

For the experiments, red blood cell concentrate units preserved in CPDA or CPD-Optisol® were utilized. Each unit was divided into 6 satellite bags, 5 of which were irradiated at different doses (2, 5, 10, 15 and 25 Gy) and the remaining one was used as a control (0 Gy). Samples from each bag were analyzed weekly for 35 days. The viscoelastic and aggregation parameters of the erythrocyte were determined using the Erythrocyte Rheometer and the Optical Chip Aggregometer.

Hemorheological parameters exhibited different changes depending on the storage duration, the gamma dose, and the specific preservation medium used. The data obtained provides information on the damage caused to red blood cells due to the radiation dose and

storage, which is related to the different characteristics of the two standard preservation media evaluated.

L13. Red blood cell aggregability in Hypertension

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Aim. We investigated the alteration in the aggregation extent of red blood cells (RBC) in hypertension. Additionally, we proved the contribution of the cellular properties of RBC (aggregability) in this alteration.

Materials and Methods. We compared the aggregation behaviour of RBC in original blood samples from 61 healthy persons and 38 individuals with hypertension. The Zeta sedimentation technique was used to determine the extent of RBC aggregation. The Zeta sedimentation ratio (ZSR) and new defined parameter based on it were applied for comparison. The RBC aggregability was obtained from measurements in dextran containing phosphate buffered saline (PBS).

Results and Discussion. We found significant increase in the ZSR from the original blood samples in the hypertensive individuals (The two-tailed P value is 0.0429, considered significant). For blood samples with standardized hematocrit (H = 0.40) – two-tailed P value was 0.0116, considered significant. After correction of ZSR with blood plasma viscosity - The two-tailed P value is 0.0049, considered very significant. To discriminate the role of RBC aggregability we compered the whole blood ZSR (H = 0.40) and ZSR (H = 0.40) in 2 g/dl dextran. The result obtained was that the contribution of cellular factor for the elevated aggregation was about 50%. Significantly increased fibrinogen concentrations and decreased RBC membrane sialic acid – confirmed this finding.

Conclusion. Our investigation approach shows good applicability in determining the RBC aggregability contribution for alteration in aggregation extent.

L14. Synthesis and physical characteristics of magnetic nanoparticles coated with albumin and casein for the needs of nanomedicine. A theoretical and experimental study.

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Aim. Synthesis and physical characteristics of magnetic nanoparticles coated with albumin and casein.

Materials and Methods. The choice of magnetite (Fe3O4) as a material for the synthesis of SPIONs (superparamagnetic iron oxide nanoparticles) allows to use the method of precipitation of iron salts (Fe2+ and Fe3+) in the presence of an inert atmosphere. The surface of nanoparticles is modified with APTES (3-aminopropyltriethoxysilane) and activated with glutaraldehyde. This allows the covalent binding of albumin and casein to the surface.

Results and discussion. The changes in the physical characteristics of the magnetic particles at each stage of their synthesis and surface modification were monitored. X-ray diffraction (XRD), small-angle X-ray scattering (SAXS), scanning electron microscopy (SEM) and energy dispersive X-ray microanalysis (EDXMA) were used. These methods give naked SPIONs an average diameter value of about 14 nm. The determined magnetic susceptibility (according to Maher) at two different frequencies proved their paramagnetic properties. Surface modification of the particles with APTES leads to the formation of stable aggregates of several dozen SPIONs with an irregular shape and an average size of 160-180 nm (SEM). These aggregates were activated with glutaraldehyde and covalently bound to human serum albumin (HSA) and casein in isotonic phosphate buffer solution (PBS) at pH 7.4. By means of dynamic laser light scattering (DLS), a hydrodynamic diameter of the wrapped aggregates of about 200 nm was determined. The degree of envelopment of the particles by albumin and casein was estimated by Bradford (average protein/magnetite mass ratio was 22.4 and 34.6, respectively) and confirmed by Raman spectroscopy.

Conclusions. The analysis methods used provide characteristics of the SPIONs we synthesized that are similar to those synthesized by other authors and provide a basis for future applications.

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Keywords: magnetic nanoparticles, surface modification, human serum albumin, casein

L15. Overview of lıfespan of platelets (The Relationship Between Stuructural, Functional and Behaviour Properties)

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Platelets are discoid and are the smallest anucleate blood cells, expressing their dynamism through their morphologic properties. They are mainly associated with hemostasis, which is to initiate blood clotting. Despite being very dynamic, they generally remain in an inactive state and are merely activated when a blood vessel is damaged. But hemostasis or blood clotting is not the only function of platelets; instead they are used in a variety of multifunctional properties that monitor the body's homeostasis. Platelet ultrastructure reveals their behavioral properties. Megakaryocytes in the bone marrow are the site of platelet formation. A mature platelet is 2-3 μm in diameter and usually remains viable for 7-10 days.

Platelets are unique in their structural organization, being anucleate but with prominent mitochondria. The platelet plasma membrane is composed of a phospholipid bilayer.

Site of expression of various surface receptors and lipid layer that aid in signaling and intracellular communication.

An injury in the vessel surfacel, activates platelets to initiate blood clotting. Powerful platelets are easily activated or inhibited by various intracelular and extracelular stimuli. Change in membrane fluidity has been assigned to the impairment of platelet functions since membrane fluidity can modulate cell function, and reduced membrane fluidity in cholesterol-enriched platelets is associated with platelet hypersensitivity to different agonists. Because of glycation of membrane proteins, platelet membrane fluidity has been seriously impaired. Decreased membrane fluidity of these platelets is probably associated with an increased cholesterol-phospholipid ratio in the membranes.

L16. Estimation of IHD patients' parameters of oxygen transfer for creation of binary classification models of functional state of the microcirculation system

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The **aim** of the work is to build binary classification models to estimate the type of oxygen transfer (OT) disorders in patients with various types of cardiovascular pathology. As input signs, parameters of oxygen transfer (OT) to tissues, conjunctival biomicroscopy, erythrocyte sedimentation and deformability rate, platelet activation, blood viscosity, lipid metabolism, age are used. Models are built separately for men and women. At the output, the model predicts the presence or absence of OT disorders of a certain type. The purpose of this stage of work is to assess the characteristics of OT in middle-aged men (n=115; age 53 $\pm$ 4,9 years) with coronary heart disease (stable angina pectoris of 2-3 functional class).

Methods. OT parameters were measured under ischemic test (IT) conditions - of oxygen's level in the tissue before and after ischemia (1pO2, 2pO2, mmHg), latent periods and rates of oxygen consumption and recovery (LP1, LP, V1, V2), and the volume of blood flow in the It area was determined by thermal deviation. The Student's t test for dependent rows was used to assess the statistical difference between the pO2 levels before and after ischemia.

Results. The combination of OT parameters in the studied group of patients is characterized as type 2: [1pO2 > 2pO2; LP1<LP2; V2 < 1], which can be defined as a reduction in tissue oxygen utilization at baseline pO_2 below 35 mmHg and type 2a [1pO2 < 2pO2; LP1≤LP2; V2 < 1] at baseline pO2 above 40 mmHg.

Conclusions. The results obtained are the basis for the development of models for predicting the functional state of the microcirculation system in various types of cardiovascular pathology, including for monitoring the effectiveness of the therapy.

Keywords: oxygen transfer, microcirculation system, binary classification models.

