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CLINICAL AND NEUROLOGICAL ANALYSIS OF SPEECH DISORDERS IN CHILDREN WITH VARIOUS FORMS OF ORGANIC CENTRAL NERVOUS SYSTEM PATHOLOGY

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Abstract. Speech disorders in children with organic central nervous system pathology remain a significant issue in pediatric neurology due to their high prevalence and impact on cognitive development. A comprehensive clinical and neurological assessment, including evaluation of higher cortical functions and neurophysiological data, is a key approach for the accurate diagnosis and differentiation of these disorders.

Objective. To perform a comparative clinical and neurological analysis of the structure, frequency, and pathogenetic mechanisms of speech disorders in children with cerebral palsy, epilepsy, and autism spectrum disorders, and to identify key neurological factors influencing speech development and their clinical significance.

Materials and Methods. The study included 150 children aged 3–10 years: 40 patients with cerebral palsy, 38 with epilepsy, 42 with autism spectrum disorders and 30 children with developmental language disorder. All participants underwent a comprehensive neurological examination, including assessment of motor status, higher cortical functions, electroencephalographic data, and neuroimaging findings.

Results. Speech disorders were identified in 95% of children with cerebral palsy, 65.8% with epilepsy, and 92.9% with autism spectrum disorders. In cerebral palsy, dysarthric disorders predominated and were associated with lesions of the corticobulbar pathways and subcortical structures. In epilepsy, speech disturbances were mainly cognitive-dysphasic and often transient, demonstrating correlation with seizure frequency and disease duration. In autism spectrum disorders, impairments were primarily neurocognitive and related to social communication, occurring in the absence of significant motor deficits.

Conclusions. Speech disorders in children with organic central nervous system pathology differ significantly in their clinical presentation and pathogenetic mechanisms depending on the underlying nosological form. These findings emphasize the importance of a differentiated neurological approach to diagnosis, prognosis, and the selection of comprehensive therapeutic and rehabilitation strategies. The absence of unified clinical and neurological assessment algorithms complicates timely diagnosis and management, highlighting the need for their development and implementation.

Keywords: cerebral palsy, epilepsy, autism spectrum disorders, neurocognitive disorders, dysarthria.

ОРТАЛЫҚ ЖҮЙКЕ ЖҮЙЕСІНІҢ ОРГАНИКАЛЫҚ ПАТОЛОГИЯСЫНЫҢ ӘРТҮРЛІ ТҮРЛЕРІ БАР БАЛАЛАРДАҒЫ СӨЙЛЕУ БҰЗЫЛЫСТАРЫН КЛИНИКАЛЫҚ ЖӘНЕ НЕВРОЛОГИЯЛЫҚ ТАЛДАУ

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Аңдатпа. Бас миының органикалық зақымдануы бар балаларда сөйлеу бұзылыстары жиі кездеседі және олар баланың ойлау мен когнитивтік дамуына кері әсер етеді. Сондықтан бұл мәселе балалар неврологиясында маңызды клиникалық проблема болып саналады. Жоғары қыртыстық функцияларды және нейрофизиологиялық деректерді талдауды қамтитын кешенді клинико-неврологиялық бағалау осы бұзылыстарды дәл диагностикалау мен дифференциациялаудың негізгі тәсілі болып табылады.

Зерттеу мақсаты. Бас миының органикалық патологиясының әртүрлі нозологиялық формаларында балалардағы сөйлеу бұзылыстарын клинико-неврологиялық тұрғыдан талдау және негізгі ауруға байланысты олардың патогенетикалық механизмдеріндегі айырмашылықтарды анықтау.

Материалдар мен әдістер. Зерттеуге 3–10 жас аралығындағы 150 бала енгізілді: 40 науқас – балалар церебралды сал ауруымен, 38 – эпилепсиямен, 42 – аутизм спектрі бұзылыстарымен және 30 – сөйлеу дамуының бұзылыстары бар балалар. Барлық қатысушыларға қозғалыс жағдайын, жоғары қыртыстық функцияларды, электроэнцефалографиялық деректерді және нейровизуализация нәтижелерін қамтитын кешенді неврологиялық тексеру жүргізілді.

