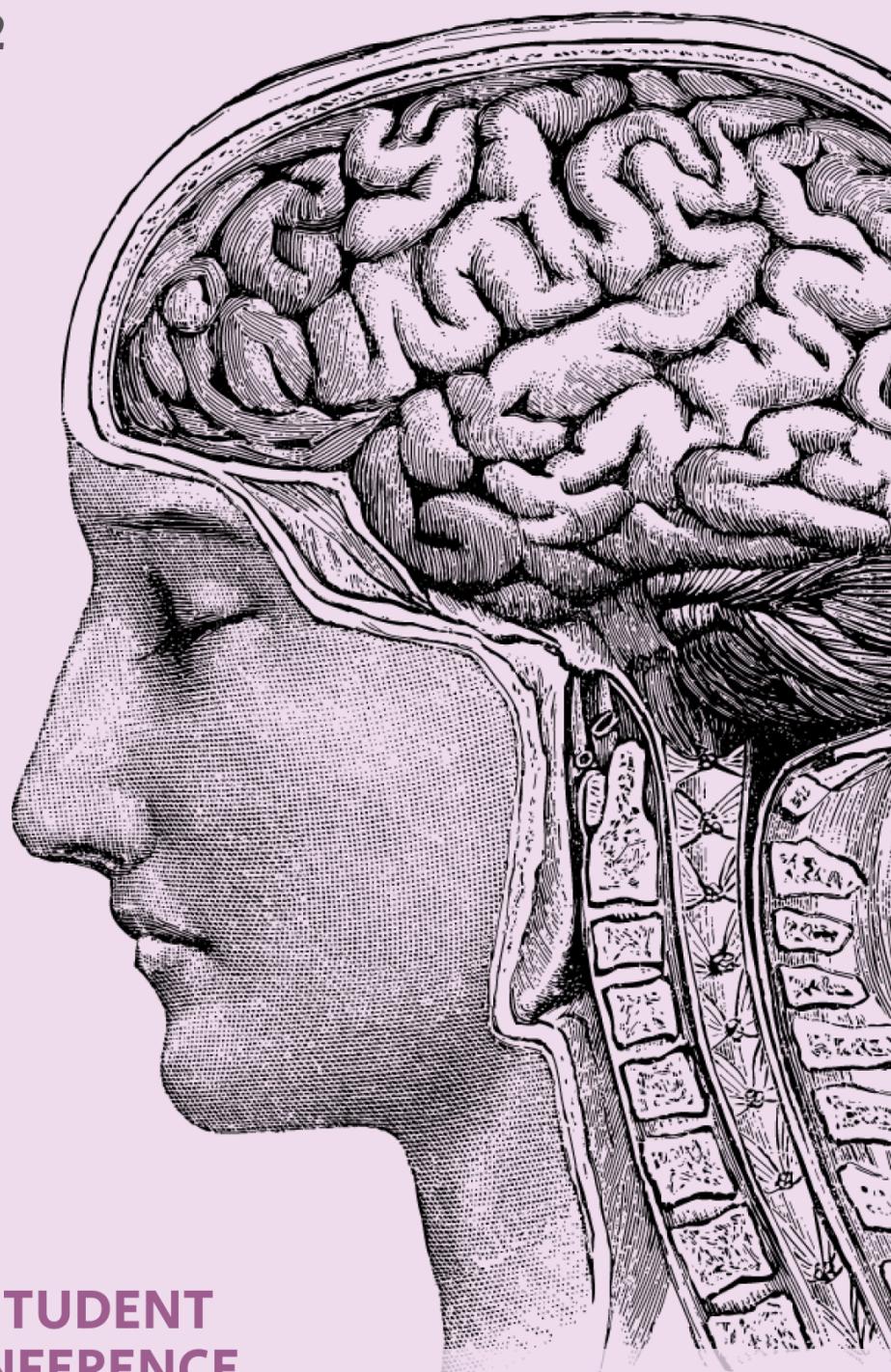


23-24 APRIL 2022  
RZESZÓW



1ST NATIONAL STUDENT  
HISTOLOGY CONFERENCE

# THE BRAIN, THE FASCINATING WORLD OF SYNAPSES AND NEURONS – COGITO ERGO SUM

Program | Abstracts

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***THE BRAIN, THE FASCINATING WORLD OF SYNAPSES AND  
NEURONS – COGITO ERGO SUM***  
**1st National Student Histology Conference**

**PROGRAM | ABSTRACTS**

**23-24 April 2022**  
**Rzeszów**



**Uniwersytet Rzeszowski**

**EDITORS:**

**Agata Wawrzyniak**  
**Krzysztof Balawender**  
**Maksymilian Kłosowicz**  
**Angelika Wiatr**



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## Welcome message

Ladies and Gentlemen,

Welcome to the 1-st National Student Histology Conference “**The brain, the fascinating world of synapses and neurons - Cogito Ergo Sum**” organized by the Histology and Anatomy Student Research Group, affiliated with the Department of Morphological Sciences, College of Medical Sciences, University of Rzeszow.

Neuroscience is one of the most versatile and fastest growing fields of medicine today.

The central nervous system, particularly the brain, is a kind of command center for the entire body. The brain is responsible for a number of key human functions. It is the source of all our emotions. Due to it, we feel anger, aggression, sadness, but also joy, curiosity or a feeling of pleasure and addiction. It is the brain that makes us fall in love, worry, and take care for those closest to us. On the other hand, the brain is a machine that is involved in complex thought processes, expressing and understanding speech, learning and remembering, or coordinating the work of virtually all other organs. Better and better research methods allow us to gradually reveal more and more secrets hidden in the brain. Despite the development of modern research tools at our disposal, the brain is still an unsolved mystery to us.

*“If our brains were as simple as we could understand them,  
than we would be so stupid that we couldn’t understand them again.”*

Jostein Gaarder

On behalf of the whole Scientific and Organizing Committee of the 1-st National Student Histology Conference we wish you a pleasant and well spent time!

**Dr hab. n. wet. Agata Wawrzyniak, prof. UR**

Chairman of Scientific Committee

**Dr n. med. Krzysztof Balawender**

Vicechairman of Scientific Committee

**Maksymilian Kłosowicz**

Chairman of Organizing Committee

**Angelika Wiatr**

Vicechairman of Organizing Committee



## DETAILED PROGRAM

### *1st National Student Histology Conference – “The brain, the fascinating world of synapses and neurons – Cogito Ergo Sum” – oral presentation sessions*

#### 1ST DAY OF THE CONFERENCE (23.04.2022)

09:00 – 18:00

09:00 – 09:15 - Opening of the first day of the conference

09:15 – 09:35 – „*The fascinating world of the brain*” – **dr hab. n. wet Agata Wawrzyniak, prof. UR** – Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

#### SESSION I

09:40 – 10:55

09:40 – 10:10 – „*A disturbed mind.*” – **dr hab. n. med. Przemysław Pacan, prof. UR** – Department of psychiatry, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

10:10 – 10:25 – „*How COVID-19 affects central nervous system?*” – Barbara Nowak, Mikołaj Grodzki, Julia Jastrzębska, Krzysztof Balawender – Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

10:25 – 10:40 – „*Anticancer therapy targeted at the cell membrane*” – Klaudia Dynarowicz, David Aebisher - Department of Photomedicine and Physical Chemistry, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

10:40 – 10:55 - „*A 52-year-old woman with rapidly progressive dementia*” – Emilia Majewska – Student’s Scientific Club “Eskulap”, Collegium Medicum, Jan Kochanowski University of Kielce, Kielce, Poland

#### SESSION II

10:55 – 12:40

10:55 – 11:20 – “*Brain neuroplasticity*” – **Prof. dr hab. n. med. Halina Bartusik Psujek** – Department of neurology, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

11:20 – 11:40 – “*The Neurobiology of Burnout*” – **dr Agnieszka Zelek-Molik** – Department of brain biochemistry, Jerzy Maj Institute of Pharmacology Polish Academy of Sciences in Kraków

11:40 – 11:55 – *Lecture of the Polish Society for Nervous System Research (PTBUN)* - **dr Agnieszka Zelek-Molik** - PTBUN

11:55 – 12:10 – “*Severe tick-borne encephalitis with simultaneous spinal cord involvement with tetraparesis - a case report*” – Karolina Pięta, Izabela Rudy – Student’s Scientific Club of Neurology, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

12:10 – 12:25 – „*Encephalitis as a complication of mild COVID-19 infection*” – Aleksandra Pięta – Student’s Scientific Club “Eskulap”, Collegium Medicum, Jan Kochanowski University of Kielce, Kielce, Poland

12:25 – 12:40 - „*Neuroplasticity of the brain and its possible stimulation in therapy after ischemic brain stroke*” – Julia Florek, Mateusz Bartoszek, Krzysztof Balawender – Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

**COFFEE BREAK – 12:40 – 13:20**

**SESSION III**

**13:20 – 14:25**

- 13:20 – 13:40** – „*Is the mammalian target of rapamycin (mTOR) a potential therapeutic target for Alzheimer’s disease*” – **prof. Tommaso Cassano** – Department of Medical and Surgical Sciences University of Foggia
- 13:40– 13:55** – „*The assessment of mossy fibers in the hippocampus of PTENflox mice*” – Karol Sadowski, Adam Gorlewicz – The Nencki Institute of Experimental Biology, The Department of Histology and Embryology in the Medical Warsaw University, Students Scientific Group HESA
- 13:55 – 14:10** – „*Primary Pulmonary Meningioma*” – Yana Nyankovska, Katarzyna Gunia – Student’s Scientific Club of Pathomorphology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 14:10 – 14:25** – „*Primary meningeal melanomatosis*” – Rafał Kołodziej, Yana Nyankovska – Student’s Scientific Club of Pathomorphology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

**SESSION IV**

**14:25 – 15:50**

- 14:25 – 14:45** – „*Microspectroscopic examination of human glioma cells treated with combination of sorafenib and lensoside Abeta*” – **dr hab. Bożena Pawlikowska-Pawłęga**, **prof. UMCS** - Polish Society for Histochemistry and Cytochemistry
- 14:45 – 15:05** – „*Phylogenetic analyses as a source of information on vertebrate brain evolution on the example of oligodendrocyte proteins*” – **mgr Maciej Golan** – Military Medical Institute in Warsaw
- 15:05 – 15:20** – „*Methodology of antropometric measures by analysis of the cranial index (CI)*” – Angelika Wiatr, Adrian Morawiec, Maria Jasiewicz, Krzysztof Balawender – Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 15:20 – 15:35** – „*Myxoma isn’t only in the heart – short story about dermal nerve sheath myxoma of lateral cutaneous nerve of the forearm in a 23 year-old female*” – Emilia Majewska – Student’s Scientific Club “Eskulap”, Collegium Medicum, Jan Kochanowski University of Kielce, Kielce, Poland
- 15:35 – 15:50** – „*Lambert-Eaton myasthenic syndrome in a patient with ulcerative colitis*” – Aleksandra Piąta – Student’s Scientific Club “Eskulap”, Collegium Medicum, Jan Kochanowski University of Kielce, Kielce, Poland

**SESSION V**

**15:50 – 17:10**

- 15:50 – 16:10** – “*The human brain - one and a half kilograms of secrets*” – **mgr Małgorzata Wąsacz** – Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:10 – 17:25** – **Presentation of posters**

**END OF THE 1ST DAY OF THE CONFERENCE**

**17:30 – 18:00** – **Prize-giving and official closing of the first conference day**

## 2ND DAY OF THE CONFERENCE (24.04.2022)

09:00 – 16:30

09:00 – 09:15 – Opening of the second day of the conference

09:15 – 09:35 – „*The Neurobiology of Transgender Identity*” – **Dr n. med. Krzysztof Balawender** – Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

### SESSION I

09:35 – 10:45

09:35 – 10:00 – „*The Apocalypse in Our Heads: How do modern epidemics affect brain structure and function?*” – **dr hab. n. med. Jacek Szczygielski, prof. UR** – Department of Neurosurgery and Neurotraumatology with Subdivision of Spinal Cord Injury, Clinical Provincial Hospital No. 2 in Rzeszow, Rzeszow, Poland

10:00 – 10:15 – „*Machine Learning in neuropathology – application of convolutional neural networks using Digital Brain database*” – Anna Głowacka, Andrzej Gucwa – Student’s Scientific Club of Pathomorphology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

10:15 – 10:30 – „*Distribution of the postganglionic sympathetic fibers within the cavernous sinus revisited*” – Michał Golberg, Józef Kobos, Grzegorz Wysiadecki – Department of Histology and Embryology, Medical University of Łódź, Łódź, Poland

10:30 – 10:45 – „*Management of traumatic brain injury*” – Wiktoria Kraus, Bartłomiej Kowalski – Students’ Scientific Club of Surgery, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

### SESSION II

10:45 – 11:55

10:45 – 11:05 – “*The histological structure of the striatum in the aspect of procedural memory*” **dr. n. wet. Karol Rycerz** – Polish Society for Histochemistry and Cytochemistry

11:05 – 11:25 – “*The uniqueness of endocannabinoids in the neurotransmitter world*” – **mgr farm. Anna Szyszkowska** – „Pokochaj Siebie” Foundation

11:25 – 11:40 – „*Multiple sclerosis as an autoimmune disease – analysis of histopathological images*” – Patryk Brzezicki, Antonina Pieluszczyk, Aldona Sokołowska – Student’s Scientific Club of Immunology, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

11:40 – 11:55 – „*The influence of marijuana on the central nervous system during adolescence and prenatal period*” – Julia Ingot, Maksymilian Kłosowicz, Jadwiga Ingot, Karol Bednarz, Agata Wawrzyniak – Student’s Scientific Club of Histology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

### SESSION III

11:55 – 13:00

11:55 – 12:15 – “*Cerebrovascular Diseases*” – **Dr n. med. Natalia Leksa** – Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

12:15 – 12:30 – “*Primary brain tumors – gliomas*” – Justyna Bogdan, Benedykt Baljon – Student’s Scientific Club of Pathomorphology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

12:30 – 12:45 – **“Creutzfeldt-Jakob disease”**– Aleksandra Łoś, Barbara Tomaszek, Paulina Tajchman – Student’s Scientific Club of Pathomorphology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

12:45– 13:00 – **„Hereditary neuropathies”** – Jadwiga Inglot, Karol Bednarz, Maksymilian Kłosowicz, Julia Inglot, Agata Wawrzyniak – Student’s Scientific Club of Histology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

#### **COFFEE BREAK – 13:00 – 13:45**

#### **SESSION IV**

##### **13:45 – 14:55**

13:45 – 14:05 – **„Generation of singlet oxygen and its role in modern medicine.”** – **dr n. o. zdr. inż. Łukasz Ożóg** – Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

14:05 – 14:25 – **“Why is the brain susceptible to oxidative stress?”** – **dr n. biol. Sabina Galiniak** – Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

14:25 – 14:40 – **„Immunohistochemical characteristics of renin-secreting tumors (reninoma) – a review”** – Jakub Krzysztof Gałązka, Marcin Czezelewski, Michał Zarobkiewicz – Students’ Scientific Association at Chair and Department of Clinical Immunology, Medical University of Lublin

14:40 – 14:55 – **„Mechanisms underlying lung damage in EVALI disease”** – Kozicka Marcelina, Krawczyk Oliwia, Marta Patrycja, Agata Wawrzyniak – Student’s Scientific Club of Histology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

#### **SESSION IV**

##### **14:55 – 15:45**

14:55 – 15:15 – **“Does music sound in the brain...do we have a “musical brain?”** – **dr n. med. Anna Sęk-Mastej** – Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland

15:15 – 15:30 – **„Analysis of incidence data for malignant brain tumors”** – Matylda Mikołajczyk, Anna Wolan, Agata Wawrzyniak – Student’s Scientific Club of Histology, Student’s Scientific Club of Immunology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland

#### **SESSION V**

##### **15:30 – 18:00**

15:30 – 15:50 – **“Brain lesions in the course of Covid 19 virus infection”** – **lek. Elżbieta Trojnar** – Clinical Department of Pathomorphology, Clinical Provincial Hospital No. 2 St. Jadwiga Królowej in Rzeszów, Poland

15:50 – 18:00 – **Presentation of posters**

#### **END OF THE 2ND DAY OF THE CONFERENCE**

18:00 – 18:30 – **Prize-giving and official closing of the second day of the conference**

**„1st National Student Histology Conference – “The brain, the fascinating world of synapses and neurons – Cogito Ergo Sum” – poster session**

