
IMBM
INSTITUTE OF MOLECULAR BIOMEDICINE
ANNUAL
REPORT
2021

Scientometric data 2021

NUMBER OF CC/IF PUBLICATIONS: 35
OF THESE WITH FIRST/LAST AUTHORS FROM IMBM: 16
CUMULATIVE IF: 128,3

12 YEARS

1 professor
6 associate professors
7 postdocs
17 PhD students
11 diploma thesis students
7 bachelor students

8 APVV
1 KEGA
5 VEGA

grants

5 UK grants
4 GLFUK grants
35 CC/IF publications



THE VIEW OF THE HEAD OF THE INSTITUTE

Who would expect that a small virus will rule the world for another year? While in 2020 scientists developed the vaccines in 2021 it was up to the public to make use of the research outcomes. It is a hard lesson about us that we all need to learn while counting the thousands of deaths that could have been prevented, if… On the other side, what we can see is "evolution live" in progress. Astonishing.s while we are still working on the same topics as before… extracellular DNA, pathogenesis of sepsis, salivary diagnostics. It is a very good example of how important basic research is. It is not the research that brings the applications, but rather the changing world outside. One of our mentors and supporters once said that there is no basic or applied research, but good and bad science.

There were times when this institute had no grant support. Null. In 2021 we had more grant support than ever before. The short-term effects on productivity are minimal.Of course, it is easier to conduct experiments and analyses, but the public tendering and the whole bureaucracy takes so much time and effort that there is hardly time for the research itself. Of course, we are grateful for all the support and it will surely help us in the next years to achieve the goals and outcomes, but this year reminded us again that it is not only about the finances, but also about the way how they are spread, divided and controlled. Hopefully, we will be able to improve these "details" via our major grant agencies.

Finally, our outcomes are not only grant projects, publications and citations, but especially our students, the scientists of the next generation. Dr. Janovičová, Dr. Csongová and Dr. Marônek successfully defended their PhD theses, several students learned new techniques and gained a new scientific perspective in the best laboratories in France, Italy or the USA. I hope that they will help to solve the issues that will arise in the post-pandemic world as the focus on the virus will slowly disappear.

Peter Celec

PROFESSORS:

PETER BOOR, prof., MD, PhD
CC/IF publications - 237, SCI citations - 5407, h-index - 48
renal fibrosis, nephropathology, immunopathomechanisms,
models of renal diseases, imaging
boor.peter@gmail.com
pboor@ukaachen.de

PETER CELEC, assoc. prof., MD, MSc, Ing, DrSc, MPH
CC/IF publications - 256, SCI citations - 3323, h-index - 34
extracellular DNA, testosterone, salivary biomarkers, sepsis
peter.celec@imbm.sk

JÚLIUS HODOSY, assoc. prof., MD, MSc, PhD, MPH
CC/IF publications - 94, SCI citations - 1303, h-index - 22
sex steroids, oxidative stress, sepsis, sleep apnea syndrome, traumatic brain injury
julius.hodosy@imbm.sk

KATARÍNA ŠEBEKOVÁ, assoc. prof., MD, DrSc
CC/IF publications - 178, SCI citations - 3175, h-index - 32
metabolic syndrome, diabetes mellitus,
advanced glycation end products, clinical biochemistry,
pathogenesis of renal diseases
katarina.sebekova@imbm.sk

ROMAN GARDLÍK, MD, MSc, PhD
CC/IF publications - 75, SCI citations - 765, h-index - 15
inflammatory bowel disease, animal models,
extracellular DNA, microbiome
roman.gardlik@imbm.sk

ĽUBOMÍRA TÓTHOVÁ, assoc.prof., PhD
CC/IF publications - 83, SCI citations - 912, h-index - 17
salivary markers, oxidative stress, urinary tract infections,
experimental nephrology , bacteriophages
lubomira.tothova@imbm.sk

BARBORA VLKOVÁ, assoc. prof., MSc, PhD
CC/IF publications - 48, SCI citations - 799, h-index - 13
extracellular DNA, non-invasive prenatal diagnostics,
neutrophils, pneumonia, sepsis, molecular pathology
barbora.vlkova@imbm.sk

POSTDOCS:

JANKA BÁBÍČKOVÁ, MSc, PhD
CC/IF publications - 36, SCI citations - 541, h-index - 13
phage display, sex steroids, inflammatory bowel disease,
extracellular DNA, experimental nephrology
jana.babickova@gmail.com

MICHAL PASTOREK, MSc, PhD
CC/IF publications - 24, SCI citations - 298, h-index - 11
Neutrophil biology, sterile inflammation, autoimmune diseases
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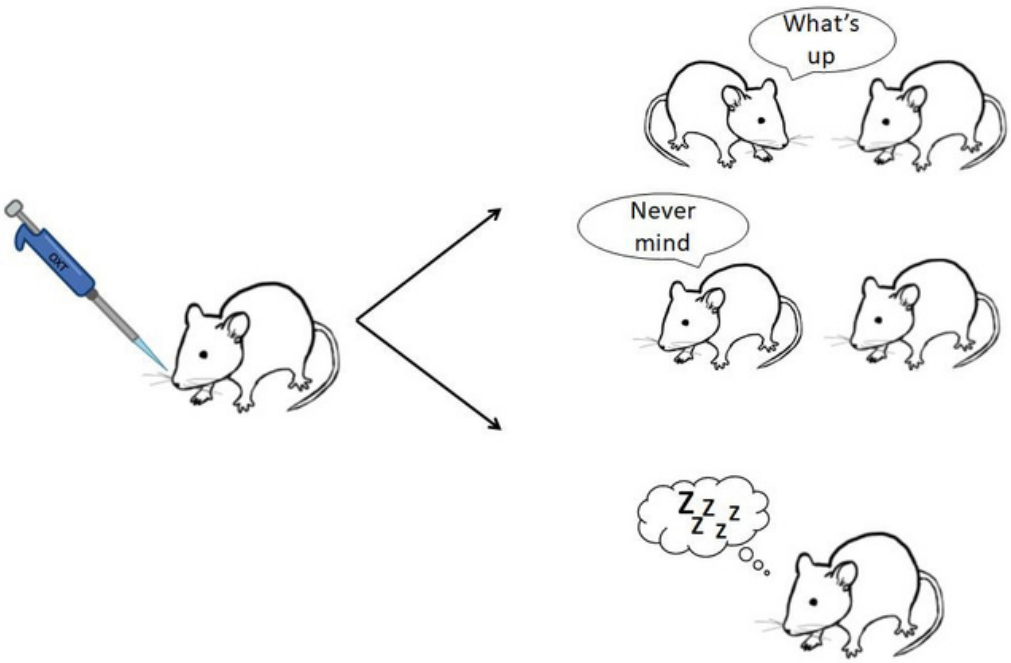
VERONIKA BORBÉLYOVÁ, MSc, PhD
CC/IF publications - 28, SCI citations - 138, h-index - 7
animal models, autism spectrum disorder, metabolic syndrome, rheumathoid arthritis, sex hormones
veronika.borbelyova@imbm.sk

