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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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SEMANTICS AND DYNAMICS OF HEADACHE IN PATIENTS WITH CHIARI MALFORMATION TYPE I AFTER DECOMPRESSION SURGERY: EXPERIENCE FROM AZERBAIJAN

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Abstract.

Introduction: Chiari malformation type I (CMI) is a congenital anomaly characterized by the descent of the cerebellar tonsils into the foramen magnum (FM), leading to cerebrospinal fluid circulation disturbances at the level of the posterior cranial fossa (PCF) and the craniovertebral junction (CVJ). Headache (HA) is the predominant symptom, often mimicking primary cephalalgias, complicating diagnosis and optimal surgical strategy selection.

Aim of the Study: To analyze the characteristics of headache in CMI, identify the pathophysiological mechanisms of typical (tHA) and atypical headaches (aHA), and assess the effectiveness of different decompressive surgical techniques in postoperative pain relief.

Materials and Methods: The study included 102 patients (58 females, 44 males, aged 2–69) with isolated or complicated CMI who underwent decompressive surgery at the Neurosurgery Department of Azerbaijan Medical University and the Republican Neurosurgical Center (2016–2024). Patients were divided into two groups based on headache type: typical HA (tHA, n=82) and atypical HA (aHA, n=20). Headache characteristics and dynamics were assessed using neurological and neuroimaging monitoring.

Results: Decompression surgery significantly reduced headache severity, particularly in tHA patients. The best outcomes for aHA patients were observed with intra-arachnoid dissection and duraplasty.

Conclusion: The findings can contribute to optimizing surgical approaches for CMI treatment.

Key words. Chiari malformation type I, headache, decompressive surgery, craniovertebral junction, posterior cranial fossa, duraplasty.

Introduction.

Chiari malformation type I (CMI) is the most common and potentially reversible craniovertebral junction (CVJ) anomaly, first described by Austrian pathologist Hans Chiari in the 19th century [1]. Despite extensive research, there is still no consensus on the definition, classification, and etiopathogenesis of CMI. The modern definition describes CMI as a "syndrome of foramen magnum obstruction by the cerebellar tonsils, accompanied by brainstem and cranial nerve compression, as well as cerebrospinal fluid (CSF) circulation and vascular disturbances at the CVJ". The primary pathogenetic mechanism is associated with congenital mesodermal developmental abnormalities leading to posterior cranial fossa (PCF) hypoplasia, skull base anomalies, and CVJ instability while maintaining normal neural tissue development [2].

Diagnostic criteria for CMI remain a topic of debate. Traditionally, tonsillar descent of ≥5 mm below McRae's line was considered a key criterion, but in 2019, most experts rejected this as a universal measure, emphasizing the need for a comprehensive assessment of anatomical and physiological factors, including CSF circulation dynamics [3-5].

CMI can manifest at any age, as confirmed by surgical series data: 27% of patients are diagnosed after 18 years of age, 30% before 18 years, while in 43% of cases, age at diagnosis is unspecified [6].

In 65% of cases, CMI is associated with syringomyelia. Depending on the involvement of brain structures, the clinical presentation of CMI can include a wide range of neurological symptoms such as cognitive impairment, muscle weakness, dizziness, sensory disturbances, tinnitus, fatigue, difficulty swallowing, insomnia, and depression. However, the most common symptom in both pediatric and adult patients is headache (HA), reported in 50–98% of cases [7].

According to the International Classification of Headache Disorders (2013), characteristic headaches in CMI are localized in the occipital region, provoked by Valsalva maneuvers, and accompanied by symptoms of brainstem, cerebellar, or cranial nerve dysfunction [8].

The pathophysiology of headache in CMI is explained by several mechanisms: the pulsatile impact of cerebrospinal fluid (CSF) on spinal cord structures (Oldfield's theory), increased intracranial pressure (Williams' theory), and cerebrospinal fluid circulation disturbances in the posterior cranial fossa (PCF) [9,10]. In addition to typical headaches, patients may experience nonspecific cephalalgias such as migraines or tension-type headaches, which are not directly related to the malformation. Recent studies differentiate between typical (suboccipital, responsive to surgical treatment) and atypical (e.g., migraines or trigeminal neuralgia, requiring a conservative approach) headache forms.

