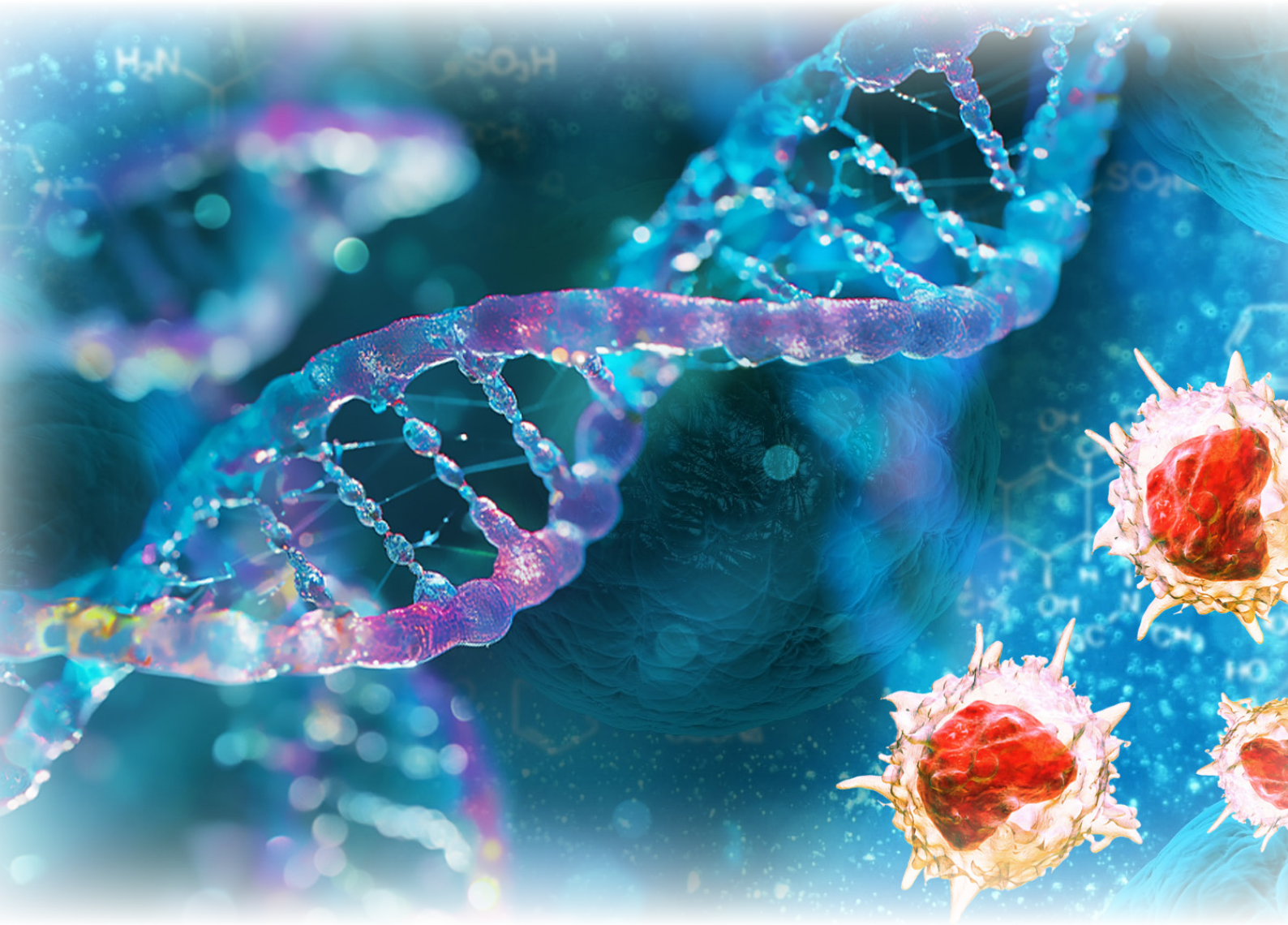
ISSN 3009-3848
ISSNe 3009-383X

Oncology Insights

Official Journal of the Serbian Association for Cancer Research



Year 2025/No. 3

ISSN 3009-3848
ISSNe 3009-383X

ONCOLOGY INSIGHTS

Official Journal of
the Serbian Association for Cancer Research

Belgrade, Serbia
September, 2025

ONCOLOGY INSIGHTS
Official Journal of the Serbian Association for Cancer Research
Publishing annually