L17. Biomechanics of aortic valve: numerical simulation and additive manufacturing

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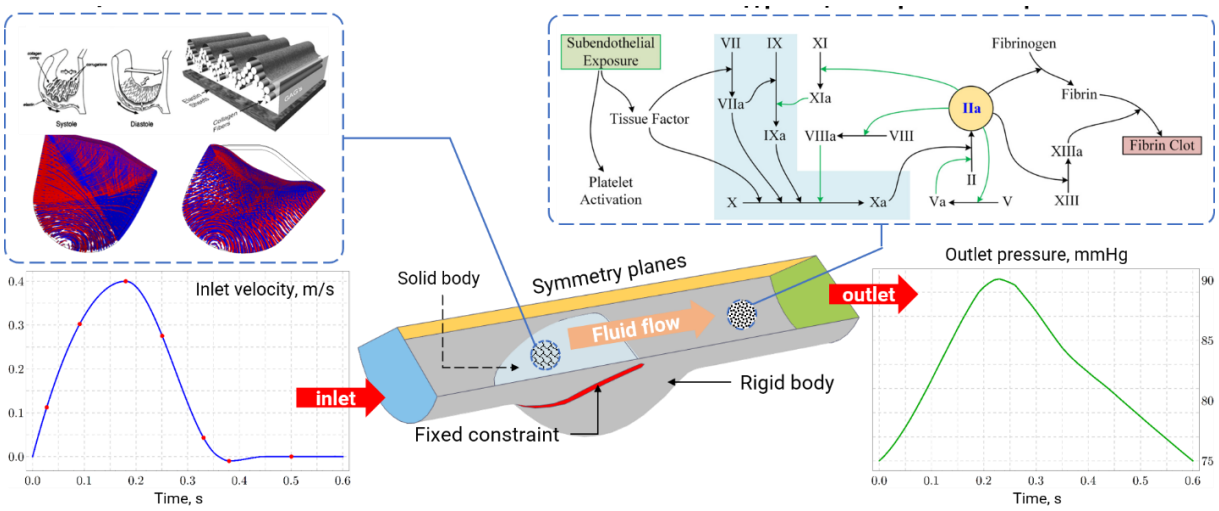
Hemodynamic models of native and artificial aortic valves pay little attention to the physiological processes occurring in tissues and body fluids. To describe the biomechanical behavior of native valve flaps, various phenomenological material models ranging from linear to anisotropic hyperelastic are mainly used. The anisotropy of properties arises due to the presence of collagen fibers distributed in circumferential direction. In this paper, they are modeled explicitly taking into account the distribution of properties.

The blood model should also be specified when modeling artificial aortic valves, particularly transcatheter aortic valve replacement. These have a stent design that can damage the epithelium, resulting in a risk of thrombus formation. The reactions taking place in the blood at this point are described by a clotting cascade involving three phases.

Using a model that considers the reactions of the blood coagulation cascade, it is proposed to describe blood as a multicomponent mixture and to consider the thrombosis process in modeling artificial aortic valves.

Moreover, additive manufacturing of TAVI stents via FDM and SLM technology will be also discussed.



Acknowledgements. Part of this work was supported by the International Research Groups-2024 grant by Ministry of Perm Region (project: Technologies for the personalized aortic valve treatment with TAVI surgery: from numerical modeling to additive manufacturing of shape memory alloy stent meshes).

L18. Methodological Aspects in Blood Rheology - From Experiments to Numerical Simulations and Instrument Development

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Many experimental and clinical studies have been focused on disturbances of rheological properties of blood in patients with cerebrovascular disease of ischemic origin, stroke, in patients with type 2 diabetes mellitus, etc. The main estimated hemorheological parameters were apparent whole blood viscosity (WBV), plasma viscosity (PV), hematocrit (Hct) and fibrinogen (Fib). We found increased apparent whole blood viscosity within the wide range of shear rates. They were correlated with blood flow velocities (BFV) and vasomotor reactivity indices (VMRI) and others. Experimental and clinical investigations in ischemic cerebrovascular disorders (CVD) have shown the influence of blood viscosity and its determinants on the cerebral blood flow. On the other hand, abnormal hemorheological changes are considered also as risk factors for acute and chronic cerebral ischemia.

An area of special interest is the carotid artery circulation, where stenoses, thromboses, atherosclerotic plaques and other lesions can cause cerebral disturbances. The investigation of the hemodynamics in the carotid artery bifurcation with stenoses by means of the 3D numerical analysis of blood flow based on the numerical solution of the Navier-Stokes and continuity equations was done. The blood flow in the arteries was treated as incompressible viscous flow. Fluid motion was modeled by solving numerically the system of equations of the continuity and the equations of motion by finite volume method. The hemodynamic parameters as Peak (P) wall shear stress (WSS); Circumferential wall tension (CWT); Peak (n_P) Tensile stress (TS) have been calculated. In patients with risk factors for cerebrovascular disease and with cerebral infarctions alteration of the hemodynamic shear forces in the common carotid arteries was observed. The decrease of wall shear stress and the increase of radial compressive pressure is related to thickening of the intima-media complex and to development of carotid atherosclerotic plaques.

Methods, based on atomic force microscopy in the study of the mechanical properties of the blood cells' membrane and PLT's activation were introduced and applied. The introduction of atomic-force microscopy (AFM) technologies in biomedical research opens opportunities for the development of fundamentally new approaches in the study of the mechanical properties of blood cells' membrane at various stages of ontogenesis. The results

of the AFM scan integrate data on the morphology of the native cell surface with its biophysical properties such as stiffness, adhesion force in the “cell-cell” system and surface potential. In particular, the deformability of blood cells, which mainly determined the mechanical properties of biomembranes, predetermines the formation of aggregates of blood cells in small vessels, the probability of which increases with age and with the development of pathophysiological processes in the organism.

Microfluidics has become a prominent field for studying blood microrheology and mechanical properties of blood cells - erythrocytes, leukocytes and platelets. This work reviews the recent developments in microfluidic technologies for *in vitro* tests of red blood cells (RBCs) deformability and RBC aggregation, leukocyte aggregation and adhesion, and platelet thrombus formation. The developed devices and experimental systems are promising tools for the study of erythrocyte deformability and aggregation, as well as leukocyte adhesion and thrombus formation.

Electrorheological methods were developed and used for quantification of blood microstructural changes due to RBC aggregation-desaggregation and deformation processes at different shear rates and at different local structure of the flow field. A method, based on dielectric properties of dispersed systems in Couette viscometric blood flow was applied to investigate the kinetics of RBC aggregation and the break-up of the aggregates. By measuring the electric properties of blood, valuable information could be received about mechanical properties of blood during evaluation of some diseases, which affect modification of the local flow pattern and the rheological properties of blood in particular and about the kinetics of RBC aggregation

Acknowledgements. The study has been supported by the Bulgarian National Science Fund - Project № КП-06-Н57/14/2021 “Investigation of the hemorheological characteristics, the parameters of coagulation and the mechanical properties of the blood cells as a basis for numerical simulations of their role for the blood flow in cerebrovascular, peripheral vascular diseases and Diabetes mellitus type 2”.

COMMUNNICATIONS

Elongation index derivative: a promising hemorheological parameter in Diabetes mellitus erythrocyte analysis

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Aim. Diabetes mellitus (DM) is greatly impacted by alterations in the deformability of the erythrocyte membrane [1,2]. Moreover, there is strong evidence suggesting that hemorheological determinants, such as the calculated Elongation Index (EI) from deformability measurements, play a crucial role in the development of diabetic organ complications, notably retinopathy, nephropathy, and neuropathy [3,4]. We measured the deformability of red blood cells in patients with DM by analyzing the erythrocyte EI and its change in response to shear stress (SS) (dEI/dSS) at specific physiologically relevant points, to be used as a new hemorheological parameter.

Materials and methods. For all samples tested, DM erythrocytes (n=13) and age- and sex-matched controls (n=11), we used a RheoScan-D300 ektacytometer (RheoMeditech Inc., Korea).