The standard surgical approach for CMI includes foramen magnum decompression and C1 laminectomy, aimed at restoring CSF flow and relieving brainstem compression. However, ongoing debates persist regarding the necessity of duraplasty and cerebellar tonsil coagulation, underscoring the lack of universal guidelines [11,12]. Studies indicate that decompressive surgery alleviates symptoms, including headache, although its effectiveness depends on the chosen surgical technique. However, previous research has either focused exclusively on headache semiology without detailed postoperative assessments or examined headache outcomes post-surgery without specifying headache characteristics [13].

This study aims to analyze the characteristics and pathophysiology of headache in CMI and evaluate the effectiveness of different surgical methods in reducing headache intensity. The findings will help refine treatment strategies, determine the optimal extent of surgical intervention, and predict postoperative quality of life in CMI patients.

Materials and Methods.

The study included 102 patients with CMI, of whom 34 (33.3%) had the classic form and 68 (66.7%) had a complicated form (syringomyelia, hydrocephalus, scoliosis). The mean age was 35.1 ± 1.4 years (58 females and 44 males). All patients underwent surgical treatment in the neurosurgical departments of Azerbaijan Medical University and the Republican Neurosurgical Center between 2016 and 2024.

The diagnosis of CMI was confirmed based on MRI scans of the brain and cervical spine.

Inclusion criteria: Radiologically confirmed cerebellar tonsillar descent of ≥5 mm and the presence of neurological symptoms characteristic of CMI. Exclusion criteria: Patients with secondary cephalalgias and intracranial abnormalities were excluded.

Patients were divided into two groups according to headache type, classified based on the International Classification of Headache Disorders, 3rd edition (ICHD-3):

• Typical headache (tHA) (n=82): Suboccipital pain triggered by coughing, laughing, or Valsalva maneuvers, lasting up to 5 minutes.

• Atypical headache (aHA) (n=20): Cephalalgias meeting the criteria for migraine or tension-type headache, without Valsalva maneuver provocation.

Surgical techniques used:

1. Microsurgical suboccipital, resection of the C1 arch, (if necessary, and C2) without dural opening (PFD1).
2. Microsurgical suboccipital, resection of the C1 and C2 arches without dural opening (PFD2).
3. Microsurgical suboccipital decompression of PCF, resection of the C1 arch, (if necessary, and C2) with extra arachnoid dilatory duraplasty (PFDD).
4. PFDD with subarachnoid revision of the Magendie foramen, excision of arachnoid adhesions (PFD1D-RM).
5. PFDD with subarachnoid revision of the Magendie foramen, excision of arachnoid adhesions (PFD2D-RM).
6. PFDD with subarachnoid revision of the Magendie foramen, excision of arachnoid adhesions (PFD1D-RM) with cerebellar tonsil resection or coagulation (PFD1D-RM/CT).
7. PFDD with subarachnoid revision of the Magendie foramen, excision of arachnoid adhesions (PFD2D-RM) with cerebellar tonsil resection or coagulation (PFD2D-RM/CT).
8. Other procedures (syringomyelic cyst shunting, ventricular shunting, tethered cord release).

Evaluation of Outcomes.

The intensity and characteristics of headaches were assessed before and after surgery at three time points: immediate (0–5 days), early (5–21 days), and late (≥3 months). Data collection was based on medical records, structured surveys, and consultations. Statistical analysis was performed using the SPSS-26 statistical package (IBM, USA). Discriminant (Pearson's χ^2 test) and rank-based (Mann–Whitney U-test) analyses were applied. The null hypothesis was rejected at $p < 0.05$.

Results.

The analysis of the patient population with CMI between the typical headache (tHA) and atypical headache (aHA) groups revealed no significant gender differences: females predominated in both groups (57.3% and 55.0%; $\chi^2 = 0.035$; $p = 0.851$). The interquartile age range was 25–43 years (tHA) and 24–49.5 years (aHA). In the tHA group, the most common age groups were 30–39 years (32.9%) and 20–29 years (19.5%), whereas in the aHA group, they were 20–29 years (30.0%) and 30–39 years (20.0%). The age differences were statistically insignificant ($\chi^2 = 2.677$; $p = 0.750$). The mean BMI was within the normal range: 27.4 and 26.8 ($p = 0.289$).