BARBORA KONEČNÁ, MSc, PhD
CC/IF publications - 31, SCI citations - 207, h-index - 8
extracellular DNA, extracellular vesicles,
pregnancy complications, quantitative real-time PCR
barbora.konecna@imbm.sk

EMESE RENCZÉS, MSc, PhD
CC/IF publications - 23, SCI citations - 126, h-index - 6
sex hormones, behavioral phenotyping in rats and mice,
mental disorders, autism
emese.domonkos@imbm.sk

MÁRIA SUCHOŇOVÁ, MSc, PhD
CC/IF publications - 4, SCI citations - 47, h-index - 3
optics, optical spectroscopy, biomedical physics,
laser-induced breakdown spectroscopy,
imaging methods in medicine
maria.suchonova@imbm.sk

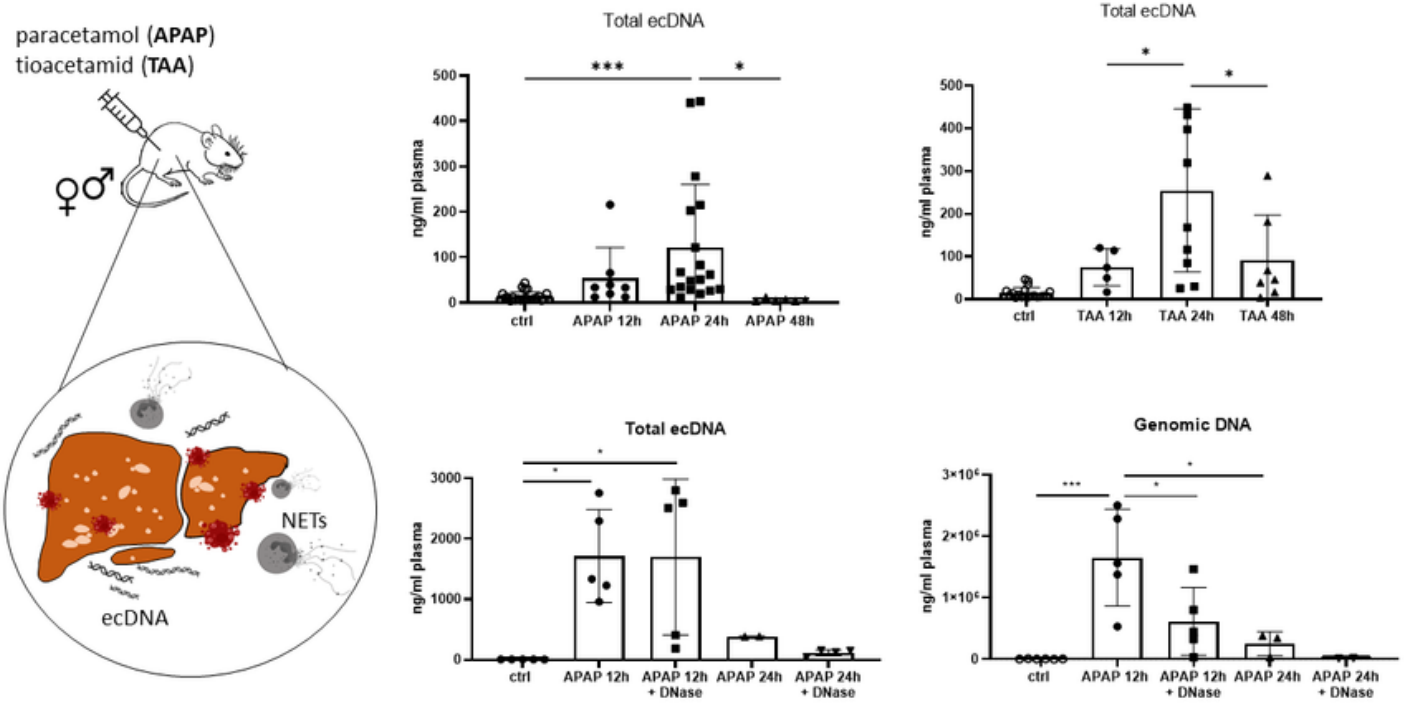
ĽUBICA JANOVIČOVÁ, MSc, PhD
CC/IF publications - 9 , SCI citations - 26, h-index - 4
extracellular DNA, DNase activity, sepsis, anemia, animal models
lubica.janovicova@gmail.com



INTRANASAL OXYTOCIN IN A GENETIC ANIMAL MODEL OF AUTISM

What is new?

