

**PROCEEDINGS OF THE 8th STUDENTS INTERNATIONAL CONFERENCE „FRONTIERS IN NEUROLOGY, NEUROPHYSIOLOGY AND NEUROPHARMACOLOGY” POZNAŃ, POLAND, 15-16<sup>th</sup> November, 2024**

**Abstracts in alphabetical order delivered by the lecturers**

**EXPERTS SESSION**

**Pros and cons of the neuromonitoring during the scoliosis surgery**

Juliusz Huber

Department of Pathophysiology of Locomotor Organs, University of Medical Sciences, 28 Czerwca 1956 No 135/137, 60-545 Poznań, Poland, [juliusz.huber@ump.edu.pl](mailto:juliusz.huber@ump.edu.pl)

Apart from the undoubted advantages of intraoperative neuromonitoring using the recording of motor evoked potentials used during spine surgery, there are certain limitations of this method that may give rise to doubts about its actual reliability. The anaesthesiology-related influences, like neuromuscular blockade (0.5 mg/kg of Rocuronium bromide), seem to moderate evoke the diminishing of the MEPs amplitude parameters, especially when they are recorded from nerves in comparison to muscles of lower extremities. The proper communication between the anesthesiologist and the neurophysiologist in maintaining the relationship between Bispectral Index Monitor (BIS, 40-60) and applied transcranial electrical stimulation stimulus strength (TES, 130-95 mA) is crucial. The non-invasive approach for paediatric purposes of using the surface electrodes during MEP recordings in scoliosis surgery has been proven to be as precise enough as the needle approach, even if the amplitude of the signal recorded from muscle was about half as small. Disadvantages of using surface electrodes may include technical aspects related to their higher resistance than needle electrodes and their possible displacement from the bioelectric signal source, effectively resolved by hermetic, sterile tape protection. “Real-time neuromonitoring”, intraoperative neuromonitoring mainly based on simultaneous recording and inspection of evoked potential and camera recordings by neurophysiologist, reduces surgery duration and minimizes anaesthesia's impact on cardiac and nervous systems. Finally, it increases the surgery security by limiting the surgeon-neurophysiologist's communication and avoiding the risk of attention disturbances.

Key words: neurophysiological neuromonitoring, motor evoked potentials recordings, advantages and disadvantages

**Pros and Cons of Surgical Treatment of Idiopathic Scoliosis with MAGEC Corrective Instrumentation**

Piotr Janusz

Department of Spine Disorders and Pediatric Orthopedics, Poznan University of Medical Sciences, 28 Czerwca 1956 r. Street 135/147, 61-545 Poznań, Poland

Early-onset scoliosis requiring surgical intervention must account for the potential growth of the spine. Inhibition of spinal growth at an early age prevents proper development of the rib cage and lungs and may lead to secondary rotational deformities, known as the crankshaft phenomenon. Treatment with traditional growing rods requires cyclic, multiple reoperations to allow for continued spinal growth. This approach is associated with high surgical risks, which increase with each surgery and

negatively impact the patient's quality of life. The MAGEC (Magnetic Expansion Control) rods represent a groundbreaking advancement in the treatment of early-onset idiopathic scoliosis. Unlike traditional growing rods, the MAGEC system allows for non-surgical expansion using a remote magnetic controller, reducing the need for frequent reoperations. This approach is particularly beneficial for young patients, as it minimizes the physical and emotional toll of multiple surgeries and potential complications. The distraction procedure can be performed on an outpatient basis, limiting hospital stays, which is a significant convenience for patients. While the MAGEC system presents several advantages, it also has limitations. The rods' larger size compared to traditional systems, and their inability to be bent, make them unsuitable for patients with small distances between fixation points, kyphotic deformities, or insufficient subcutaneous tissue. Due to the magnetic components, the rods cannot be used in patients who require MRI scans or those treated with cardioverters. Moreover, the expansion force of the MAGEC rods is limited, reducing their effectiveness in cases of severe scoliosis and stiff curves. Mechanical failure of the rods may also necessitate additional, unplanned surgeries. In conclusion, while the MAGEC system offers a promising alternative to traditional growing rods, careful patient selection is crucial to maximize its benefits and minimize the need for further interventions.

Key words: MAGEC, early-onset idiopathic scoliosis, distraction, idiopathic scoliosis, magnetic growing rods

### **Endoscopic spine surgery, is this the future?**

Łukasz Kubaszewski<sup>1,2</sup>, Mateusz Wawrzynowicz<sup>2,3</sup>, Emilia Żywiecka<sup>2,3</sup>

<sup>1</sup> Department of Adult Spine Orthopaedics, Poznan University of Medical Sciences, 28 Czerwca 1956 r. Street 135/147, 61-545 Poznań, Poland

<sup>2</sup> Centrum Medycyny Kręgosłupa-ORTEA [medycynakregoslupa.pl](http://medycynakregoslupa.pl)

<sup>3</sup> Adult Spine Ortopedics - Student Research Group

The number of surgical interventions at the spine boosts year by year. This is due to epidemiological factors and in particular life duration. The rising average life expectancy causes that the symptoms of degenerative disease are more often observed and are a noticeable cause of disability, especially in the older population. Surgical treatment is the last resort treatment in the event of failure of conservative treatment, i.e. pharmacotherapy and physiotherapy. The original techniques of surgical treatment of the spine, like other branches of surgery, have evolved from open techniques to less invasive techniques. The difficulties of minimally invasive techniques in the spine are related to many factors. These include the complicated anatomy and the specific biomechanical role of the spine. In the presentation, we show how endoscopic treatment techniques adapt to the specific requirements of spine surgery. We show what can be achieved with endoscopic techniques compared to classical treatment. We also show the advantages and disadvantages of both strategies. The answer to the question of whether endoscopic treatment is the future in spine surgery is obvious, though the question remains how endoscopic techniques will evolve.