Headache semiology.

Headache was present in all patients and was the leading symptom in 73.5% (n=75). The analysis of headache characteristics in CMI patients revealed significant differences between typical and atypical forms (Table 1). All patients with tHA (100%) reported Valsalva-induced pain, whereas this feature was completely absent in the aHA group, confirming statistically significant differences ($\chi^2 = 102.000$, $p < 0.001$). Tension-type headache was significantly more common in aHA patients (45.0% vs. 13.4% in the tHA group, $p = 0.001$). Meanwhile, migraine-like headache did not show statistically significant differences between groups ($p = 0.074$). tHA was predominantly suboccipital (98.8%), while occipital localization was most frequent in aHA patients (85.0%). Additionally, aHA patients more frequently reported temporoparietal (70.0%) and generalized headache (60.0%), with statistically significant differences ($p < 0.001$).

In the tHA group, brief episodes (<5 minutes) predominated (74.4%), whereas 50.0% of aHA patients experienced headache episodes lasting over 24 hours. These differences were also statistically significant ($p < 0.001$). One of the key distinctions between groups was the response to physical activity. In 72.0% of tHA patients, headache worsened with exertion, compared to only 15.0% in the aHA group ($p < 0.001$). However, changes in head or body position did not significantly influence pain severity in either group. Accompanying symptoms, such as vomiting, nausea, loss of consciousness, dizziness, and photophobia/phonophobia, showed no statistically significant differences between groups ($p > 0.05$).

Symptomotology and its Association with Pain Mechanisms.

Patients in both the typical headache (tHA) and atypical headache (aHA) groups most frequently experienced pain in the cervico-occipital region (93.9% and 75%), dizziness (86.6% and 75%), nausea (74.4% and 75%), vomiting (81.7% and 80%), and balance disturbances (62.2% and 75%). Moderate-frequency symptoms included weakness (59.8% and 65%), diffuse limb pain (lower limbs: 84.1% and 70%; upper limbs: 61% and 60%), nocturnal apnea (34.1% and 20%), and loss of consciousness (17.1% and 15%). Less common symptoms were upper limb numbness (37.8% and 30%), seizures (2.4% and 5%), visual disturbances (3.7% and 5%), as well as choking and swallowing difficulties (8.5% and 20%). All symptoms occurred at similar frequencies in both groups, except for the characteristic suboccipital localization in tHA patients ($p = 0.011$).

The average time from symptom onset to diagnosis was ~4.3 years in both groups: 4.4 years for tHA and 4.3 years for aHA. No significant differences were found between the groups ($p = 0.470$).

Table 1. *Headache semiology.*

		Patient groups				Pχ2
		tHA		aHA		
			N %		N %	
HA localization	occipital	1	1,2%	17	85,0%	<0.001*
	suboccipital	81	98,8%	3	15,0%	
HA duration	no	0	0,0%	5	25,0%	<0.001*
	<5 min	61	74,4%	1	5,0%	
	> 5 min	11	13,4%	4	20,0%	
	> 24 h	10	12,2%	10	50,0%	
Frontal HA	absent	61	74,4%	12	60,0%	0.201
	present	21	25,6%	8	40,0%	
Temporoparietal HA	absent	64	78,0%	6	30,0%	<0.001*
	present	18	22,0%	14	70,0%	
Migraine-like HA	absent	71	86,6%	14	70,0%	0,074
	present	11	13,4%	6	30,0%	
Tension type HA	absent	71	86,6%	11	55,0%	0,001*
	present	11	13,4%	9	45,0%	
General HA	absent	60	73,2%	8	40,0%	0,005*
	present	22	26,8%	12	60,0%	
HA+general weakness	absent	49	59,8%	13	65,0%	0,667
	present	33	40,2%	7	35,0%	
Pain in the cranio-cervical area	absent	5	6,1%	5	25,0%	0,011*
	present	77	93,9%	15	75,0%	
Pain in the neck	absent	26	31,7%	8	40,0%	0,481
	present	56	68,3%	12	60,0%	
HA+ nausea	absent	67	81,7%	16	80,0%	0,860
	present	15	18,3%	4	20,0%	
HA+ vomiting	absent	64	78,0%	16	80,0%	0,849
	present	18	22,0%	4	20,0%	
HA+ loss of conciseness	absent	67	81,7%	18	90,0%	0,372
	present	15	18,3%	2	10,0%	
HA+ dizziness	absent	55	67,1%	15	75,0%	0,493
	present	27	32,9%	5	25,0%	
Foto/Phono phobia	absent	69	84,1%	14	70,0%	0,145
	present	13	15,9%	6	30,0%	
Increasing HD by change of the body and head position	absent	67	81,7%	17	85,0%	0,729
	present	15	18,3%	3	15,0%	
Increasing HD by physical activity	absent	23	28,0%	17	85,0%	<0.001*
	present	59	72,0%	3	15,0%	
Increasing HD in a lying position	absent	62	75,6%	15	75,0%	0,955
	present	20	24,4%	5	25,0%	

