

EPILEPSY

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Developmental disorders in epileptic children

SUMMARY

In cases of developmental age epilepsy, development disorders may increase as symptoms, on the one hand, of progressing biological changes, negative psychosocial factors and unintended effects of pharmacological treatment, thus, resulting in neuro-disintegration. The assessment of the motor, cognitive and communication skills of a child with epilepsy enables determination of the kind and range of disorders, the dynamics of motor and cognitive processes.

Keywords: epilepsy, speech development disorders, cognitive disorders, emotion disorders, motor disorders

1. INTRODUCTION

Epilepsy and its treatment influence the operation of the brain. The brain controls human cognition and all the other human functions. Epilepsy disrupts cognition while disturbed functioning of the nervous system affects psychomotor development disorders. Epilepsy as a chronic and recurring disorder can manifest itself in disruptions to neurobiological, cognitive, social and socio-emotional processes (Fischer 2005).

The problem of epilepsy in children and young people is significantly more complex than that of epilepsy in adults, and the reason for this is neither its frequency nor the prognosis. The multitude of interrelated pathogenic factors of various intensity in children at different stages of broadly-understood development leads to a considerable variety of deviations from the norm, which differ in their intensity and the configuration of symptoms.

The multifaceted clinical picture of childhood epilepsy and the variety of treatment methods require the use of multi-specialist procedures. The diagnostic and rehabilitative team includes a paediatric neurologist, a paediatric psychiatrist, a logopedist, a physiotherapist, a psychologist and a special needs teacher. Their tasks encompass the evaluation of the child's development in the individual areas of his functioning, regular checks and treatment. In the broadest of terms these concern the child's biological, mental, cognitive, motor, emotional as well as linguistic and communication development. Logopedists perform a special role in the process of diagnosis and treatment: planning therapies to stimulate the development of language and communication skills, i.e. the most complex competences, requires that they take into consideration the information from the other specialists (Kozłowska 2015: 356).

All the areas of the child's functioning need to be stimulated through all-developmental therapy, which is part of the integration trend and supports the development of psychomotor as well as emotional and motivational processes. A well-planned early therapy enables the child to compensate for the deficits and, consequently, to fully participate in social life, the quality of which also improves.

Recognizing the need for the multidirectional stimulation of development in epileptic children, this study aims to discuss the most common dysfunctions in the cognitive, emotional motor and language areas. The diagnosis of deficits in the individual areas of the child's functioning makes it possible to directing rehabilitation activities towards elimination or minimisation of disintegration changes.

2. FACTORS AFFECTING THE PATTERN OF DISORDERS IN EPILEPSY

The occurrence of developmental disorders in epileptic children and the pattern of these disorders are determined by multiple factors. The first category consists of biological factors related to epilepsy: the age when the first seizures occurred, the form of seizures, the location of disturbances in the bioelectric brain activity and the frequency of the seizures. The second category encompasses factors related to treatment, i.e. the so-called drug-induced symptoms. The third category includes environmental variables related to the attitude of the family and school environments to the child's disorder (Table 1).

The biological, pharmacological and environmental factors that influence the pattern of disorders in epilepsy may disturb the child's healthy development in all the areas of his functioning.

Table 1. The variables determining the pattern of developmental disorders in epileptic children (Kozłowska, Panasiuk 2015)

No.	Factor type	Factor description	Factor consequences
1.	biological	time of first seizure	the earlier the first seizure occurs, the more serious the negative consequences for the child's development
		form of seizures	from mild myoclonic seizures (with spasms usually in the limbs and face), through absence seizures occurring even several times a day, to more alarming large tonic-clonic seizures
		location of the epileptic focus in the brain	the most serious consequences are associated with seizures located in the temporal and frontal lobes of the brain
		seizure frequency	each subsequent seizure increases the risk of dementia
		occurrence of status epilepticus	loss of consciousness lasting more than 30 minutes and the resulting brain hypoxemia may lead to irreversible damage to the brain
		duration of disorder	prolonged influence of pathogenic factors causes worsening of developmental deficits
2.	pharmacological	pharmacological treatment	may be neurotoxic and negatively influence the functioning of the nervous system; antiepileptic drugs reduce neuronal excitability and, consequently, seizures; however, since the influence is of global character, the activity of neuronal systems involved in the development and sustainability of cognitive functioning may also be reduced
3.	environmental	overprotectiveness of parents and other family members	limiting the child's physical activity and contact with peers
		rejection and fear among people in the child's environment	lack of understanding; stigmatising the child by educators and school environment

3. THE PATTERN OF DISORDERS IN EPILEPSY

The above-listed pathogenic factors cause a wide range of deviations from developmental norms, from mild deficits in a few areas to neurodegeneration in the case of drug-resistant epilepsies following a severe course. Research results show that, even in children whose intellectual and motor development is not dis-

turbed, the chronicity of epilepsy and its treatment cause the emergence of deficits in language development, communication skills, cognitive and mental functions as well as emotional and motor functioning.