Key words: Degenerative disease, endoscopic surgery, spine

## **Brachial plexus injury. The clinical neurophysiology diagnostic algorithm**

Agnieszka Wiertel-Krawczuk, Juliusz Huber

Department of Pathophysiology of Locomotor Organs, University of Medical Sciences, 28 Czerwca 1956 No 135/137, 60-545 Poznań, Poland, juliusz.huber@ump.edu.pl

This lecture aims to present the principles of an algorithm of the neurophysiological examination in patients with brachial plexus injury of various aetiology. Neurophysiological studies in patients with symptoms of changes in the neural conduction of nerves in the upper extremity can precisely indicate the source of pathology, single, double or even triple, in cases of overlapping symptoms of disease syndromes. Expected diagnostic results include determining the location of damage, assessment of the severity of damage, assessment of muscle denervation and reinnervation, and treatment prognosis through comparative studies. The results of electroneurographic (ENG), electromyographic (EMG) and motor evoked potentials induced by a magnetic field (MEP) studies can indicate the advancement of the pathology, allowing a decision to finish the treatment with conservative methods and introduce surgical procedures. The specificity and sensitivity of diagnosing pathological damage in the brachial plexus using EMG, ENG and MEP methods ranges from 85 to 95%. MEP studies allow evaluation of the proximal part of the peripheral motor pathway (between the cervical root level and Erb's point and via trunks of the brachial plexus to the target muscles) following the application of stimulus over the vertebrae. The rehabilitation treatment for patients with brachial plexus injuries is an individualised process, and the selection of procedures and the effectiveness of the treatment undertaken should be confronted with results of neurophysiological tests verifying the motor neural transmission from the level of the cervical motor centre to the effector, peripheral nerve function, and muscle's motor unit activity.

Key words: brachial plexus injury, neurophysiological studies, diagnostic algorithm

## **Advances in anesthesiology applied during the surgical scoliosis correction. A narrative review**

Małgorzata Reysner

Department of Palliative Medicine, University of Medical Sciences, Poznań, Poland  
Os.Rusa 55, 61-245 Poznan, mdomagalska@ump.edu.pl

Scoliosis surgery, particularly in adolescent idiopathic scoliosis, necessitates careful anesthetic management to optimize surgical outcomes and minimize neurophysiological compromise. This narrative review examines current anesthetic techniques, focusing on Total Intravenous Anesthesia (TIVA) and inhalational methods and their implications for intraoperative neurophysiological monitoring and postoperative recovery. TIVA, utilizing agents like propofol and remifentanyl, has emerged as a preferred approach due to its favorable pharmacodynamics, resulting in less suppression of somatosensory and motor-evoked potentials than inhalational agents. The review highlights the potential of adjuncts, including dexmedetomidine and low-dose ketamine, in enhancing analgesia and mitigating opioid-related side effects. Furthermore, the erector spinae plane (ESP) block is discussed as an innovative regional technique that may improve postoperative pain control while reducing systemic opioid requirements. Emphasizing a multimodal analgesic strategy, the review underscores the importance of integrating various pharmacological and non-pharmacological approaches to optimize postoperative pain management. Ongoing research is vital for refining anaesthetic protocols and enhancing

patient outcomes in scoliosis surgery, ultimately ensuring the safety and efficacy of these complex procedures.

## **STUDENTS SESSION**

### **Non-pharmacological Treatment Methods for Depressive Disorder. A systematic review**

Zofia Kiestrzyn, Marta Kubik, Aleksandra Kałużna, Jagienka Polaszek, Gabriela Górecka, Ewa Mojs

Department of Clinical Psychology, Poznań University of Medical Sciences, Poland, 89012@student.ump.edu.pl

Depressive disorder is a widespread psychological condition. It affects approximately 5% of adults globally. Untreated depression can compromise the quality of life in all its aspects, leading to deterioration of physical health or even suicide. Currently, the recommended treatment is pharmacological therapy, however, not all patients respond to traditional methods, and drug treatment is related to many undesirable side effects. While antidepressants remain the gold standard, non-pharmacological treatment methods are gaining popularity and recognition in Western medicine. While these methods are not always available as a substitute for pharmacotherapy, they can complement and enhance the therapeutic effects. In this paper, we will cover the newly researched, holistic methods of non-pharmacological treatment of depression, including physical exercise, dietary adjustments, psychedelics, or mindfulness, as well as the commonly accepted techniques, such as psychotherapy, electroconvulsive therapy, or deep brain stimulation. This review aims to present alternative treatments for depression and offer insight into the complex topic of improving quality of life and obtaining general well-being.