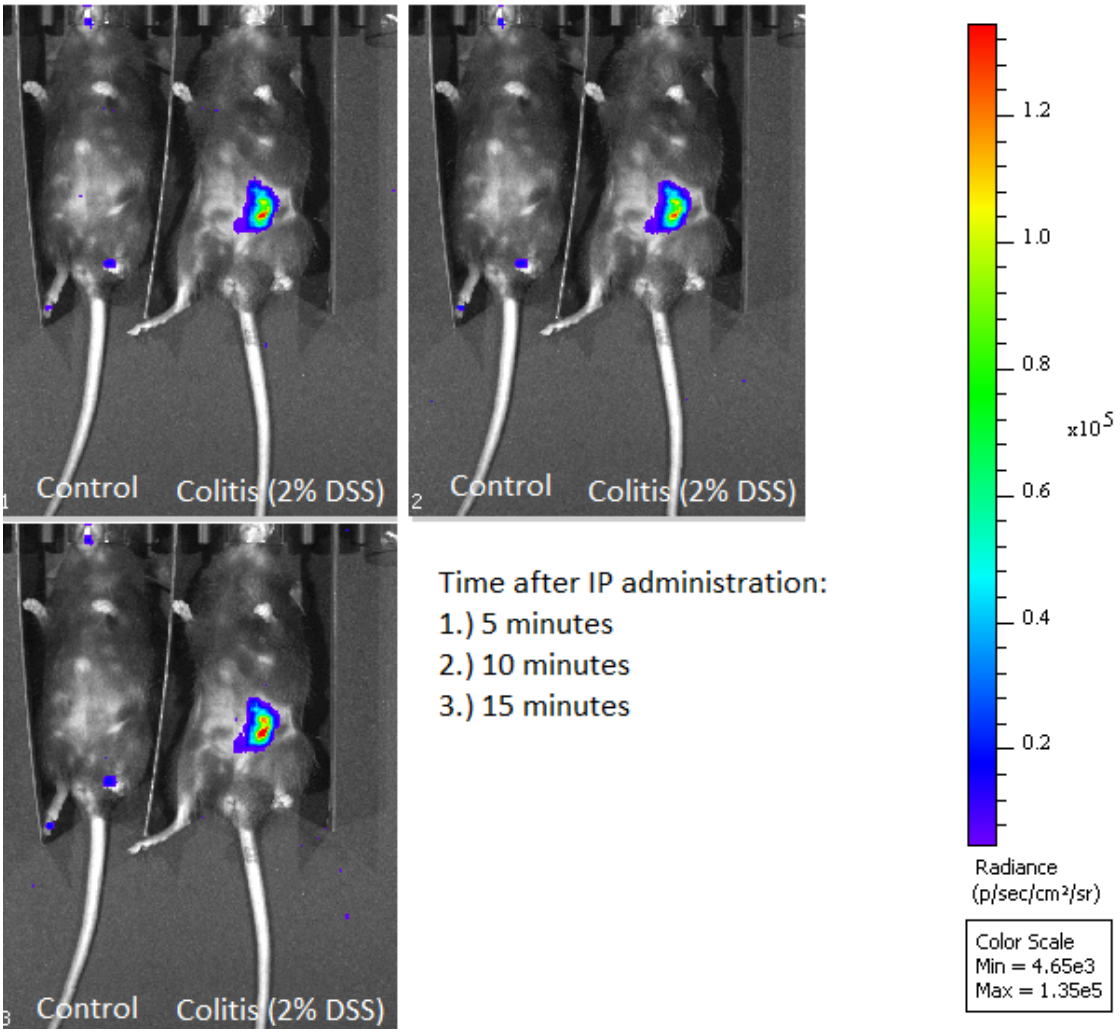
- Prosocial effect of oxytocin could make it a candidate drug in the treatment of repetitive behavior and social shortfalls
- Daily intranasal oxytocin treatment alleviates the deficits in sociability by 50%, but treated animals exhibit a form of social ambivalence as well
- Mice treated with oxytocin explore their surrounding half as much as controls
- Whether and how the outcomes can be translated to humans requires clinical research



EXTRACELLULAR DNA CONCENTRATION AND DNASE ACTIVITY IN MICE WITH ACUTE AND CHRONIC LIVER FAILURE

What is new?

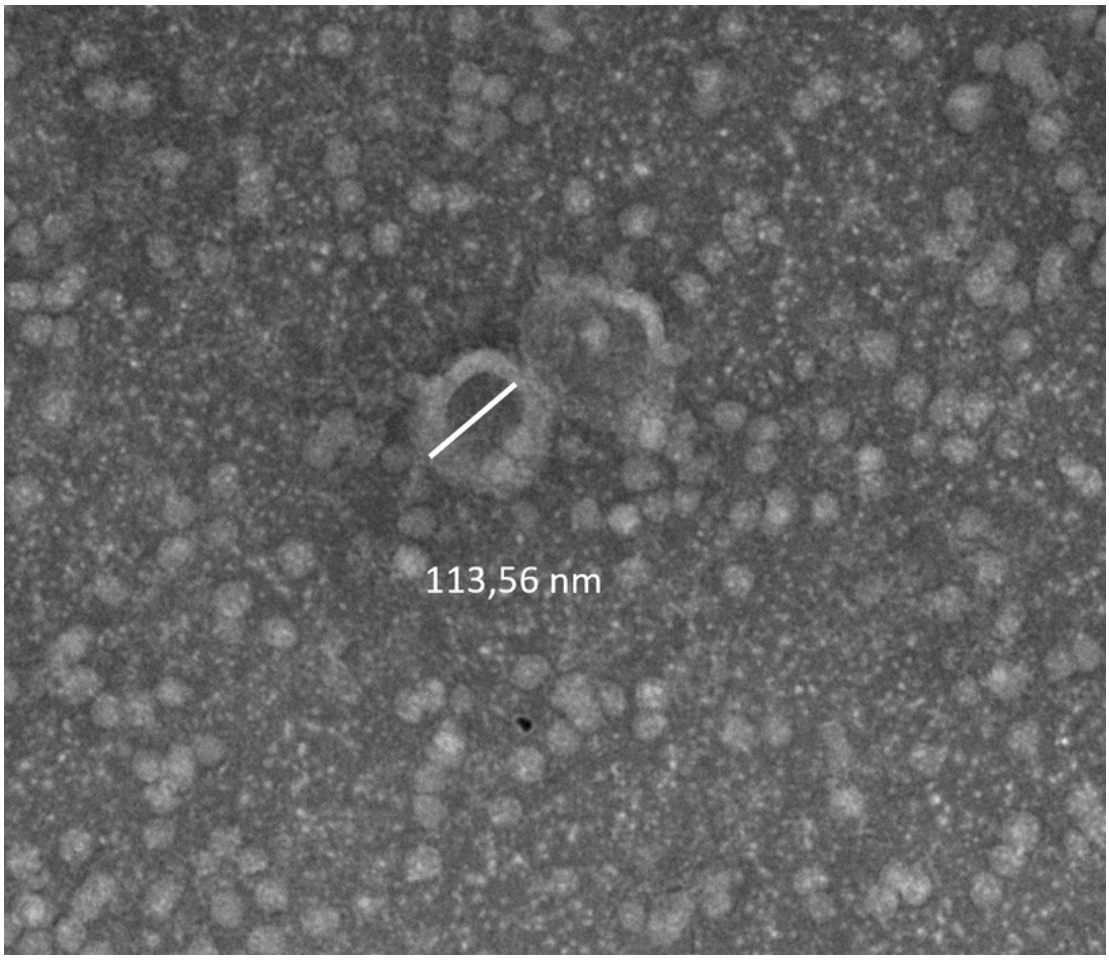
- experimental models of acute liver failure (acetaminophen or thioacetamide) lead to a rapid increase in plasma ecDNA (within 24 hours after induction) and DNase activity is increased within 12 hours
- DNase application reduces the concentration of subcellular fractions of ecDNA but does not completely eliminate ecDNA, which can be explained by higher fragmentation
- NETs do not appear to be a major source of ecDNA in liver damage



INFLAMMATORY BOWEL DISEASES AND NON-INVASIVE IN VIVO DETECTION OF INFLAMMATION AND EX VIVO DETECTION OF FECAL BLOOD USING LUMINOL

What is new?