**1ST DAY OF THE CONFERENCE (23.04.2022)**

- 15:50 – 16:10 – “The human brain – one and a half kilograms of secrets” – mgr Małgorzata Wąsacz**  
– Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:10 – 16:14 – „Guillain-Barré syndrome as a neurological complication of SARS-CoV-2 infection” – Karolina Pięta, Izabela Rudy, Mateusz Iwański, Kinga Polityńska** – Student’s Scientific Club of Immunology, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:14 – 16:18 – „Biomarkers of the immune response in head and neck cancer” – Julia Trojniał, David Aebisher, Dorota Bartusik-Aebisher** – English Division Science Club, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:18 – 16:22 – „Photodynamic therapy of brain tumors” – Maria Przygoda, Aldona Sokołowska** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:22 – 16:26 – „Application of proteomics in the discovery of radio-sensitive cancer biomarkers” – Magdalena Koman, Szymon Płaneta, David Aebisher, Dorota Bartusik-Aebisher** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:26 – 16:30 – „Immune biomarkers of response to immune-checkpoint inhibitors in head and neck squamous cell carcinoma” – Karolina Miś, Patrycja Przebieradło, Nikola Król, David Aebisher, Dorota Bartusik-Aebisher** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:30 – 16:34 – „Effects of thyroid hormones on CNS development and function” – Bernadetta Jakubowska, Izabela Kiebała, Krzysztof Balawender** – Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 16:34 – 16:38 – „Lateral orbitotomy of orbital tumor” – Łukasz Zarębski, Jeremi Wnorowski, Aleksandra Wrzos, Magdalena Żybura, Maciej Superson, Patrycja Świerczek, Katarzyna Szymańska, Kamil Walczak i Aleksandra Burbelka** – Student’s Scientific Club of Otolaryngology, Institute of Medical Sciences, Medical College of the University of Rzeszow, Rzeszow, Poland
- 16:38 – 16:42 – „Schizophrenia-changes in neural pathways in the brain and modern concepts of its treatment” – Aleksandra Roztoczyńska, Aleksandra Jeńć, Krzysztof Balawender**– Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 16:42 – 16:46 – „Classical psychedelics as an alternative to the treatment of depression” – Patrycja Przebieradło, Karolina Miś** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:46 – 16:50 – „Saliva protein biomarkers in head and neck cancer” – Radosław Starzyk, Marcin Skowronek, David Aebisher, Dorota Bartusik-Aebisher** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:50 – 16:54 – „ Current research on immunotherapy in head and neck cancer” – Julia Florek, David Aebisher, Dorota Bartusik-Aebisher** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:54 – 16:58 – „ Immunotherapy in head and neck cancer” – Gabriela Barszcz, David Aebisher, Dorota Bartusik-Aebisher** – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland

- 16:58 – 17:02 – „*Mental disorders - first symptoms of Creutzfeldt–Jakob disease*“ – Emilia Majewska – Student’s Scientific Club “Eskulap”, Collegium Medicum, Jan Kochanowski University of Kielce, Kielce, Poland
- 17:02 – 17:06 – „*Pick’s disease – rare face of dementia*” – Karolina Sobek, Dorota Waz, Michał Mazur, Agata Wawrzyniak – Student’s Scientific Club of Histology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 17:06 – 17:10 – „*The role of BMI1 as a cancer stem cell biomarker in head and neck cancer*” – Katarzyna Koszarska, Aleksandra Kotlińska, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:10 – 17:14 – „*Assessment of the concentration of hypoxia factors in patients with a tumor of the parotid gland.*” – Lidia Bieniasz, Wojciech Domka, David Aebisher, Dorota Bartusik–Aebisher – Department of Photomedicine and Physical Chemistry, College of Medical Sciences, University of Rzeszów, Department of Otolaryngology, University of Rzeszów, Provincial Clinical Hospital No. 1 for them. Frederic Chopin in Rzeszów, Department of Biochemistry and General Chemistry, College of Medical Sciences, University of Rzeszów
- 17:14 – 17:18 – „*Photodynamic therapy in the diagnosis and therapy of head and neck tumors.*” – Lidia Bieniasz, Wojciech Domka, David Aebisher, Dorota Bartusik–Aebisher – Department of Photomedicine and Physical Chemistry, College of Medical Sciences, University of Rzeszów, Department of Otolaryngology, University of Rzeszów, Provincial Clinical Hospital No. 1 for them. Frederic Chopin in Rzeszów, Department of Biochemistry and General Chemistry, College of Medical Sciences, University of Rzeszów
- 17:18 – 17:22 – „*Metabolomics of oral / head and neck cancer*” – Krawczyk Oliwia, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland

## 2ND DAY OF THE CONFERENCE (24.04.2022)

- 15:30 – 15:50 – “*Brain lesions in the course of Covid 19 virus infection*” – lek. Elżbieta Trojnar – Clinical Department of Pathomorphology, Clinical Provincial Hospital No. 2 St. Jadwiga Królowej in Rzeszów
- 16:05 – 16:09 – „*Neurogenesis in Alzheimer’s and Parkinson’s diseases*” – Karolina Miś, Nikola Król – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:09 – 16:13 – „*Is pharmacotherapy the most effective way of treating Parkinson’s Disease (PD) in advanced stage?*” – Aleksandra Roztoczyńska, Aleksandra Jeńć, Krzysztof Balawender – Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 16:13 – 16:17 – „*Photodynamic therapy – application on glioblastomas*” – Laura Evgenia Ketsetzi – English Division Science Club, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:17 – 16:21 – „*Development of cirrhosis in a patient with Wilson’s disease*” – Jeremi Wnorowski, Łukasz Zarębski, Magdalena Żybura, Maciej Superson, Kamil Walczak, Patrycja Świerczek, Katarzyna Szymańska, Aleksandra Wrzos, Weronika Wilczyńska, Agata Surowiec, Katarzyna Szmyt – Student’s Scientific Club of Infectious Disease, Institute of Medical Sciences, Medical College of the University of Rzeszow, Rzeszow, Poland
- 16:21 – 16:25 – “*Brachytherapy as a method of treating glioma*” – Karolina Pięta, Izabela Rudy, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland

- 16:25 – 16:29 – „*PDT therapy in glioma treatment*” – Wiktorja Mytych – English Division Science Club, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:29 – 16:33 – „*Significance and meaning of white matter tracts in CNS*” – Michał Orczyk, Martyna Orzechowska, Krzysztof Balawender – Student’s Scientific Club of Anatomy, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 16:33 – 16:37 – „*Radiotherapy for head and neck cancer*” – Julia Michalik, Julia Motyka, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:37 – 16:41 – „*Head and neck cancer*” – Katarzyna Wajda, Karolina Warzocha, Halszka Wajdowicz, Mateusz Warzocha, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:41 – 16:45 – „*Paradoxical and dangerous – paradoxical embolism*” – Joanna Barwacz, Dagmara Gładysz – Student’s Scientific Club of Pathomorphology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 16:45 – 16:49 – „*Influence of traumatic experiences from childhood, as a predisposing factor of developing schizofrenia in future*” – Marcelina Kozicka, Oliwia Krawczyk, Agata Wawrzyniak – Student’s Scientific Club of Histology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 16:49 – 16:53 – „*Neurotoxic consequences of using electronic cigarettes*” – Kozicka Marcelina, Krawczyk Oliwia, Marta Patrycja, Agata Wawrzyniak – Student’s Scientific Club of Histology, Department of Morphological Sciences, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 16:53 – 16:57 – „*The influence of bilingualism on the development of cognitive diseases*” – Aleksandra Burbelka, Łukasz Zarebski
- 16:57 – 17:01 – “*Stem cells in the treatment of neurodegenerative diseases*” – Gabriela Rajtar – Student’s Scientific Club “Neuronus”, Faculty of Biology, Institute of Zoology and Biomedical Research, Jagiellonian University
- 17:01 – 17:05 – „*The use of hydrogels in neural tissue engineering*” – Kornelia Tryzno – Student’s Scientific Club “Neuronus”, Faculty of Biology, Institute of Zoology and Biomedical Research, Jagiellonian University
- 17:05 – 17:09 – „*Neurological Complications of Cancer Treatment*” – Aldona Sokołowska, Maria Przygoda, Mateusz Iwański – Student’s Scientific Club of Immunology, Institute of Medical Sciences, Medical College of the University of Rzeszow, University of Rzeszow, Rzeszow Poland
- 17:09 – 17:13 – „*Squamous cell carcinoma of the head and neck: genomics and new biomarkers of immunomodulating cancer treatment*” – Klaudia Kusz, Damian Bezara, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:13 – 17:17 – “*The future of personalised radiotherapy for head and neck cancer*” – Monika Błądek, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:17 – 17:21 – „*Prognostic significance of tumour-associated CD68<sup>+</sup> and CD163<sup>+</sup> macrophages in squamous cell carcinoma of the head and neck: a systematic review and meta-analysis*” – Aleksandra Wiechecka, Marcelina Dymon, Alicja Zajęc, Małgorzata Kraska, David Aebisher, – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland

- 17:21 – 17:25 – „**Genetic and proteomic biomarkers for head and neck cancer: a systematic review**” – Katarzyna Wachała, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:25 – 17:29 – „**Circulating microRNAs in head and neck cancer: a review of methods**” – Magdalena Paško, Matylda Mikołajczyk, Anna Wolan, Gabriela Pinkowska, Maja Mularczyk, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:29 – 17:33 – „**Methylation as a biomarker for head and neck cancer**” – Kacper Rogóż, Agnieszka Przygórzewska, Iga Serafin, Paweł Woźnicki, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:33 – 17:37 – „**DNA: a new biomarker for head and neck cancer**” – Paulina Nowak, Kamil Jugo, Adrian Groele, Jacek Mazanek, Oliwia Wójcik, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:37 – 17:41 – „**Saliva biomarkers in cancer detection**” – Sara Bień, Aleksandra Flak, Aleksandra Faff, David Aebisher, Dorota Bartusik-Aebisher Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:41 – 17:45 – „**Designing biomarker studies for head and neck cancer**” – Marta Sowińska, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:45 – 17:49 – „**Head and neck cancer: proteomic advances and biomarkers**” – Katarzyna Piekarz, Izabella Prządo, David Aebisher, Dorota Bartusik-Aebisher Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:49 – 17:53 – „**Discovery of protein biomarkers for head and neck cancer**” – Sylwia Lepak, Katarzyna Jucha, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland
- 17:53 – 17:57 – „**Genetic polymorphisms and the risk of head and neck cancer**” – Izabela Niziołek, Halszka Wajdowicz, Natalia Żyłka, David Aebisher, Dorota Bartusik-Aebisher – Student’s Scientific Club „URCell”, Institute of Medical Sciences, Medical College of Rzeszow, University of Rzeszow, Rzeszow, Poland

*„1st National Student Histology Conference – “The brain, the fascinating world of synapses and neurons – Cogito Ergo Sum” – Workshops*

**1ST DAY OF THE CONFERENCE (23.04.2022)**

**09:00 – 18:00**

**09:00 – 11:00 – ECG interpretation workshop**

**09:00 – 09:45 – „ECG in patients with a history of syncope** – Prof. dr hab. N. med. Sebastian Stec

**09:45 – 11:00 – a workshop on interpretation of exemplary ECGs in patients with a history of syncope**  
– dr hab. n. med. Wojciech Wąsek, prof. UR

**11:00 – 15:35 – Laparoscopic workshop**– dr. n. med. Krzysztof Balawender, lek. Mateusz Zasadny, lek. Piotr Młodożanec

**11:00 – 12:30 – 1st group**

**12:35 – 14:05 – 2nd group**

**14:05 – 15:35 – 3rd group**

**16:30 – 18:00 – Electron microscopy workshop** – PIK Instruments

**2ND DAY OF THE CONFERENCE (24.04.2022)**

**09:00 – 14:30**

**09:00 – 10:30 – Neurological Workshops** – dr n. med. Natalia Leksa

**11:00 – 14:10 – Histology competition** – Student’s Scientific Club of Histology, University of Rzeszow

**11:00 – 11:45 – 1st group**

**11:50 – 12:35 – 2nd group**

**12:40 – 13:25 – 3rd group**

**13:40 – 14:10 – playoff**

# **ORAL PRESENTATIONS – ABSTRACTS**



## How COVID-19 affects central nervous system?

Barbara Nowak<sup>1</sup>, Mikołaj Grodzki<sup>1</sup>, Julia Jastrzębska<sup>1</sup>, Krzysztof Balawender<sup>2</sup>

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<sup>2</sup>Department of Morphological Sciences, Institute of Medical Sciences, Medical College of Rzeszow University, Rzeszow, Poland

Supervisor: dr n. med. Krzysztof Balawender

**Introduction and aim.** Currently, the ongoing pandemic triggered by the SARS-CoV-2 virus that causes COVID-19 disease became a fundamental problem due to the fact that this disease resulted in numerous deaths, has a severe course and is easily spread.

**Material and methods.** We summarized the current state of knowledge regarding the impact of COVID19 virus on the central nervous system. The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed, Science Direct, Web of Science database has been conducted.

**Analysis of literature.** It is widely acknowledged that SARS-CoV-2 primarily infects the respiratory system; however, there is also data proving that it can affect other systems,

including the central nervous system, as well. During the pandemic, numerous neurological symptoms caused by COVID-19 disease have been documented. Among these symptoms, we can distinguish the ones that occur during the course of this disease and those that persist even after recovery. In addition, there is evidence that SARS-CoV-2 infection may contribute to the exacerbation of coexisting neurological diseases in some patients.

**Conclusion.** At present, it is not clear how exactly the virus penetrates the central nervous system. However, possible ways of spreading the virus in which receptor and cytokines based mechanism can be highlighted.

**Keywords.** Central nervous system, COVID-19



## Anticancer therapy targeted at the cell membrane

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Supervisor: dr hab. n. med. David Aebisher, Prof. UR

**Introduction and aim.** The development of anti-cancer therapy aimed at cell membranes is possible due to the existing differences between the composition of the cell membrane of a normal and neoplastic cell. In cancer cells, the amino groups are exposed on the membrane surface, unlike in normal cells, where the amino groups are inside the membrane. New approaches in cancer therapy based on targeting membrane lipids in tumor cells have not yet been fully explored.

**Materials and methods.** The work presents a literature review of the works of scientists undertaking research in the field of developing anti-cancer therapy aimed at cell membranes. The following literature databases were used: Pubmed, Google Scholar and ScienceDirect.

**Analysis of literature.** One of the components of cell membranes is phospholipid phosphatidylethanolamine. Due to the differences in the presence of this phospholipid on the cell membrane surface, it is a potential therapeutic target in anti-cancer treatment. Targeting phosphatidylethanolamine could be a potential anti-angiogenesis approach to inhibit tumor growth.

**Conclusion.** The study of potential molecular targets for anti-cancer therapy is extremely important in the context of future clinical trials.

**Keywords.** Cancer therapy, phosphatidylethanolamine, targeted therapy



## A 52-year-old woman with rapidly progressive dementia

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Supervisor: dr hab. n. med. Waldemar Broła, prof. UJK

**Introduction and aim.** Depressed mood, mental disorders and disturbed memory are the most common causes of seeing psychiatrist. However, these symptoms may be a sign of serious illness on the border of neurology and psychiatry like prion diseases. They cause rapidly progressive dementia due to the deposition of prion proteins in the brain tissue. One of them is Creutzfeldt-Jacob Disease (CJD).

**Description of case.** 52-year-old woman with lack of comorbidities is complaining about memory and mood disorders. She isn't taking any medications. After a psychiatric consultation, she started antidepressant therapy. Despite of two weeks treatment the cognitive impairment was progressive. Speech and movement disorders appeared for the first time. She was admitted to neurology department. MRI examination revealed discrete hypodense changes in the occipital lobe. EEG examination showed slow down in basic activity of brain. Blood

tests and cerebrospinal fluid tests without deviations. Rapid deterioration of neurological condition appeared in next week. Incorrect waves and triphasic waves on EEG. In MRI - hyperintense signals in the basal ganglia. Protein 14-3-3 has been identified in the cerebrospinal fluid. Clinical symptoms and these tests put forth the suspicion of Creutzfeldt-Jacob disease. Despite of proper treatment, there was no improvement. She died 3 months after first symptoms. Neuropathological examination confirmed Creutzfeldt-Jacob disease.

**Conclusion.** Non-specific symptoms, initial diagnosis of CJD is difficult and requires a series of diagnostic tests at different times. There is no causal treatment, and the course of the disease is rapid and almost always leads to death.

**Keywords.** Creutzfeldt-Jacob disease, dementia, prion disease, 14-3-3 protein



## Severe tick-borne encephalitis with simultaneous spinal cord involvement with tetraparesis - a case report

Karolina Pięta<sup>1</sup>, Izabela Rudy<sup>1</sup>

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Supervisor: dr n.med. Marcin Wiącek

**Introduction and aim.** Tick-borne encephalitis is one of the arthropod-borne diseases in Central and Eastern Europe. Its etiological factor is tick-borne encephalitis virus (TBEV), belonging to the flavivirus genus of the Flaviviridae family. This pathogen causes a generalized infection of the central nervous system, most often manifested by meningitis.