Key words: depression, depression treatment, non-pharmacological treatment of depression

### **Can nutrition modulate the progression of Alzheimer's Disease? A comprehensive review of dietary interventions**

Wojciech Michał Jankowski, Jakub Fichna, Aleksandra Tarasiuk-Zawadzka

Department of Biochemistry, Faculty of Medicine, Medical University of Lodz, Mazowiecka 5, 92-215 Lodz, Poland

Alzheimer's disease (AD) is the most prevalent neurodegenerative disorder, with an estimated global prevalence of approximately 50 million individuals. By the year 2050, it is projected that the number of individuals with AD will increase to 152 million. The most prevalent symptoms of the disease include cognitive decline, memory impairment, difficulty communicating with others, difficulty performing daily activities, and personality changes. In the absence of an efficacious therapeutic intervention, the identification of modifiable AD risk factors, such as dietary habits, remains a crucial aspect of disease management. Findings from current studies suggest that a balanced diet, rich in anti-inflammatory and antioxidant compounds, may delay the pathogenesis of AD. Polyphenols, found in a variety of dietary sources, including fruits, vegetables, coffee, tea, and red wine, have been demonstrated to play a pivotal role in reducing oxidative stress and inflammation in the brain. B vitamins, along with vitamins A, C, D, and E, have been shown to assist in protecting neurons and enhancing cognitive

function. Furthermore, omega-3 fatty acids, such as docosahexaenoic acid and eicosapentaenoic acid, have been shown to impede the formation of amyloid beta deposits and diminish the hyperphosphorylation of tau protein. It is noteworthy that the Mediterranean diet, which is rich in healthy fats, antioxidants, and fiber, has been shown to have beneficial effects on brain health. This contrasts with the Western diet, which has been linked to an increased risk of developing AD. The review also emphasizes the role of gut microbiota and how its disruption can lead to elevated neuroinflammation and amyloid deposition. The review's findings underscore the necessity for further research into optimal dietary recommendations for the prevention and treatment of AD. Such research could potentially reduce the social and economic consequences of the disease.

### **Central Sleep Apnoea in the Course of a Brain Aneurysm in a Patient with Polycystic Kidney Disease**

Szymon Jęsko-Białek, Katarzyna Turcza, Leszek Niepolski

Faculty of Medicine, Poznan Academy of Medical Sciences, 60-320 Poznan, Bulgarska 55, Poland, [szyjes@st.amu.edu.pl](mailto:szyjes@st.amu.edu.pl)

In the available medical literature, we have found descriptions of four clinical cases presenting vascular abnormalities that caused central sleep apnoea. We describe the case of a patient with polycystic kidney disease (PKD) who experienced sleep apnoea due to an aneurysm in the brainstem region. A 64-year-old man was admitted to the hospital due to severe positional vertigo and persistent vomiting that had lasted for several weeks. During hospitalization, the patient underwent a computed tomography (CT) scan without a vascular program caused by high creatinine level. Due to the difficulty in assessing the CT results, magnetic resonance imaging (MRI) was recommended. The neurosurgeon reviewing the results found a brain aneurysm in the posterior cranial fossa, compressing the brainstem, measuring 32x26x25mm. The patient was qualified for neurosurgical intervention. After an unsuccessful attempt to implant a vascular stent, no further neurosurgical interventions were pursued. The patient was discharged home with a recommendation for continued conservative treatment. Six months later, the patient was readmitted to the hospital with a suspicion of stroke and symptoms of acute respiratory failure. An interview conducted with the family revealed progressive sleep-related breathing disorders, described as sudden interruptions of the breathing reflex after falling asleep. These breathing disturbances interrupted the sleep of the patient and subsided upon awakening. Based on the interview and available imaging studies, consulting neurosurgeons assessed that the cause of the disturbances might be compression of the brainstem respiratory centres by the aneurysm. This clinical case outlines the progression of a patient with central, paroxysmal sleep apnoea resulting from the compression of the brainstem respiratory centres by brain aneurysm, within the context of kidney failure caused by PKD. Brain aneurysms associated with PKD are commonly encountered complication in clinical practice. However, central sleep apnoea as a result of this complication is an exceedingly rare disorder.

## **Mechanisms and Therapeutic Strategies for Combating Neuronal Network Degeneration in Alzheimer's Disease. Meta-Analysis**

Weronika Kruczkowska and Julia Gałęziowska

Faculty of Biomedical Sciences, Medical University of Lodz, Żeligowskiego 7/9, 90-752 Lodz, Poland

Alzheimer's disease is a progressive neurodegenerative disorder characterized by the gradual loss of neurons and synapses in the brain, leading to cognitive decline and memory impairment. Decline of neuronal networks is believed to be a critical factor in the disease process. This meta-analysis focuses on several aspects associated with Alzheimer's development, such as loss of synapses and neuronal connectivity in the brain, amyloid beta and Tau protein aggregation, as well as lack of inter-frequency hubs and network efficiency. The presented paper aims to synthesize current research findings on the mechanisms underlying neuronal network degeneration in this disorder and to evaluate potential therapeutic strategies to counteract this decline. The meta-analysis explores the efficacy of various interventions, including pharmacological treatments, lifestyle modifications, and emerging therapies such as neurostimulation and gene editing. We carried out a systematic search of relevant databases (PubMed, ScienceDirect, Embase, Google scholar, Scopus and Web of Science) to identify studies that quantify neuronal network integrity in Alzheimer's disease patients. This analysis included original papers written in English: randomized controlled trials, case reports, cohort studies with patients suffering from Alzheimer's disease. Studies using various methods to assess neuronal networks were included. The conducted meta-analysis aims to contribute to a deeper understanding of the neuropathological mechanisms underlying Alzheimer's disease and may inform the development of diagnostic tools and therapeutic strategies targeting neuronal network integrity.