Publisher
Serbian Association for Cancer Research
Pasterova 14, 11000 Belgrade, Serbia
phone: +381 11 2067 210; e-mail: info@sdir.ac.rs

Editor-in-Chief
Dr Milena Čavić, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia

Associate Editors
Dr Milica Pešić, Institute for Biological Research "Siniša Stanković", Belgrade, Serbia
Dr Ivana Z. Matić, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia

Managing Editor
Dr Ana Damjanović Veličković, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia

Technical Editors
Dr Marija Đorđić Crnogorac, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia
Dr Milica Nedeljković, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia

Lector/Corrector
Jana Stefanović

Printed by:
Connect Online Studio
Ćirila i Metodija 2a
Belgrade, Serbia

Cover image created by:
Dr Milica Nedeljković, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia

This is an open access article is under the terms of the Creative Commons Attribution License 4.0, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

The Journal is listed in the Digital Repositorium of the National Library of Serbia and Co-operative Online Bibliographic System & Services - Cobiss

CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

616-006-08

ONCOLOGY Insights : official Journal of the Serbian Associaton for Cancer Research / editor in chief Milena Čavić. - [Štampano izd.]. - 2023, no. 1- . - Belgrade : Serbian Associaton for Cancer Research, 2023- (Belgrade : Connect Online Studio). - 30 cm

Godišnje. - Drugo izdanje na drugom medijumu:
Oncology Insights (Online) = ISSN 3009-383X
ISSN 3009-3848 = Oncology Insights (Štampano izd.)
COBISS.SR-ID 125366281

Editorial Office
Serbian Association for Cancer Research

Editors
Dr Radmila Janković, Institut za onkologiju i radiologiju Srbije
Dr Marko Radulović, Institut za onkologiju i radiologiju Srbije
Prof. dr Katarina Zeljić, Biološki fakultet, Univerzitet u Beogradu
Prof. Engin Ulukaya, Medical Faculty of Istinye University
Prof. Konstantinos Dimas, Faculty of Medicine - University of Thessaly
Dr Sergi Castellvi-Bel, Fundació de Recerca Clínic Barcelona-Institut d'Investigacions Biomèdiques August Pi i Sunyer, Barcelona
Prof. Sonja Levanat, Ruđer Bošković Institute, Zagreb
Dr Neda Slade, Ruđer Bošković Institute, Zagreb
Dr Petar Ozretic, Ruđer Bošković Institute, Zagreb
Prof. Evi Lianidou, Nacionalni i kapodistrijanski Univerzitet u Atini, Grčka

Editorial Council
Dr Ana Đurić, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia
Dr Marko Radulović, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia
Dr Radmila Janković, Institute for Oncology and Radiology of Serbia, Belgrade, Serbia
Prof. Katarina Zeljić, Faculty of Biology, University of Belgrade, Belgrade, Serbia
Dr Lidija Todorović, The Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia
Dr Nina Petrović, The Vinča Institute of Nuclear Sciences, University of Belgrade, Serbia

CONTENTS

ONCOLOGY INSIGHTS INFO I

AUTHOR GUIDELINES II

LEGACY INSIGHTS 1

PATIENT POINT OF VIEW 7

FUTURE HORIZONS IN CANCER 13

ORIGINAL ARTICLES 23

PERSONAL POINT OF VIEW 31

PROCEEDINGS BOOK 37

POSTER SESSION 85

SESSION 1: *Benefits of combination therapies in cancer treatment* 85

SESSION 2: *Personalized anticancer treatment through targeting signaling pathways* 88

SESSION 3: *Tumor microenvironment - friend of foe* 99

SESSION 4: *Immunooncology* 104

SESSION 5: *Exploring the role of mdr mechanisms and stem cell biology in cancer and cancer treatment strategies* 107

SESSION 6: *Cancer epidemiology- strategies for prevention and early detection* 108

SESSION 7: *Advancements in molecular diagnostics and cancer biomarkers in oncology* 114