Нәтижелер. Сөйлеу бұзылыстары балалар церебралды сал ауруымен ауыратындардың 95%-ында, эпилепсиясы барлардың 65,8%-ында және аутизм спектрі бұзылыстары барлардың 92,9%-ында анықталды. Балалар церебралды сал ауруында негізінен кортико-бульбарлық жолдар мен субкортикальды құрылымдардың зақымдалуымен байланысты дизартриялық бұзылыстар басым болды. Эпилепсия кезінде сөйлеу бұзылыстары көбінесе когнитивті-дисфазиялық сипатта болып, ұстамалардың жиілігі мен ауру ұзақтығына тәуелді транзиторлы көріністермен сипатталды. Аутизм спектрі бұзылыстарында айқын қозғалыс тапшылығы болмай, нейрокогнитивтік және элеуметтік-коммуникативтік бұзылыстар басым болды.

Қорытынды. Бас миының органикалық патологиясы бар балалардағы сөйлеу бұзылыстары клиникалық көріністері мен патогенетикалық механизмдері бойынша нозологиялық формаға байланысты айтарлықтай ерекшеленеді. Алынған нәтижелер диагностика, болжам жасау және кешенді емдік-реабилитациялық стратегияларды таңдау кезінде дифференциацияланған клинико-неврологиялық тәсілдің маңыздылығын көрсетеді. Бірыңғай клинико-неврологиялық бағалау алгоритмдерінің болмауы пациенттерді уақытылы диагностикалау мен жүргізуді қиындатады, бұл олардың әзірленуі мен енгізілу қажеттілігін айқындайды.

Түйін сөздер: балалар церебралды сал ауруы, эпилепсия, аутизм спектрі бұзылыстары, нейрокогнитивтік бұзылыстар, дизартрия.

КЛИНИЧЕСКИЙ И НЕВРОЛОГИЧЕСКИЙ АНАЛИЗ РЕЧЕВЫХ НАРУШЕНИЙ У ДЕТЕЙ С РАЗЛИЧНЫМИ ФОРМАМИ ОРГАНИЧЕСКОЙ ПАТОЛОГИИ ЦЕНТРАЛЬНОЙ НЕРВНОЙ СИСТЕМЫ

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Аннотация. Нарушения речи у детей с органической патологией центральной нервной системы остаются значимой проблемой детской неврологии вследствие их высокой распространённости и влияния на когнитивное развитие. Комплексная клиничко-неврологическая оценка, включающая анализ высших корковых функций и нейрофизиологических данных, является ключевым подходом к точной диагностике и дифференциации данных нарушений.

Цель исследования. Провести клиничко-неврологический анализ нарушений речи у детей с различными формами органической патологии центральной нервной системы и выявить различия их патогенетических механизмов в зависимости от основного заболевания.

Материалы и методы. В исследование включены 150 детей в возрасте 3–10 лет: 40 пациентов с детским церебральным параличом, 38 — с эпилепсией и 42 — с расстройствами аутистического спектра и 30 - дети с расстройством развития речи. Все участники прошли комплексное неврологическое обследование, включающее оценку двигательного статуса, высших корковых функций, электроэнцефалографических данных и результатов нейровизуализации.

Результаты. Нарушения речи выявлены у 95% детей с детским церебральным параличом, у 65,8% с эпилепсией и у 92,9% с расстройствами аутистического спектра. При детском церебральном параличе преобладали дизартрические расстройства, связанные с поражением кортико-бульбарных путей и подкорковых структур. При эпилепсии речевые нарушения носили преимущественно когнитивно-дисфазический и часто транзиторный характер, с корреляцией с частотой приступов и длительностью заболевания. При расстройствах аутистического спектра преобладали нейрокогнитивные и социально-коммуникативные нарушения при отсутствии выраженного двигательного дефицита.