**Description of the case.** In about 5-10% of TBE-Eu cases, monoparesis, hemiparesis, and tetraparesis may develop. The paper describes a case of tick-borne encephalitis with simultaneous involvement of the cervical segment of the spinal cord

at the level of C3-C7 and the vermis of cerebellum, which was confirmed by magnetic resonance imaging (MRI). The patient developed a biphasic course of the disease, initially consisting of flu-like symptoms (weakness, low-grade fever, episode of diarrhea, fine spots rash), and then severe, manifested by flaccid tetraparesis. The diagnosis of TBE was confirmed in the patient by serological tests.

**Conclusion.** Involvement of the spinal cord in the course of tick-borne encephalitis is usually associated with the severe clinical course of the disease, which increases the likelihood of life-threatening respiratory disorders.

**Keywords.** MRI, TBE, tetraparesis



## Encephalitis as a complication of mild COVID-19 infection

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Supervisor: dr hab. n. med. Waldemar Broła, prof. UJK

**Introduction and aim.** SARS-CoV-2 virus causes lesions primarily in the respiratory system, but neuro-logical complications are also common in patients with COVID-19. These usually affect patients hospitalized for severe respiratory infection.

**Description of the case.** A 32-year-old recovering patient was admitted to the Department of Neurology one week after termination of a mild COVID-19 infection confirmed by a positive PCR result, due to disturbances of consciousness and fever of 39.5°C. On admission the PCR test was negative. RM examination showed extensive lesions in the left temporal lobe. Inflammatory cerebrospinal fluid (protein 0.73 g/L, cytosis 447) was sent for testing for Lyme disease, viral diseases and onconeural antibodies. Antibody to SARS CoV-2 virus in the cerebrospinal fluid was not found. Because of the patient's severe condition (consciousness dis-

orders, fever >39 °C), empirical treatment was initiated (antibiotics, Remdesivir, Acyclovir). The follow-up examinations after 7 days showed receding inflammatory changes in the cerebrospinal fluid and evolution of changes in cerebral MRI (linear haemorrhagic lesions appeared in the medial part of the left temporal lobe). HSV1 virus was found in the cerebrospinal fluid. The whole picture allowed the diagnosis of herpes encephalitis. After 14 days of treatment, the patient was motor functional but had increased memory and association disorders.

**Conclusion.** The past COVID-19 infection suggested its late neurological sequelae. Meanwhile, immunosuppression was the cause of additional HSV1 infection and severe herpes encephalitis.

**Keywords.** Herpes encephalitis, HSV1, SARS-CoV-2



## Neuroplasticity of the brain and its possible stimulation in therapy after ischemic brain stroke

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Supervisor: dr n. med. Krzysztof Balawender

**Introduction and aim.** According to Santiago Ramón y Cajal's thesis, all neuronal pathways in adult nerve centers are well established and cannot be changed. However, it is known that the brain has the ability to create new synapses, which is the basis for growth and accompanying changes.

**Material and methods.** We summarized the current state of knowledge in the field of potential brain plasticity stimulation for the treatment of ischemic stroke. The review was done according to the current literature, analysis of scientific data from PubMed, Science Direct, Web of Science databases was performed.

**Analysis of literature.** Brain neuroplasticity enables repair processes after ischemic stroke, neurons die by secondary processes that are only indirectly related to the primary ischemic injury. This is associated with energy disruption and excitotoxicity, and cells undergo apoptosis as a result of oxidative and nitrosative stress and inflammatory processes. Under favor-

able conditions, however, this process can be arrested. When applied quickly enough, neuroprotective treatment produces good results. The most thoroughly studied is basic fibroblast growth factor (bFGF) because of its high permeability across the blood-brain barrier. Another important substance is cerebrolysin, which reduces the activity of proteolytic enzymes that play a key role in cell apoptosis. Studies show that drugs given as an adjunct to standard rehabilitation in stroke patients improve their function

**Conclusion.** The studies showed that in citicoline-treated patients better results have been obtained in terms of concentration, sense of direction, activity, cognitive functioning, and quality of life. In summary, stimulation of neuroplasticity will play an increasingly important role in neurology.

**Keywords.** Cytidine diphosphate choline, ischemic stroke, neuronal plasticity

## The assessment of mossy fibers in the hippocampus of PTENfloxed mice

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Supervisor: PhD Adam Gorlewicz

**Introduction and aim.** The classical trisynaptic circuit in the hippocampus consists of granule cells in the dentate bend, pyramidal neurons in CA3, and pyramidal neurons in CA1. In the dentate bend, synapses are formed with pyramidal cells in CA3 via myofilaments that form a distinctive anatomical pattern called the stratum lucidum, and the myosin fiber pathway in CA3 undergoes a highly specific structural rearrangement in mice with a mutated PTEN gene, a genetic model for autism spectrum disorders. It was hypothesized that this rearrangement of myofibrils may affect the proper transmission of information in hippocampal myofibrils, and cognitive processes. The aim of the present study was to morphologically characterize the rearrangement of Mossy fibers in mice with mutated PTEN gene in granule cells of the Dentate Gyrus.

**Material and methods.** Experiments were performed on male mice with a PTEN gene flanked by loxP sites (PTENfloxed). To produce DG selective PTEN mutant mice, we used a lentiviral vector expressing Cre-recombinase under the control of CaMKII promoter. In a typical procedure, PTENfloxed animals were anesthetized, placed in a stereotactic frame, and after that, viral solution was injected intracranially. Four weeks after vector injection brains of the animals were dissected, cryosectioned and subjected to immunodetection. The detection of synaptopodin was performed on coronal hippocampal

sections using primary anti synaptopodin antibody and species-specific secondary antibody coupled with fluorophore. Specimens were co-stained with DAPI. Fluorescent specimens were examined under a spectral confocal microscope. The synaptic clusters were labeled by ImageJ and the numbers of non-zero pixels in each object were calculated.

**Results.** Mossy fiber rearrangement in mice with mutated PTEN gene in dentate gyrus causes widening of stratum lucidum. Moreover, the analysis of synaptopodin immunoreactivity demonstrates that the density of synaptopodin clusters and the average size of a cluster remains unchanged.

**Conclusion.** The PTEN mutation from dentate granule cells provokes mossy fiber rearrangement in the mouse model of autism spectrum disorder and epilepsy. This leads to stratum lucidum widening, which suggests altered mossy fiber synapses localization on CA3 cells. Moreover, unaffected density of synaptopodin clusters in affected stratum lucidum implicates an increased number of synapses in that region. Altogether that suggests the amplified glutamatergic impact of mossy fibers on CA3 cells and allows to formulate hypotheses about altered information processing by mossy fibers in the hippocampus.

**Keywords.** Epilepsy, hippocampus, PTEN gene, seizure, stratum lucidum



## Primary Pulmonary Meningioma

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**Introduction and aim.** Primary pulmonary meningioma (PPM) is a rarely described, usually benign neoplasm, which belongs to the group of primary ectopic meningiomas. Primary ectopic meningiomas arise outside the dura mater and can be detected in the head and neck regions, paraspinal soft tissues, the orbit, the nose, the paranasal sinuses, oropharynx, but very rarely in the lungs.

**Material and methods.** In this study, we summarized the current state of knowledge about primary pulmonary meningioma using case reports starting from the first one in 1982. Thorough analysis of the scientific data from PubMed database has been conducted. Also, we studied and analyzed the pathomorphological tissue changes in these disease using the specimen of owned by Department of Morphological Sciences in Rzeszow University.

**Analysis of literature.** The prevalence of primary ectopic meningiomas is low, accounting 1-2% of all primary meningio-

mas. Primary lung meningioma usually presents as a single lung nodule, which is usually benign and has good prognosis. This disease affects slightly more women than men. Also it requires differentiation from the metastasis of the intracranial meningioma, which may occur from several months until several years after primary tumor removal.

**Conclusion.** Up to now only about 50 cases of PPM have been described in the literature. Like their counterparts in the central nervous system, the PPM shows a diversified histological structure, but their etiology is not established. The hypotheses include origin from the embryonic remnants or from the subpleural pluripotential mesenchymal cells and the differentiated meningotheelial cells. The key diagnostic criterion of PPM is the absence of intracranial changes.

**Keywords.** Ectopic meningioma, meningioma, primary, primary lung meningioma



## Primary meningeal melanomatosis

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**Introduction and aim.** Primary meningeal melanomatosis is a very rare type of the malignant melanoma that affects the CNS with poor prognosis. This type of melanoma accounts less than 0.1% of all central nervous system neoplasms. The cause of the disease is uncontrolled proliferation of the melanocytes in pia matter.

**Material and methods.** To write this article about primary meningeal melanomatosis we summarized information from the scientific medical articles and also used PubMed database to find and summarize information from the case reports about this rare disease. Furthermore, thanks to our pathomorphological cathedra, which gave us their specimen of the primary meningeal melanomatosis we had an opportunity to study and analyze the specific pathomorphological tissue changes of this disease.

**Analysis of literature.** During embryotic development melanocytes travel to the eyeballs, mucosa, skin, and pia matter where they transform into the cancer cells causing the devel-

opment of the primary meningeal melanomatosis. This type of melanoma has two forms: 1. Diffuse meningeal melanomatosis 2. Solid tumour diffuse meningeal melanomatosis infiltrates the subarachnoid space and the cerebral cortex, what causes such symptoms as: inflammation, tumour development. Clinically, it is very difficult to diagnose this type of neoplasm because of the unspecific symptoms like convulsions, mental disorders, the cranial nerves damage, speech difficulties. Because of the reason there are so many different symptoms it is easy to misdiagnose and to mix it up with the diffuse meningeal tumors, subacute meningitis, viral encephalitis and with the other pathologies.

**Conclusion.** Clinical and radiological diagnosis for this tumor must be done very carefully, because only early and accurate diagnosis gives the patient a chance for the appropriate treatment.

**Keywords.** Melanoma, primary meningeal melanomatosis, rare CNS tumor



## Methodology of anthropometric measures by analysis of the cranial index

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Supervisor: dr. n. med. Krzysztof Balawender

**Introduction and aim.** Variation in cranial structure among different individuals, including length, flattening, or height, has always been in the sphere of interests of anthropologists. Considering the length index of every cranium, we distinguish three main types of structure: brachycephalic, mesocephalic, or dolichocephalic. Their assignment to one of the groups depends on the value of cranial index (CI).

**Material and methods.** The measurement of cranial index among the population of Provincial Clinical Hospital No. 2 in Rzeszow was performed to determine the prevalence of each type of cranial structure. We performed anonymized selection of CT head scans of 300 adult patients, including 147 women and 153 men. Based on CT head scans, measures of maximal cranial length (g-op) and maximal cranial width (eu-eu) of each participant have been acquired. Finally, based

on the data collected, the cranial index has been calculated using the equation:  $(eu-eu)/(g-op) \times 100$ .

**Results.** The mean value of the cranial index for male crania was 82.91 (SD±3.71), for female 83.91 (SD±3.79). The brachycephalic type of cranial structure accounted for 66% of totality, mesocephalic 31% and dolichocephalic 3%.

**Conclusion.** The brachycephalic cranial phenotype was the most prevalent in this study. The tendency of progression to the brachycephalic cranial type was observed in the studied population, as nearly one-third of described crania counted as mesocephalic. A minor fraction of the crania analyzed was dolichocephalic type. Comparative analysis of the cranial index may be useful in forensic medicine and plastic surgery for clinical and experimental purposes.

**Keywords.** Anthropology, brachycephalization, cranial index



## Myxoma is not only in the heart – short story about dermal nerve sheath myxoma of lateral cutaneous nerve of the forearm in a 23 year-old female

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**Introduction and aim.** Myxoma is usually in the left atrium in the heart. Location in nervous system is atypical. Dermal nerve sheath myxoma is rare, benign neoplasm of peripheral nervous system. The tumours are more than 5 times rarer than neurothekeoma. Etiology is unknown. The most common locations for this tumor are extremities, especially hands and fingers. This neoplasm usually presents with small, painless nodule. This myxoma affects men and women equally with a predilection for adults in 2- 4 decade of life.

**Description of case.** A 23-year-old female presented with a two years history of a nodule on her left forearm which was slow growing. The tumor was very painful during by touching. The physical examination with palpation revealed the small nodule with tenderness. She had imaging study like MRI with contrast. The first medical diagnosis suggested to schwanno-

ma of cutaneous nerve of forearm. The neurosurgeon decided to do excision of tumour. Histopathological examination of the tissue and immunohistochemical analyses recognized a dermal nerve sheath myxoma.

**Conclusion.** Despite the fact that the dermal nerve sheath myxoma is a rare, benign neoplasm it should be take into account in the diagnosis. This case report shows how important are imaging exams to correct diagnosis. Well, not every tumor reveals in the same symptoms. The patient complained about severe pain but the pain isn't typical for the type of myxoma. It is worth to remember about differential diagnosis. The histopathological examination and immunohistochemical analyses are necessary to correct diagnosis.

**Keywords.** Benign neoplasm, dermal nerve sheath myxoma, myxoma, peripheral nervous system, rare neoplasm



## Lambert-Eaton myasthenic syndrome in a patient with ulcerative colitis

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Supervisor: dr hab. n. med. Waldemar Broła, prof. UJK

**Introduction and aim.** Lambert-Eaton myasthenic syndrome (LEMS) is caused by neuromuscular junction disorders. It is characterized by generalized paresis of upper and lower limb muscles. In 60-70% of patients LEMS is a paraneoplastic syndrome, in the rest an autoimmune disease.

**Description of the case.** A 71-year-old man, admitted because of increasing weakness of lower limbs, then upper limbs since 8 months. History of ulcerative colitis treated with steroids and mesalazine, paroxysmal atrial fibrillation, ischemic heart disease, hypertension. Neurological examination revealed flaccid paresis of the upper and lower limbs, more severe proximally, and impaired deep reflexes, without pathological symptoms. Neoplastic screening did not confirm the presence of cancer. Neurological diagnosis included electrostimulation fatigue test (typical features of

LEMS) and AChR level. Myasthenic test from the thumb adductor muscle confirmed the presence of neuromuscular conduction disturbances and the observed rolling, indicating Lambert-Eaton syndrome (LEMS). Immunoglobulins at a dose of 0.4 g/kg for 5 days were administered, with significant improvement in muscle strength and general performance. A previous diagnosis of ulcerative colitis suggested an immunologic basis. A panel of laboratory, imaging and electrophysiological studies performed allowed the diagnosis of LEMS and the implementation of effective treatment. **Conclusion.** The prevalence of electrophysiologic testing and the ability to perform specialized laboratory and imaging studies have enabled the diagnosis and successful treatment of this rare neurologic condition.

**Keywords.** LEMS diagnosis, limb paresis, ulcerative colitis



## Machine Learning in neuropathology – application of convolutional neural networks using Digital Brain database

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**Introduction and aim.** Machine Learning (ML) as a subset of Artificial Intelligences (AI) is one of the most promising fields in IT. At its core it's training an algorithm at finding patterns and correlations in large datasets. This way of data analysis enables forecasting and taking optimal decisions. Properly designed and trained ML-based systems become more effective over time, since their accuracy depends first and foremost on size of the training dataset and its quality. The aim of this talk is to identify opportunities and difficulties involved in implementing ML in neuropathology.

**Material and methods.** The artificial intelligence was trained by using images from the publicly available Digital Brain database. Compared to a network with the same number of layers but not the convolution, the confidence interval narrows faster. Unfortunately, this method is only partially able to supplement the lack of training data.

**Results.** After iterative analysis of well-labelled sample base, performed under the supervision of a diagnost, the pro-

gramme would learn to distinguish between images of healthy and pathological tissues, as well as grade the severity of changes. A desirable outcome would be the AI highlighting early-stage changes, unnoticeable to humans. The important obstacles are, inter alia, obtaining a sizable digitalised bank of histopathological samples, indispensable in training; the necessity of constant and rigorous supervision of an experienced pathomorphology specialist while the AI is learning; technical constraints resulting from large file sizes (reaching 1 GB in some cases); finally, the very length of training process.

**Conclusion.** A partial solution to these difficulties may lie in applying a mathematically promising technique of convolutional networks (CNN), which can be trained using images of relatively low resolution. The talk examines usefulness "Digital Brain" database towards training an artificial intelligence.