SESSION 8: *Liquid biopsy* 120

SESSION 9: *Clinical oncology - bridging patients and researchers* 126

SESSION 10: *Bioinformatics and cancer genomics* 132

SESSION 11: *Novel cancer therapies and drug development strategies* 139

SESSION 12: *Toxic triggers: enviromental chemicals and cancer risk* 154

SESSION 13: *Tumor metabolism* 155

SESSION 14: *Innovative models and approaches in cancer research* 162

ONCOLOGY INSIGHTS

Aims and Scope

Oncology Insights is a annual oncological open-access peer-reviewed journal that publishes new research from different areas of oncology. It strives to provide a platform for the exchange of cutting-edge research and knowledge in the field of oncology. This journal aims to advance the understanding, prevention, diagnosis, and treatment through the dissemination of high-quality scientific discoveries.
The journal applies a fair and accurate peer review process, employing double-blind review methodologies. Acceptance of manuscripts is based on their scientific merit, originality, clarity, and contribution to the field.

Topics

Oncology Insights covers a wide spectrum of topics within the field of oncology, including but not limited to:

- Basic and Translational Research
- Clinical Oncology
- Radiation Oncology
- Surgical Oncology
- Pediatric Oncology
- Hematologic Oncology
- Palliative Care
- Epidemiology and Public Health
- Cancer Genetics
- Immunotherapy and Targeted Therapies
- Experimental Therapeutics
- Computational Biology and Artificial Intelligence

About/Information

Oncology Insights welcomes various types of contributions, including original research articles, review articles, case reports, case studies, clinical trials, registered reports, comments, brief communications, editorials, letters to the editor, perspectives, and conference papers from a wide range of disciplines related to cancer research.
Through encouraging interdisciplinary collaborations, the journal welcomes contributions that integrate oncology with related fields such as immunology, genetics, biochemistry, radiology, and other relevant disciplines. The journal places a special emphasis on publishing research that highlights emerging trends, novel technologies, and innovative approaches in cancer research and clinical practice.
Oncology Insights is intended for a diverse readership, including oncologists, researchers, clinicians, nurses, allied healthcare professionals, patients, patient advocates, policymakers, and all stakeholders involved in the prevention, diagnosis, and treatment of cancer. It adopts a global perspective, encompassing research from diverse regions addressing oncological challenges that may vary across different populations.
The journal is committed to upholding the highest ethical standards in research and publication provided by established international guidelines.
Periodically, Oncology Insights may publish special issues focusing on specific topics to highlight particular areas of interest or emerging needs.
Authors are provided with clear and comprehensive guidelines for manuscript preparation, including structure, formatting, and other specific requirements.

AUTHOR GUIDELINES

Manuscript submission

By submitting a manuscript, authors affirm that their contribution to Oncology Insights journal is entirely original, has not been published before, is not under consideration for publication elsewhere, and has received approval for publication from all co-authors. Additionally, tacit or explicit consent must be obtained from the responsible authorities at the institution where the research was conducted.

Authors bear sole responsibility for the content of their submissions, and the accuracy of the experimental findings, and must ensure they possess proper permission from all involved parties to disseminate the data.

In the event that authors intend to incorporate figures or text excerpts from prior publications, they are obligated to seek authorization from the respective copyright holder(s). Evidence of such authorization must be provided upon submission. Materials lacking this evidence will be presumed to originate from the authors.

Furthermore, authors must ensure that only those contributors who have made significant contributions to the submission are credited as authors. Conversely, all contributors who have made substantial contributions must be acknowledged as authors. Authors are requested to send the prepared manuscript to the email address info@sdir.ac.rs.

Pre-Evaluation Manuscript

Manuscripts undergo a preliminary assessment at the Editorial Office to ensure compliance with fundamental publishing criteria and quality benchmarks. Additionally, they are screened for plagiarism.

Authors will receive an email confirmation upon receipt of their submission. Only contributions adhering to the provided guidelines will proceed to peer-review. Manuscripts not meeting these criteria will be returned to the authors with observations, comments and annotations.

Manuscript preparation

Authors are required to adhere strictly to the provided instructions.
The manuscripts should be written in English with clarity and conciseness. Both American and British English are accepted, but a combination of these is discouraged.

The manuscript should contain the title, authors' names and affiliations, abstract, keywords, the text of the manuscript:

- Introduction
- Materials and methods[1]
- Results[1]
- Discussion
- Conclusion
- Acknowledgments
- References

Mark the position of figures and tables in the text. Please, do not include tables and figures in the manuscript. They should be submitted as separate files.