Выводы. Нарушения речи у детей с органической патологией центральной нервной системы существенно различаются по клиническим проявлениям и патогенетическим механизмам в зависимости от нозологической формы. Полученные данные подчёркивают необходимость дифференцированного клиничко-неврологического подхода к диагностике, прогнозированию и выбору комплексных лечебно-реабилитационных стратегий. Отсутствие единых клиничко-неврологических алгоритмов оценки затрудняет

своевременную диагностику и ведение пациентов, что определяет необходимость их разработки и внедрения.

Ключевые слова: детский церебральный паралич, эпилепсия, расстройства аутистического спектра, нейрокогнитивные нарушения, дизартрия.

Introduction. Speech represents a complex integrative function of the central nervous system, ensured by the coordinated activity of cortical (frontal, temporal, parietal), subcortical, cerebellar structures, and conducting pathways [1]. In childhood, active processes of neurogenesis, synaptic plasticity, and myelination determine both the rapid development of speech and its high vulnerability to organic and functional brain disorders [2].

From the standpoint of pediatric neurology, speech disorders reflect structural or functional dysfunction of specific CNS regions. Their clinical characteristics depend on the level and timing of brain injury, the degree of nervous system immaturity, and the severity of associated cognitive impairments. Early speech delay often serves as a marker of perinatal brain injury or neurodevelopmental disorders [2,3].

Cerebral palsy (CP), epilepsy, and autism spectrum disorders (ASD) occupy a significant place in pediatric neurological pathology and are characterized by a high prevalence of speech impairments with distinct pathogenetic mechanisms [4,5]. In CP, speech disorders are mainly associated with damage to corticobulbar pathways, subcortical nuclei, and cerebellum, manifesting as dysarthria and pseudobulbar syndrome [6]. In epilepsy, speech disturbances are linked to epileptiform activity, focal cortical dysfunction (predominantly temporal-frontal), and long-term antiepileptic therapy, presenting as both transient and persistent cognitive-speech deficits [7]. In ASD, impairments are related to dysfunction of frontal-temporal neural networks responsible for social communication, resulting in predominant neurocognitive and pragmatic speech deficits without pronounced motor impairment [8,9].

Developmental language disorder (DLD) represents a functional impairment of cortico-subcortical networks involved in phonological processing and verbal memory, occurring in the absence of significant neurological deficits [10,11].

Despite numerous studies describing speech disorders in individual conditions, comparative clinical and neurological analyses focusing on pathogenetic mechanisms remain limited. Existing research is largely centered on speech therapy aspects, while neurological determinants of speech impairment are insufficiently systematized.

Thus, the research gap lies in the lack of an integrated comparative neurological framework for understanding speech disorders across different CNS pathologies.

Aim and Hypothesis: The present study aims to conduct a comparative clinical and neurological analysis of speech disorders in children with cerebral palsy, epilepsy, and autism spectrum disorders, with identification of key pathogenetic mechanisms and neurological factors influencing speech development, based on the hypothesis that speech impairments in these conditions differ significantly in their structure and underlying neurobiological mechanisms, thereby requiring a differentiated diagnostic and therapeutic approach.

Materials and Methods

Study design and setting. A cross-sectional observational study was conducted at a pediatric neurological department and outpatient consultation center.

Participants.

The study included 150 children aged 3–10 years (mean age 6.3 ± 1.7 years); 62% were boys and 38% girls.

Group formation. Participants were divided into four clinical groups:

- 40 children (26.7%) with cerebral palsy (CP);
- 38 children (25.3%) with epilepsy;
- 42 children (28%) with autism spectrum disorders (ASD);
- 30 children (20%) with developmental language disorder (DLD).