**Keywords.** Artificial intelligence, diagnostics, machine learning, neuropathology, pathomorphology



## Distribution of the postganglionic sympathetic fibers within the cavernous sinus revisited

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**Introduction and aim.** The course of postganglionic sympathetic fibers derived from the internal carotid plexus is of particular interest to anatomists and clinicians. It is especially true regarding the topographic relations between the internal carotid plexus and selected cranial nerves located within the cavernous sinus. Knowing these relations can help better understand clinical symptoms associated with pathologies involving the cavernous sinus. The study aimed to verify the distribution of postganglionic sympathetic fibers using histochemical and immunohistochemical techniques.

**Material and methods.** The research was conducted on ten cavernous sinus specimens fixed in 10% buffered formalin solution and harvested en bloc. Specimens were processed using routine histological techniques and embedded in paraffin. Selected methods were used, including histochemistry (Gordon Sweet and Klüver-Barrery staining) and immunohistochemistry (detection of tyrosine hydroxylase) to determine the distribution of the postganglionic sympathetic fi-

ber bundles. Additionally, endothelial markers (CD31 and CD34) were applied.

**Results.** The internal carotid plexus gives communications to selected cranial nerves located within the cavernous sinus. A strong bundle of fibers derived from this plexus joins the abducens nerve. Some of the sympathetic fibers continue towards the abducens nerve, while the remaining fibers reach the lateral wall of the cavernous sinus and travel to the orbit along with the ophthalmic nerve. The sympathetic plexus itself accompanies the internal artery along its course. Moreover, the communications derived from the internal carotid plexus are directly adjacent to the venous canals located within the cavernous sinus.

**Conclusions.** The cavernous sinus is a segregation site for postganglionic sympathetic fibers.

**Keywords.** Cavernous sinus, cranial nerves, sympathetic fibers, tyrosine hydroxylase

## Management of traumatic brain injury

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**Introduction and aim.** Traumatic brain injury is a disruption (TBI) of brain architecture and function as a result of an external physical force on the brain structure. It has a high mortality rate as it accounts for one in three deaths due to trauma. About 80% of cases are assessed as a mild condition, while moderate and severe conditions are found in about 20% of patients. The assessment of the patient's clinical condition significantly influences the differences in management. In our work, we focused on collecting and summarising recent data related to the management of traumatic brain injury.

**Materials and methods.** For the final literature analysis, 10 articles from the PubMed database were used, selected based on their relevance to the topic, date of publication and number of citations.

**Analysis of the literature.** We distinguish between pre-hospital and hospital management. The main assumption in pre-hospital management is to follow the ABC scheme, to assess the patient on the Glasgow scale and to maintain basic vital signs: systolic blood pressure above 110 mmHg, saturation not less than 90%. Hospital management focuses on controlling and

lowering intracranial pressure and avoiding hypotonia and hypoxia. In patients in moderate to severe condition, CT should be performed immediately. In patients with mild TBI, CT is indicated only for symptomatic patients and those on anti-thrombotic therapy. Some cases require neurosurgical intervention in the form of external ventricular drainage, haemicranectomy and evacuation of intracranial haematomas.

**Conclusion.** The current 4th edition of the guidelines on the management of TBI is based on evidence supported by numerous randomised trials, however, this management does not take into account the significant differences in the course of secondary complications. In order to improve treatment outcomes, future research and guidelines for the management of patients with TBI should focus on the development of individualised approaches for specific subgroups of patients due to the wide variability in the aetiopathogenesis and clinical presentation of patients.

**Keywords.** Invasive treatment, management, pharmacotherapy, traumatic brain injury



## Multiple sclerosis as an autoimmune disease – analysis of histopathological images

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**Introduction and aim.** Multiple sclerosis (MS) is a neuro-degenerative disorder of the central nervous system with a complex and still not fully understood etiology leading to motor control deficits, cognitive impairment, pain, and ultimately to disability. MS is associated with autoimmunity, in which chronic inflammation coupled with the unsealing of the blood-brain barrier causes autoreactive lymphocytes to migrate to the CNS and leads to damage to the myelin sheaths of axons, disruption of neuronal signaling, and eventually neuronal death. The aim of this study is to summarize the knowledge of multiple sclerosis as chronic inflammation. **Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed database has been conducted.

**Analysis of literature.** The genetic factors determining the development of the disease are loci HLA-A \* 02: 01 and HLA-DRB1 \* 15: 01, the genes encoding the  $\alpha$ -receptor chains of the IL-2 and IL-7 receptors, and peripheral differences in effector T cell function. Myelin protein-derived antigens are the

primary targets of autoreactive T cells and antibodies. Myelin basic protein (MBP) and oligodendrocyte myelin glycoprotein (MOG) are recognized by circulating CD4 + T cells, mainly Th1 and Th17. The presence of T lymphocytes in the CNS is detectable in the early stages of MS, the association of HLA with the disease reflects the presentation of specific autoantigen epitopes. In the course of the disease, B lymphocytes induce the production of IL-6 and antibodies.

**Conclusion.** Chronic inflammation causes an increased production of reactive oxygen species and reactive nitrogen species, damaging neuronal mtDNA; the accumulation of these mutations results in metabolic stress, protein misfolding and energy deficiency; the associated accumulation of glutamate, an excitotoxin responsible for ion imbalance, makes the compensatory mechanisms insufficient to stop retrograde degeneration.

**Keywords.** B cells, chronic inflammation, multiple sclerosis, neurological complications, T cells



## The influence of marijuana on the central nervous system during adolescence and prenatal period

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**Introduction and aim.** Cannabinoids, of which marijuana is a major source, are commonly used by both younger and older adults. The purpose of this paper is to provide background information on these substances, distribution, and receptors. and to explain the mechanisms by which they affect the central nervous system during prenatal and adolescence.

**Material and methods.** The review paper was based on articles posted in the PubMed database.

**Analysis of the literature.** Statistics show that drugs are used several times less frequently than alcohol. The most popular drug is marijuana, which contains more than 50 cannabinoids. To date, 4 receptors have been identified: CB1 and CB2, CB-vanilloid and abn-CBD. Depending on the dose taken and the age at which smoking begins, cannabis has different effects on central nervous system structures. Taking small amounts of cannabis for short periods of time during the teenage years may prove to be more harmful than continuously taking large amounts as an adult. However, other studies have provided evidence that although the effects last slightly longer than in adults, cognitive impairment resolves completely after longer

periods of abstinence. With reasonable dosage, marijuana can also have positive effects. It is used as a treatment for spasticity in multiple sclerosis, for migraines, and as an anti-cancer therapy for various types of cancer. Side effects may include adverse psychological, cognitive, gastrointestinal, and cardiovascular effects. Cannabis can induce tolerance and lead to the development of addiction after long-term use. Further work is needed on the potential medical uses of cannabis-based preparations, as the small number of studies to date does not allow for the identification of all possible therapeutic effects and adverse reactions.

**Conclusion.** Marijuana has a significant effect on the function and structure of the CNS. Depending on the dose, frequency of use, and age of first use, these effects may be positive or, more often, negative. When used improperly, it can quickly lead to addiction, rational dosage is increasingly used in medicine as a cure for numerous diseases.

**Keywords.** Adolescence, cannabinoids, central nervous system, marijuana, prenatal period



## Primary brain tumors – gliomas

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**Introduction and aim.** Brain tumors are most often diagnosed in children up to 14-years of age. Almost 30% of all tumors in the CNS are malignant tumors, in which gliomas lead the way, accounting for approximately 80% of malignant CNS tumors. Malignant tumors are the leading cause of death from intracranial tumors, although they are less frequent.

**Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed database has been conducted.

**Analysis of literature.** Tumors present in the CNS show features similar to tumors present in other organs. The differences are: no tendency to metastasize beyond the primary site, the possibility of spread through the cerebrospinal fluid, significant correlations between tumor location and prognosis, as well as frequent occurrence of cysts within or around the tumor. The symptoms of CNS tumors depend on the location,

duration of the disease, histological type of the tumor and grade of malignancy. CNS tumors are manifested by subtle disturbances in sensation, vision, or speech. More severe cases may include epileptic seizures or even changes in personality and behavior. In the course of the neoplastic process in the CNS, the so-called mass effect is associated with an increase in intracranial pressure. It manifests itself with headaches, vomiting and nausea, posing a serious threat to the patient's life.

**Conclusion.** Gliomas are derived from glial tissue, which supports, repair and nourish neurons. Due to the type of cell from which they originate, we divide them into astrocytomas (80%), oligodendrogliomas (5-15%) and ependymomas (7%). They are also classified according to the level of malignancy in a 4-point scale and according to the location of supratentorial and subtentorial gliomas.

**Keywords.** CNS tumors, gliomas, primary CNS tumors

## Creutzfeldt-Jakob disease

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**Introduction and aim.** Creutzfeldt-Jakob disease is the most common prion disease in humans. It leads to neurodegeneration, which is a progressive and irreversible process of degeneration and subsequent death of nerve cells. There are four basic forms of the disease: sporadic, familial, iatrogenic, and variant CJD. The most common form is sporadic. The frequency of sporadic CJD is estimated to be 0.5-1:1,000,000 population.

**Material and methods.** We summarized the current state of knowledge about Creutzfeldt-Jakob disease. The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed database has been conducted.

**Analysis of literature.** The deposition of misfolded proteins is responsible for the development of spongiform encephalopathy. Prion is a glycoprotein that, despite lacking metabolism and nucleic acids, is capable of self-replicating in the host. In healthy humans, the prion (PrP – prion protein) exists in a physiological form (PrPC – prion protein cellular), in which the  $\alpha$ -helix structure predominates. This protein is synthesized in relatively small amounts and is located in the cytoplasmic

membrane of cells, primarily nerve cells. The pathogenic form of prion (PrP<sup>Sc</sup> – prion protein Scrapie) has a characteristic  $\beta$ -harmonic conformation, is poorly soluble in water, and is resistant to protease action. CJD is characterized by a typical triad of symptoms: progressive cerebral dementia, changes in EEG, and myoclonus. However, these symptoms affect only 70% of patients, in 30% prodromal symptoms such as weakness, sleep disturbances, anorexia can be observed. Other symptoms can be observed in variant CJD, mainly related to rapid death, neurological disorders such as depression, anxiety, memory disorders, tremors, or paresthesias.

**Conclusion.** The diagnosis of CJD is very difficult. Diagnosis with imaging studies and EEG is usually insufficient. It is possible to determine the 14-3-3 protein in cerebrospinal fluid, which is a nonspecific marker of neuronal decay and occurs not only in CJD. However, there is great hope for the detection of trace amounts of PrP<sup>Sc</sup> protein, which is specific for prion diseases.

**Keywords.** Creutzfeldt-Jakob disease, neurodegenerative disease, prion diseases, prions



## Hereditary neuropathies

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**Introduction and aim.** Neuropathies are conditions affecting the peripheral nervous system. Hereditary motor neuropathies are rare conditions in which a pathological process taking place in the motor cells of the anterior horns leads to paresis and atrophy of the peripheral limb muscles. Symptoms of the disease occur primarily in the lower extremities, although in rare cases they may predominate in the upper extremities. Sensory dysfunction in some neuropathies of this group leads to significant complications such as ulcerations, joint deformities, spontaneous amputations due to impaired pain perception and trophic changes. The most common genetic neuropathy is Charcot-Marie-Tooth (CMT) disease. It is named after three researchers who were the first to report it. To date, approximately 40 genes or gene sites involved in the pathogenesis of various forms of CMT have been identified.

**Material and methods.** Analysis of available publications in

the PubMed medical database on genetically determined neuropathies.

**Analysis of the literature.** There are many case reports on genetically determined neuropathies, but diseases of this group still represent a significant problem for physicians. So far, there is no adequate causal treatment. It is possible to alleviate the symptoms of the disease and to treat its effects.

**Conclusion.** Genetically determined neuropathies are an important part of diseases of the peripheral nervous system. Further neurological and genetic research may lead to a better understanding of the pathogenesis of these conditions and contribute to the development of more effective treatments.

**Keywords.** Charcot-Marie-Tooth disease, genetically determined neuropathies, hereditary motor neuropathies, hereditary sensory-autonomic neuropathies



## Immunohistochemical characteristics of renin-secreting tumors (reninoma) – a review

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**Introduction and aim.** The renin-secreting tumor (reninoma) is a rare endocrine cause of secondary hypertension. Immunohistochemical (IHC) tests, performed on surgically extracted tissue samples, confirm its diagnosis. Due to the rareness of reninoma, the IHC markers prevalence is not investigated decently. The aim is to determine reninoma IHC phenotype based on a review of the literature.

**Material and methods.** From 2010, 31 cases of reninoma have been reported in scientific literature. Most of the patients were from the Far East region (70.97%; n=22), and women (74.19%; n=23) were more affected than men.

**Results.** The majority of tumours was positive for CD34 (82.61%; n=19) and vimentin (65.22%; n=15), while negative for chromogranin A (43.48%; n=10) and HMB-45 (34.78%;

n=8), cytokeratin (17,39%; n=4) and S100 protein (13.04%; n=3). Other markers including actin, CK7, CK20, AE1/AE3, synaptophysin, WT-1, EMA, CD56, RCC, and melatonin A were evaluated in individual cases. There is an ambiguous prevalence of SMA reported both three times positive and negative, and CD31 – reported both 2 times positive and negative.

**Conclusion.** Collected data indicate that reninoma expresses CD34 and vimentin while not expressing chromogranin A, HMB-45, cytokeratin, and S100 protein. The results need to be confirmed by a study on a larger group of patients.

**Keywords.** Immunohistochemical test, juxtaglomerular cell tumor, reninoma



## Mechanisms underlying lung damage in EVALI disease

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**Introduction and aim.** As a result of usage of e-cigarettes, there are biochemical, cellular and molecular changes being observed. Inhalation of substances present in fumes causes EVALI disease (e-cigarette, or vaping, product use-associated lung injury). In further part of the article, particular aspects of observed mechanisms of lung damaging will be described, as well as changes, which are taking place in other tissues of organism

**Material and methods.** The assessment was based on thorough analysis of up-to-date literature. The data was gathered from the PubMed's and Google Scholar's database

**Analysis of literature.** Smoke produced in electric cigarettes are composed e.g. From acrolein, acetaldehyde, formaldehyde, vitamin E acetate (VEA) and heavy metals. Vitamin E acetate was discovered in liquids from bronchoalveolar lavage, which came from several people diagnosed with EVALI disease. As a

result of that, it is believed that VEA is a possible trigger factor of EVALI. Probably, inhalation with vitamin E acetate or its derivatives leads to interaction with phospholipids and surface-active substances of fluid padding out epithelium which may result in physiological disturbances of lungs function. Neurotoxic effect of pyrolysis' side product – phenyl acetate (structurally analogic to vitamin E acetate), suggest, that VEA may cause central nervous system disorders.

**Conclusion.** For thorough assessment of vitamin E acetate role in development of EVALI and other diseases linked with e-cigarettes usage, it is necessary to run more evidence-based surveys. At this point, precise mechanism of lung damage in EVALI is not known yet and is still the subject of many scientists' researches.

**Keywords.** E-cigarette, EVALI, vitamin E Acetate

## Analysis of incidence data for malignant brain tumors

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**Introduction and aim.** Tumors of the central nervous system are a group of diseases with diverse clinical and histological characteristics, it is estimated that brain tumors constitute 2% of the cancer incidence in Poland. Brain tumors constitute a specific group of oncological processes, in which the localization and character of the proliferation are crucial for clinical symptoms and prognosis. The aim of this paper is to compare the trends in the incidence of malignant brain tumors.

**Material and methods.** The paper uses selected methods of descriptive statistics, such as analysis of structure and dynamics of phenomena. Data from the cancer registry for the years 1963-2010 were used, divided into provinces, as well as by gender.

**Analysis of literature.** In our study, we describe data on the

incidence of malignant brain tumors with a presentation of the morphology of glioblastomas and a comparison of their different forms. The main literature sources are the national cancer registry and numerous articles describing the types of glioblastomas.

**Conclusion.** The results of the analyses indicate a significant increase in the incidence of malignant brain tumor, both in women and men, and it is worth noting the significant differences in the number of patients between different provinces. The cited results were used to determine the causal factors responsible for the increase in the number of patients with malignant brain tumor.