Title
The title should be clear, not too long, but explanatory.

The full name(s) of the author(s)
Write the full name and surname of each author.

1 Original Research/Case Studies

The affiliation(s)
Each author's name should be followed by the affiliated department, institution (school, university, research institute, company, or independent scholar status), city, and state.

Corresponding author
Clearly indicate who is responsible for correspondence at all stages of publication, including post-publication. Ensure that the e-mail address is provided.

Abstract
Abstract should contain a short review of the methods and the most important results of the work, so that its original text can be used in reference periodicals and databases. Do not include citations in the abstract.

Keywords
Keywords are listed in a separate line at the end of the abstract. A maximum of five keywords should be provided and relevant to the topic and content of the paper.

Units
The SI system should be used for all scientific and laboratory data.

Photos, drawings, and other illustrations should be of good quality. The acceptable image formats include: TIFF and JPEG.

Acknowledgements
Acknowledgements should be presented in a distinct section located at the conclusion of the article, preceding the references. This section should include any pertinent funding information.

References
References should be compiled at the conclusion of the article and numbered according to their appearance in the text. The list of references should exclusively comprise works that have been cited in the text, and they should be listed in the language of their original publication.

After Acceptance
Upon acceptance, the corresponding author will be provided with the Authors' Statement for signature. We are committed to expediting the publication of your article with precision. To streamline the process, please consolidate all corrections in a single communication. Take care to review thoroughly before responding, as we cannot guarantee the inclusion of subsequent corrections. Proofreading is the sole responsibility of the author.

Author guidelines can be downloaded from https://www.sdir.ac.rs/pdf/Author%20guidelines.pdf

Dear colleagues,

The third volume of Oncology Insights, the Official Journal of the Serbian Association of Cancer Research (Srpsko društvo istraživača raka, SDIR) nicely depicts the advancements in oncology today, with a glimpse of efforts invested into broadening the scope of our research. We insist on excellence and integrity, bringing innovative approaches into our community with an open view of the specific needs of our patients.

The third volume of Oncology Insights features Original Research articles, Review Future Horizons articles, and Personal Points of View from researchers and patient advocates highlighting publishing integrity and advocating for wider access to oncological care.
Oncology Insights also serves as a venue for new original data from the first Regional Congress of EACR-affiliated Serbian, Croatian and Turkish societies SDIR, HDIR, and MOKAD (SHM1RC) held in Belgrade, Serbia, from October 8 to 10, 2025. The congress addressed key topics in cancer research and enhanced collaboration and the exchange of new ideas within the EACR national communities.
Lectures and short abstracts from the fields of Combination anti-cancer therapies, Clinical oncology, Molecular diagnostics in oncology, Stem cells and cancer, MDR in cancer treatment, Liquid biopsy, Cancer epidemiology, (Epi)genetics, Cancer biomarkers, New cancer therapies, Signaling pathways, Anticancer drug development, Personalized anticancer treatment, Translational oncology and Cancer radiobiology among others, are published as official Congress material.

Oncology Insights offers a platform aimed at challenging our comfort zone, discussing topics which are sometimes avoided in the everyday struggle to publish articles and prepare new projects. We invite researchers, physicians, nurses, laboratory technicians, as well as patients, survivors, caregivers, and patient advocates to offer their valuable expert insights to our journal on topics you consider important. Offering your tailored point of view stimulates the progress of oncology by collaborative efforts. We invite you tojoin us in shaping the future by providing evidence-based, unbiased multidisciplinary content for our future volumes, thus inspiring new lines of interest for our readers.

During these challenging times, we invite you to strive for personal and collective scientific integrity and hold on to your knowledge as your superpower. Please enjoy exploring the third volume of our journal - we hope it brings you numerous moments of intellectual freedom.

With kind regards,

Milena Čavić, SDIR President
Editor-in-Chief
Oncology Insights
Official Journal of the Serbian Association for Cancer Research

The third number of Oncology Insights includes
PROCEEDINGS BOOK of
The 1st Regional SDIR-HDIR-MOKAD Congress

The 1st SDIR-HDIR-MOKAD regional congress

October 8-10, 2025, Belgrade, Serbia
Nobel Zira Hotel
ORGANIZERS
Serbian Associaon for Cancer Research
www.sdir.ac.rs
Croatian Association for Cancer Research
https://hdir.hr/en/
Molecular Cancer Research Association
https://mokad.org
with the support of EACR

Dear Colleagues,

The organization of the 1st Regional Congress of the three national societies is now complete. It is an understatement to say that this has been an extremely demanding task, requiring the involvement of all of us over the past few months. We believe we have fulfilled our responsibilities well.