General criteria for all groups included: age 3–10 years, confirmed clinical diagnosis, and absence of severe sensory impairments (deafness or blindness).

Additional criteria for the DLD group were: absence of structural brain abnormalities on MRI, normal hearing, intelligence quotient (IQ) ≥ 85 , and absence of pronounced focal neurological deficits.

Examination procedures: All patients underwent a comprehensive assessment including:

1. clinical and neurological examination;
2. evaluation of motor function (using the Gross Motor Function Classification System in CP patients);
3. analysis of seizure type and frequency (in epilepsy);
4. electroencephalography (EEG);
5. magnetic resonance imaging (MRI) when clinically indicated;
6. assessment of higher cortical functions;
7. standardized neuropsychological testing.

Statistical analysis was performed using IBM SPSS Statistics version 25.0. Categorical variables were compared using the chi-square (χ^2) test. When appropriate, Fisher's exact test was applied. Results are presented as frequencies and percentages (n, %). A p-value of <0.05 was considered statistically significant.

Ethical considerations: The study was conducted in accordance with the principles of the Declaration of Helsinki. Informed consent was obtained from the parents or legal guardians of all participants. The study protocol was approved by the local ethics committee.

Results. A total of 150 children were examined. Speech disorders were identified with varying frequency depending on the nosological group.

In children with cerebral palsy (CP, $n = 40$), speech disorders were detected in 95% ($n = 38$) of cases. The structure was dominated by dysarthria - 34 (85%) and oromotor dysfunction - 29 (72.5%), while anarthria was observed in - 4 (10%) of patients. Pseudobulbar syndrome was identified in - 12 (30%) of cases. Delayed phrase speech formation occurred in - 18 (45%) of children. Clinical features varied by CP form: spastic dysarthria predominated in spastic forms, hyperkinetic articulation disorders in dyskinetic forms, and scanning speech in ataxic forms. The severity of speech impairment significantly correlated with motor deficit level (GMFCS III–V; $p < 0.01$) (Table 1).

In the epilepsy group (n = 38), speech disorders were observed in 65.8% of children (n = 25). The most frequent manifestations included slowing of speech production – 17 (44.7%), decreased verbal memory - 16 (42%), and postictal aphasia - 14 (36.8%). Dysphasic disorders were identified in – 9 (23.7%) of cases. Speech impairment was more common in focal epilepsy (72%) compared to generalized forms (56%). With disease duration exceeding 5 years, the prevalence of cognitive-speech deficits increased to 72%. Polytherapy was associated with reduced psycholinguistic processing speed (47%).

Among children with autism spectrum disorders (ASD, n = 42), speech disorders were detected in 92.9% (n = 39). The predominant features included impaired intonational modulation (73.8%) and echolalia (61.9%). Absence of phrase speech was noted in 35.7%, and regression of speech skills in 16.7% of cases. Although no gross motor deficits were observed, 66.7% of children demonstrated signs of neuromotor immaturity. Epileptiform activity on EEG was recorded in 42.8% of patients.

In the developmental language disorder group (DLD, n = 30), speech impairment was present in all children (100%). Expressive speech delay (60%) and grammatical structure impairment (70%) predominated. Phonemic perception deficits were observed in 56.7% of cases. Neurological examination revealed no focal deficits; however, mild coordination disturbances (26.7%), synkineses (23.3%), and fine motor immaturity (40%) were noted. MRI findings were normal, and EEG showed no significant epileptiform activity.