Results and discussion. Although statistically insignificant differences were found in EI values between the DM and control groups, the study uncovered specific data points on the deformability curve and highlighted the potential of the first derivative of the deformability curve (dEI/dSS) as an indicator of red blood cell response to deformation. Notably, statistically significant variations in dEI/dSS at the half maximum value of the deformability curve were observed, suggesting a delayed red blood cell response to shear stress in individuals with DM. Moreover, scatter plot analysis revealed a linear decline in the dEI/dSS index with increasing shear stress, indicating a reduced red blood cell responsiveness to higher shear stress levels, particularly prominent in DM patients.

Conclusion. Despite being a pilot study, understanding the relationship between dEI/dSS and DM pathology could significantly enhance our knowledge of how red blood cells respond to

different shear stress levels, offering crucial insights into the hemorheological implications and contributing to a comprehensive understanding of their mechanobiological behavior [5].

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Neutral polymer properties effecting the red blood cell aggregation

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Aim: Different macromolecules are used in medicine as a part of solutions for fluid resuscitation therapy and organ preservation in transplantation. Some of them originate from living systems: albumin (e. g. human, bovine), dextrans (Dx), hydroxyethyl starches (HES)). Others are synthetic: polyethylene glycols (PEG), polyvinyl pyrrolidone (PVP). One of problems associated with their medical applications is their effect on red blood cells (RBC) aggregation. Here we varied the concentration, molecular weight (M_w) within one chemical type, as well as the chemistry of the neutral polymers - quantifying the RBC aggregation.

Materials and Methods: Washed in phosphate buffered saline (PBS) human RBC are used during the study. The zeta sedimentation technique is used for quantification of the extent of cell aggregation. Zeta sedimentation ratio (ZSR) based indices (AI) are used for comparisons. The hydrodynamic radius (R_h) of the polymer molecules is determined using viscometric approach.

Results and Discussion: For all polymers tested a linear range in the relationship AI - concentration was found. The slope of the linear regression line is the measure of the polymers's aggregation potential (AP). The AP ranking is the following: PEG > PVP > DX > HES. Within the same chemical type of polymer, the increasing R_h of the molecules leads to intensified aggregation. Comparison of the AP of molecules with similar R_h reveals a significant dependence on their chemical nature.

Conclusions: For all investigated polymers a linear range concentration dependence of RBC aggregation was found. AP ranking determined is PEG > PVP > DX > HES. The chemistry of polymer is of value.

Polymer depletion from biological surfaces – an electrophoretic investigation

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Aim: We studied the depletion of neutral polymers from the surface of "smooth" and "hairy" negatively charge liposomes and normal and PEGylated human red blood cells (RBC).

Materials and Methods: Particle electrophoresis is used for this purpose. The electrophoretic mobility (EM) of RBC was determined by a microelectrophoretic experimental set-up, equipped with a thermostated rectangular chamber in isotonic phosphate buffer containing glucose (pH = 7.4). EM-values were calculated from measurements of the migration times of 35-40 cells in the front stationary plane, in both field directions, at a current of 8 mA. We made "smooth" and "hairy" negatively charge liposomes from egg phosphatidylcholine, phosphatidylserine and phosphatidylethanolamine conjugated to polyethylene glycol chains (PE-PEG 2000 or PE-PEG 5000). We varied the mol fraction of PE-PEG lipids at constant total phospholipid negative charge modifying the conformation and size of PEG grafted chains on the membrane surface. The electrophoretic mobility (EM) of the liposomes in 10 mmol/l HEPES buffer (pH=7.40) was determined with a Zetasizer 4 from Malvern.

Results and discussion: The electrophoretic mobility (EM) of the „smooth“ charged negative liposomes and untreated RBC in media containing neutral polymers is decreased but not in the expected extend. Our interpretation is, that the observed effect is due to depletion of the polymer from the particle surface. Covalent binding of PEG to the surface of both type of particles decreases their electrophoretic mobility. The reduction is dependent to the length and binding density of the grafted polymer. Electrophoresis of the polymer decorated liposomes and cells in media containing free polymer is complicated with change in the direction of movement in the electric field for particles with long grafted chains at high binding density.

Conclusion: Particle electrophoresis is very useful technique to study the effect of neutral polymers on the charged surfaces – liposomes and cells.

Acknowledgments: S. Jovtchev is indebted to Dr. O. Zschörnig and Prof. K. Arnold from the Institute of Med. Physics and Biophysics, Universität Leipzig, Germany for the liposome study.

Impact of albumin and casein modified magnetic nanoparticles on blood hemorheological parameters and the functional state of human neutrophils by evaluating their chemiluminescent response upon stimulation with Zymosan, fMLF and PMA.

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Aim. Effect of albumin and casein modified magnetic nanoparticles on blood chemorheological parameters and the functional state of human neutrophils.

Material and Methods. SPIONs (superparamagnetic iron oxide nanoparticles) were synthesized by the method of precipitation of iron salts. They are covalently coated with albumin or casein. Whole blood and isolated neutrophils were stimulated with various stimulants in the presence or absence of naked or albumin- or casein-coated SPIONs, and luminol-enhanced chemiluminescence (CL) was measured. Neutrophil functional states were evaluated by analysis of CL kinetic curves. SPIONs influence on the aggregation of erythrocytes with ZSR (zeta sedimentation ratio) was tested.

Results and discussion. SPIONs (without or with protein coating) don’t change the aggregation of erythrocytes in blood. Naked and coated SPIONs most probably don't affect spontaneous CL for whole blood and isolated neutrophils, as neutrophils originate from a resting neutrophil population. Probably HSA-coated and naked SPIONs influence the initiation and development of the zymosan-stimulated response of the neutrophil population in the

sample. It is discussed whether, under these experimental conditions, the obtained CL results are the result of different activities of existing neutrophil subpopulations induced by the nanoparticles or whether the nanoparticles pre-program new subpopulations. Caution should be taken when activated or primed neutrophils are present in the blood circulation. It is then possible that SPIONs may interfere with normal neutrophil responses.

Conclusions. Coated SPIONs don't initiate ROS generation by neutrophils in the resting state but probably modulate the zymosan-stimulated response. The SPIONs (without or with protein coating) don't change the aggregation of erythrocytes in blood. Our synthesized modified SPIONs have characteristics that are a good basis for future applications.

Acknowledgments. This work was realized in conformity with contract № Д-181/03.08. 2023 for support of scientific research works on behalf of the Council for medical science in Medical university - Sofia.

Keywords: neutrophils, chemiluminescence, magnetic nanoparticles, human serum albumin, casein.

Non-Newtonian behavior of complex fluids studied in nano/micro-scale confinements

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The aggregation and rheological behavior of complex fluids within nanoscale confined geometries are important for understanding various industrial and biological problems. It is acknowledged that bulk rheological properties, measured using conventional techniques, don't always fully reflect fluid flow at such micro/nano-scale dimensions. Here, we demonstrate the applicability of thin liquid film technique (TLF) and capillary driven flow in microfluidic device to probe fluid rheology at micro- /nano-scale [1,2]. The characteristic lengths of both systems are below 100 nm. Results for pure solvents and model crude oil mixtures are used as examples. The estimates show that verry small Bingham yield stress can be detected in TLF and microfluidic experiments, while it is inaccessible by conventional rheological methods. Even though small, such yield stress can have a dramatic effect in processes related to liquid flow in micro-/nano-porous media. These findings highlight the potential of utilizing the thin liquid film technique and microfluidics platforms, along with appropriate theoretical models, to investigate the rheological properties of complex liquids in nanoscale confinements.