We set ourselves two important goals. The first was to create a welcoming atmosphere for every participant, allowing them to expand their knowledge, present their results, establish new collaborations, and develop new scientific ideas. The second goal was to provide ample free time for participants to enjoy our beautiful city, which is especially inspiring this autumn.

We hope you will make the most of the time ahead. We aldo want you to take wonderful memories from Belgrade, share them with us, and inspire us to continue pursuing such initiatives. Scientific inquiry knows no boundaries; it should flourish for the benefit of all, especially for those who come after us.

Sincerely,

on behalf of the Organizing Committee

Dr sc Ana Damjanović Veličković
Senior research associate
Institute for Oncology and Radiology of Serbia
Belgrade, Serbia

Adj. Asst. Prof. Dr Petar Ozretić
Senior research associate
Ruđer Bošković Institute
Zagreb, Croatia

1ST REGIONAL SDIR-HDIR-MOKAD CONGRESS ORGANIZING COMMITTEE

Presidents:

Dr Ana Damjanović Veličković, Institute for Oncology and Radiology of Serbia,

Dr Petar Ozretić, Ruđer Bošković Institute, Croatia

Members:

Dr Marija Đorđić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Milica Nedeljković, Institute for Oncology and Radiology of Serbia, Serbia
Prof. Sonja Levanat, Ruđer Bošković Institute, Croatia
Dr Maja Sabol, Ruđer Bošković Institute, Croatia
Dr Neda Slade, Ruđer Bošković Institute, Croatia
Dr Engin Ulukaya, Medical Faculty of Istinye University, Istanbul , Turkey
Dr Aysegul Cebi, Giresun University Faculty of Health Sciences, Giresun, Turkey
Dr Sofija Jovanović Stojanov, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Ass. dr Maja Milošević Marković, Faculty of Dental Medicine, University of Belgrade, Serbia
Dr Nina Petrović, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Serbia
Prof. Dr. Vesna Ćorić, Faculty of Medicine, University of Belgrade, Serbia
Dr Mladen Marinković, Institute for Oncology and Radiology of Serbia, Serbia
Dr Ana Đurić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Snežana Bjelogrlić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Jovana Despotović, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Serbia
Dr Sandra Dragičević, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Serbia
Dr Vladana Petković, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Tijana Išić Denčić, Institute for the Application of Nuclear Energy INEP, University of Belgrade, Serbia
Dr Bojana Kožik, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Vanesa Sekeruš, Institute for Pulmonary Diseases of Vojvodina, Serbia
Dr Tamara Babić, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Serbia
Dr Milena Čavić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Milica Pešić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Radmila Janković, Institute for Oncology and Radiology of Serbia, Serbia
Dr Marko Radulović, Institute for Oncology and Radiology of Serbia, Serbia
Dr Katarina Zeljić, Faculty of Biology, University of Belgrade, Serbia
Dr Ana Krivokuća, Institute for Oncology and Radiology of Serbia, Serbia
Dr Ivana Matić, Institute for Oncology and Radiology of Serbia, Serbia
Dunja Pavlović, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Serbia
Aleksandra Stanojević, Institute for Oncology and Radiology of Serbia, Serbia
Maja Petrović, Institute for Oncology and Radiology of Serbia, Serbia
Ivana Pašić, Institute for Oncology and Radiology of Serbia, Serbia
Vanja Stevanović, Institute for Oncology and Radiology of Serbia, Serbia
Miodrag Vuković, Institute for Oncology and Radiology of Serbia, Serbia
Kristina Živić, Institute for Oncology and Radiology of Serbia, Serbia
Katarina Živić, Institute for Oncology and Radiology of Serbia, Serbia
Milica Pajović, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Teodora Ćato, Institute for Oncology and Radiology of Serbia, Serbia
Isidora Pantović, Institute for Oncology and Radiology of Serbia, Serbia
Valentina Karadžić, Institute for Oncology and Radiology of Serbia, Serbia
Milica Marković, Faculty of Pharmacy, University of Belgrade
Ema Lupšić, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia

1ST REGIONAL SDIR-HDIR-MOKAD CONGRESS SCIENTIFIC COMMITTEE

Congress Presidents:
Dr Milena Čavić, Institute for Oncology and Radiology of Serbia, Serbia
Prof. Sonja Levanat, Ruđer Bošković Institute, Croatia
Dr Engin Ulukaya, Medical Faculty of Istinye University, Istanbul , Turkey

Scientific Committee Chairs:
Dr Milica Pešić, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Neda Slade, Ruđer Bošković Institute, Croatia
Dr Sergi Castellvi-Bel, principal research fellow, Fundació de Recerca Clínic Barcelona-Institut d'Investigacions Biomèdiques August Pi i Sunyer, Barcelona,Spain

Members:
Dr Radmila Janković, Institute for Oncology and Radiology of Serbia, Serbia
Dr Marko Radulović, Institute for Oncology and Radiology of Serbia, Serbia
Prof. dr. Katarina Zeljić, Faculty of Biology, University of Belgrade
Dr Ana Krivokuća, Institute for Oncology and Radiology of Serbia, Serbia
Dr Ivana Matić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Nina Petrović, "VINČA" Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Aleksandra Nikolić, Institute of Molecular Genetics and Genetic Engineering, University of Belgrade, Serbia
Dr Danijela Maksimović-Ivanić, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Sanja Mijatović, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Ljubica Harhaji-Trajković, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Jelena Grahovac, Institute for Oncology and Radiology of Serbia, Serbia
Dr Miljana Tanić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Nevenka Gligorijević, Institute for Oncology and Radiology of Serbia, Serbia
Dr Ana Đurić, Institute for Oncology and Radiology of Serbia, Serbia
Dr Tijana Išić-Denčić, Institute for the Application of Nuclear Energy INEP, University of Belgrade, Serbia
Prof. Dr Aleksandra Buha Đorđević, Faculty of Pharmacy, University of Belgrade, Serbia
Dr Jasmina Obradović, Institute for Information Technologies, University of Kragujevac, Serbia
Dr Jelena Spasić, Institute for Oncology and Radiology of Serbia, Serbia
Prof. Dr Katarina Nikolić, Faculty of Pharmacy, University of Belgrade, Serbia
Dr Vesna Vučić, Institute for Medical Research, University of Belgrade
Prof. Dr Vesna Ćorić, Faculty of Medicine, University of Belgrade, Serbia
Dr Sofija Jovanović-Stojanov, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Jelena Dinić, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Ana Podolski-Renić, Institute for Biological Research "Siniša Stanković", National Institute of the Republic of Serbia, University of Belgrade, Serbia
Dr Mladen Marinković, Institute for Oncology and Radiology of Serbia, Serbia
Dr Irina Besu Žižak, Institute for Oncology and Radiology of Serbia, Serbia
Dr Ana Vuletić, Institute for Oncology and Radiology of Serbia, Serbia
Prof. Dr Jelena Milašin, Faculty of Dental Medicine, University of Belgrade
Dr Jelena Milovanović, Institute for Oncology and Radiology of Serbia, Serbia
Dr Bojana Cikota Aleksić, Military Medical Academy, Serbia
Dr Andreï Turtoi, French Institute of Health and Medical Research, Institut de Recherche en Cancérologie de Montpellier, France
Prof. Dr Şukru Güllüoğlu, Marmara University, Turkey
Dr Thomas Mohr, Center for Cancer Research, Medical University of Vienna, Austria
Prof. Dr Konstantinos Dimas,Faculty of Medicine - University of Thessaly,Greece
Prof. Dr Chiara Riganti, Department of Oncology, Faculty of Medicine, University of Torino, Italy