**Keywords.** Brain tumor, central nervous system

## **POSTER PRESENTATIONS – ABSTRACTS**

## Guillain-Barré syndrome as a neurological complication of SARS-CoV-2 infection

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**Introduction and aim.** COVID-19 is an acute infectious disease of the respiratory system caused by infection with the SARS-CoV-2 virus. The main clinical manifestation of SARS-CoV-2 infection is respiratory symptoms, however, there is scientific evidence to suggest the neuroinvasive potential of the virus. In the literature, there are reports of neurological symptoms among patients such as headache, vomiting, nausea, dizziness, muscle aches, anosmia, lack of taste and impaired consciousness. Recently, there have been many case reports suggesting a link between SARS-CoV-2 virus infection and the occurrence of Guillain-Barre syndrome (GBS), which is an acute inflammatory demyelinating polyradiculoneuropathy of unknown etiology. GBS is an autoimmune disorder of the peripheral nervous system, in which there is damage to the motor nerves in the form of flaccid paresis, accompanied by the abolition of muscle reflexes as a result of the destructive action of the autoreactive cellular and humoral immune response. A special role in the autoimmune mechanism of GBS is attributed to the phenomenon of molecular mimicry.

The aim of this paper is to summarize the knowledge about the occurrence of Guillain-Barré syndrome as a rare complication after infection with the SARS-CoV-2 virus.

**Material and methods.** For the final analysis of the literature, 12 articles from the Pubmed database were used.

**Analysis of the literature.** Clinical manifestations can spread rapidly, leading paralysis of the limbs and paralysis of the respiratory muscles, which in turn may lead to the death of the patient. The cause of this disease has not been fully clarified but the occurrence of the disease associated with bacterial infections has been demonstrated. e.g. *H. influenzae* or viruses e.g. influenza, EBV, CMV, HSV or HIV and recently with SARS-CoV-2 infection.

**Conclusion.** Although the mechanisms of neuroinvasion of the SARS-CoV-2 virus are not yet well understood their understanding is crucial for the treatment of patients.

**Keywords.** COVID-19, Guillain-Barré syndrome, neurological complications, SARS-CoV-2



## Biomarkers of the immune response in head and neck cancer

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**Introduction and aim.** Preclinical data suggest that squamous cell carcinoma of the head and neck is a deeply immunosuppressive disease. What characterizes the abnormal secretion of pro-inflammatory cytokines and the dysfunction of immune effector cells. The aim of this work was to summarize the current data on novel immunotherapy response biomarkers in head and neck squamous cell carcinoma.

**Material and methods.** The literature search was performed in PubMed data base in years 2022-2010. The results of this search was concluded in 17 research papers.

**Analysis of the literature.** Based on the research, two anti-programmed cell death-1 (PD-1) antibodies, pembrolizumab and nivolumab, have been approved by the FDA and the EMEA for the treatment of recurrent/metastatic squamous cell cancer of the head and neck. In addition, pembrolizumab has recently

been approved by the FDA and the EMEA as a first-line treatment. In practice, only a minority of patients with squamous cell carcinoma of the head and neck benefit from immunotherapy. Much research is ongoing to identify new biomarkers. **Conclusion.** Besides Programmed death ligand-1 (PD-L1) expression, other biomarkers such as immune infiltration, tumor mutational burden or immune-gene expression profiling have been explored, but none of them has been validated in this disease. Among these results, the microbiota has recently garnered tremendous interest since it has proven to influence the efficacy of PD-1 blockade in some tumor of head and neck cancer.

**Keywords.** Biomarkers, immunotherapy response, neck squamous cell carcinoma

## Photodynamic therapy of brain tumors

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**Introduction and aim.** High-grade gliomas (HGGs), including glioblastomas (GBMs), are among the most common and aggressive brain tumors in adults. In 98% of cases, patients with GBM require resection of the tumor. However, due to the coexistence of healthy and malignant brain tissues, a complete GBM resection means sacrificing healthy brain tissue. Photodynamic therapy (PDT) is a therapeutic technique involving the use of a photosensitizing agent (PS) which, when activated with light of a specific wavelength, causes selective tissue damage by cytotoxicity to cancer cells. Therefore, research into the use of PDT in the treatment of brain tumors is ongoing. To discuss the mechanisms of opening the blood-brain barrier via PDT and the use of PDT as the alternative therapy of brain tumors.

**Material and methods.** The publication explains the mechanisms of PDT-mediated blood-brain barrier opening and the age differences in PDT-related increase in blood-brain barrier permeability, including the formation of cerebral edema. The

review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed database has been conducted.

**Analysis of the literature.** The lymphatic system of the meninges plays a key role in the mechanism of brain drainage and removal of metabolites and toxic molecules. Non-invasive photonic stimulation of fluid removal through the lymphatic vessels of the meninges and the use of optical coherence tomography (OCT) to monitor bedside meningeal drainage have promising prospects for wide application in both experimental and clinical research in PDT.

**Conclusions.** PDT is a promising tool among the least invasive alternative treatments for brain tumors. The newly discovered PDT-induced opening of the blood-brain barrier demonstrates new drug delivery strategies to the brain during the post-operative treatment of GBM.

**Keywords.** Brain tumor, OCT, PDT



## Application of proteomics in the discovery of radio-sensitive cancer biomarkers

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**Introduction and aim.** Proteomic is a new technology that can systematically analyze protein composition and measure the level of changes including head and neck cancer. Radiation is used for the treatment of various types of cancer including head and neck. Radiotherapy is very effective in treating a variety of cancer-related problems including pain, tumour bleeding. The aim was of this work was to discuss research regarding application of proteomics and protein analysis to the discovery of radio-sensitive cancer biomarkers.

**Material and methods.** The literature search was performed using keywords such as radiotherapy, radio-sensitive, cancer biomarkers. We selected PubMed to perform literature this research. The search for the use of proteomics for the discovery of radio-sensitive cancer biomarkers resulted in 25 papers.

**Analysis of the literature.** The use of biomarkers for early can-

cer detection, staging and individualization of therapy might improve patient care. Tumor heterogeneity, a highly dynamic nature of the intrinsic and extrinsic determinants of radio- and chemoresistance, along with the plasticity and diversity of cancer cells make biomarker development a challenging task.

**Conclusion.** This analysis analyzed the current advances and future directions of proteomics in the discovery of radio-sensitive cancer biomarkers. The proteomics is an emergence and powerful genomic technologies in conjunction with advanced bioinformatic tools. Proteomics allows the simultaneous analysis of thousands of biological molecules. These techniques yield the discovery of new tumor signatures.

**Keywords.** Cancer biomarkers, radio-sensitive treatment, radiotherapy

## Immune biomarkers of response to immune checkpoint inhibitors in head and neck squamous cell carcinoma

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**Introduction and aim.** The clinical efficacy of advanced head and neck squamous cell carcinoma (HNSCC) has been moderately improved. Programmed cell death prevention measures are the constant standard in the treatment of platinum-resistant recurrent/metastatic squamous cell carcinoma of the head and neck. The aim of this research was to discuss immune biomarkers of response to in head and neck squamous cell carcinoma.

**Material and methods.** The literature search was performed in PubMed, EMBASE, Google Scholar, and the Cochrane Library. The selected research papers were systematically searched with the purpose of identifying all studies addressing the effects of checkpoint inhibitors as treatment for HNSCC in human clinical trials.

**Analysis of the literature.** In addition to the expression of programmed death-1 (PD-L1) ligand, immune infiltration,

tumour mutation load, or immune gene expression profile were investigated, but none of them was confirmed in this disease. Immunotherapy with checkpoint inhibitors such as anti-CTLA-4 anti-PD-1 and anti-PD-L1 has shown promising results in treating patients with recurrent/metastatic HNSCC. **Conclusion.** Recently, there has been a lot of interest in the microbiota that has proven to influence the efficacy of PD-1 blockade in some types of cancer. Considering the accumulated evidence for the influence of microflora on tumour genesis and progression of squamous cell carcinoma of the head and neck were justified to study the potential role as a prognostic immune biomarker. There is a further need for randomized clinical trials investigating a putative role of checkpoint inhibition in the treatment of advanced HNSCC.

**Keywords.** Biomarker, immune infiltration, squamous cell carcinoma



## Effects of thyroid hormones on CNS development and function

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**Introduction and aim.** The endocrine system plays a significant role in the development of the central nervous system. The two systems are functionally related. Some of the most important substances affecting the development and differentiation of microglia, oligodendroglial, and astrocytes are thyroid hormones (TH). TH is synthesized by follicular cells of the thyroid gland and secreted as prohormone (T<sub>4</sub>), which is deiodinated to bioactive T<sub>3</sub>.

**Material and methods.** We summarized the current state of knowledge in the field of the influence of thyroid hormones on the proper development and functioning of the central nervous system. The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed, Science Direct, Web of Science database has been conducted.

**Analysis of literature.** Thyroid incretin, through complex signaling mechanisms, influences not only nerve cell activity but also the development of the myelination pathway. It is of

great importance to supply adequate TH to myelin-producing cells, oligodendrocytes, to promote their maturation, as this is a key element for normal neuronal function. Thyroid hormone deficiency can significantly affect neuron-glia interactions. Thyroid secretory products affect microglia migration and phagocytosis. It should be noted that TH hormones affect glial morphology in a coordinated manner between age and sex. Their deficiency can affect neuronal function and brain function, leading to mental disorders. The role of microglia, an immune cell population in the CNS, in the relationship between thyroid dysfunction and neuropsychological disorders is still under investigation.

**Conclusion.** A more thorough understanding of the mechanism of neuron-glia interaction in the control of thyroid gland products will allow a more detailed diagnosis of psychiatric disorders and diseases associated with their deficiency.

**Keywords.** Central nervous system, microglia, thyroid hormones

## Lateral orbitotomy of orbital tumor

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**Introduction and aim.** Primary tumors of orbital cavities are rare. One of the common causes among benign orbital neoplasms are hemangiomas, which can be divided into two groups – capillary hemangiomas and cavernous hemangiomas. Cavernous hemangiomas occur mostly in adults. Treatment of choice is the procedure of surgical removal of the growth, including lateral orbitotomy. Diagnostic methods used to establish the tumor's characteristics and location are: ultrasound, x-ray, MRI and CT, with CT being the most commonly used. Presentation of lateral orbitotomy as one of the methods of removing orbital tumors.

**Description of the case.** 49-year-old woman was admitted to the hospital with tumor of the right orbital cavity, which was confirmed by CT and MRI. For six months she had been com-

plaining of headaches, and initially also dizziness. Lateral orbitotomy was performed, during which the tumor was completely removed. There were no post-surgical complications, apart from mild and brief swelling of the right eye's eyelids. During histopathologic examination the extracted tumor was diagnosed as cavernous hemangioma.

**Conclusion.** Depending on clinical course or location of the tumor ways of treatment can vary and have other results, however in case of benign tumors lateral orbitotomy is a procedure that enables complete removal of the growth and full recovery of the patient, while simultaneously preserving motor function of the eye and the ability to see.

**Keywords.** Cavernous hemangioma, lateral orbitotomy, orbital tumor



## Schizophrenia-changes in neural pathways in the brain and modern concepts of its treatment

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**Introduction and aim.** Schizophrenia is a psychotic disorder characterized by inadequate perception, experience, and reception of reality. Patients with schizophrenia incorrectly perceive their person, environment, information that is reaching them, and relationships with people around them. The disease can occur in several forms, in Poland, the most common is paranoid. Its symptoms can be positive, productive, or “added”, e.g. hallucinations. Then the dopaminergic system in the mesolimbic pathway becomes overactive. Negative symptoms (less visible to the environment, more difficult to treat), e.g. impoverishment of emotions.

**Material and methods.** We summarized the current state of knowledge regarding changes in the neural pathways in the brain in people with schizophrenia. The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed, Science Direct, Web of Science database has been conducted.

**Analysis of literature.** The pathomechanism of schizophrenia has not yet been fully known and understood, and the anti-

psychotic drugs currently available on the market are characterized by serious limitations, which are mainly related to the effectiveness of treatment. These remedies alleviate the main positive symptoms, whereas the negative symptoms remain untreated. They act on different receptors for neurotransmitters and, more particularly, on those that are G-protein coupled (GPCR).

**Conclusion.** Dopamine, serotonin, and epinephrine receptors are the traditional molecular targets of these drugs. Examples of neuroleptics are haloperidol and chlorpromazine, the mechanism of which is based on blocking D2 receptors in the dopaminergic pathway of the brain, thus the released dopamine has less effect. Furthermore, these drugs act as 5-HT<sub>2A</sub> antagonists, which is seriously important for receptors because some alleles of the 5-HT<sub>2A</sub> receptor code are related to each other with the risk side of schizogony and psychosis depletion in people suffering from depression.

**Keywords.** Dopamine, neural pathways, schizophrenia



## Classical psychedelics as an alternative to the treatment of depression

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**Introduction and aim.** Depression is one of the most common mental disorders and can affect people of all ages. It is a fatal disease that kills around 3800 people every day, which means more than 1 million suicides per year. Today's treatment methods are mainly based on SSRIs (selective serotonin re-uptake inhibitors), SNRIs (serotonin norepinephrine re-uptake inhibitors) or, if drug-resistant depression is diagnosed, electroconvulsive therapy or inhalation therapy. However, this treatment does not always have the expected success and, unlike the anxiety-reducing effect, the antidepressant effect is not immediately observed, which increases the risk of suicide.

**Material and methods.** we summarized the current state of knowledge regarding the use of classic psychedelics as an alternative method in the treatment of depression

**Analysis of literature.** An alternative therapy that might be

introduced in the future is the treatment of depressive disorders with classic psychedelics such as LSD, psilocybin in hallucinogenic fungi and DMT, which is part of ayahuasca. The synthesis and possession of the above substances is illegal today, despite the results of studies that clearly state: classic psychedelics are the safest drugs known to mankind.

**Conclusion.** A fatal overdose is practically impossible, as is addiction. In addition, studies show that they can be used therapeutically, including, but not exclusively, for the treatment of depressive diseases. Studies have shown that their antidepressant effect is almost instantaneous, giving psychedelics an advantage over current medicines, and their long-term effect is comparable to or greater than that of conventional therapy.

**Keywords.** Antidepressant treatment, depression, psychedelics



## Saliva protein biomarkers in head and neck cancer

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**Introduction and aim.** Saliva contains a biomolecule that can detect cancer in its early stages or control patients' response to treatment. Some salivary proteins have been proposed as potential biomarkers for head and neck cancers. The aim was to search for clinical trials with investigation of the treatment with checkpoint inhibition for head and neck squamous cell carcinoma (HNSCC).

**Material and methods.** The literature search was done in PubMed, EMBASE, Google Scholar, and the Cochrane Library. The research examples were systematically searched with the purpose of identifying all studies addressing the effects of checkpoint inhibitors as treatment for HNSCC in human clinical trials. We used 25 papers for discussion.

**Analysis of the literature.** Despite the increase in research, there is disagreement as to which proteins have the greatest clinical utility in head and neck cancer. Most studies have

looked at individual proteins, not the protein panel approach. It should be remembered that combining different proteins in the form of a panel can increase accuracy and potentially change current clinical practice in patients with head and neck cancer. There was noticed a highly significant increase in salivary miRNA-21 and miRNA-184 when compared to healthy and diseased head and neck cases.

**Conclusion.** This work provided up-to-date information on salivary protein biomarkers in head and neck cancer. The research shows emerging potential salivary biomarkers for early diagnosis of oral premalignant and cancerous lesions in head and neck cancer. **Recent findings** is a broad collection of technologies used to explore different types of molecules contained in saliva.

**Keywords.** Biomolecule, head and neck cancers, salivary proteins



## Current research on immunotherapy in head and neck cancer

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**Introduction and aim.** The use of immune checkpoint inhibitors has made tremendous progress in cancer therapy. Activating your immune system is a new and effective option in the treatment of lung cancer. Moreover, the method of immunotherapy is widely studied in other malignant neoplasms. The aim of this study was to review current literature on applications of immunotherapy in head and neck squamous cell carcinoma (HNSCC).

**Material and methods.** The literature search was performed on PubMed and the Cochrane Library. The research examples were searched between 2022-2000. For herein presentation we carefully select 22 papers.

**Analysis of the literature.** In all papers was visible domination of the use of immune checkpoint inhibitors. Activating of immune system is a new and effective option in the treatment of oral cancer. Since 2010, a PubMed search has been performed for the use of immune checkpoint inhibitors in head

and neck cancer clinical trials. A total of 45 relevant studies using immune checkpoint inhibitors in head and neck cancer were identified. In most of these studies, antagonist antibodies target the immune checkpoint PD-1 receptors. We identified 16 trials that used checkpoint inhibition as a neoadjuvant/adjuvant for curative treatment. The studies showed an overall response rate in the range of 20%. These preliminary data suggest that PD-L1 expression  $\geq 1\%$  is associated with a higher response rate compared to PD-L1 expression  $\leq 1\%$ .

**Conclusion.** This review summarizes current clinical trials using immune checkpoint modulators in the treatment of head and neck cancer. Although currently only PD-L1 is widely used as a predictive biomarker for response to immune checkpoint inhibitors in HNSCC, there are many ongoing trials focusing on the identification of new biomarkers.