Table 2. *Distribution of Surgical Procedures by Groups.*

		Patient groups				Pχ2
		tHA		aHA		
			N %		N %	
Surgery type	PFD1	16	19,5%	2	10,0%	0,223
	PFD2	6	7,3%	0	0,0%	
	PFDD	15	18,3%	3	15,0%	
	PFD1D-RM	18	22,0%	10	50,0%	
	PFD2D-RM	1	1,2%	1	5,0%	
	PFD1D-RM/CT	22	26,8%	4	20,0%	
	PFD2D-RM/CT	1	1,2%	0	0,0%	
	other	3	3,7%	0	0,0%	

Radiological Findings.

CMI was associated with comorbid pathologies in 63.4% of tHA patients and 80.0% of aHA patients. Syringomyelia was more frequent in aHA patients (75.0% vs. 48.8%, p = 0.035). The prevalence of hydrocephalus was 15.0% and 18.3% (p = 0.729), scoliosis 10.0 % and 9.8 % (p = 0.836), basilar invagination 5.0% and 4.9% (p = 0.982), and a small posterior cranial fossa 0% and 6.1% (p = 0.257) in the aHA and tHA groups, respectively. The mean cerebellar tonsillar descent was 10 mm (median 9.5 mm) in tHA patients and 11.3 mm (median 11.0 mm) in aHA patients. However, no statistically significant differences were observed between groups for this parameter (p = 0.539).

Surgical Treatment Outcomes.

In patients with typical headache (tHA), the most frequently performed surgical procedure was PFD1D-RM/CT (26.8%), followed by PFD1D-RM (22.0%). Less commonly performed were PFD2D-RM/CT (1.2%) and other types of interventions (3.7%). Among patients with atypical headache (aHA), PFD1D-RM was the predominant procedure (50.0%), while PFD1D-RM/CT was performed in 20.0% (p = 0.04), and PFD2D-RM in 5.0%. No other surgical interventions were applied in this group (Table 2).

Postoperative Outcomes.

The data indicate differences in recovery dynamics and overall treatment results between patients with typical (tHA) and atypical (aHA) headaches (Table 3). In the immediate postoperative period (IPOP-HA, 0–5 days), improvement was observed in 98.8% of tHA patients and 80.0% of aHA patients. In 20.0% of aHA cases, the condition remained unchanged, which was statistically significant (p <0.001). In the early postoperative period (EPOP-HA, 5–21 days), improvement persisted in 95.1% of tHA patients and 80.0% of aHA patients, while deterioration was noted in 5.0% of aHA patients and 2.4% of tHA patients (p = 0.032). In the late postoperative period (LPOP-HA, >3 months), improvement was sustained in 74.4% of tHA patients and 75.0% of aHA patients, while deterioration was recorded in 4.9% and 10.0%, respectively (p = 0.610). Postoperative outcomes assessed using the Chicago Chiari Outcome Scale (CCOS) demonstrated more favorable results in tGB patients. A high CCOS score (>13) was achieved by 81.7% of tHA patients compared to 50.0% of aHA patients, with statistically significant differences (p = 0.012). The highlighted sentence was replaced by the following: Assessment of postoperative outcomes using the Chicago Chiari Outcome Scale (CCOS) demonstrated that patients with tHA had more favorable results. A high mean score of 14.0 was recorded in 81.7% of patients with tHA, whereas in 50.0% of patients with aHA the score was 12.7 (p = 0.012).