Table 1. Frequency and structure of speech disorders in different nosological groups

Group	N	Speech disorders (%)	Main speech manifestations	Neurological / instrumental findings
Cerebral palsy (CP)	40	95% (n=38)	Dysarthria – 85% (n=34); oromotor dysfunction – 72.5% (n=29); anarthria – 10% (n=4); delayed phrase speech – 45% (n=18)	Pseudobulbar syndrome – 30% (n=12); motor-dependent speech impairment
Epilepsy	38	65.8% (n=25)	Slowed speech production – 44.7% (n=17); reduced verbal memory – 42% (n=16); postictal aphasia – 36.8% (n=14); dysphasia – 23.7% (n=9)	Higher frequency in focal epilepsy (72%) vs generalized (56%); ↑ with disease duration >5 years (72%); polytherapy → reduced psycholinguistic speed (47%)
Autism spectrum disorders (ASD)	42	92.9% (n=39)	Impaired intonation – 73.8%; echolalia – 61.9%; absence of phrase speech – 35.7%; speech regression – 16.7%	Neuromotor immaturity – 66.7%; EEG epileptiform activity – 42.8%; no gross motor deficits
Developmental language disorder (DLD)	30	100% (n=30)	Expressive delay – 60%; grammatical impairment – 70%; phonemic perception deficit – 56.7%	No focal neurological deficits; coordination disorders – 26.7%; synkineses – 23.3%; fine motor immaturity – 40%; MRI normal; EEG without epileptiform activity

Comparative analysis demonstrated statistically significant intergroup differences (Table 2). The motor component of speech disorders was significantly higher in CP (85%) compared to epilepsy (34%), ASD (19%), and DLD (10%) ($p < 0.01$). Structural CNS lesions and focal neurological symptoms were most prevalent in CP and least common in DLD ($p < 0.001$).

Table 2. Intergroup comparison of key clinical parameters

Variable	CP (n=40)	Epilepsy (n=38)	ASD (n=42)	DLD (n=30)	Statistical significance
Motor component of speech disorder (%)	85%	34%	19%	10%	$p < 0.01$
Structural CNS lesions (%)	High prevalence	Moderate	Low	Minimal/none	$p < 0.001$
Focal neurological symptoms (%)	High prevalence	Moderate	Rare	Absent/minimal	$p < 0.001$

Discussion. The findings indicate that speech disorders in children with different CNS pathologies have distinct pathogenetic mechanisms.

In CP, speech impairment is primarily determined by structural damage to corticobulbar pathways and subcortical structures, resulting in predominantly motor (dysarthric) deficits.

In epilepsy, speech disturbances are associated with functional cortical instability and epileptiform activity, leading to variable and often transient cognitive-speech impairments dependent on seizure characteristics and disease duration.

In ASD, speech disorders reflect dysfunction of distributed neural networks responsible for social communication, with predominant impairment of pragmatic and intonational aspects rather than motor articulation.

In DLD, the absence of structural CNS pathology suggests a functional immaturity of cortico-subcortical networks involved in phonological processing and grammatical organization. The presence of minimal neurological signs supports the role of subtle neurodevelopmental dysfunction.

Thus, the obtained results confirm the heterogeneity of speech disorders and emphasize the necessity of a differentiated neurological approach to diagnosis and rehabilitation.

Conclusion. The present study demonstrated that speech disorders in children with cerebral palsy, epilepsy, autism spectrum disorders, and developmental language disorder differ significantly in their structure and underlying neurological mechanisms. In cerebral palsy, speech impairment is predominantly associated with structural damage to corticobulbar pathways and is closely correlated with the severity of motor deficit. In epilepsy, speech disorders are mainly functional-cortical, showing variability depending on seizure characteristics, disease duration, and treatment factors. In autism spectrum disorders, impairments are primarily related to dysfunction of neural networks responsible for social communication, with predominant involvement of pragmatic speech components. In developmental language disorder, speech deficit occurs in the absence of structural CNS damage and is associated with functional immaturity of speech-related neural systems, accompanied by minimal neurological signs. These findings confirm the

heterogeneity of pathogenetic mechanisms underlying speech disorders and substantiate the necessity of a differentiated clinical and neurological approach to diagnosis, prognosis, and selection of individualized therapeutic strategies.

Conflict of Interest. The authors declare no conflict of interest. The authors have no financial or other relationships that could have influenced the results presented in this manuscript.

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