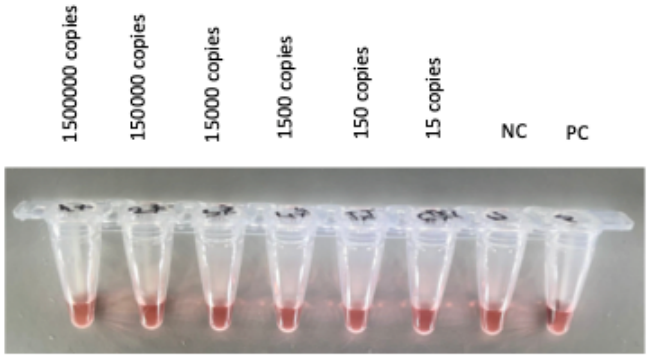
- Colon inflammation can be detected by a chemiluminescent non-invasive in vivo method only in chronic colitis, especially during the active phase of the disease
- Detection of fecal blood using luminol is more effective than the usual monitoring of body weight and stool consistency; it can detect colon inflammation before the onset of the first clinical symptoms
- This method is a potential tool for long-term and repeated monitoring of the activity IBD without the need for invasive intervention
- The subject of our current research remains the non-invasive detection of colon inflammation before the onset of symptoms in the acute form, and the remission of the chronic form of IBD



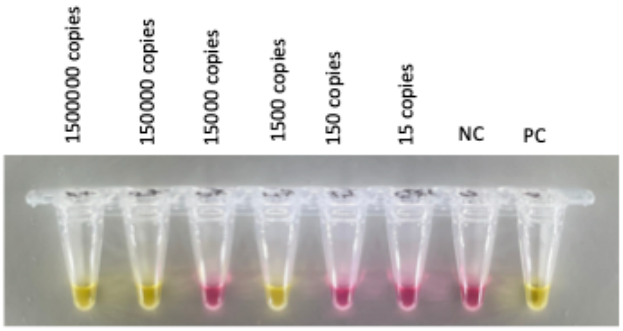
PLASMATIC EXOSOMES

What is new?

- Plasma exosomes contain ecDNA (genomic and mitochondrial DNA)
- 60 - 70 % of ecDNA is localized on the surface of exosomes
- We managed to visualize plasma derived exosomes through a new method of exosome preparation - negative staining with uranyl acetate
- We managed to detect exosomal markers CD9 and CD81 with flow cytometry



Before incubation

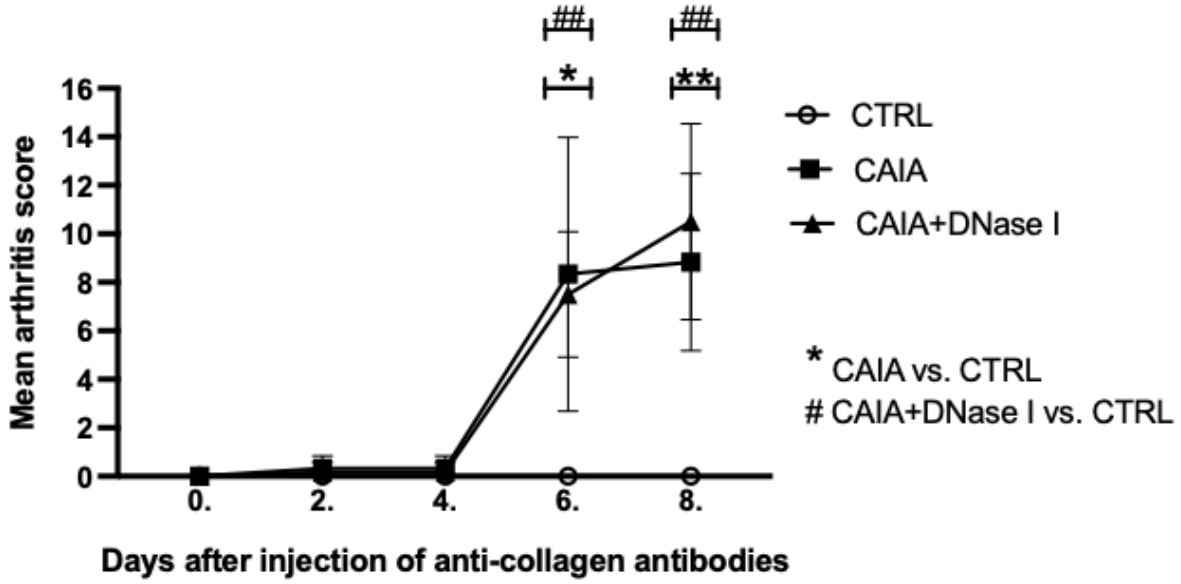


After incubation

WASTEWATER

What is new?