Residual pain was observed in both groups, but pain levels showed no significant differences. Persistent severe pain (4 points) was reported in 57.3% of patients with tHA and 45.0% of patients with aHA. These differences were not statistically significant (p = 0.393).

Postoperative complications were rare and did not depend on headache type. Infectious complications occurred in 7.3% of tHA patients and 5.0% of aHA patients, while non-infectious complications were absent in both groups. No statistically significant differences in complication rates were identified between the groups (p = 0.713).

Table 3. *Surgical Treatment Outcomes.*

		Patient groups				**Pχ2**
		tHA		**aHA**		
			N %		**N %**	
Complications	absent	76	92,7%	19	95,0%	0,713
	Non-infectious	0	0,0%	0	0,0%	
	Infectious	6	7,3%	1	5,0%	
IPOP-HA, 0–5 days	Regress	0	0,0%	0	0,0%	<0,001*
	Improvement	81	98,8%	16	80,0%	
	No changes	1	1,2%	4	20,0%	
	Worsening	0	0,0%	0	0,0%	
EPOP-HA, 5–21 days	Regress	1	1,2%	0	0,0%	0,032*
	Improvement	78	95,1%	16	80,0%	
	No changes	1	1,2%	3	15,0%	
	Worsening	2	2,4%	1	5,0%	
LPOP-HA, >3 months	Regress	0	0,0%	0	0,0%	0,610
	Improvement	61	74,4%	15	75,0%	
	No changes	17	20,7%	3	15,0%	
	Worsening	4	4,9%	2	10,0%	
CCOS	> 13 points	67	81,7%	10	50,0%	0,012*
	9 - 12 points	13	15,9%	9	45,0%	
	4 - 8 points	2	2,4%	1	5,0%	
Pain	1	1	1,2%	0	0,0%	0,393
	2	9	11,0%	5	25,0%	
	3	25	30,5%	6	30,0%	
	4	47	57,3%	9	45,0%	

Discussion.

CMI is a complex neurological disorder characterized by diverse symptoms, with headache being the most common. This study confirmed that headache in CMI varies in nature, duration, and intensity, complicating diagnosis and treatment. Differences between tHA and aHA are crucial for refining therapeutic strategies. The findings indicate that tHA is usually localized in the suboccipital region and exacerbated by Valsalva maneuvers (coughing, sneezing, straining), observed in 100% of patients. This symptom suggests a link between headache and intracranial hypertension caused by mechanical compression of the cerebellar tonsils. This type of headache is brief (lasting less than five minutes) and has a clear association with pressure changes. In contrast, aHA, which is non-specific for CMI, is characterized by prolonged episodes, lack of association with Valsalva maneuvers, and migraine-like symptoms such as photophobia, phonophobia, nausea, and dyspepsia, complicating its diagnosis [8,11].

In our cohort, women were predominant in both groups, aligning with the general trend of CMI being more common in females. However, in the aHA group, the gender distribution was more balanced, suggesting a weaker dependence of this headache type on sex. Patients with tHA were more frequently aged 30–39 years (32.9%), which may be related to the progression of malformation into adulthood. In the aHA group, the majority were aged 20–29 years (30%), suggesting an earlier onset that requires complex diagnostic approaches.

Syringomyelia was more prevalent in the aHA group (75% vs. 48.8% in the tHA group), consistent with findings on its association with severe neurological impairments in CMI [12]. The sentence was removed-Additionally, scoliosis was more frequent in the aHA group (10% vs. 3.2%), emphasizing the need to consider comorbid conditions when planning treatment.

The primary symptoms of CMI-related headache—dizziness, nausea, and coordination disturbances—were common in both typical and atypical headaches, indicating shared pathophysiological mechanisms related to cerebrospinal fluid circulation disturbances and compression of posterior fossa structures. However, aHA patients more frequently exhibited nocturnal apnea, limb numbness, and swallowing difficulties, possibly reflecting more severe cerebrospinal fluid circulation impairment or involvement of additional structures such as the spinal cord and peripheral nerves [13].