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Hematological and hemorheological parameters of blood platelets as biomarkers in diabetes mellitus type 2. A comprehensive review

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Diabetes mellitus – type 2 (DM2) is a hypercoaguable state with enhanced platelets (PLTs) activation and increased clotting factor production. Simultaneously, the fibrinolytic cell system is inhibited due to formation of clots with high resistance to fibrinolysis. The stages of PLTs "activation" have been well-characterized microscopically, morphometrically and nanomechanically (by light microscope, transmisiion electron microscope - TEM, scanning electron microscope - SEM and atomic force microscope - AFM). Thrombocytes in "acivated" (pro-coagulant) state play central role in two main biological processes: hemostasis and repair of vascular vessels. Pro-coagulant PLTs participate in generation of thrombin and in development of fibrin fibers in the clot matrix. Enhanced PLTs reactivity in dibetic- (diabetes mellitus - DM2) patients is considered as a "pro-thrombotic" state. In the retrospective- and prospective- studies on the topic, the higher are the PLTs' hematometrical indices: PLTs (count), MPV (mean platelet volume), PDW (platelet distribution width), PCR (plateletcrit), as well as PLTs/Ly ratio. The PLs parameters/indices are usefull biomarkers in early diagnosis and prognosis of DM2. The precise studies of PLTs' state of activation during DM2 might be useful for creation of new diabetes (DM2) treatment strategies and effective medicines. Using the amount of blood glucose, attached to hemoglobin (HbA1c values) as markers of glycemic control in diabetic patients, researchers have observed association between MPV and medications as Insulin, Metformin, sulphonyl ureas. Computational modellng of PLTs' activation in DM2 is also a controlling factor for thrombocyte distribution and margination in bood vessels, associated with micro- and macrovascular disease in DM2. PLTs- derived mi RNAs are novel molecular biomarkers for diagnosis and prognosis of DM2, insulin resistance and diabetes complications. We have proposed (2010) oleic acid (OA) as a substance suppressing "PLT hyperactivation" and inhibiting "thrombocyte aggregation". Antiplatelet agents, natural plant products including, could be effective in the prevention and the secondary treatment of micro- and macrovascular complications in the type 2 Diabetes mellitus. Our

proposal on following up of a combination of hematological-, hemorheological- and hemostatic parameters (indices) as a new way in diagnosis, treatment, predicting and management of DM2 and its related vascular complications, probably could be more explored in future studies.

Keywords: Diabetes mellitus type 2; blood platelets (PLTs), PLT-hematological / hemorheological parameters (indices); PLT "activaion" / "hyperactivation".

Influence of blood flow on the mechanical and rheological properties, as well as the activation and adhesion of white blood cells to the endothelium

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Many pathological processes in the circulatory system are associated with changes in the speed of blood flow and blood viscosity, respectively, thrombus formation and the multi-stage process of white blood cell penetration through the wall of blood vessels into inflamed tissues. Interactions of the blood cells with the inner layer of blood vessels, which consists of endothelial cells, are fundamental in regulating these processes.

While the mechanical and biochemical changes in erythrocytes are relatively well studied during various pathological processes, there are relatively few studies concerning the events (mechanical and biochemical) associated with the interaction of the white blood cells with the endothelium and plasma proteins under blood flow.

Good *in vitro* models for studying the interaction of white blood cells with endothelium are the constructed various types of micro-chambers, creating conditions for mimicking blood flow in small blood vessels (capillaries). These models allow studying the effect of altered velocity of blood flow on the process of binding, rolling, firm adhesion and penetration of leukocytes through the endothelium. In this respect the expression of many adhesion molecules and their ligands can be studied.

In the present study, we consider the application of different microfluidic systems as suitable models for study *in vitro* the biochemical and immunological behavior of leukocytes as well as the changes in their mechanical and rheological parameters during blood flow and the role of

the endothelium. In this regard, the role of endothelium for leukocyte processing during inflammation will be elucidated.

Keywords: white blood cells, endothelial cells, blood rheology, blood flow mechanics, inflammation

Hematological changes in adult rats in conditions of diabetes mellitus and cadmium exposure

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The aim is to study the hematological changes in diabetic adult rats with concomitant exposure to cadmium chloride ($CdCl_2$). Mothers and their newborn pups were divided into four groups: 1. control; 2. toxic control - the mothers obtained daily 5 mg/kg cadmium chloride ($CdCl_2x2.5H_2O$) dissolved in tap water and the newborn pups were exposed to the metal ions via the breast milk until postnatal day 25; 3. Diabetes mellitus (DM) was induced in the newborns by a single i.p. injection of streptozotocin (100 mg/kg b.w.) on postnatal day 1; 4 - DM was induced as in Group 3 with concomitant exposure to $CdCl_2$ as in Group 2. Until postnatal day 65 rats obtained tap water and chaw ad libitum. Fasting glucose, albumin and lipid profile (cholesterol, HDL and LDL) were measured in serum. Hematological parameters were obtained in whole blood. Results show hyperglycemia in all experimental groups compared to the control. Glucose in Group 4 was significantly higher than in the diabetic group, indicating that cadmium exacerbated diabetes. Although exposure to Cd alone decreased total cholesterol content, the concomitant treatment of diabetic rats led to an increase in cholesterol concentration. The same tendency was observed for albumin. In all experimental groups LDL concentration was insignificantly increased while HDL were decreased. Exposure to Cd significantly reduced erythrocyte count compared to the untreated controls. Diabetes significantly reduced leukocyte, lymphocyte, monocyte and granulocyte count indicating that diabetic rats will be susceptible to infections. The erythrocytes number and hemoglobin content were insignificantly reduced. Concomitant exposure to cadmium resulted in significant decrease of WBC, monocyte and granulocyte number compared to the toxic control. RBC and hemoglobin content were increased leading to significant increase in the mean cell volume.

Our data suggest alterations in hemorheology which may explain the development of some perturbations observed in diabetic patients.

Acknowledgements: The study was supported by Grant No KP-06-N71/7 from the Bulgarian National Science Fund.

Studying the mass-inertial characteristics in some NASA positions of astronauts: investigation based on improved 3D model of the human body

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Aim: This work aims to identify the mass-inertial properties of the average Bulgarian male human body in several of NASA's standard astronaut positions.

Materials and Methods: Our approach is grounded in an enhanced 20-segmental biomechanical model of the male human body, created within a CAD/CAM computer environment. We validate the model by contrasting analytical outcomes for any of the body's segments with the results derived from the computer model.

Results: We determine the mass-inertial characteristics of a male human body in different body positions for space exploration, as classified by NASA, using the available anthropometric data for average Bulgarian men.

Discussion: We are confident that the suggested model can be used to calculate the relevant characteristics in question at any posture of the body of interest based on the comparison we made between our model results, presented in the current work, and data reported in the literature, where available. It is important to emphasize that although the model is applied to the typical Bulgarian male, it can be applied to any gender, any race, and any individual as long as the appropriate anthropometric measurements are performed.

Conclusion: The model can be widely applied when such parameters like those studied are required to address issues arising in daily life, the workplace, leisure, rehabilitation, sport, criminology, space exploration involving astronauts, etc.

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Girls versus boys' tennis players: Comparison of body composition contents

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Aim: To examine the differences in the body compositions of girls and boys' tennis players, as evaluating these traits is crucial to enhancing athletic performance.

Materials and Methods: The body composition parameters of 78 tennis players, ages 14 to 17, are assessed in the current study. The participants are divided into two groups: 34 girls tennis players and 44 boys' tennis players. The criteria for inclusion were all athletes trained at least 5 times per week and competed regularly at the regional, national or international level championships. Using the InBody (model: 170) analyzer, multi-frequency bioelectrical impedance measurements were used to identify the components of body composition. This is a widely used innovative method for assessing body composition. For accurate analysis, the measurements of each athlete were made at least two hours after a meal and at least 12 hours before training.

Results: We present the mean values and standard deviations of the height (cm), weight (kg), body mass index (kg/m^2), waist to hip ratio, visceral fat and basal metabolic rate together with the corresponding probability distributions of these components for every group.