## **Alice in Wonderland Syndrome**

Hanna Marciniak

Medical Biology Center, Poznan University of Medical Sciences, Rokietnicka No 8, 60-806 Poznań, Poland, [90949@student.ump.edu.pl](mailto:90949@student.ump.edu.pl)

The "Alice in Wonderland Syndrome" (AIWS) is a rare neurological condition characterized by distortions in perception, body image, and spatial awareness. This work, delves into the intricacies of AIWS, exploring its origins, symptoms, and implications for those affected. Named after Lewis Carroll's iconic character, the disorder is often associated with migraines, epilepsy, and other neurological conditions, where individuals experience a disconnection from reality that can lead to sensations of size distortion, altered visual perception, and an overall sense of confusion. Individuals may perceive objects as larger or smaller than they are, a phenomenon known as micropsia and macropsia. The psychological impact of these symptoms is significant, often causing anxiety and distress, which can further exacerbate the condition. Through a review of scientific literature and case studies, the discussion highlights the varying prevalence of AIWS and its association with other conditions, emphasizing the need for comprehensive diagnostic criteria. Parallels between Carroll's narrative and the experiences of individuals living with the disorder are recognized. The disorienting nature of "Alice in Wonderland Syndrome" serves as a metaphor for the challenges faced by those with AIWS, who navigate a world that often feels disjointed. In conclusion, the "Alice in Wonderland Syndrome" work advocates for greater awareness and understanding of AIWS within the medical community and society at large, emphasizing

the importance of empathy and support for those who experience this enigmatic disorder. By shedding light on AIWS, we can foster a deeper appreciation for the complexities of human perception and the experiences of those affected.

### **Plasma Gingipains K and R levels and pharmacotherapy in patients with Alzheimer's disease**

Joanna Poszwa<sup>1</sup>, Mikołaj Hurła<sup>1</sup>, Natalia Banaszek<sup>1</sup>, Wojciech Owecki<sup>1</sup>, Ulyana Goutor<sup>1</sup>, Wojciech Kozubski<sup>2</sup> and Jolanta Dorszewska<sup>2</sup>

<sup>1</sup>Laboratory of Neurobiology, Department of Neurology

<sup>2</sup>Chair and Department of Neurology

Poznan University of Medical Sciences, Poznan, Poland, jposzwa@ump.edu.pl

**Background:** Alzheimer's disease (AD) is characterized by a progressive impairment of cognitive functions. Its pathogenesis remains unknown. Recently hypothesized that *Porphyromonas gingivalis* may be a factor linking the different hypotheses related to AD pathogenesis. They produce cysteine proteinases called Gingipain K (KGP) and Gingipain R (RGP). The KGP and RGP have been shown in the brains of over 90% of AD patients. *Porphyromonas gingivalis* is involved in AD pathogenesis by inflammation, microglial activation, hyperphosphorylated Tau, and neuronal loss.

**Method:** The studies were conducted on 74 subjects, AD patients, and controls (related, RC and unrelated, UC to AD patients). The duration of the disease, the degree of dementia and pharmacotherapy used were taken into account. The levels of KGP and RGP were analyzed by ELISA method.

**Results:** A tendency to increase levels of KGP ( $p=0.0820$ ) and RGP ( $p=0.0740$ ) was found in AD compared to UC. The levels of KGP were lower in RC than in patients with a disease duration of less than 5 years ( $p=0.0515$ ). The level of KGP was lower also in RC than in patients with moderate cognitive impairment ( $p=0.0505$ ). RGP levels were higher in patients treated with both memantine and donepezil than in UC and RC ( $p<0.01$ ). However, RGP levels were lower in patients treated with memantine alone than in patients treated with both memantine and donepezil ( $p<0.01$ ).

**Conclusion:** It seems that KGP and RGP are more involved in neurodegeneration in AD patients with severe cognitive impairment and during both memantine and donepezil treatment.

**Key words:** Gingipains, pharmacotherapy, Alzheimer's disease

### **The role of Glucagon-like peptide-1 (GLP-1) receptor agonists in delaying the progression of Parkinson's disease. A review**

Iwona Staniszevska

Collegium Medicum, University of Zielona Gora, Poland

Parkinson's disease is the second most common neurodegenerative disorder. In Poland, it affects around 60,000 to 70,000 individuals. The risk of developing Parkinson's disease increases with age. The main symptoms of this disease are slow movements (bradykinesia), shaking when at rest (resting tremor), stiff muscles, and problems with balance and posture. A characteristic feature of Parkinson's disease is the gradual loss of brain cells that produce dopamine, known as dopaminergic neurons, in a part of the brain called the substantia nigra. Another important feature is the presence of Lewy bodies in other neurons. Currently, treatment for Parkinson's disease focuses on managing symptoms, but it does not prevent or slow down the progression of

neurodegeneration. The standard treatment involves increasing dopamine levels, as dopamine deficiency is the main cause of the symptoms. However, long-term use of these medications can lead to side effects, such as uncontrolled movements or changes in motor abilities. Researchers are actively exploring new therapeutic strategies to slow down the progression of the disease. One hypothesis suggests that insulin resistance in the brain or the presence of type II diabetes might be linked to the development of Parkinson's disease. Scientists are currently investigating a group of drugs called GLP-1 receptor agonists, which are already used to treat type II diabetes and obesity, to determine if they could also be beneficial in Parkinson's disease. According to preclinical studies, these medications may help restore dopamine levels, protect neurons, and reduce the symptoms of Parkinson's disease. Clinical trial results are also encouraging, suggesting that these drugs might become a part of future treatment options for Parkinson's disease.