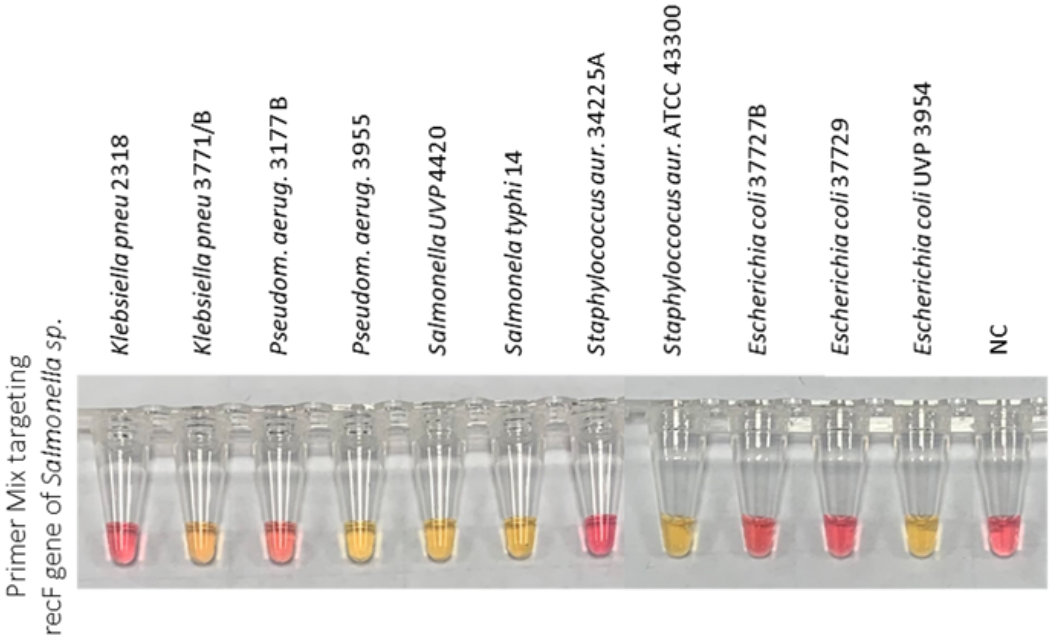
- COVID-19 Delta variant was first detected in Bratislava wastewater in August
- High concentrations of human extracellular DNA in wastewater were confirmed, although the concentration varies throughout the year and does not correlate with the waterflow
- Biochar, an efficient sorption material removes 90% of DNA and RNA from wastewater
- RT-LAMP sensitivity for the presence of SARS-CoV-2 in wastwater seems to be 1500 copies of the virus



EXTRACELLULAR DNA IN PATHOGENESIS OF RHEUMATOID ARTHRITIS

What is new?

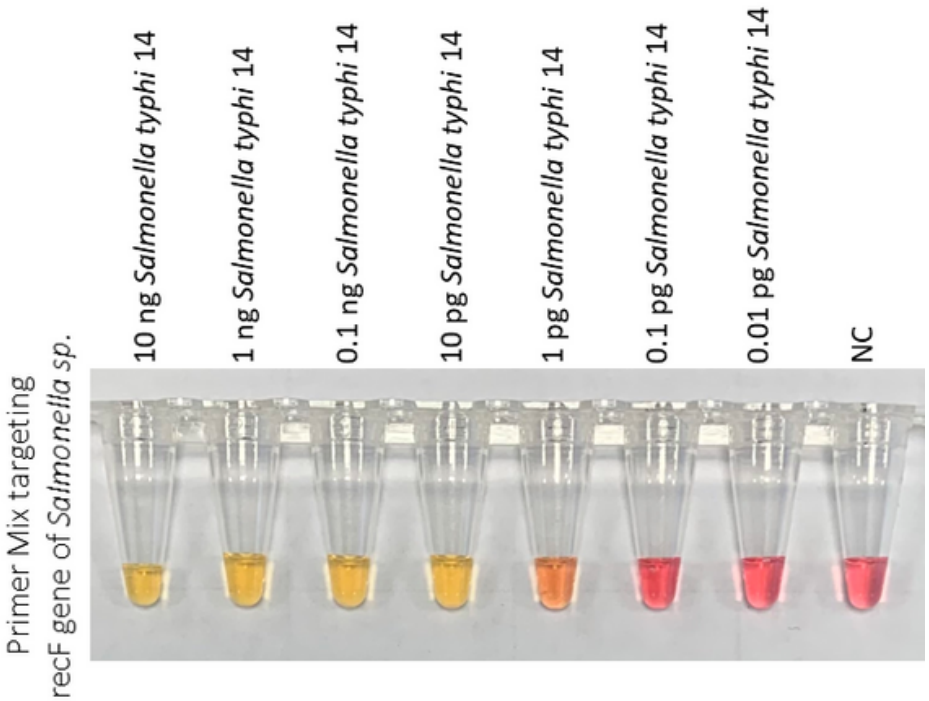
- Plasma ecDNA concentrations decreased significantly (by 60%) only in patients who responded well to bDMARDs according to clinical criteria.
- No significant decrease in ecDNA concentration was observed in patients with a mild and non-responders to the treatment.
- Based on the results from clinical samples, circulating ecDNA could be used as a good prognostic marker of treatment success.
- Application of exogenous, bovine DNase in an animal model of RA does not prevent the development of this disease.
- Results of the experiment suggest that ecDNA is not a suitable target for new therapeutic approaches.

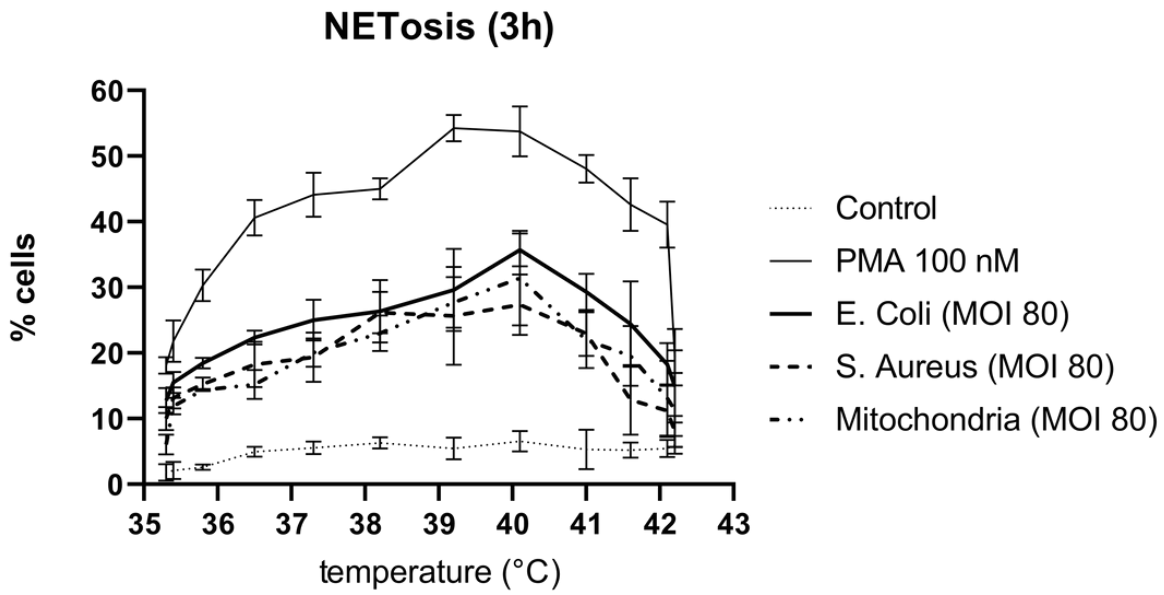


LOOP-MEDIATED ISOTHERMAL AMPLIFICATION IN DETECTION OF BACTERIAL PATHOGENS

What is new?