Discussion: The differences between boys and girls' tennis players' body composition are visible. The physical development of young tennis players follows the general trends established during adolescence, shown in better musculoskeletal development in boys and more body fat distribution in girls playing tennis.

Conclusion: Tennis players' body composition profile need to be continuously monitored to provide coaches and athletes with the knowledge they need for developing successful programs aimed to improve player performance and reduce injury risk.

Biomechanical jump performance of adolescent basketball female players after an isometric stretching program

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The effects of isometric stretching on the muscle-tendon-joint biomechanics in the literature data are contradictory. The aim of the study was to verify the effectiveness of the applied isometric stretching program for the improvement of jump performance of six adolescent basketball female players (17-19 years). The isometric stretching protocol with eleven exercises was used after the last daily regular training program, four times per week for 40 minutes. All exercises were repeated three times with detention duration 15 seconds for 11 weeks. G-Walk wireless system, detecting a single jump, was used to evaluate six important biomechanical jump characteristics for the participants. The obtained Mann-Witney statistics of the measured parameters for our six participants shows contradictory results and individual stretching body adaptation. The obtained statistical significances in comparissons does not allow to make the important conclusions for the applied isometric stretching program effectiveness. The presented results underline that lower extremity control and performance are strongly related with the motion and synergy work of the upper limbs.

Keywords: isometric stretching, jump height, lower extremity elasticity index, usefulness of arms index

Selective laser melting technology development for coronary stents

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When a patient has coronary heart disease, a tube-shaped device called a coronary stent is inserted into the coronary arteries that feeds blood to the heart, keeping the arteries open. The development of 3D printed metallic stents has been an attempt to address the shortcomings of traditional stent production methods, which involve laser cutting of the stent from a tube.

This work aims to create stent mesh architectures with tunable macrostructure and microgeometry characteristics by design, numerical simulation, and selective laser melting.
Using the conventional methodology, the primary technical, chemical, and physical attributes of the powder were ascertained. A COXEM EM-30AXPlus scanning electron microscope was utilized for powder elemental analysis of the particle and the acquired samples' microtopography. Comsol Multiphysics was used to do the temperature distribution study and the track fusion simulation. Parts were produced with the Realizer SLM-50 device through selective laser melting (SLM). NX software was used to create the sample designs. According to the analysis, the CoCr and TiNi powder particles are spherical in shape, with an average particle size of d_{50} being 26 μm and 24 μm, respectively. A scheme of temperature fields distribution for the stent struts was obtained. The maximum temperatures in the fusion zone, as well as its geometric parameters, were determined. The fusion was carried out in the range of laser radiation powers 38-63 W and speeds of 0.083-0.75 m/s. Single frame elements were obtained by melting TiNi and CoCr powders. As a result of modeling and experimental studies, modes have been established that allow the formation of stent framework defect-free elements. SLM of CoCr and TiNi powders were used to obtain coronary stents grid structures with a diameter of 2 to 6 mm with a bridge size of 150 μm to 500 μm.
Acknowledgements. This research was funded by Ministry of science and higher education of the Russian Federation (Project № FSNM-2024-0009); IRG № SED-26-08-08-31.

Biomaterials for treating consequences of periimplantitis. Strategies for development and application

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Nowadays, dental implants are gaining popularity and are preferred over the traditional removable prosthesis. Unfortunately, some patients develop inflammation around the placed implans as a complication, associated with treatment.
The purpose of this work is to present a conceptualized idea for tackling this common complication after implant placement. Development of different biomaterials with various mechanisms of action will be presented as a strategy to address the stages of perimplantitis onset. These include materials with abilities to perform implant debridement and hydrogels to promote healing and regeneration of affected tissues (bone and gingiva).

Long COVID and Microcirculation

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Since the first Long COVID symptoms were reported, many different pathophysiological mechanisms were proposed for their explanation without a consensus. From those mechanisms, some have a direct and some have an indirect relation to the microcirculation. Mechanisms with direct association are related to the respiratory system (pulmonary embolism), cardiovascular system (cardiac arrest, heart failure, myocardial inflammation, stroke, endothelial dysfunction, microangiopathy), and hematological conditions (coagulopathy, deep vein thrombosis, microclots, and endothelial abnormalities). However, very few of these proposed mechanisms were based on quantitative data and primary physiological principles and laws. Moreover, there are no sufficient diagnostic and therapeutic techniques. In this report, a brief description of those processes is given with a special emphasis on quantitative data and recent advancements related to microcirculation.

Biopsychosocial Determinants of Metabolic Control and Microvascular Health: An Interdisciplinary Approach

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Diabetes mellitus is a serious public health challenge worldwide. The global prevalence is rapidly increasing, with currently 60 million EU patients affected by the disease. The IDF Atlas estimated that the EU spends 9% of its health budget (EUR 149 billion) on the treatment of diabetes complications for the period 2012-2016. Besides biomedical complications, diabetes has significant psychosocial impacts, including psychological distress, mental health problems, cognitive impairments, and reduced quality of life, which can be addressed through psychosocial interventions. Psychosocial factors such as stigma, depression, and lack of social

support are associated with poor diabetes control in both type 1 and type 2 diabetes. However, the relationship between psychosocial diabetes-related factors and metabolic control is unclear.

We propose an interdisciplinary approach, based on the biopsychosocial model, considering both the biomedical and the psychosocial perspectives on the chronic effects of diabetes and their self-management by patients. Our theoretical model includes biomedical and psychosocial diabetes-related factors as determinants and microvascular health as the dependent variable. We propose that characteristics of the disease (type of diabetes, duration of the disease, type and severity of complications, etc.) and emotions, anxiety, depression and social support affect the patient's metabolic control and thus can influence endothelial function and vasodilation.

Data on the disturbances of the vascular tone regulation and endothelial dysfunction will be collected non-invasively using Microtest devices and laser Doppler flowmeter. Wavelet analysis will be used to assess the skin temperature fluctuations, caused by periodic changes in blood flow resulting from oscillations in vasomotor smooth muscle tone, corresponding to the myogenic, neurogenic and endothelial regulation. Input data will be collected both automatically and through daily self-report from the subject. The trained algorithm will provide predictions of changes in the capillary tone of the diabetic patient based on biological and psychosocial indicators.

Training High School Students in First Aid: A Peer-Led Initiative by Medical Students

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First Aid training is a critical component in the survival during cardiac and respiratory emergencies, where immediate and effective intervention can significantly improve outcomes. Despite its importance, First Aid skills is not the mandatory part in school curricula. This study examines a peer-led initiative aimed at addressing this gap by empowering high school students with essential life-saving skills.
First Aid skills training is the compulsory component of the Medical Doctor program of European University. Before we started the project, six second-year medical students from a medical doctor program of the European University received additional, extracurricular comprehensive training in First Aid. These students then organized and conducted First Aid

training sessions for 11th and 12th-grade pupils from their former secondary schools under the supervision of academic staff. The training sessions took place at the University Simulation Center, with a total of 110 pupils participating. The sessions were designed to be highly interactive, allowing participants to practice BLS techniques in a realistic, controlled environment. The initiative received overwhelmingly positive feedback, with an overall satisfaction rate of nearly 95%.

The introduction of First Aid training at the high school level not only equips students with vital skills but also fosters a culture of preparedness and confidence in responding to emergencies. Furthermore, this program significantly benefits the university by enhancing its role in social responsibility, raising awareness about the importance of early intervention in medical emergencies, and improving its reputation within the community. The successful implementation of this peer-led initiative underscores the potential for universities to contribute positively to public health while simultaneously enriching the educational experience of their students.