**Keywords.** Biomarkers, head and neck cancer, immunotherapy



## Immunotherapy in head and neck cancer

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**Introduction and aim.** Metastatic squamous cell carcinomas of the head and neck (SCCHN) remain difficult to treat disease. Immunotherapy relies on the functional restoration of the immune system to help counteract various cancer avoidance strategies. Nivolumab and pembrolizumab on the surface of PD-1 T cells can be used for the process of carcinogenesis. Nivolumab and pembrolizumab have been approved by the FDA as new standard second-line treatment options. For recurrent and/or metastatic squamous cell carcinoma of the head and neck. The study aims to summarize the innovative immunotherapeutic methods in head and neck cancer and to present future directions of development in this rapidly developing field.

**Material and methods.** The literature search in PubMed was performed using keywords head and neck cancer, immunotherapeutic and squamous cell carcinoma. We reviewed immunotherapy in head and neck in regards of nivolumab and pembrolizumab. Herein, we discussed 7 research papers.

**Analysis of the literature.** Until 2015, the epidermal growth factor receptor inhibitor cetuximab, a tumour-specific antibody, represented the only Food and Drug Administration (FDA)-approved targeted therapy for SCCHN. In 2016, the results from two prospective trials employing the immune-modulating antibodies nivolumab and pembrolizumab heralded a new era of anticancer treatment. In 2017, nivolumab and pembrolizumab have been approved by the FDA as new standard-of-care options for the second-line treatment.

**Conclusion.** The response rate was 13.3% and 15% in the nivolumab and pembrolizumab group, respectively in the immunotherapy in head and neck cancer. Based on recent reported results we conclude that, both, nivolumab and pembrolizumab are efficient monoclonal antibodies against programmed cell death protein-1 (PD-1), an ‘immune checkpoint’ receptor.

**Keywords.** Head and neck cancer, immunotherapeutic, squamous cell carcinoma

## Pick's disease – rare face of dementia

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**Introduction and aim.** Niemann-Pick disease (NPD) is a group of inherited metabolic diseases known as lipid storage diseases. Lipids and proteins are normally used for energy production. In NPD small fractions of lipids are stored in the brain, spleen, liver, lungs and bone marrow, which causes a number of serious symptoms, neurological being the most severe. The aim of this paper is to explain the essence of this disease and why further research about treatment is needed.

**Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed and ScienceDirect database has been conducted.

**Analysis of literature.** NPD is classified into four subtypes: A, B, C, and E. Type A is known as infantile neurovisceral and is usually fatal before the age of three. It results in neurological deficits and impaired growth. Type B has minimal neurological involvement and it mostly consist of visceral symptoms.

Type C has a diverse clinical presentation and involves systemic, neurologic, and psychiatric manifestations. NPC can affect children but it mostly occurs during adulthood. Type E is a less frequent variant of NPD that mainly affects adults. The most common neurologic symptoms of NPD include cognitive or motor developmental delay in childhood-onset cases, vertical supranuclear gaze palsy, cerebellar ataxia, dysarthria, dysphagia, spasticity and dystonia. There is currently no cure for NPD and treatment is supportive. However, there is promising data concerning development of enzyme replacement, gene therapies, bone marrow transplantation as well as recently developed drug called miglustat.

**Conclusions.** Recent development of new treatment for Niemann-Pick disease gives hope for improvement of affected individuals' life and better symptom management.

**Keywords.** Dementia, metabolic disorders, Niemann-Pick disease, sphingolipids



## The role of BMI1 as a cancer stem cell biomarker in head and neck cancer

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**Introduction and aim.** Advances in early diagnosis and treatment have greatly improved understanding of the molecular events underlying the appearance of multiple head and neck tumors. To establish a genetic link between the various head and neck cancers that developed in patients, loss of heterozygosity was investigated using microsatellite markers. The aim of this study was to show different research work subjected to the biomarker BMI1.

**Material and methods.** The literature search regarding multiple head and neck tumours and their genetic relationship was done as well as data regarding mutations and polymorphisms in mitochondrial DNA in head and neck cancer cell lines was reviewed. We used for this work 10 papers. The papers shows that due to the lack of reliable markers for the identification of cancer stem cells. The National Library of Medicine Data Base was used for our search.

**Analysis of the literature.** Analysis of the literature was done base on keywords. The meta-analysis showed that the primer sequences were obtained from the genome database for all of these markers. In experimental oncology for some time, in recent years there has been an explosion of information about the clonal architecture of tumors and their ancestors, stimulated primarily by the availability of new molecular techniques. Moreover, analysis of multiple articles shows that the potential impact of considerations such as spot size and clonal evolution on determining clonality has been largely ignored, making many of these studies misleading.

**Conclusion.** Additional research is conducted to investigate the role of cancer stem cells in head and neck cancer. Oncoprotein BMI1 is a promising intracellular marker of neoplastic stem cells in head and neck cancer.

**Keywords.** CD24, CD29, CD44, CD31, CD34, CD133, genetic regulation of head and neck cancer

## Assessment of the concentration of hypoxia factors in patients with a tumor of the parotid gland

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**Introduction and aim.** Hypoxia develops in head and neck tumors because of a less ordered vascular supply compared with that in normal tissues. Hypoxia can increase resistance to radiation and cytotoxic drugs and lead to malignant progression. Endogenous markers have the potential to indicate therapeutically relevant levels of hypoxia within tumors. The aim of this review was to evaluate the concentration of hypoxia factors in patients with a tumor of the parotid gland.

**Material and methods.** The literature search regarding advances in diagnostics of hypoxia and imaging techniques used to distinguish between chronic and acute hypoxia were performed. To prepare this abstract we used our clinical experience and papers published in Medline data base. In addition to the material and methods we used 67 papers to prepare this review.

**Analysis of the literature.** The presented research at the moment is based on a review of the literature on this topic. Tu-

mor diagnosis include ultrasound examination and fine needle biopsy. In cases of suspicion of a malignant tumor, a tumor in the deep part or parapharyngeal space, computed tomography and intraoperative histological examination will be performed. Post-operative histological examination will be performed in all cases. When assessing the concentration of hypoxia factors in patients with a tumor of the parotid gland, only surgery can be performed in the case of a biopsy, while in the case of a negative biopsy, we look for the parameter of hypoxia.

**Conclusion.** Increased knowledge of the molecular biology shows that the hypoxia problem in head and neck cancer needs to be addressed together with improvements in current treatments. Finding a clinically relevant test for measuring hypoxia that is cheap, non-invasive and reproducible remains a major challenge.

**Keywords.** Histological examination, hypoxia factors, imaging techniques



## Photodynamic therapy in the diagnosis and therapy of head and neck tumors.

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**Introduction and aim.** Advanced head and neck squamous cell carcinoma represents a great challenge to potential diagnostics and treatment to overcome acquired resistance. Photodynamic therapy (PDT) is a new form of cancer treatment with low morbidity. The aim of this review was to evaluate the effectiveness of photodynamic therapy in early or advanced squamous cell carcinoma of the head and neck.

**Material and methods.** This systematic review sought to answer the following focused question: “The usefulness of photodynamic therapy in the diagnosis and treatment of squamous cell carcinoma of the head and neck?” PubMed was searched for publications from 2021 using various combinations of the following keywords: photodynamic therapy, oral precancerous conditions, and oral precancerous lesions. Herein, we used 15 papers.

**Analysis of the literature.** Photodynamic therapy is a special type of treatment that uses a photosensitizer or photosensitizer along with a special type of light that, in combination, induce the production of a form of oxygen that is used to kill surrounding cells in different areas of the human body. PDT appears to be a useful therapeutic strategy in the treatment of head and neck cancer as a non-surgical treatment. PDT is a very accurate and effective therapy, especially in the early stages of squamous cell carcinoma of the head and neck, and can have a major impact on the surgical outcomes of cancer patients.

**Conclusion.** The photodynamic therapy can be used as a convenient and promising tool in the treatment of various malignant neoplasms of the head and neck. Its usefulness and palliative treatment of inoperable cases can be considered a method of treatment improving the quality of life.

**Keywords.** Head, neck, PDT, treatment



## Metabolomics of head and neck cancer

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**Introduction and aim.** In the world, oral/head and neck cancer is the sixth most common malignancy. Despite advances in treatment, patient survival has not improved significantly over the past few decades. Metabolomics can help identify the mechanisms of metabolic reprogramming underlying the proliferation, invasion, and metastasis of head and neck cancer cells as a new methodological approach and can be used to identify biomarkers of metabolites for clinical use. Metabolomics refers to the study of the metabolome, which has been defined as “the quantitative complement of metabolites in a biological system. A metabolome, estimated to contain thousands of compounds, is organism-specific and sample type-specific. The aim of this review was to present metabolomics of oral/head and neck cancer.

**Material and methods.** The literature search was performed in PubMed. Herein, we used 8 scientific research papers presented review on metabolomics of head and neck.

**Analysis of the literature.** The human serum metabolome has been reported to contain 4,229 unique compounds, detection of which involved the use of several analytic techniques, and is still not considered exhaustive. Metabolomics studies performed in head and neck aim to discriminate pathological metabolic profiles from that of a normal physiological state and to predict class assignment based on this set of metabolite biomarkers. Blood plasma, blood serum, and cerebrospinal fluid (CSF) have been extensively investigated in the oral (head and neck) metabolomics literature.

**Conclusion.** In this brief review, we present recent metabolomic applications in head and neck cancer. These biofluids are readily available and are interpreted as an average representation of the surrounding tissue.

**Keywords.** Head and neck cancer, metabolic applications, methodological approach



## Neurogenesis in Alzheimer's and Parkinson's diseases

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**Introduction and aim.** Neurogenesis is the process of the formation of new neurons, including embryonic (prenatal) neurogenesis and adult (postnatal) neurogenesis. Until the 1960s, it was believed that the formation of new nerve cells only took place during fetal life. However, further studies have shown that the brain of adult mammals produces new neurons in the subventricular zone (SVZ) and the dentate gyrus of the hippocampus. It is postulated that these neurons are involved in memory and learning.

**Material and methods.** we summarized the current state of knowledge regarding the process of neurogenesis in Parkinson's and Alzheimer's disease. The review was performed according to the up to date literature.

**Analysis of the literature.** Abnormal neurogenesis has been observed in people with neurodegenerative diseases such as Alzheimer's disease. During this disease, it is believed that malfunctioning neurons release too much glutamic acid, the toxic metabolites of which lead to cell death. Apart from the

glutamatergic system, the cholinergic system also plays an important role in the pathogenesis and neurogenesis of Alzheimer's disease. Another disease in which we observe abnormal neurogenesis is Parkinson's disease. It is caused by a loss of dopaminergic neurons, resulting in symptoms such as resting tremors and muscle stiffness. It belongs to the diseases of the extrapyramidal system, in which environmental and genetic factors play a role. The decrease in dopamine levels results in a reduction of the activity of neurogenesis in the subventricular zone.

**Conclusion.** Recent studies suggest that it is possible to stimulate neurogenesis leading to an increase in the number of dopaminergic neurons in the substantia nigra. The discovery that neurogenesis lasts a lifetime offers hope for the development of new treatments for neurodegenerative diseases.

**Key words.** Alzheimer's disease, neurogenesis, Parkinson's disease

## Is pharmacotherapy the most effective way of treating Parkinson's Disease (PD) in advanced stage?

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**Introduction and aim.** Parkinson's Disease is an idiopathic and slow-progressing disease. The way it affects the body is by degenerating specific brain structures which is extrapyramidal system. The disease is characterised by atrophy of so-called dopaminergic cells which are located in black matter of the brain. The main symptom is bradykinesia which is that the patient performs all the motoric activities slower, tremor while resting, microangiography, instability of posture, problems while starting activity.

**Material and methods.** We summarized the current state of knowledge about the methods of treatment of advanced Parkinson's disease. The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed, Science Direct, Web of Science database has been conducted.

**Analysis of literature.** Pharmacotherapy is implemented since the diagnosis. The golden standard is levodopa, the amino acid

which is considered to be most effective. Sadly, the long-term usage of levodopa results in lower response for the treatment which leads to the necessity of increasing the dose and thus chorea dyskinesia. The second most effective therapeutic option are agonists of dopamine, which do not cause so much side effects as levodopa. The most advanced stages of the disease are treated surgically.

**Conclusion.** There are 3 therapeutic options: ablative surgery (pallidotomy), deep stimulation of thalamus, globus pallidus and subthalamic nuclei and the implantation of the fetal mid-brain cells to the striatum of the patient. The ideal patients qualified for pallidotomy are young, in good overall condition and their main reason for disability is dyskinesia. Patients with bilateral problems in severe condition are qualified for deep stimulation of brain structures listed above.

**Keywords.** Dopamine, levodopa, Parkinson's disease, pharmacotherapy



## Photodynamic therapy – application on glioblastomas

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**Introduction and aim.** Nowadays, various techniques are used to treat tumors such as glioblastomas in the brain. Photodynamic therapy, also known as PDT, is one of them. The roots of PDT go back to ancient cultures, where the sunlight was used to treat diseases such as rickets and skin cancer. Since then, photodynamic therapy has changed and improved in the field of medicine.

**Material and methods.** The review was performed according to the up to date literature.

**Analysis of literature.** Generally, today a photosensitizer is either applied directly to the tissue or injected into the bloodstream. After absorption of the photosensitizer into the desired matter, it is being exposed to a light source in the presence of oxygen in the cells. This chemical process results in the death of the tumor cells. Since glioblastomas are known to be one of the most aggressive brain tumors and usually recur after seven months, the usual treatment is resection of the tumor

followed by chemotherapy. The remained tumor cells which surrounded the actual tumor, could not be all resected, otherwise brain areas with functions like language and memory could get destroyed. These remained tumor cells could be treated by photodynamic therapy.

**Conclusion.** The injected precursor photosensitizer 5-aminolevulinic acid is preferably accumulating in abnormal cells. Due to the light source and tissue oxygen, the accumulated photosensitizer gets activated and produces cytotoxic reactive oxygen species, which in turn causes damage to membranes of organelles, mitochondria, and endoplasmic reticulum. Simplified, photosensitizer gets activated and subsequently destroys any remained abnormal cells, which in turn reduces the probability of recurrence.

**Keywords.** Brain tumor, cell death, glioblastoma, photodynamic therapy, photosensitizer

## Development of cirrhosis in a patient with Wilson's disease

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**Introduction and aim.** Wilson's disease, also known as hepatolenticular degeneration, is a rare genetic disorder caused by a defect of ATPase transport protein (ATP7B). As a result of the mutation, excretion of copper into the bile is impaired, causing retention of copper in the liver, and in other organs as the disease progresses.

**Description of the case.** 29-year-old female patient with Wilson's disease, who was previously under neurologic and psychiatric care, was admitted to the hospital ward with increasing ascites, oedema of lower extremities and general deterioration of well-being. In the interview the patient confirmed irregular use of drugs that inhibit the progress of the disease – penicillamine and zinc. Medical imaging showed small, cohesive liver with regenerative nodules and micronodular contour. CT scan showed atelectasis in the right lung and fluid in the right pleural cavity. Laboratory tests showed increased INR, thrombocytopenia, hypoalbuminemia, increased activity of transaminases and megaloblastic anemia with haemo-

lysis. MELD score was 22. There were no clinical features of hepatic encephalopathy or neurological symptoms of Wilson's disease. Empirical therapy was implemented – albumin infusions, diuretics, rifaximin and lactulose. Treatment resulted in regression of peripheral oedema and ascites, with no change in INR. Because of the considerable degree of liver damage the patient was referred for liver transplantation.

**Conclusion.** Correct functioning of the liver in patients suffering from Wilson's disease is possible only thanks to drugs that increase the excretion of copper and reduce its absorption. Treatment must be regular and it has to last for life from the moment of diagnosis. Diagnosing the disease too late or deliberate discontinuance of treatment by the patient leads to excess copper building up in the body, which results in liver failure and possible necessity of liver transplantation.

**Keywords.** Hepatolenticular degeneration, liver failure, Wilson's disease



## Brachytherapy as a method of treating glioma

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**Introduction and aim.** Primary central nervous system cancers are extremely rare and account for only 1.5% of all malignant tumors. The most common CNS tumors are tumors derived from CNS glial tissue cells - gliomas, which include ependymomas, astrocytomas, oliguria and mixed gliomas

**Material and methods.** Despite the huge progress in the treatment of gliomas in the world, effective therapy of this cancer still poses a challenge for many doctors. This applies primarily to patients with relapse of the disease. The most commonly used methods in the treatment of these tumors are neurosurgical procedures, radiation therapy and systemic treatment. The review was performed according to the up to date literature.