### **Age-Related Decline of Red Nucleus Volume in Healthy and Parkinson's Patients**

Bhavana Pagidela, Rujith Kovinthalpillai, Keerthana Pagidela, Mikolaj Pawlak

Department of Neurology, Poznan University of Medical Sciences, Przybyszewskiego 49, 60-355 Poznań, 86602@student.ump.edu.pl

Motor control is primarily governed by the corticospinal tract which is supported by other extrapyramidal tracts that involve the cortex and various brainstem nuclei. The structures of the brain that contribute to movement include the cortex, substantia nigra, basal ganglia, cerebellum all of which are well studied and understood. In contrast, the red nucleus, which also contributes to movement, has been less researched regarding its implications in aging and movement disorders. The aim of this study is to investigate changes in red nucleus volumes with age, emphasizing on the onset and progression of volume decline, in both healthy and Parkinson's disease patients. The research sample comprised 225 participants sourced from the dataset - the Max Planck Institute Leipzig Mind-Brain-Body Dataset (LEMON). These participants were divided into nine age groups, each spanning five-year intervals. T2-weighted MRI scans were conducted on the subjects and volumetric brain data were derived using the volBrain platform. Statistical analyses were performed using R-Studio version 2023.12.1+402. The average red nucleus volume began at 0.53cm<sup>3</sup> and progressively declined to 0.38cm<sup>3</sup> revealing a p-value of  $6.53 \times 10^{-19}$ , which indicates significant differences in brain volumes across the age groups. Statistical analysis of the data demonstrated strong correlation with an R<sup>2</sup> value of 0.846, indicating a steady decline in red nucleus volume, particularly between the ages of 30-40. In comparison to patients with Parkinson's disease, the red nucleus volume is up to 32% lower in healthy aging, suggesting its compensatory role in the disease process following the initial degeneration. Understanding the changes in the red nucleus may provide valuable insights into the processes of healthy aging and their implications for the decline of fine and gross motor function in patients with Parkinson's disease, potentially aiding in strategies to mitigate motor function decline.



## **Perioperative complications in patients treated for imparity of lower and upper limbs in nursing practice**

Natalia Kownacka<sup>1</sup>, Zofia Borowczyk<sup>1</sup>, Zuzanna Chołdrych<sup>1</sup>, Katarzyna A. Kozłowska<sup>2</sup>  
Grażyna Bączyk<sup>2</sup>

<sup>1</sup>Student Scientific Club Surgical Nursing, Poznan University of Medical Sciences, Poznań, Poland

<sup>2</sup>Department of Nursing Practices, Poznan University of Medical Sciences, Poznań, Poland, kkozłowska@ump.edu.pl

Limb inequality is a relatively common condition. Functional inequality is distinguished - caused by an oblique position of the pelvis or contractures in the joints, and natural inequality is associated with shortening or lengthening of the limb. The condition is most often treated surgically. The most common method is limb lengthening using external distraction stabilizers or an intramedullary nail. Paley introduced a classification of complications, dividing it into three groups: problems, difficulties, and real complications. The study aimed to determine perioperative complications in patients treated for lower and upper limb inequality and to indicate the relationship between the type of complications and demographic and clinical factors. The study was conducted among members of 3 social groups, associating people with limb inequality. The research tool was an original questionnaire, which 79 people completed between December 2022 and December 2023. The most common complications were psychological problems, pain, wound discharge, and skin redness. A significant relationship was found between the reason for limb lengthening and bone/surrounding tissue injury ( $p=0.0250$ ). Femoral lengthening is associated with swelling, pain, and limited joint mobility. People living in the city are more likely to experience psychological problems. No relationship was found between the occurrence of the issues during treatment and the stage or method used. However, in logistic regression, the technique of lengthening ( $p=0.0411$ ) and the bone being treated ( $p=0.0056$ ) turned out to be a significant variable. Limb lengthening is not a standard medical procedure, but studies show that treatment is associated with the risk of complications. The presence of complications should be taken into account during therapy and patient care.

Key words: limb irregularities, surgeries, complications

## **The BDNF gene promoter methylation in the course of antidepressant treatment in adolescent girls with first-lifetime depressive episode. A prospective study.**

Natalia Niedziela<sup>1</sup>, Karolina Paluchowicz<sup>1</sup>, Maksymilian Kundera<sup>1</sup>, Weronika Zwolińska<sup>1,2</sup>, Karolina Bilaska<sup>3</sup>, Kateryna Tarhonska<sup>4</sup>, Edyta Reszka<sup>4</sup>, Agnieszka Słopień<sup>1</sup>  
Monika Dmitrzak-Węglarz<sup>3</sup>

<sup>1</sup> Department of Child and Adolescent Psychiatry, Karol Jonscher Clinical Hospital, Poznan University of Medical Sciences, Szpitalna 27/33 St., 60-572 Poznan, Poland; wzwolinska@ump.edu.pl (W.Z.); agaslopien@ump.edu.pl (A.S)

<sup>2</sup> Poznan University of Medical Sciences, Doctoral School, Collegium Stomatologicum, Bukowska St. 70, 60-812, Poznan, Poland

<sup>3</sup> Poznan University of Medical Sciences, Department of Psychiatric Genetics, Medical Biology Center, Rokietnicka St. 8, 60-806 Poznan, Poland; kbilaska@ump.edu.pl (K.B.); mweglarz@ump.edu.pl (M.D-W.)