Dr Joanna Kopecka, Department of Oncology, University of Torino, Italy
Dr Cristina Xavier, i3S - Institute for Research and Innovation in Health, Porto,Portugal
Prof. Dr Gabriel Fernandez Calvo, Department of Mathematics & MOLAB-Mathematical Oncology Laboratory, University of Castilla-La Mancha, Ciudad Real, Spain
Prof. Dr Gabriella Spengler, Szent-Györgyi Albert Medical School, University of Szeged Hungary
Prof. Dr Barbara Breznik,National Institute of Biology, Ljubljana, Slovenia
Prof. Dr Anamaria Brozović, Ruđer Bošković Institute,Croatia
Dr Ana Čipak Gašparović, Ruđer Bošković Institute,Croatia
Prof. Dr Yusuf Baran, İzmir Institute of Technology, İzmir,Turkey
Dr Remond Fijneman, principal research fellow, the Netherlands Cancer Institute, Holland
Dr Ieronymos Zoidakis, principal research fellow, Biomedical Research Foundation Academy of Athens, Greece
Prof. Dr Alexey Bogdanov. Oncocentre GBUZ "SPb KNTsSVMP(o) named after N.P.. Napalkova",Russia
Dr Maja Sabol, Ruđer Bošković Institute, Croatia
Dr Petar Ozretić, Ruđer Bošković Institute, Croatia
Prof. Dr Serap Celikler, Uludağ University, Bursa, Turkey
Prof. Dr Sedef Ziyanok, Uludağ University, Bursa, Turkey
Prof. Dr. Ilhan Yaylim, Istanbul University, Aziz Sancar Institute of Molecular Medicine, Turkey
Prof. Dr Xinyu (Eric) Wang, PhD, Professor of Neuroscience, Physiology, & Pharmacology, PCOM Georgia
Prof. Dr GergelySzakacs, Center for Cancer Research, Medical University of Vienna, Austria
Prof. Dr. Kormosné Goda Katalin Klára, Faculty of Medicine, University of Debrecen, Hungary

SESSION 8

LIQUID BIOPSY

P41

Basic properties of extracellular vesicles from cerebrospinal fluid of subjects with non-malignant and malignant neurological disorders

Ninoslav Mitić[1], Filip Janjić[1], Ljiljana Vujotić[2], Sanja Goč[1], Tamara Janković[1], Miroslava Janković[1]

[1]*Institute for the Application of Nuclear Energy – INEP, University of Belgrade, Belgrade, Serbia*
[2]*Clinic for Neurosurgery, University Clinical Center of Serbia, Belgrade, Serbia*

Keywords: brain cancer, extracellular vesicles, nanoparticle tracking analysis, sialic acid

Background: Cerebrospinal fluid (CSF) is a clear fluid with low protein content, widely used for both diagnostic and prognostic purposes. Although extracellular vesicles (EVs), small particles with a bilayer membrane, are present in CSF, data regarding their properties remain scarce. In this study, EVs were isolated from CSF of subjects with non-malignant (hydrocephalus) and malignant (medulloblastoma/ependymoma) neurological disorders to compare their concentration, size distribution, and surface presence of sialic acid-containing glycans. This study aims to provide preliminary data on the potential of basic CSF EVs properties as discriminating markers.
Material and Methods: EVs were isolated from pooled CSF samples of subjects with non-malignant (nmEVs) and malignant (mEVs) neurological disorders by differential centrifugation. Fluorescently labeled sialic acid-binding plant lectins: wheat germ agglutinin (WGA) and Sambucus nigra agglutinin (SNA) were used in nanoparticle tracking analysis (NTA) to assess EVs surface sialylation. The presence of tetraspanins, commonly used as EVs markers, was evaluated using antibodies against CD9, CD81, and CD63.
Results: Higher concentration of mEVs (1.08×10^{11} particles/mL) compared to nmEVs (1.50×10^{10} particles/mL) was revealed. Size distribution showed that the majority of EVs in both subject groups fell within the 100-200 nm range. The share of CD9-positive EVs was five times higher in nmEVs compared to mEVs, while the share of CD81-positive EVs did not differ notably between the two groups. Anti-CD63 antibody exhibited minimal reactivity to both nmEVs and mEVs. The share of WGA-reactive EVs was similar between nmEVs and mEVs, whereas the share of SNA-reactive EVs was over three times higher in mEVs.
Conclusions: An increased share of SNA-reactive mEVs, indicating changes in sialylation, was found. In addition, a reduced share of CD9-positive mEVs was observed. Alterations in basic CSF EVs properties may serve as potential markers of their origin.

Acknowledgments and funding: This work was supported by the Ministry of Science, Innovation and Technological Development of the Republic of Serbia [Grant No. 451-03-136/2025-03/200019].