**Analysis of literature.** Brachytherapy is the interstitial implantation of radioactive materials. With the help of this method, the delivery of a high dose of radiation to a well-defined target volume is prolonged while minimizing the irradiation of neighboring healthy tissues. The main stages of the stereotactic brachytherapy procedure for intracranial glioma are: fixa-

tion of the stereotactic frame, stereotactic imaging (CT, MRI, 18F-fluoroethylthiosine PET) and image fusion, biopsy of stereotactic lesion through the 2 mm burr opening, creation of a 3-dimensional treatment plan with brachytherapy, stereotactic implantation of radioactive seed catheters through 2 mm burr holes (per catheter), fusion of pre- and postoperative computed tomography images for positioning control. The procedure lasts 2-2.5 hours and the expected duration of hospitalization is 3 days.

**Conclusion.** However, it is extremely difficult to assess the response to this method of treatment, and the changes caused by therapy may be the cause of problems that arise during differential diagnosis. Although promising results have been reported over time, the role of this method in the treatment of brain tumors is still poorly defined and only a few centers around the world use it in clinical practice.

**Keywords.** Brachytherapy, CNS, glioma



## PDT therapy in glioma treatment

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**Introduction and aim.** About one-third of primary brain tumors are malignant gliomas. The main method used to treat gliomas is resection. Intraoperative surgical fluorescence control is then used very frequently. A photosensitizing substance allows real-time visualization of tumor margins for maximum resection and safety for healthy tissue.

**Material and methods.** PDT therapy is now very commonly used as an adjunctive therapy. PDT photodynamic therapy is an innovative method used in precancerous and cancerous diseases. The review was performed according to the up to date literature.

**Analysis of literature.** PDT therapy is based on the use of an appropriate light beam length to act on a selectively accumu-

lated photosensitizer under aerobic conditions. Treatment of brain gliomas with PDT therapy involves activation of cytotoxicity mechanisms. These mechanisms result in apoptosis, necrosis, necroptosis, autophagy, or paraptosis of tumor cells.

**Conclusion.** Each of these pathways ultimately leads to the induction of necrosis in the desired cells – a direct action.

The therapy processes can also act indirectly on the tumor by damaging the tumor vasculature, so that the transport of essential nutrients and oxygen is stopped. The application of photodynamic therapy can also lead to the development of systemic anti-tumor immunity. Immune activation of cells in the body occurs, followed by immunogenic tumor cell death.

**Keywords.** Cytotoxicity, glioma, PDT therapy



## Significance and meaning of white matter tracts in CNS

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**Introduction and aim.** The brain is an organ which has not yet been fully researched and understood. It is a complicated structure that includes grey matter and white matter where the white matter forms the largest part of the brain cortex and during evolution the white matter achieved a higher level of development.

**Material and methods.** We summarized the current state of knowledge regarding the characteristics and anatomical structure of the tracts present in white matter, as well as their role in the proper functioning of the nervous system. The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed database has been conducted.

**Analysis of the literature.** The white matter consists of myelin axons which are an extension of neurons responsible for send-

ing and receiving nervous signals and also control of neurobehavioral operations. White matter pathways ensure the flow of information within the brain, thereby enabling the rapid and efficient integrative ability of neuronal systems that are crucial to cognitive operations in humans. In the white matter, there are present tracts (fibers) of white matter which could be divided into projection, association and connection fibers depending on purpose of the axons.

**Conclusion.** Today, examining white matter and its deeper understanding is viable thanks to modern techniques of imaging such as diffusion tensor imaging, which is a MRI technique that uses anisotropic diffusion to estimate the axonal organization of the brain.

**Key words.** Central nervous system, medical imaging, white matter



## Radiotherapy for head and neck cancer

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**Introduction and aim.** Radiotherapy is used to treat approximately 80% of patients with cancer of the head and neck. Nowadays, radiotherapy is still being improved in the control of cancer and toxicity of induced radiotherapy for head and neck. Annually, more than half a million cases of cancer are diagnosed. The aim of this analysis is focus on the critical assessment of the treatment options for xerostomia, dysphagia, mandibular osteoradionecrosis, trismus, and hearing loss.

**Material and methods.** A review of the literature on radiotherapy of head and neck cancer was performed. This review work describes the efforts to prevent therapy related complications by presenting the state of the art regarding advanced radiation therapy.

**Analysis of the literature.** Nearly 75% of patients with head and neck disease will benefit from radiation therapy after sur-

gical resection. More than 90% of cases are squamous cell carcinoma of the mouth, pharynx and larynx. Radiotherapy may replace the need for surgical resection in the early stages of cancer. Radiotherapy, also used in the procedure, aims to preserve organs, including avoiding laryngectomy through the use of chemo-radiotherapy.

**Conclusion.** This work showed the development and progress in radiotherapy for head and neck cancer with different types of induced toxicity and their management.

Radiation therapy for squamous cell carcinoma of the oral cavity may be curative, but carries a risk of permanent damage to bone, salivary glands, and other soft tissues. The safety of the use of radiotherapy is under daily improvements by scientists.

**Keywords.** Laryngectomy, radiotherapy, surgical resection



## Head and neck cancer

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**Introduction and aim.** Head and neck cancer diagnosis and treatment require the imaging techniques of ultrasound including contrast-enhanced ultrasound, computed tomography and magnetic resonance imaging (MRI) including diffusing weighted imaging and contrast-enhanced iron oxide MRI. The aim of this work is to describe the progress in modern imaging methods, their techniques, ability, and performance in staging head and neck tumor.

**Material and methods.** The imaging modalities in head and neck cancer including ultrasound, contrast-enhanced computed tomography, contrast-enhanced magnetic resonance imaging (MRI), and positron emission tomography scans is presented base on selected 25 scientific review publications placed in PubMed.

**Analysis of the literature.** The progress in the treatment of

head and neck has led to the development of therapeutic strategies that target dysregulated processes in the tumor micro-environment. Among various imaging modalities, MRI presents most of advantages. These advantages subjected to head and neck cancer are observed mainly due to the increased soft tissue contrast and the ability to obtain tissue characteristics in different sequences, including diffusion- and perfusion-weighted sequences and proton spectroscopy imaging.

**Conclusion.** Important progress has been made in the molecular understanding of head and neck cancer and its application for diagnosis, prognosis and treatment. The use of appropriate imaging techniques for diagnostics of head and neck cancer is resulted in improvement of treatment efficacy.

**Keywords.** Cancer research, head cancer, neck cancer



## Paradoxical and dangerous – paradoxical embolism

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**Introduction and aim.** An embolus is a solid, liquid or gaseous intravascular mass unrelated to the vessel wall, which is carried by the bloodstream to distant sites. It most often develops in the arteries and brings serious consequences including myocardial infarction or stroke, which may be fatal. Crossed embolism is an atypical form of embolism that poses significant diagnostic difficulties.

**Material and methods.** In this work, materials from the Department of Morphological Sciences of the University of Rzeszów were used. The following research methods were used: case study analysis of patients with cross-embolism.

**Analysis of literature.** Crossed embolism is a condition in which the embolus from the venous system enters the arterial system through an opening between the left and right side of the heart, causing stroke, blockage of visceral vessels or acute limb ischemia. The most common cause of this phenomenon

is a persistent oval hole found in up to about 30% of the population. The prerequisite of crossed embolism is reversal of the pressure gradient between the left and right heart, which may be induced by cough or Valsalva test causing increased chest pressure. The occurrence of simultaneous pulmonary and arterial embolism in the same patient raises the suspicion of crossed embolism. The embolic material entering the arterial system may inhibit the blood flow through cerebral vessels and lead to severe neurological complications such as stroke, which is directly life-threatening.

**Conclusion.** Proper diagnosis and early detection of the cause of crossed embolism enables implementation of prompt treatment and minimization of the risk of disorders by surgical closure of the persistent oval hole.

**Keywords.** Foramen ovale, paradoxical embolism, stroke



## Influence of traumatic experiences from childhood, as a predisposing factor of developing schizophrenia in future

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**Introduction and aim.** The etiology of schizophrenia is not fully known yet, due to its multicausality. Finding schizophrenia-inducing factors should be important element of curing this specific disease. The aim of this article is to examine links between bad experiences from childhood and development of schizophrenia.

**Material and methods.** The assessment was based on thorough analysis of up-to-date literature. The data was gathered from the PubMed's database.

**Analysis of literature.** There was a number of tests run. These tests have shown noticeable concatenation between disease's development and sexual, emotional and physical violence. Abused children, who were affected by violence of more than one kind, are much more likely to develop schizophrenia. There are number of factors, which are being listed as neg-

ative for neuronal development of children. Neglect and lack of care in childhood disturb cognitive functions and lead to many psychiatric disorders in future. Cognitive deficits regarding working memory, motoric and vision functions, are observed in both – schizophrenics and abused children. In the end, there is no clear evidence for one, specific factor responsible for development of schizophrenia among small number of people.

**Conclusion.** Experiencing violence during childhood is highly connected with increased predisposition of becoming ill and worse prognosis throughout the course of schizophrenia. Above-mentioned statement still needs more specific, deeper analysis in broader group of respondents.

**Keywords.** Childhood abuse, cognitive deficit, neglect, schizophrenia



## Neurotoxic consequences of using electronic cigarettes

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**Introduction and aim.** Electronic cigarettes are seemingly better alternative for traditional cigarettes, due to the fact that they are generating less carcinogens and other toxic compounds. Recent reports about lungs damage linked with e-cigarettes, aroused concern regarding using these devices. Particular interest regards to neurological side effects of usage.

**Material and methods.** The assessment was run based on thorough analysis of up-to-date literature. The data was gathered from the PubMed's database.

**Analysis of literature.** In electronic cigarettes, containing many substances, specific liquid is being heated to 200-300 Celsius' degrees. Nicotine is the most well-known ingredient of e-cigarettes showing neurotoxic effects. As an addictive substance, it stimulates central reward pathway. Effects

on functional connection of brain at rest caused by nicotine included in liquids, are similar to those observed in traditional cigarettes. Many neurotoxic consequences of using e-cigarettes are not nicotine-related. Remaining substances present in liquids are propylene glycol and vegetable glycerin, in case of which it is proven that in high temperature, they produce number of toxic carbonyls, which may be a background for neurodegenerative diseases.

**Conclusion.** Exposure to nicotine and other factors present in liquids may lead to delay in development, neurobehavioral changes and cognitive deficits. On molecular level those changes are linked with mitochondrial damage, oxidative stress, inflammation and neurotransmitter disorders.

**Keywords.** Brain, e-cigarette, neurotoxicity, nicotine



## The influence of bilingualism on the development of cognitive diseases

Aleksandra Burbelka, Łukasz Zarębski

**Introduction and aim.** Establishing cure for dementia and other cognitive diseases remains challenging due to their omnidirectional and complex pathophysiology. Identifying possible ways of delaying onset of Alzheimer's disease and dementia should remain as a priority as the number of ageing populations successfully increases across the world. The aim of this work was to investigate correlation between bilingualism and cognition.

**Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed database has been conducted.

**Analysis of literature.** Attentional control is one of the most central aspects of cognitive function throughout life and is a big part of cognitive decline with ageing. Therefore, anything that boosts these attention systems has the potential to also sustain cognitive function in older age. Acquisition of new language is a complex process which activates many different parts of the brain, causing an increase of white and gray

matter which provides greater cortical connectivity. Cognitive functions that have been shown to be impacted by bilingualism largely concern attention. Bilingual individuals possess eminent ability to switch between different types of stimuli displays in shorter time span than monolinguals. Switching between large number of different words and grammatical structures remains as a form of natural brain training. Factors such as gender, occupation and person's education influence the onset of dementia and bilingual individuals strongly seem to experience later onset of cognitive diseases, regardless of previously implied factors.

**Conclusions.** assessment of the relationship between bilingualism and cognition should be further investigated, as it appears to be promising form of prevention and treatment of cognitive diseases.

**Keywords.** Alzheimer disease, bilingualism, cognitive diseases, dementia



## Stem cells in the treatment of neurodegenerative diseases

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**Introduction and aim.** According to WHO reports, neurodegenerative diseases such as Alzheimer's disease, Parkinson's disease, amyotrophic lateral sclerosis, Huntington's disease, and multiple sclerosis are currently one of the leading causes of disability, cognitive impairment and death worldwide. As a result, numerous studies are being conducted to understand the specifics of these diseases and the therapies that could reduce these statistics

**Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from Google Scholar database has been conducted.

**Analysis of literature.** Recently, many reports from laboratory and preclinical studies have seen great potential in the use of stem cells in the treatment of neurodegenerative diseases.

Mesenchymal stem cells (MSCs) are so-called "adult" multipotent stem cells capable of dividing and differentiating into certain types of specialized cells, including neurons. In addition, they are capable of secreting factors that promote the repair and maintenance of healthy neural tissue. The cells will be able to be harvested from a healthy donor or the patient themselves, grown in ex vivo cell culture, and then transplanted into a patient participating in regenerative cell therapy. The use of MSCs aims to arrest clinical deterioration by regeneration in locally damaged tissue.

**Conclusion.** Although new treatments are still being developed the use of MSCs in the treatment of neurodegenerative diseases seems to be very promising.

**Keywords.** Neurodegenerative diseases, stem cells, therapy



## The use of hydrogels in neural tissue engineering

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**Introduction and aim.** Tissue engineering is developing intensively due to its great potential in regenerative medicine. Finding the right material to provide the right conditions for tissue growth is a key aspect. Much hope, especially in neural tissue engineering, lies in scaffolds that generate a favorable cellular microenvironment.

**Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from Google Scholar database has been conducted.

**Analysis of literature.** One of the materials used to create such scaffolds are hydrogels, which due to their elastic properties resulting from their high water content perform well under biological conditions. Synthetic and natural hydrogels

can be distinguished, but the latter are more commonly used due to their high biocompatibility, biodegradability, favorable physical and biological variability, and provide a lower risk of immune response compared to synthetic ones. The porous structure of hydrogels is similar to the extracellular matrix so that cells receive adequate stimulation for growth and differentiation.

**Conclusion.** Hydrogel scaffolds provide controlled drug delivery and release and, when combined with stem cells, are a promising strategy for treating neural tissue damage caused by neurodegenerative diseases, hypoxia or trauma.

**Keywords.** Hydrogel, neural tissue, regenerative medicine, tissue engineering

## Neurological Complications of Cancer Treatment

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**Introduction and aim.** The increase in cancer incidence observed in the world shows the correlation between the length of survival of patients undergoing immunotherapy and the increased risk of neurological complications after the applied antitumor therapy. Amazing advances in understanding the regulatory mechanisms of the immune system have led to the creation of new therapeutic options for the treatment of cancer.

**Material and methods.** The review was performed according to the up to date literature. Thorough analysis of the scientific data from PubMed and Google Scholar database has been conducted.

**Analysis of literature.** Side effects may be due to the type of therapy used: from surgery, radiation and chemotherapy, bone marrow transplantation, and rapidly evolving therapy with monoclonal antibodies, immune checkpoint inhibitors (ICIs) and genetically modified T cells (CAR-T therapy) that have neurological side effects caused by an immune response. The

main function of the PD-1 receptor is to reduce the activity of T cells in peripheral tissues, which is important in preventing autoimmunity. Therapeutic blockage of this pathway with monoclonal antibodies such as nivolumab and pembrolizumab may increase the immune response against cancer cells. However, many side effects are observed after the use of anti-PD-1 antibodies, such as thyroid dysfunction, pneumonia, kidney, liver and pituitary inflammation. Neurological complications related to the use of this therapy have a varied picture, but the most common symptoms are myasthenia gravis, necrotic myopathy, vascular neuropathy, polyradiculoneuropathy, Guillain-Barry syndrome or encephalitis.

**Conclusion.** It is very important that side effects that are mediated by an immune system are quickly recognized and treated effectively as this increases the chances of a full recovery.

**Keywords.** Brain, neurological complications, oncological therapy, PD-1, solid organ tumors



## Squamous cell carcinoma of the head and neck: genomics and new biomarkers of immunomodulating cancer treatment

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**Introduction and aim.** Head and neck squamous cell carcinoma (HNSCC) represents 6% of all cancers. Targeting the immune checkpoint pathway has demonstrated antitumor cytotoxicity in treatment-refractory head and neck squamous cell carcinoma. Identifying predictive biomarkers has become a priority in immunomodulating cancer treatment. The aim of work is to present research advances. The aim was to prepare narrative review regarding HNSCC in head and neck cancer inhibitory therapy.

**Material and methods.** The literature search was performed using keywords inhibitor therapy, neoplasms, squamous cell carcinoma in Science Direct. We reviewed 16 papers of narrative review.