THE YOUNG SCIENTISTS' SESSION*

Changes in microcirculation and tensile strength in small intestine end-to-end anastomoses in experimental model

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Aim. Microcirculation and sufficient perfusion are key factors in the regeneration of intestinal anastomoses. Impaired microcirculation may lead to increased bacterial translocations and anastomoses insufficiency. During sceletization therefore it is important to estimate well the optimal distance of the anastomosis line from the last-order mesenteric vessels. Our study aimed to collect experimental data by investigating the microcirculation of the intestinal wall at various distances from the anastomosis.

Materials and Methods. Eight female juvenile pigs were anaesthetized (permission reg. nr.: 16/2018/UDCAW). Via paramedian laparotomy, end-to-end jejuno-jejunostomy was performed using Mikulicz-stitches (4/0, monofilament suture material). A Cytocam-IDF imaging device was used for microcirculatory measurements taken at the site of the planned suture line, and 1 to 3 mesenteric vessel mural trunk distance from it, just before performing

the anastomoses, and 15 and 120 minutes after finishing the anastomoses. The tensile strength of the bowel segments was measured by a device based on a single-point load transducer.

Results. Density and the proportion of perfused vessels significantly decreased after completing the anastomosis. The density and the ratio of the perfused vessels increased gradually away from the anastomosis line, and 2 hours after finishing the anastomoses these values seemed to normalize. The maximal tensile strength of the anastomosed small intestine segments (9.6±3 N) was significantly lower compared to the intact bowel part (17.5±4.4 N, $p<0.001$). We also observed that the bowel wall at the sites of the intestinal clamps weakened.

Discussion and Conclusion. The IDF imaging videomicroscope was helpful to monitor intestinal microcirculation providing data to estimate better the optimal distance of the anastomosis from the last-order mesenteric vessel. These results are encouraging to continue the study investigating further the optimization of the circumstances of intestinal clamp usage, time factor and the long-term microcirculatory changes affecting anastomosis healing.

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Investigating vascularization of mesenchymal mesoblastic nephroma: hemorheology, microcirculation and histomorphology

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Aim. The development of malignant tumors and their abnormal vasculature can result in severe alterations in tissue perfusion, as evidenced by vascularization, flow dynamics and rheological factors. The aim of this study was a rat-origin mesenchymal mesoblastic nephroma (Ne/De) tumor cell implantation model to examine changes in the kidney microcirculation, associated micro-rheological changes, and parenchymal structural abnormalities.

Materials and Methods. Twenty female Fischer-344 rats were split into groups: 10 with tumors and 10 with sham operations. A 0.9% NaCl solution or tumor cells containing Gelaspon® disc was positioned behind the renal capsule after the retroperitoneum in the lumbar area was opened while under anesthesia. The kidney microcirculation was observed using

Cytocam on the 1st and 9th postoperative (p.o.) days. On the 1st, 4th and 9th p.o. days, blood samples were collected to test for hematological parameters, red blood cell (RBC) deformability, and aggregation.

Results. The leukocyte counts significantly increased by the 4th p.o. day followed by a decrease on day 9. The platelet count was elevated on p.o. days 4 and 9. A steady and notable enhancement was seen in all RBC aggregation. In the tumor group, RBC deformability considerably deteriorated by the 9th p.o. day. The heterogeneous blood flow pattern and structural characteristics of the tumor tissue were seen when compared to the healthy or contralateral intact kidney. In records where flow parameters were enhanced, abnormally shaped and sized vessels were frequently identified, and RBC aggregates were seen.

Discussion. The malignant kidney tumor, which was expanding, resulted in aberrant vessels and impaired blood micro-rheology, which caused severe deterioration and heterogeneity in the microcirculation.

Conclusion. The model seems to be suitable for studying the further mesenchymal mesoblastic nephroma and related haemorheological, microcirculatory and parenchymal structural differences.

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The impact of interferon-alpha on RBC-endothelium interaction: optical tweezers study

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Interferon alpha-2b (IFN-α) is an approved antiviral drug against hepatitis C and B. Recently, IFN-α was used to treat patients with COVID-19. It is also known that IFN-α impacts endothelial cells, decreasing their permeability and reducing NO production. RBC-endothelium interaction, either adhesion or extracellular signaling, is known to determine blood rheology parameters at some circumstances. While endothelium is severely damaged in some cases of COVID-19, it is of interest, whether IFN-α alterates RBC-endothelium interaction, either direct (adhesion) or indirect (NO production).

Aim. The main aim of this study was to investigate *in vitro* RBC-endothelium interaction and endothelial impact on RBC aggregation at different concentrations of IFN-α.

Materials and methods. To achieve the goal, an optical tweezers trapping technique was applied to measure the forces of interaction between single RBCs and between RBC and the monolayer of endothelial cells.

Results and discussion. The results demonstrate statistically significant decrease of RBC aggregation in the presence of endothelium and IFN-α. The degree of the effect is higher if IFN-α was added in the plasma without preliminary incubation. On the contrary, samples with endothelium incubated with IFN-α for 24 hours, but lacking IFN-α in the plasma during the measurements, showed weaker tendencies in decreasing RBC aggregation. The force of RBC-endothelium adhesion demonstrated weak tendencies of decreasing with the raise in IFN-α concentration.

Conclusion. These results may be witnessed in favor of short-time IFN-α effect to the RBC-endothelium system. Further investigation of RBC-endothelium-IFN-α interplay may spread light on the underlying mechanisms and provide clues for new therapeutic targets.

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Assessing the microcirculation and microrheology of blood in patients with type 2 diabetes mellitus by different optical techniques

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Diabetes mellitus (DM) is a group of metabolic diseases in which chronic hyperglycemia leads to the development of pathology in the most organs and systems. The prevalence of DM is growing rapidly, so, according to the data of the World Health Organization, the global incidence of DM almost tripled from 1980 to 2020. One of the complications of DM are related with specific damage of the microvascular system.

Aim. The main aim of this study was to evaluate the microcirculation and microrheological parameters of red blood cells (RBCs) in patients with type 2 diabetes mellitus (T2DM), using *in vivo* and *in vitro* methods accordingly.

Materials and methods. To achieve the goal, *in vitro* measurements of the aggregation parameters of RBCs were carried out using the method of laser aggregometry, an optical tweezers trapping technique was applied to measure the forces of interaction between single RBCs *in vitro*. The method of digital capillaroscopy was used to study the parameters of blood flow *in vivo*.

Results and discussion. The results demonstrate statistically significant increase of aggregation index (the proportion of RBCs that aggregated during the first 10 seconds of the spontaneous aggregation process) in patients suffering from T2DM. The aggregation time of paired RBCs is statistically significantly reduced for patients with T2DM by (26.9 ± 5.5) % compared to the control group, which is consistent with the results obtained using laser aggregometry methods. The magnitude of capillary blood velocity measured *in vivo* significantly decreases with T2DM by (55.9 ±16.4) % compared to the control group of volunteers. It was shown that in patients with T2DM the number of aggregates per minute flowing in the capillary blood flow increases by 80% and the number of aggregates per square millimeter increases by 98%. These can lead to increased blood viscosity, which makes it difficult for red blood cells to move through blood vessels and reduces their ability to deliver oxygen to tissues. An increase in these parameters can lead to an increased risk of blood clots formation and blockage of blood vessels.

Conclusion. The results clearly demonstrate the possibility of using laser aggregometry, digital capillaroscopy and laser tweezers to assess changes in microrheologic and microcirculatory parameters of blood.

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*The studies participate in the competition for the best work of a young scientist

POSTERS

P1. Characterization of explanted hernia meshes

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Hernia mesh is a typical soft tissue substitute. In some cases, reoperation is needed because of complications and characterization of explanted hernia mesh is possible. We applied mechanical and chemical testing to identify the explanted hernia meshes according to their material composition and to compare their mechanical properties.