- DNA of bacterial pathogens is identifiable by specific primers if at least 10 pg of the relevant bacterial DNA is present in the reaction mixture
- Cross - reactivity is present between primers designs and non-belonging strains of pathogens

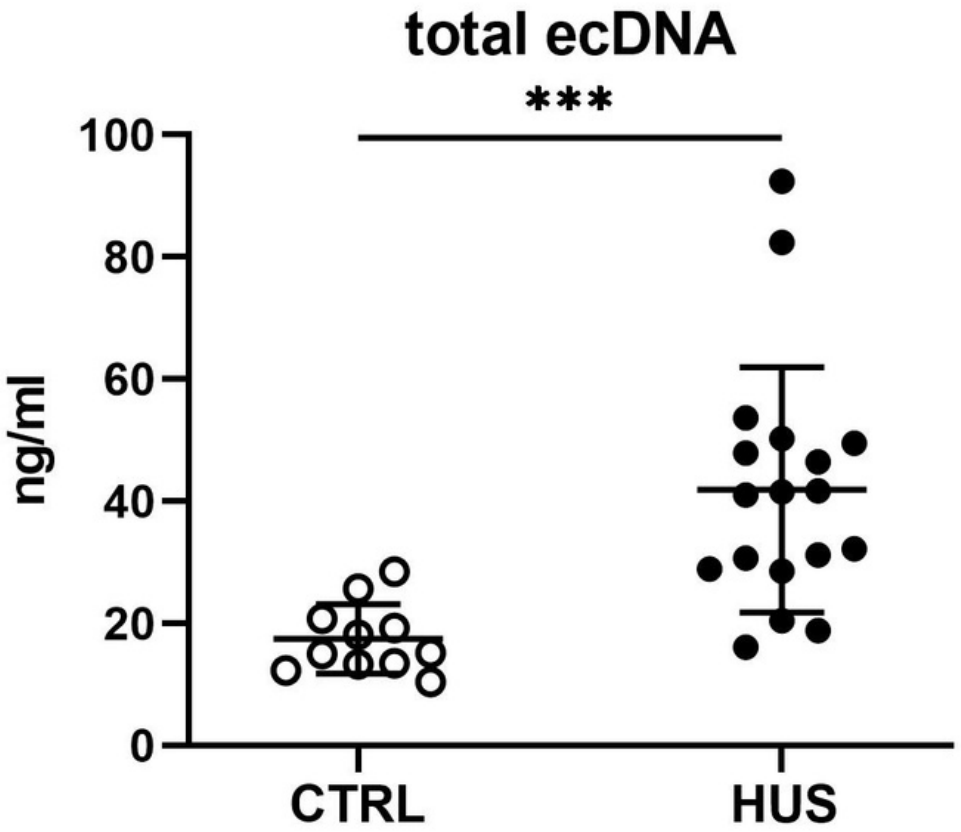




FORMATION OF NETS DURING FEVER

What is new?

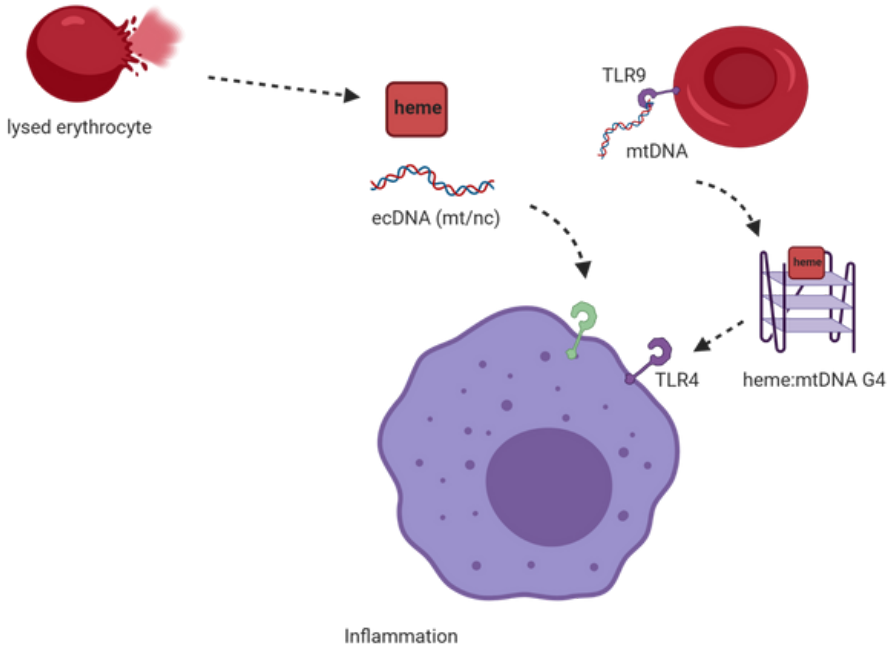
- NETs (neutrophil extracellular traps) formation is dependent on body temperature not only in the response to bacteria and mitochondria but also chemical stimuli of Phorbol Myristate Acetate (PMA).
- NETs formation in neutrophils exposed to lower temperatures 35-36°C was lowered by 20% compared to 37°C.
- NETs formation during fever peaks at 40°C, but interestingly, decreases when the temperature rises too high (>41°C).



EXTRACELLULAR DNA IN HEMOLYTIC UREMIC SYNDROME

What is new?