**Analysis of the literature.** A separate subgroup of neoplasms arises from the tonsil epithelium and the base of the tongue

as a result of human papillomavirus (HPV) infection. In HPV-positive are an expression of viral p7 oncoproteins E6 and E7 and functional inactivation of Rb for the squamous cell carcinoma of the head and neck.

**Conclusion.** Immune therapies, in particular those targeting the PD1 receptor or its PD L1 ligand, including nivolumab, pembrolizumab, durvalumab, and atezolizumab, have shown significant efficacy in the subgroups of patients with squamous cell carcinoma of the head and neck. Although biomarkers, including PD-L1 expression, PD-L2 expression, and the interferon-gamma gene signature, have the potential to predict the benefit of checkpoint inhibitory therapy.

**Keywords.** Inhibitory therapy, neoplasms, squamous cell carcinoma

## The future of personalised radiotherapy for head and neck cancer

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**Introduction and aim.** Radiotherapy has long been a staple in the treatment of head and neck cancer patients and has traditionally included a stage-based strategy whereby all patients with the same stage of cancer receive the same treatment. Radiotherapy may be administered in conjunction with chemotherapy to avoid surgical removal and preserve certain organs in head and neck cancer. We believe there is an opportunity to improve radiotherapy delivery beyond just technological and anatomical precision. The aim of this work is to present current radiotherapy research in head and neck cancer and safety during this treatment.

**Material and methods.** The literature search was performed in time window from 2022-2010. We used PubMed and find more than 100 papers regarding this subject. The use of radiotherapy is common and efficient, however we are obligated to search for way to improve safety. We will present the

new technology regarding personalised radiotherapy in head and neck cancer.

**Analysis of the literature.** It discusses how exploiting these differences and applying precision medicine tools such as genomics, radio mics, and mathematical modelling can open new doors for personalized adaptation and treatment of radiotherapy. Radiotherapy can generally be employed only once, which presents difficulties in cases of recurrent disease or second primaries within the irradiated field.

**Conclusion.** We propose options for a new one-size-fits-all approach to radiotherapy in patients with head and neck cancer and develop evidence to help personalize and biologically adapt radiotherapy to improve outcomes and reduce toxicity. Personalized treatment can control dosimetry in more efficient way.

**Keywords.** Mathematical modelling, radiotherapy, tumor



## Prognostic significance of tumour-associated CD68<sup>+</sup> and CD163<sup>+</sup> macrophages in squamous cell carcinoma of the head and neck: a systematic review and meta-analysis

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**Introduction and aim.** Tumour-associated macrophages are among the most common cells in the tumour microenvironment. CD163: a specific marker of macrophages in paraffin-embedded tissue samples. The meta-analysis of overall survival, disease-free survival and progression-free survival was performed using the inverse variance test. A risk assessment of bias and subgroup analysis were also performed. This study aimed to investigate the relationship between CD68<sup>+</sup>/CD163<sup>+</sup> expression of tumour-associated macrophages and prognosis in patients with squamous cell carcinoma of the head and neck through a meta-analysis of the current literature.

**Material and methods.** Studies in the English language were identified by searching the MEDLINE, EMBASE database (2010-2020) using the search terms head and neck, squamous cell, carcinoma, chemotherapy, radiation, human papilloma-virus, epidermal growth factor receptor, and targeted therapy.

**Analysis of the literature.** Head and neck cancers account for less than 5% of all cancers and for less than 3% of all cancer deaths in the United States. Tumour-associated macrophages are among the most common cells in the tumour microenvironment. Several studies have been conducted to determine whether tumour-associated macrophage markers CD68 and CD163 may be prognostic factors in patients with head and neck squamous cell carcinoma.

**Conclusion.** Combination therapies hold promise for improving outcomes of patients with head and neck squamous cell cancer, both human papilloma virus-associated and human papilloma virus-negative tumors. The CD163 demonstrated greater specificity as a marker of disorders of monocyte/macrophage origin.

**Keywords.** Macrophages, meta-analysis, tumour microenvironment

## Genetic and proteomic biomarkers for head and neck cancer: a systematic review

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**Introduction and aim.** Head and neck squamous cell cancer (HNSCC) is the most common cancer associated with chewing tobacco, in the world. The development of genetic and proteomic research has increased the interest in alternative methods of detecting head and neck cancer. The study aimed to review the latest literature on the diagnostic and prognostic potential of genetic and proteomic biomarkers of head and neck cancer. We introduced the following important aspects: genetic changes and proteomic changes in human head and neck cancer.

**Material and methods.** This systematic review was performed as per PRISMA guidelines. Only human studies published in English were included to discussion.

**Analysis of the literature.** In the review were included 50 relevant studies. Thirty of them concerned proteomic changes and twenty genetic changes in head and neck cancer. We identified in this review work 242 genes and 44 proteins related to head and neck cancer. Proteins (14-3-3 $\gamma$ , matrix metalloproteinase inducer and PA28 $\gamma$ ) have been described as most valuable for the prognostic follow-up of head and neck cancer.

**Conclusion.** Prospective use of knowledge regarding identified 242 genes and 44 proteins in the clinical setting can enable early detection, prediction of response to treatment, improvement in treatment selection, and early detection of tumor recurrence for disease monitoring.

**Keywords.** Head cancer, neck cancer, proteomic biomarkers



## Circulating microRNAs in head and neck cancer: a review of methods

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**Introduction and aim.** Currently, circulating miRNAs have emerged as a new class of promising cancer biomarkers. Therefore, circulating microRNAs have been described as biomarkers of head and neck cancer. The different methods used to collect, store, process, and interpret these miRNAs are likely to be biased and contribute to conflicting results. The aim of this study was to review circulating microRNAs in head and neck cancer.

**Material and methods.** The literature search was conducted in way of therapy and diagnostics. We discuss the application and existing questions surrounding circulating miRNAs in head and neck cancer diagnostics. We perform search in years 2002-2010 using keywords miRNA, biomarkers, salivary glands in data base PubMed. We included 30 papers to metanalysis.

**Analysis of the literature.** Were identified thirty articles of cancer in the nasopharynx, oral cavity, squamous cell carcinoma of the oropharynx and larynx and primary malignant

neoplasms of the salivary glands. Comprehensive methodological analysis revealed the poor reporting for the detailed methodology, differences in the collection, storage, pretreatment, RNA isolation and relative quantification. Including the normalization method and relative quantification in the biomarker detection stage.

**Conclusion.** The literature review aims to identify and reflect the available evidence regarding the technical details and problems that arise in the context of studying circulating miRNAs from clinical samples in head and neck cancer. The exciting potential of circulating miRNAs as cancer biomarkers could confer an important advance in the disease management, but their clinical significance might not be proven without a global consensus of procedures and standardized protocols for their accurate detection.

**Keywords.** Biomarkers, miRNA, salivary glands

## Methylation as a biomarker for head and neck cancer

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**Introduction and aim.** Cancer genomics has provided new insights into genetic alterations and signaling pathways involved in thyroid cancer. Activation of proto-oncogenes and inactivation of tumor suppressor genes are the major molecular changes associated with carcinogenesis. Recent technological advances allowed the identification of novel differentially methylated regions, methylation signatures and potential biomarkers. The aim of this review research is to presents the current knowledge on DNA methylation in thyroid cancer and discuss its potential clinical applications

**Material and methods.** In this review, we summarize the current knowledge on methylation as a biomarker in this field, focusing on their feasibility, limitations, and key areas of clinical applications. The literature search in PubMed data base was performed. In total we used for this meta-analysis 10 papers.

**Analysis of the literature.** The main goal of the use of methylated biomarkers in clinical research is to evaluate and measure the state of normal and pathological biological processes as well as pharmacological responses to specific therapies. Tracking these biomarkers is an important part of identifying early-stage of head and neck cancer. There is also research on thyroid and larynx with the identification of methylated biomarkers.

**Conclusion.** Although most head and neck cancers originate from the oral mucosa and can be easily detected during routine clinical examination, a definitive diagnosis will not be made quickly due to the difficulty of unlike other similar lesions.

**Keywords.** Biomarker research, gene methylation, head cancer, neck cancers



## DNA: a new biomarker for head and neck cancer

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**Introduction and aim.** Genomic instability is a key hallmark of cancer that arises owing to defects in the DNA damage response and/or literature increased replication stress. These alterations promote the clonal evolution of cancer cells via the accumulation of driver aberrations, including gene copy-number changes, rearrangements and mutations; however, these same defects also create vulnerabilities that are relatively specific to cancer cells, which could potentially be exploited to increase the therapeutic index of anticancer treatments and thereby improve patient outcomes. The aim of this study was to present discussion on biomarkers detection.

**Material and methods.** We perform the search for publication regarding DNA function in head and neck cancer between years 2010-2022 in PubMed data. We found 32 papers with discussion DNA as a new biomarker for head and neck cancer.

**Analysis of the literature.** In the absence of a useful biomarker, both primary and recurrent squamous cell carcinomas of the head and neck are diagnosed using conventional imaging and clinical examination. Tumour DNA is a new biomarker in squamous cell carcinoma of the head and neck. Using next-generation sequencing techniques tumour DNA can be characterized and quantified. Also, this can be used as a minimally invasive fluid biopsy to obtain a specific tumour profile. **Conclusion.** This review discussed the benefits and challenges of using tumour DNA as a biomarker. The defective repair of DNA damage is one of the highlight of cancer, and closely linked with the development of malignancies and upregulation of these pathways linked with resistance to treatment.

**Keywords.** DNA, new biomarker, squamous cell carcinoma

## Saliva biomarkers in cancer detection

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**Introduction and aim.** Human saliva helps control oral health and plays a role in chemical and microbial communication. Human saliva contains peptides, proteins, and numerous volatile organic compound. The method provided excellent reproducibility for a wide range of salivary compounds, including alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides, lactones, and hydrocarbons. The aim of work was to present quality analysis of saliva in cases of head and neck cancer.

**Material and methods.** We performed the literature search for diagnostics methods of saliva biomarkers. Chromatography method provided excellent reproducibility for a wide range of salivary compounds, including alcohols, aldehydes, ketones, carboxylic acids, esters, amines, amides, lactones, and hydrocarbons. In results of search we obtain 12 papers reported the detection of saliva biomarkers.

**Analysis of the literature.** As a multi-component oral fluid, saliva contains secretions from large and small salivary glands, which are largely supplied with blood. Molecules such as DNA, RNA, proteins, metabolites and microbiota present in the blood also can be found in saliva. Recently, a lot of attention has been paid to diagnosing saliva to identify specific biomarkers because sampling and processing are simple, cost-effective and accurate and cause no discomfort to the patient.

**Conclusion.** Saliva is able to study by chromatography. At this point, research consider the latest candidate salivary cancer biomarkers for systemic cancer, categorizing them into genomic, transcriptomic, proteomic, metabolic and microbial according to their origin. Also were reported salivary biomarkers used for systemic cancer detection.

**Keywords:** DNA, proteins, metabolites, RNA



## Designing biomarker studies for head and neck cancer

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**Introduction and aim.** Molecular biomarkers of human squamous cell carcinoma (HNSCC) of the head and neck are currently recommended for routine clinical use. However, there are a number of treatment modalities that can be employed both single and in combination, but at present only site and stage of the tumor are used for treatment planning. The data base created from biomarkers and clinical condition is useful for research and clinical cases. Knowledge about biomarkers is helpful to make decision about treatment. The prognosis of HNSCC depends primarily on the stage of disease. The aim of work was to present the role of biostatistics and bioinformatics in designing of studies.

**Material and methods.** We performed the literature search regarding types of biomarkers detected during head and neck cancers. During our discussion we find conclusion that biostatistics and bioinformatics is the main steps in validation of results base on biomarkers discovery.

**Analysis of the literature.** The main reason to present this study is to show the difficulty in designing head and neck cancer research to establish the clinical utility of biomarkers. Using a few contemporary examples, we present some research design that hinder the success of biomarker development for this disease area and propose several potential solutions. New diagnostics techniques showed of difficult for biologists and clinicians biomarkers with emphasizing the important role of biostatisticians and bioinformaticians.

**Conclusion:** This work aims to provide guidance that can help researchers more effectively transfer the promising head and neck cancer biomarkers from discovery to clinical practice. This work shows that the use of biostatistics and bioinformatics is providing a machine learning process. Initial studies were usually underpowered and suffered from a lack of thorough validation in independent series. Thus, validation is necessary to be performed.

**Keywords:** biomarker research, head cancer, neck cancer



## Head and neck cancer: proteomic advances and biomarkers

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**Introduction and aim.** Tumors of the head and neck are important neoplasia group. The incidence of the head and neck cancer is increasing in many parts of the world. Head and neck tumors are an important cancer group with an increasing incidence worldwide. Recent advances in diagnostic techniques and the therapeutic effects of these changes allowed for early head and neck cancer detection.

**Material and methods.** We performed the literature search using keywords head cancer, neck cancer, signaling pathways, proteomics and biomarker. All reviewed papers showed that proteomics is a tool for studying the distribution of proteins and small molecules in biological systems. We discussed 10 selected diagnostics papers.

**Analysis of the literature.** All published research papers suggest that a large number of samples must be included in the

analysis subjected to detect biomarkers. The proteomic profiles of different types of cancer were investigated to understand how cancer develops. Proteomics is a powerful tool for investigating the distribution of proteins and small molecules within biological systems through the analysis of different types of samples. The diagnostics used in proteomics is advanced and involves signaling pathways.

**Conclusion.** This work covers head and neck cancer, including risk factors, pathogenesis, proteomics tools, and new proteomic discoveries. This review covers recent advances for head and neck cancer; it encompasses the risk factors, pathogenesis, proteomic tools that can help in understanding cancer, and new proteomic findings in head and neck cancer.

**Keywords.** Head cancer, neck cancer, signaling pathways



## Discovery of protein biomarkers for head and neck cancer

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**Introduction and aim.** Proteomics is a powerful tool for investigating the distribution of proteins and small molecules within biological systems through the analysis of different types of samples. This work covers recent advances for head and neck cancer regarding discovery of protein biomarkers. We discuss pathogenesis and proteomic tools that can help in understanding cancer, and new proteomic findings in head and neck cancer.

**Material and methods.** We performed the literature search using keywords clinical outcomes, treatment process and protein biomarkers. The time frame was used between 2022-2010. In this way we discuss 21 papers regarding discovery and methods used for this reason.

**Analysis of the literature.** The results showed that protein biomarkers enabling early detection of primary head and neck

squamous cell carcinoma or recurrence may help improve clinical outcomes. Screening for precursor changes in the mucosa lining preceding the development of invasive tumors and accurately predicting the risk of neoplastic transformation may be beneficial throughout the treatment process. This work summarizes the recent results of proteomics in head and neck squamous cell carcinoma in biomarker research.

**Conclusion.** The validation of potential biomarkers are needed for their translation from the bench to the bedside. We also evaluated its application in early tumor detection, classification, prognosis/metastasis prediction, and the signing out of the reports. Finally, we highlighted the challenges and potential of protein biomarkers.

**Keywords.** Clinical outcomes, protein biomarkers, treatment process



## Genetic polymorphisms and the risk of head and neck cancer

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**Introduction and aim.** Identification of genetic polymorphisms that contribute to the risk of developing head and neck cancer is important for cancer prevention. The analysis of genetic polymorphisms included human studies are design to compare head and neck cancer patients with control group.

**Material and methods.** The analysis of literature shows that two hundred and eighteen publications and 3 published meta-analyses were identified. Seventy-five (34%) studies were conducted in Asia, 72 (33%) in America, and 68 (31%) in European countries. We used PubMed to search information on genetic polymorphisms and the risk of head and neck cancer.

**Analysis of the literature.** The most frequently studied gene was GSTM1 (58 trials), followed by GSTT1 (42 trials), GSTP1 (codon 105, 22 trials), and p53 (codon 72, 20 trials). GSTM1, GSTT1, GSTP1, XRCC1 codons 194 and 399, and CYP1A1

codon 462 were examined by meta-analyses, and significant relations were found between the GSTM1-null genotype and an increased risk for head and neck cancer. In addition, increased risk for HNC was associated consistently with the ALDH2\*1/\*2, p53 codon 72 Pro/Pro and EPHX1 codon 113 Tyr/His and His/His genotypes.

**Conclusion.** All articles present a comprehensive review of case-control studies, discuss current areas of uncertainty, and highlights future research directions in this field. Cohort studies that take into account many genetic and environmental factors can be used for head and neck carcinogenesis. A large number of case-control studies have investigated this hypothesis and these studies identified numerous UGT polymorphisms in UGT1A and UGT2B genes.

**Keywords.** Environmental factors, neck carcinogenesis