Materials and Methods. Explanted meshes from 7 patients undergoing hernia repair were investigated. The meshes were characterized by Image Analysis to reveal structural characteristics of explanted hernia meshes, Differential scanning calorimetry and X-ray diffraction to determine the type of polymers. The results showed information for pore size, shape, weight and material composition of the explanted meshes. Uniaxial tensile test and relaxation test were performed at physiological loads and strength, elastic modulus and stress relaxation were evaluated.

Results. The results show that the explanted meshes are made of polypropylene (PP) and polyethylene terephthalate (PET). Four explanted polypropylene meshes, mean age of the donors - 61,6 years, mean duration of mesh implantation - 38 months were investigated. The density of PP meshes is 110-150 g/m^2. The explanted polyester hernia meshes were extracted from 3 patients with mean age 62,6 years and duration of implantation 24 months. The density of PET meshes is between 64-170 g/m^2.

Discussion and conclusion. Mechanical alterations of explanted meshes were presented using chemical and mechanical tests. The tensile strength postimplantation was changed mainly in transversal direction. The elastic modulus at the same direction increases. Augmentation picture of meshes displayed distortion of the mesh material. The tests were important in achieving relevant biomechanical data.

P2. Clinically relevant experiments with hernia meshes

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The use of meshes to repair hernias is a very effective approach. Nowadays this is a common procedure in abdominal surgery. The implanted meshes can be characterized by *in vivo* or *in vitro* experiments. The study aims to use *in vitro* tests of hernia meshes in order to investigate their mechanical properties after quasi-static tests and dynamic experiments.

Materials and methods. Meshes made of polypropylene and polyester were characterized and compared after relaxation and dynamic experiment. All experiments simulate real processes – coughing, quatting and bloating. For each specimen, initial Lagrangian stress T_0 at 0 seconds, equilibrium stress T_{eq} at 1800 seconds, modulus at initial strain and at equilibrium state were calculated from derived curves. The elastic modulus after defined number of cycling for every mesh was calculated.

Results and discussion. The viscoelastic behaviour of the meshes after relaxation and cyclic loading was compared at physiological conditions. Stress and strain data were compared after first, tenth and hundredth cycle of testing. The elastic modulus for all meshes increases with number of cycles which correlate with the polymeric material. The results indicate that cyclic loading is appropriate for modelling the age-related changes in the mechanical characteristics of surgical meshes.

Conclusion. In this study clinically relevant experiments were performed using tensile, relaxation and cycling tests. In case when the deformation of examined meshes were too large the application of lower load should be applied in cycling tests. Cyclic load testing can be used to obtain boundary conditions for clinical situation and thus to improve the properties of existing hernia meshes.

P3. Changes in red blood cell deformability at the beginning of the winter swimming season and at the end of another, in females and males: preliminary reports

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Health promotion is an important area of public health. A healthy lifestyle contributes to better health and early prevention of chronic diseases. Physical activity combined with winter swimming improves physical fitness, the capacity of many human body systems, as well as mental condition. It reduces the risk of infections, colds, illnesses. Winter swimming involves bathing in cold or icy water, which provides a positive effect on health and wellbeing.[1]

The aim of the NdS-II/SP/0368/2023/01 project entitled 'Winter swimming is about passion and health,' supported by the Ministry of Science and Higher Education in Poland, is to promote sport and health through cooperation with the Krakow Society of Winter Swimmers 'Kaloryfer' in Krakow (Poland). The cooperation consists in conducting slow jogging courses, enabling the project participants to access the Indoor Swimming Pool Complex of the University of Physical Education in Krakow, as well as performing basic red blood cell deformability tests among the winter swimmers in the Blood Physiology Laboratory of the Central Research and Development Laboratory, University of Physical Education in Krakow.

Within the 'Winter swimming is about passion and health' project, constituting part of the 'Science for Society II' program (the granted amount of funding: 169,334.00 PLN, timeframe:

2023–2025), a qualified nurse collected fasting blood samples from the study group participants (winter swimmers from the Krakow Society of Winter Swimmers 'Kaloryfer'; *n* = 30; 15 women and 15 men) in November, at the beginning of the 2023/2024 winter swimming season and at the end in March. At the same time, blood samples were taken from women (*n* = 15) and men (*n* = 15) included in the control group (who did not practise winter swimming or implement any training program). Samples of 5 ml of fasting blood were collected from the cubital vein into Vacuette® EDTA K2 vacuum tubes. Red blood cell deformability (elongation index) was tested with the Laser-Assisted Optical Rotational Red Cell Analyzer (Lorrca®) MaxSis (RR Mechatronics, The Netherlands) by using the method described by Hardeman.[2] Mean elongation index was plotted versus the corresponding shear stress of 0.30–60.00 Pa. Calculations were performed with the Statistica 13 software (TIBCO Software Inc., USA). Normality of distribution was checked using the Shapiro-Wilk test. The comparison of repeated measurements in the control and winter groups was performed based on the analysis of variance (ANOVA). Tukey's HSD multiple comparison test was used.The study was approved by an Ethics Committee no. 182/KBL/OIL/2023.

Inclusion criteria: sex: male, female; age: 35–55 years; no significant cardiovascular, respiratory, or musculoskeletal conditions; written informed consent to participate in the study.

Exclusion criteria: heart rate disorders; uncontrolled hypertension; cancer; oncological treatment; diabetes; rheumatic diseases.

Results and conclusion. Statistically significant differences between the studied groups were found for red blood cell or red blood cell deformability parameters:

- Elongation Index statistically significant decreases after winter swimming men at shear stress values of 1.13 (p=0.047), 2.19 (p=0.011), 4.24 (p=0.012) as compared with the men winter swimmers before the season
- Elongation Index statistically significant decreases after winter swimming women at shear stress values of 0,30 (p=0.031) and for erythrocytes (p=0.000) as compared with the women winter swimmers before the season
- Elongation Index statistically significant decreases after winter swimming women at shear stress values of 60.00 (p=0.024) as compared with the control group.

No statistically significant changes were reported for another red blood cell or red blood cell deformability parameters. The deformability of red blood cells plays an important role in their main function, which is the transportation of oxygen and carbon dioxide via blood circulation. The average size of a single erythrocyte is 7–8 μm, while the diameter of capillaries equals 3–5 μm, which denotes a necessity to deform the erythrocytes. Exercise (winter swimming,

swimming at the pool, slow jogging) regardless of its intensity, induces acute changes in the rheologic properties of blood.

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P4. Erythrocytes' Membranes' Fatty Acid Profiles Post Laparoscopic Sleeve Gastrectomy for Obesity Management

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Aim. Obesity is linked to metabolic disorders. Bariatric surgery offers a promising therapeutic approach, but its impact on fatty acid (FA) profiles within erythrocytes and the associated clinical implications remain underexplored. This study aimed to assess changes in erythrocytes' membranes' FA post Laparoscopic Sleeve Gastrectomy (LSG).

Materials and Methods. 61 patients with morbid obesity undergoing LSG and 32 healthy controls were enrolled. Erythrocyte membrane FA composition was analyzed using gas chromatography. BMI, lipid profile, and other clinical markers were assessed.

Results. Bariatric intervention significantly reduced BMI (medians: 41.1 to 32.0). Serum triglycerides' level differed between groups (medians: baseline-1.31 ; follow-up: 1.19 and controls: 0.95mmol/L) Also, other clinial parameters were significantly altered 6 months after surgery. Controls predominantly displayed RBC membranes composed of C18:1 (16.9%). C16:0 was their main component in baseline (29.1%) and follow-up: (20.8%). N-3 Polyunsaturated FA were most prominent in controls (8.3%) and significantly lower in baseline (5.2%) and follow-up (6.4%). Favorable changes in FA metabolism in follow-up were observed. The OMEGA-3 Index increased significantly (medians: 1.8 vs 3.0).