<sup>4</sup> Department of Translational Research, Nofer Institute of Occupational Medicine, 91-348 Łódź, Poland; kateryna.tarhonska@imp.lodz.pl (K.T.); edyta.reszka@imp.lodz.pl (E.R.)

Epigenetic mechanisms regulating the level of BDNF gene expression correlate with achieving remission during major depression in adults. Research in this area may contribute to individualising antidepressant pharmacotherapy and increase its effectiveness, but the amount of data on this subject in the pediatric population is limited. To date, no study has prospectively investigated changes in the methylation level of the BDNF gene after antidepressant treatment in adolescents. Therefore, we wanted to fill this gap and investigate the methylation status of the exon IV promoter of the BDNF gene in a group of adolescents treated for their first depressive episode. In addition, we wanted to verify the usefulness of the BDNF methylation level as a predictor of treatment outcome. Our study included 30 hospitalized female patients diagnosed with depression who were treated with antidepressants. Before starting treatment and after at least 6 weeks, the methylation level of the exon IV promoter of the BDNF gene was examined. No statistically significant difference in the methylation level of the BDNF gene was observed before or after treatment, and the usefulness of BDNF methylation as a prognostic factor of treatment response has not been proven. Further studies on a larger group of patients are needed to verify whether the dynamics of BDNF methylation changes reflect the results obtained in adults. Research on this topic is essential to increase the effectiveness of treatment for depression in adolescent patients.

### **Vagus nerve stimulation as a technique in depression treatment. Current situation in Poland**

Olga Ochocka<sup>1</sup>, Aleksander Wasilewski<sup>1</sup>, Julia Gierszewska<sup>1</sup>, Michał Bałuta<sup>1</sup>, Michał Jaskóła<sup>1</sup>, Kornelia Kociemba<sup>1</sup>, Joanna Bartkowiak – Wieczorek<sup>2</sup>, Jakub Winkler-Galicki<sup>2</sup>

<sup>1</sup> Physiology Science Student Club, Department of Physiology, Poznan University of Medical Science, Poland

<sup>2</sup> Department of Physiology, Poznan University of Medical Science, Poland, jwinklergalicki@ump.edu.pl

Depression is a common and severe mental health condition characterised by persistent feelings of sadness, hopelessness, and a lack of interest or pleasure in daily activities. It often involves cognitive, emotional, and physical symptoms, including impaired concentration, fatigue, changes in sleep and appetite, and suicidal thoughts. The aetiology of depression is multifactorial, involving genetic, biological, environmental, and psychological factors. Current treatments typically include a combination of psychotherapy, medication, and lifestyle changes; however, the current development in vagus nerve analyses shows that the stimulation can significantly impact treatment. The vagus nerve (Cranial Nerve X) is considered one of the longest parasympathetic nerves in the human body. It is deeply involved in regulating the functions of several vital organs, including the heart, lungs, digestive system, and certain parts of the ear, such as the external ear and eardrum surface and throat. It also influences the pericardium, stomach, pancreas, spleen, small intestine, the start of the large intestine, kidneys, and adrenal glands. It also plays a role in the sensory and motor functions of the pharynx, throat, and parts of the ear. When the vagus nerve is stimulated, it can lead to varying degrees of relaxation throughout the body, potentially resulting in full-body calmness and rest. That is why it seems promising to use it as a tool for supporting or treating

depression, and the purpose of the following study is to show the benefits of using that method and the current situation in Poland in the matter of depression treatment.

### **Neuropharmacological Breakthrough: Ketamine's Impact on Severe, Treatment-Resistant OCD in a Young Adult**

Nandy S<sup>1,2</sup>, Rahman Simi S<sup>1,2</sup>, Suraiya Simi Rahma<sup>2</sup>

<sup>1</sup> Poznań University of Medical Sciences, Poznan, Poland

<sup>2</sup> Pala Medicine, Pasadena, California. University of Southern California, Los Angeles, CA, USA, shreya.pums@gmail.com

When traditional pharmacological treatments fail in OCD and result in treatment resistance novel therapeutic approaches are needed. Ketamine, an NMDA receptor antagonist, has emerged as a promising neuropharmacological option, offering rapid symptom relief by targeting glutamatergic pathways and disrupting maladaptive neural circuits. This case report explores the impact of ketamine therapy on a case of severe OCD in a young adult. An 18-year-old male with GAD, OCD, and PTSD, starting at age 7 subsequent to an inciting traumatic incident. At presentation he has severe OCD symptoms of hand washing and intrusive thoughts, with a Y-BOCS II score of 31/40. The patient is in an intensive day program and has failed multiple medication courses. His parents approached ketamine therapy due to his symptoms being persistent and disruptive to his functioning to the point that suicidal ideations were present. Over the course of one month, the patient underwent intensive intravenous ketamine therapy 2-3 times per week in a psychedelic model, combined with preparation, integration and coaching support. Psychometric testing at follow up demonstrated notable symptom reductions, with improved emotional regulation and cognitive flexibility. At 3 month follow up the patient continued to have durable symptom relief allowing for greater independence and move towards age-appropriate schooling, improved socialization and decreased 1:1 support. Suicidal ideations had subsided entirely as well. This case underscores the neuropharmacological efficacy of ketamine in treating severe, treatment-resistant OCD. The combination of ketamine with supportive therapy offers a novel, targeted approach to disrupting rigid neural circuits, providing both rapid and durable symptom relief. This treatment model shows promise in complex neuropsychiatric cases where traditional pharmacotherapy has failed, allowing patients and their family systems to heal using an integrative approach to ketamine-assisted therapy in the adolescent and young adult age group.