Pathophysiological differences between headache types may be associated with varying degrees of brain structure involvement. In our cohort, aHA patients exhibited more pronounced cerebellar tonsillar descent (11.3 mm vs. 9.6 mm in the tHA group), indicating more severe structural changes. Although this difference was not statistically significant, it warrants further investigation, as tonsillar descent severity may correlate with symptom intensity and disease severity, crucial for prognosis and surgical planning.

Surgical Treatment and Outcomes.

Comparative analysis of surgical approaches showed that the PFD1D-RM method was used in both groups but was more frequent in aHA patients (50% vs. 22%). PFD1D was more common in the tHA group (26.8% vs. 20%), suggesting its greater effectiveness for the typical form of the disease. Our results demonstrate that tHA and aHA respond differently to surgical treatment. Patients with tHA (74.4%) generally experienced significant improvement, likely due to the alleviation of intracranial hypertension. According to the CCOS scale, tHA patients showed greater improvement (mean score of 14.0 vs. 12.7 in the aHA group, p=0.011), indicating a higher sensitivity of tHA to posterior fossa decompression.

Conversely, aHA patients exhibited less pronounced improvements postoperatively, likely due to a more complex and multifactorial headache genesis in this group. aHA may be caused not only by intracranial hypertension but also by migraine-like processes, tension-type mechanisms, and other pathophysiological factors, necessitating a more individualized treatment approach. These findings align with other studies [12].

Conclusion.

Our study confirms the existing differences between typical and atypical headache forms in patients with Chiari malformation type I. Typical headache is associated with more favorable treatment outcomes due to its distinct clinical presentation, clear association with intracranial hypertension, and successful resolution of this trigger through surgical intervention. In contrast, atypical headache requires more thorough diagnostics and individualized treatment strategies, as it has a more complex pathophysiological nature, including migraine-like processes and tension-related mechanisms. Identified differences in clinical characteristics, such as the degree of cerebellar tonsillar descent, comorbidities, and headache patterns, should be considered in the planning of diagnostics and surgical treatment. Future research should further explore these distinctions to improve diagnostic and therapeutic approaches for CMI patients, as well as to assess long-term outcomes and quality of life after treatment.

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СЕМИОЛОГИЯ И ДИНАМИКА ГОЛОВНОЙ БОЛИ У ПАЦИЕНТОВ С МАЛЬФОРМАЦИЕЙ КИАРИ I ТИПА ПОСЛЕ ДЕКОМПРЕССИВНЫХ ОПЕРАЦИЙ: ОПЫТ АЗЕРБАЙДЖАНА

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Абстракт: Мальформация Киари I типа (МКI) — врожденная аномалия, характеризующаяся опущением миндалин мозжечка в большое затылочное отверстие (БЗО) и нарушением ликвороциркуляции на уровне задней черепной ямки (ЗЧЯ) и краниоцервикального сочленения (КЦС). Ведущим симптомом является головная боль (ГБ), часто имитирующая первичные цефалгии, что затрудняет диагностику и выбор оптимальной хирургической тактики.

Цель исследования: Изучение особенностей ГБ при МКI, выявление патогенетических механизмов тГБ и аГБ, а также оценка эффективности различных методов декомпрессивного лечения в послеоперационном периоде.

Материалы и методы: В исследование включены 102 пациента (58 женщин, 44 мужчины, 2–69 лет) с изолированной или осложненной МКI, перенесшие декомпрессивные операции на уровне КЦС. Хирургическое лечение проведено в нейрохирургическом отделении Азербайджанского медицинского университета и Республиканском нейрохирургическом центре (2016–2024 гг.). Пациенты разделены на две группы: с типичной (тГБ, n=82) и атипичной ГБ (аГБ, n=20). Оценка характера и динамики боли проводилась с использованием неврологического и нейровизуализационного мониторинга.

Результаты: Декомпрессивная хирургия значительно уменьшает ГБ, особенно типичную. При аГБ лучшие результаты показали интраарахноидальная диссекция и пластика твердой мозговой оболочки.

Выводы: Полученные данные могут помочь в оптимизации хирургической тактики лечения МКI.

Ключевые слова: мальформация Киари I типа, головная боль, декомпрессивная хирургия, краниоцервикальное сочленение, задняя черепная ямка, дуропластика.