Discussion. Our study confirms that LSG leads to weight loss and improvement of other parameters. The previous comparisons of changes in the FA after LSG were done mainly for plasma or whole blood. The message from such studies is limited as these FA profiles fluctuate based on the diet. Considering that the n-3 Polyunsaturated FA and OMEGA Index can be used for the assessment of inflammation and development of chronic diseases, our study proves that LSG can have higher quantity of beneficial effects than only weight loss, furthermore it may be more advantageous than other bariatric interventions.

Conclusions. The study presents post LSG surgery changes in erythrocyte FA profiles, potentially associated with altered biophysical properties of erythrocytes' membranes, improved inflammatory status, and lowered cardiovascular risk.

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P5. Investigation of skin temperature oscillations during local heating and cold test in patients with type 2 diabetes mellitus

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The investigation of endothelial dysfunction in clinical settings has been an important role in the progression of vascular disease. Different tests have been used for this purpose. One way to evaluate Microvascular endothelial function is by dynamic variations in cutaneous blood flow, by application the impact of stress tests: thermal, mental, orthostatic, breathing and occlusive. Being noninvasive and easy to implement, thermal tests are most widespread. The temperature tests demonstrated that diabetic patients have impaired vasodilation and vasoconstriction in response to local heating and cold influence. In this study, we investigate how temperature homeostasis changes in both types of tests - cold and heating in healthy controls and in patients with type 2 diabetes.

The alterations in the skin temperature fluctuations indicate the periodic changes in blood flow as a result from oscillations in the vasomotor smooth muscle tone. As an indicator of the disturbances of the active mechanisms regulating the vascular tone, in our work we use the

changes in the skin temperature in a selected frequency range. The skin temperature fluctuations reflecting the intrinsic myogenic activity (0.05-0.14 Hz), neurogenic factors (0.02-0.05 Hz) and endothelial activity (0.0095-0.02 Hz) indicate that they are suitable for investigating disorders in active mechanisms regulating vascular tone. The aim of our study is to investigate the possibility of wavelet skin temperature analysis (WAST) to diagnose impaired regulation of microvascular tone in patients with type 2 diabetes.

Keywords: type 2 diabetes mellitus (DM-2), cold test, local heating test, skin temperature fluctuations, WAST method

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P6. Comparative in vitro investigation of viscoelasticity in aging of healthy/melatonin deficient rat aorta

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Aim. Both aging and the pineal hormone melatonin are known to impact arterial physiology and biomechanics. Chronic deficiency of melatonin is thought to be involved in the pathological remodelling of the arterial wall, leading to changes in its stiffness. Natural aging is also associated with adaptive processes in the wall, which may cause increased arterial stiffness and hypertension. This study aimed to evaluate in vitro the effects of melatonin deficiency and aging on aortic viscoelasticity in rats.

Materials and methods. Arterial wall viscoelasticity was directly estimated in aortic strip preparations, obtained from previously sham-operated and pinealectomised Wistar male rats. The experimental animals were additionally divided into three age groups – 3, 14, and 18 months. Two characteristics of the aortic wall were measured, using the forced oscillations method – natural frequency (f_0) and modulus of elasticity (E′).

Results. Melatonin deficiency led to significantly decreased E′ in the 3- and 18-month-old age groups, while f_0 was significantly decreased only in the 18-month-old group. The age of the

experimental animals had a significant effect in decreasing E′ only at 18 months. Although there was an increase in f_0 and E′ with the rise of equivalent arterial blood pressure across all age groups, this effect was the most suppressed in aortic preparations from the 18-month-old group.

Discussion. In other studies, using younger rats, melatonin deficiency induced fibrotic remodelling of the media layer with collagen build-up, which causes increased arterial stiffness. However, our findings suggest that along with age, chronic absence of melatonin results in the opposite – decreased arterial stiffness and natural frequency.

Conclusion. Chronic melatonin deficiency and aging significantly impact the viscoelasticity of the aortic wall in male Wistar rats by reducing arterial stiffness and natural frequency measured in vitro.

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P7. Properties of Lecithin Stabilized Water-in-Oil Thin Films and the Role of Interfacial Rheology

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Lecithins are naturally occurring amphiphilic phospholipids known for their ability to stabilize both water-in-oil (W/O) and oil-in-water emulsions. Due to their natural origin, biodegradability, and nutrition benefits they are desirable choice of emulsifier in the food, pharmaceutical, cosmetic, and other industries. However, their performance as a stabilizer of W/O emulsions is lacking in comparison to some synthetic alternatives. Thus, a better understanding of the underlying mechanisms and impacts of different factors that could affect lecithin's emulsifying performance (its origin and composition, the type of oil, ionic strength, and pH of the aqueous phase, etc.) will be very beneficial.

The aim of the present study was to shed additional light on the mechanisms of W/O emulsions stabilization by soy lecithin, utilizing model thin emulsion film studies via microinterferometric method of Scheludko-Exerowa. Dynamic and equilibrium properties of emulsion films like drainage kinetics, film lifetimes, film thickness (equilibrium or at rupture) were measured.

These results are correlated to the soy lecithin adsorption properties at water-oil interface and dilatational rheology investigated using profile analysis tensiometer (PAT-1).
The results outline the favourable system conditions (concentration, pH, presence of electrolyte, etc.) to enhance emulsion stability. The combination of dynamic adsorption and interfacial rheological studies of water/oil interface, along with model thin emulsion film experiments, proved to be useful in elucidating mechanisms of emulsion stabilization.

P8. An Application of the Method of Simplest Equation for Exact Real Solutions for Advection-Diffusion Interaction

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We have observed in the last decades of a fast growth of research on nonlinear phenomena. The application of new methods for obtaining exact real solutions of partial differential equations and systems is an area of active research in mathematics and applied sciences. Partial differential equations (PDEs) are fundamental tools in modeling various phenomena in tissue biomechanics. These mathematical equations describe the relationships between the different physical quantities that vary across space and time within biological tissues.

The advection-diffusion equation is a crucial tool in cell and tissue biorheology for modeling the transport of substances such as nutrients, oxygen, signaling molecules, and drugs within biological tissues. This equation combines the processes of advection (transport due to bulk fluid flow) and diffusion (transport due to concentration gradients) to describe how these substances move through the tissue environment. Cellular communication often involves signaling molecules that diffuse through the extracellular matrix. The advection-diffusion equation can model the spatial-time dynamics of these molecules, providing insights into how signals propagate through tissues.

In this study, we will use a particular case of the recently developed SEsM (Simple Equations Method) namely the Modified method of Simplest Equation [1, 2] and one of its extended versions. We will obtain a new solution of the model system. Numerical simulations of this solution demonstrate propagation of nonlinear waves in the considered model. The characteristics of the obtained traveling wave solution are visualized and discussed.

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P9. Semantic priming as modulator of saccade directions and pupil diameter in glaucoma patients

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The aim of this research is to study the effect of semantic priming on eye movements and its potential use for early diagnosis of glaucoma. Data of the studied with Gazepoint GP3 HD eye tracker patients with glaucoma were compared to healthy subjects. The main findings of this study are - mean saccade amplitudes for static pictures are lower in glaucoma patients, while semantic priming decreases this difference with healthy controls, and pupil diameter of left and right eyes of glaucoma patients increase during static scene task compared to their diameters obtained in mesopic bright illumination during calibration procedure. It is concluded that readily measurable parameters saccades' magnitude and diameter of the eye's pupil can be used for diagnosis of glaucoma and to follow its progression. Additionally, semantic priming seems to be a simple and useful method to ease the everyday life of people with glaucoma.

Keywords: Semantic priming, eye movement, saccade, pupil contraction, glaucoma

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