### **Medical Cannabis sativa impacts the reduction of neuropathic pain and live conditions improvement in the case of terminal patients. Current situation in Poland**

Kornelia Kociemba<sup>1</sup>, Michał Bałuta<sup>1</sup>, Michał Jaskóła<sup>1</sup>, Julia Gierszewska<sup>1</sup>, Olga Ochocka<sup>1</sup>, Aleksander Wasilewski<sup>1</sup>, Joanna Bartkowiak – Wieczorek<sup>2</sup>, Jakub Winkler-Galicki<sup>2</sup>

<sup>1</sup> Physiology Science Student Club, Department of Physiology, Poznan University of Medical Science, Poland

<sup>2</sup> Department of Physiology, Poznan University of Medical Science, Poland, jwinklergalicki@ump.edu.pl

Terminal conditions are a general description of one of the most challenging situations where the most significant impact on the reduction of pain and increase of live comfort

should be paid. That situation occurs mainly in cases of severe traumas, cancers (usually followed by radical surgery, chemotherapy and radiotherapy), cardiological disorders and age. Unfortunately, because of the different medical procedures and chemotherapies used to fight different disorders, the neuropathic pains can occur, which are caused by the malfunction or damage of the neurons. That demanding situation moves the researchers to look for other techniques or active substances that can influence the situation. Currently, more frequently studies show the application of Cannabis sativa L. in therapy or supportive therapy in different medical conditions. The main active components, the cannabidiol (CBD) and tetrahydrocannabinol (THC) are numbered. However, the levels of both and the bioaccessibility determine their pharmacological effects. More often, it can be found in medical reports or scientific papers that CBD intake significantly improves cognitive and motor functions in different conditions. The positive impact of the Cannabis sativa usage in therapy can be noted in the treatment of patients suffering from disorders such as Parkinson's disease, Multiple sclerosis, dementia, depression, Muscle dystrophy or neuropathic pains. Even though the scientific aspects provide evidence of the significant impact of treatment, the current Polish situation remains difficult, both because of the law and because of low interest in use in therapy. The purpose of the overview is to show possible treatment and therapeutical points where CBD can be implemented in neuropathic pain and develop widespread discussion about access to such therapies in Poland.

### **Breath techniques application in Vagus nerve stimulation**

Konrad Bober<sup>1</sup>, Mikołaj Boruc<sup>1</sup>, Dawid Kałużny<sup>1</sup>, Tymon Górczyński<sup>1</sup>, Julia Jachymczyk<sup>1</sup>, Wojciech Rusak<sup>1</sup>, Joanna Bartkowiak – Wieczorek<sup>2</sup>, Jakub Winkler-Galicki<sup>2</sup>

<sup>1</sup> Physiology Science Student Club, Department of Physiology, Poznan University of Medical Science, Poland

<sup>2</sup> Department of Physiology, Poznan University of Medical Science, Poland, [jwinklergalicki@ump.edu.pl](mailto:jwinklergalicki@ump.edu.pl)

The Vagus nerve (Nervous vagus, Cranial nerve X) is thought to be one of the longest autonomic parasympathetic nerves in the human organism. It is responsible and involved in the regulation of processes and activities of the heart and pericardium, trachea, bronchi and pleura; stomach, pancreas, spleen, liver, small intestine, the initial section of the large intestine, kidneys and adrenal glands. Additionally, it is responsible for the control of the pharynx, throat and ear parts, such as the external part of the earlobe or the eardrum's external surface. The stimulation of the Vagus nerve can lead to different levels of the human organism's relaxation, including complete body relaxation and resting. More frequently, it can be heard that proper breath control and influencing the rhythm of the air, inhale and exhale, can be used to stimulate relaxation. In general physiotherapy, different techniques of breathing rhythm control are used to regulate the level of anxiety or aggression. What is more, in various philosophies, natural medical methods, meditation, and even in the army, similar ways of relaxation can be found. The goal of that paper research is to show how actually those systems work and how the Vagus nerve stimulation is involved in relaxation by Alternate nostril breathing, Humming technique, Diaphragmatic breathing techniques, 12-Minute Breathing Practice or box breathing used by Navy SEALs.