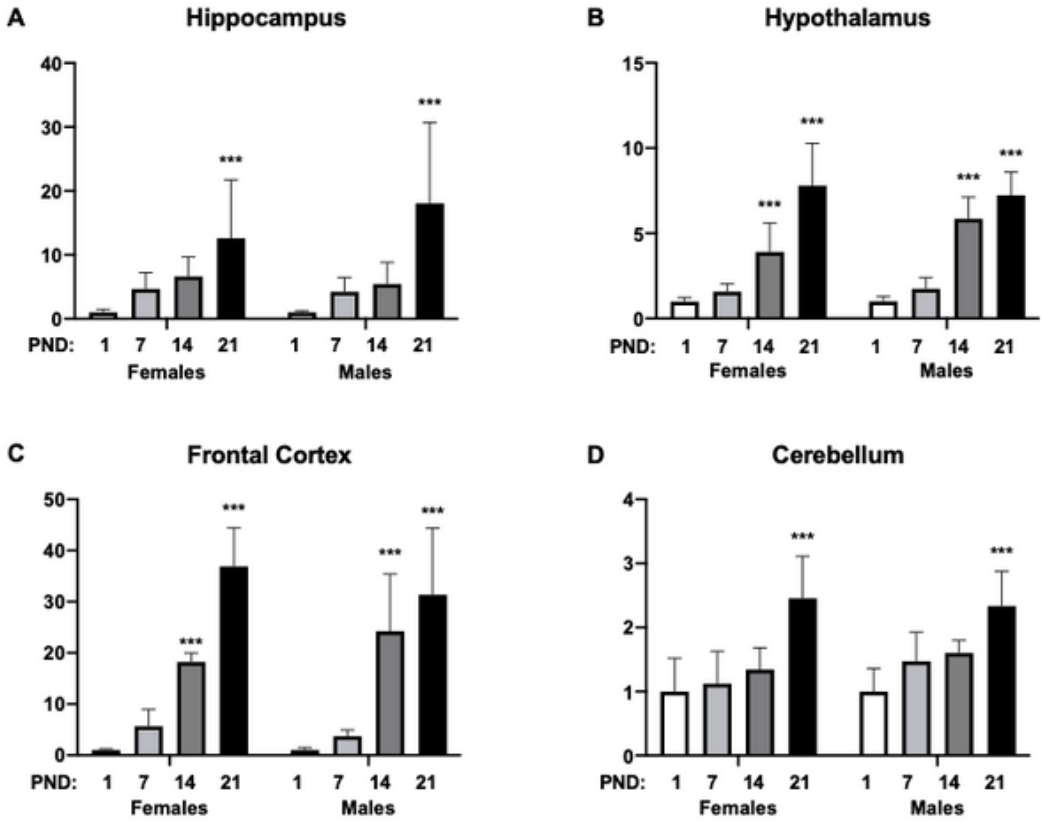
- We established a model of hemolytic uremic syndrome in our lab using single injection of Shiga toxin 2
- Extracellular DNA and DNase activity are higher in animal model of hemolytic uremic syndrome
- We aim to elucidate the role of netosis in the model of hemolytic uremic syndrome



THE ORIGIN OF EXTRACELLULAR DNA IN PLASMA IN MODELS OF STRESS ERYTHROPOIESIS

What is new?

- We applied three models of stress erythropoiesis, including phenylhydrazine (PHZ)-driven hemolytic or bleeding-induced anemia (mouse/rats) and erythropoietin (EPO) injection in wild type mice and several knockout mice
- ncDNA and mtDNA is associated with erythropoiesis
- The levels of mtDNA correlated with hemolysis while ncDNA levels were associated with increased number of CD71+/TER119+ erythroid progenitors
- Inadequate stress erythropoiesis in hemopexin knockout (Hx-/-) mice in response to PHZ with increased hemolysis and free heme in plasma, DNA damage and HO-1 inductions in the spleen correlated with overall low levels of ecDNA in the plasma
- We demonstrated increased levels of ecDNA during EPO-induced erythroid progenitor colony growth or heme-induced mouse erythroid leukemia (MEL) cell differentiation in vitro
- ecDNA was released in a form of G-quadruplexes and may contribute to the regulation of erythropoiesis



EXPRESSION OF INTRACELLULAR AND TRANSMEMBRANE SEX HORMONE RECEPTORS DURING POSTNATAL DEVELOPMENT OF RAT BRAIN

What is new?

- There is a gradual increase in the expression of testosterone as well as intracellular androgen receptor and estrogen receptor beta in brain structures during the early postnatal period.
- On the contrary, membrane receptor expression decreased in brain regions during this early postnatal period.
- Classical signaling is probably taking over rapid non classical signaling within brain regions of neonatal rats.
- Understanding the physiological development of the brain structures improves further modeling of testosterone-related behavioral research.

In 2021, the aim of Summer School of Biomedicine was to prepare a summer school for university and high school students in a way that helps them better prepare for future or ongoing studies in the biological and biomedical sciences. We felt the importance of summer school mainly during the summer of this year, as students had online teaching due to the pandemic situation since last year, and thus minimal opportunity to learn basic methods of biomedical research throughout practical courses at university or high school. Despite the pandemic situation, laboratory premises of our institute at the Faculty of Medicine, Comenius University and also at our workplace at the Slovak Academy of Sciences made it possible to admit a total of 50 students during the summer school in 2021.

Within the Summer School of Biomedicine, students had an opportunity to learn or master the basic methods of biomedical research and also obtain experience at research work in the laboratories of the Institute of Molecular Biomedicine by participating in our ongoing projects. Another advantage of the summer school itself was that the results obtained during the summer school can be presented at scientific conferences organized for students. Students who are engaged in scientific work at our institute belong to successful participants in such conferences. In 2021, the experimental results obtained during the 2020 summer school were presented at VII. Neuropsychiatric Congress and Young Neuroscientists and Cutting-Edge Research by our already PhD student Jakub Szabó. In addition, Matúš Mlynár, a student of the Summer school of Biomedicine, won 3rd place at the 32nd EUCYS - European Union Contest for Young Scientist 2020-2021. Last but not least, in 2021, we published important results obtained from the projects carried out during the Summer school of Biomedicine (The Effect of Melatonin on Periodontitis, in the International Journal of Molecular Sciences, IF: 5,923).

Long-term goals of Summer School of Biomedicine include the reintegration of Slovak students studying abroad and the integration of foreign students into biomedical research, thus, the summer school at IMBM is a good opportunity to reach these goals.