## **The physiological meaning of incorrect kinesiotherapy in patients after facial nerve palsy**

Julia Jachymczyk<sup>1</sup>, Tymon Górczyński<sup>1</sup>, Wojciech Rusak<sup>1</sup>, Konrad Bober<sup>1</sup>, Mikołaj Boruc<sup>1</sup>, Dawid Kałużny<sup>1</sup>, Joanna Bartkowiak – Wieczorek<sup>1</sup>, Jakub Winkler-Galicki<sup>2</sup>

<sup>1</sup> Physiology Science Student Club, Department of Physiology, Poznan University of Medical Science, Poland

<sup>2</sup> Department of Physiology, Poznan University of Medical Science, Poland,  
[jwinklergalicki@ump.edu.pl](mailto:jwinklergalicki@ump.edu.pl)

The facial nerve (nervous facialis, VII Cranial nerve) is one of the cranial nerves that controls the muscles of facial mimics and functions. In general plan, the facial nerve is mostly motoric fibres based; however, the sensitive and autosomal parts are present, too. One of the main problems based on the role of the VII nerve is palsy of it, which affects the mimic, motor and functionality of the face, including eating and drinking, chewing, taste distinguishment, swallowing and speaking. The palsy of the cranial VII nerve can be caused by strokes, multiple sclerosis, viral infection (e.g. Herpes virus active infection), allergic reaction, diabetes, internal ear inflammation, CO poisoning, brain cancer or lack of vitamin A. Because of the significant impact of the VII nerve dysfunction on personal lives, proper physiotherapy is needed in the convalescing process. The most common tool of it is the kinesiotherapy, to which different mimic and motoring exercises belongs. However, activating the facial muscles (nerves by the facial nerve) can lead to many secondary disorders such as mechanical injuries or different traumas such as dental traumas, gum temporal traumatisation, cheek traumas, temporomandibular joint relocation or destabilisation. What is more, the neckache, backache, or headaches can appear after and due to incorrect exercises. The main goal of the following paper is to show the potential dangers of incorrect therapy and its effects.

## **Vagus nerve stimulation (VNS) effectiveness in various CNS disorders. Review of current study**

Jakub Dudek<sup>1</sup>, Piotr Gradowski<sup>1</sup>, Joanna Bartkowiak – Wieczorek<sup>2</sup>, Jakub Winkler-Galicki<sup>2</sup>

<sup>1</sup> Physiology Science Student Club, Department of Physiology, Poznan University of Medical Science, Poland

<sup>2</sup> Department of Physiology, Poznan University of Medical Science, Poland,  
[jwinklergalicki@ump.edu.pl](mailto:jwinklergalicki@ump.edu.pl)

The vagus nerve (tenth cranial nerve, CN X) is a critical component of the autonomic nervous system, particularly the parasympathetic branch. It is the longest cranial nerve, extending from the brainstem to the abdomen and passing through various organs, including the heart, lungs, and digestive tract. The vagus nerve plays a significant role in regulating involuntary bodily functions such as heart rate, digestion, and respiratory rate. It also has sensory, motor, and parasympathetic fibres that contribute to diverse physiological processes, including the modulation of inflammation and the gut-brain axis. Currently, several methods of vagus nerve stimulation exist, such as using pressure on the determined neck position or through skin stimulation in the ear. More and more often, it can be seen that the CN X stimulation is used as a supportive or leading way of treating different psychological disorders such as anxiety, depression, and post-traumatic syndrome. However, there are still many other conditions where such

stimulation can be helpful. Positive amounts of vagus nerve stimulation can be found in the case of Parkinson's disease, Sclerosis multiplex, epilepsy, ischemic strokes, traumatic brain injuries and even migraines and headaches. The purpose of the following study is to show the application of the stimulation of the vagus nerve (VNS) in the treatment of chosen disorders and explain the neurophysiological mechanisms of the stimulation impact on the therapy, patient conditions and level change. Moreover, the authors want to discuss the capability of the VNS in the Polish health care system.

### **Glymphatic System Impairments in Alzheimer's Disease – A Review**

Igor Horacy Fonferek<sup>1</sup>, Bartłomiej Czyżniewski<sup>2</sup>

<sup>1</sup> Students' Scientific Society, Collegium Medicum, University of Zielona Góra, Poland

<sup>2</sup> Collegium Medicum, University of Zielona Góra, Poland

Alzheimer's disease has long been like a mystery, one that we are getting closer to solving with the development of new research methods and the discovery of new pathogenic causes. However, one concept appears to be significantly important not only in physiology but also in pathophysiology. The glymphatic system, which is discussed here, includes the Virchow-Robin spaces, known as perivascular spaces, whose function is to allow the flow of cerebrospinal fluid into the brain parenchyma and to regulate interstitial fluid before it is cleared through perivenous pathways. Despite doubts about the role of the glymphatic system in brain water management, current studies focus on its role in the elimination of extracellular compounds, such as beta-amyloid and alpha-synuclein. Disruptions in this function seem to be the basis of neurodegenerative diseases. These disruptions may be caused by faulty aquaporin-4 expression, sleep deficiency, or brain ageing, which in turn promotes the accumulation of harmful proteins (e.g., misfolded beta-amyloid). Lifestyle and dietary changes can improve the functioning of this system. The importance of sleep for proper functioning of the glymphatic system was demonstrated in a PET study, where beta-amyloid was observed to accumulate in the brain after just one sleepless night. The significance of aquaporin-4 in brain fluid homeostasis became evident after its knockout in mice, which eliminated differences in day-night glymphatic drainage. Given that beta-amyloid is produced at a rate of one molecule per second, the inability to efficiently clear it when damaged will lead to its aggregation and, consequently, cell necrosis. Interestingly, it has been observed that in people with Alzheimer's disease, beta-amyloid clearance is less effective compared to healthy individuals. There are also suggestions that glymphatic drainage may contribute to the removal of alpha-synuclein. Unfortunately, no therapeutic methods for repairing the glymphatic system have been discovered so far.