An active participation in scientific conferences is an indispensable element for our work. At conferences we have the opportunity to present the results of our experiments, to discuss with experts and to establish new cooperation. In 2021, we actively attended or participated online at the following scientific conferences:

VII. NEURO-PSYCHIATRIC CONGRESS

June 10-12, 2021, Tatranská Lomnica, Slovak republic (Peter Celec, Emese Renczés, Veronika Borbélyová, Jakub Szabó)

YOUNG PHYSIOLOGIST´S COMPETITION FOR THE BEST POSTER

May 6, 2021, Bratislava, Slovak republic (Veronika Borbélyová)



XIII. INTERACTIVE CONFERENCE OF YOUNG SCIENTISTS

May 10-24, Slovak republic (Emese Renczés)

XVI. SCIENTIFIC CONFERENCE OF DOCTORAL STUDENTS

Comenius University, Medical Faculty, 30.4.-8.5. 2020, Bratislava, Slovakia (Alena Potočárová, Jakub Szabó, Kristína Macáková, Nadja Ivašková, Barbora Gromová, Ľubica Janovičová, Jakub Janko, Miriam Pillerová, Martin Marônek)

MONIKA JANÍKOVÁ

Beth Israel Deaconess Medical Center/Harvard Medical School Boston, MA, USA, Department of Surgery, November 2020 – present, working on origin extracellular DNA in plasma and its structure

MIRIAM PILLEROVÁ

University of Wisconsin-Milwaukee, Milwaukee, WI, USA, Department of Psychology, February 2020 – September 2020, and September 2021 – present, working on the necessity of glycogenolysis and glutamate transport in dorsal hippocampal astrocytes for object memory consolidation

KATARÍNA KMEŤOVÁ

Jason Knight Lab, University of Michigan, Ann arbor, MI, USA, Division of Rheumatology, September 2021 – February 2022. Knight lab is focused on Antiphospholipid syndrome (APS), an autoimmune disease which is characterised by formation of massive blood cloths. In APS, autoantibodies against beta-2-glycoprotein-1 (B2GP1) induce NETs formation and enhance thrombosis. They are working on showing that B2GP1 is binding to DNA and particularly to NETs.

VERONIKA ŠARAYOVÁ

Universita degli Studi di Milano, Dipartmento di Scienze Farmacologiche e Biomolecolari, April 2021 – October 2021, working on RNA-sequencing in plasma of responders and non-responders to antidepressants

LUCIA MIHALOVIČOVÁ

Institut de Recherche en Cancérologie de Montpellier, France; Team of prof. Alain Thierry: Biomarkers for precision oncology, March 2021- November 2021, working on circulating cell-free DNA as a biomarker for inflammatory diseases including SARS-CoV-2.

IMBM is a research institute, but it is also important to participate in the educational process. Beyond institutional meetings, seminars and courses we prepared the lectures, seminars and practical courses at the Faculty of Medicine and Faculty of Natural Sciences, Comenius University in Bratislava:

FACULTY OF MEDICINE

Physiology

Pathophysiology

Pathology

Introduction to Science

FACULTY OF NATURAL SCIENCES

Molecular Endocrinology

Basics of Theoretical and Experimental Medicine

Progress in Molecular Biology

Advanced Methods in Molecular Biology

Behavioral Genetics

Special Genetics

Basics of Clinical Medicine

WHERE TO FIND US?

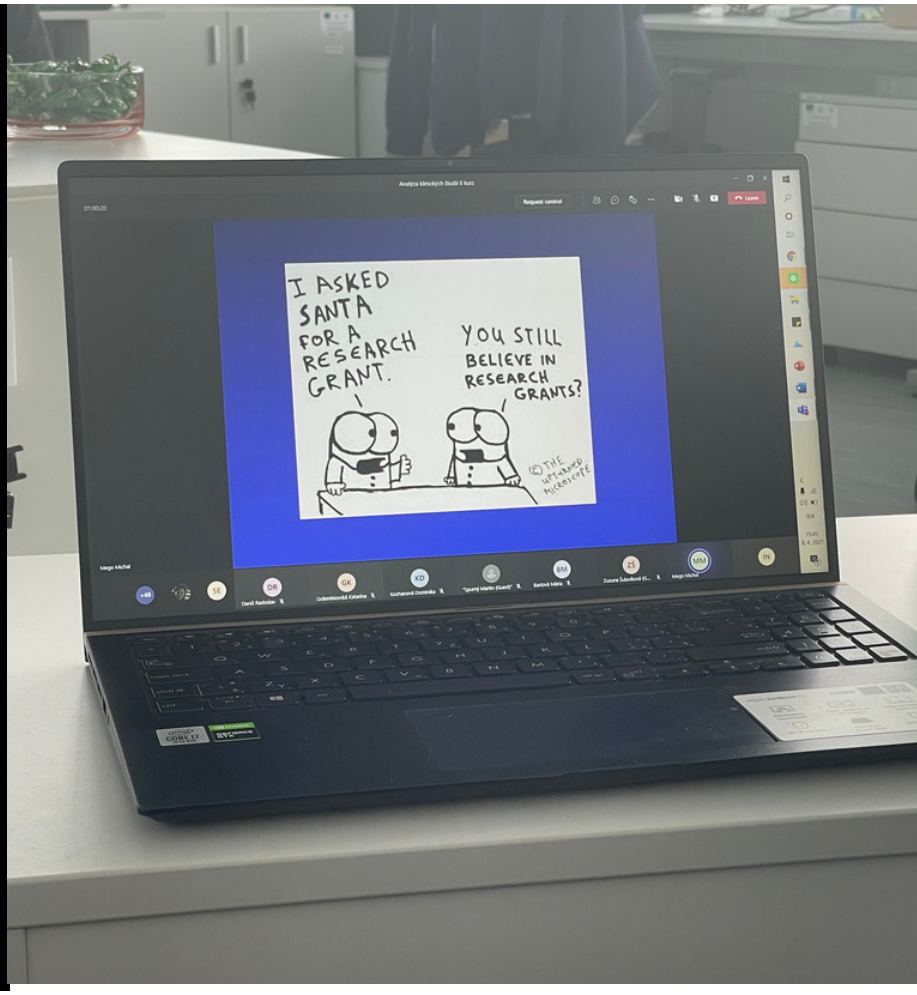
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