3.1 Cognitive disorders

The emergence of epilepsy in childhood and the accumulated effect of pathogenic factors may lead to the retardation or arrest of mental development as well as to the loss of acquired skills. Also temporary cognitive deficits connected with the occurrence of subclinical bioelectric discharges and with antiepileptic treatment are characteristic of the group in question. Cognitive disorders manifest themselves in disturbances in memory, thought, perception, attention and concentration. Disturbances in perception, especially auditory, and also, less often, visual, are the most common cognitive disorders.

One of the first symptoms of the development of pathophysiological processes is memory disturbances. Memory deficits in epileptic children frequently emerge before the symptoms of epilepsy manifest themselves. Even their mild forms are bothersome, therefore, they are quickly diagnosed by the patient's relatives. Maintaining memory disturbances paired with the emergence of other cognitive disorders may indicate the development of a neurodegenerative process. Many researchers' results show that epilepsy may be a progressive disorder leading to dementia changes. According to some statistics, the dementia syndrome occurs in 20 to 30 per cent of patients (Grabowska 2005: 56), while even 45 per cent of patients lose the acquired knowledge and skills to a greater or lesser extent (Siemianowski 2008: 30). The factors that increase the risk of dementia include organic changes in the CNS, the duration of seizures even if there are no organic changes, the location of the epileptic focus in the temporal lobe, status epilepticus, tonic-clonic seizures, drug resistance and inadequate medical treatment.

Thought disturbances manifest themselves mainly in the retardation of thought processes and their diminished flexibility. Epileptic children are diagnosed with problems with independent reasoning, inference and problem-solving. Additionally, lower resistance to various positive and negative stimuli, emotional control disorders and persistence of affect complete the picture of thought disturbances.

Compared to their healthy peers or siblings, epileptic children display deficits in visual-motor coordination, impaired kinaesthesia and kinesis, inappropriate evaluation of spatial relations and diminished pace of visual-motor learning (Lezak, Howieson, Loring 2004). The disturbances in the development of perception-motor skills restrict general activity and as a result become the reason for learning difficulties. According to Ewa Mojs's research, 37 per cent of epileptic children report learning difficulties, compared to 4 per cent in the statistically significant control group of healthy children (Mojs 2011). Problems concern mainly

the acquisition of reading and writing skills, reading comprehension skills, retention of the learnt material and calculating. Another considerable problem with rehabilitation planning is attention and concentration disorders: low divisibility of attention, impaired ability to select stimuli, and inability to focus on the task result in a diminished ability to understand and form concepts as well as in superficiality of judgement.

Polish and foreign researchers' results point to a correlation between the location of discharges and specific disorders (Engel 2001; Kotagal, Luders, Williams, Nichols 1995; Halczuk 2005). Depending on the type of epilepsy, the patients with generalised seizures which affect the whole brain show more serious deficits than those with focal seizures. Classifying epilepsies into syndromes may also have prognostic value. Iwona Halczuk's research conducted on a group of 251 people indicates a correlation between the location of discharges and specific symptoms. Among patients with juvenile myoclonic epilepsy there is a higher risk of impairment of frontal functions: abstract reasoning, planning and mental flexibility. Children suffering from mild epilepsy with discharges in the temporal area have worse results in terms of IQ, memory, visual perception, verbal fluency and movement precision (Halczuk 2005: 363–370).

Summing up, epileptic children display symptoms of diminished cognitive activity, limited interests and restricted general activity, all of which form the typical pattern of cognitive limitations. Researchers observe deteriorating results in psychological tests as the disturbances in bioelectric brain activity become more serious. Intelligence, as the most complex function, is relatively the rarest one to deteriorate. "In most probability, this is connected with the fact that a number of distant brain areas are involved in the execution of this function as well as with the existence of neuroplasticity phenomena in the nervous system" (Mojs 2001: 60).

3.2 Emotional disorders

The diagnosed cognitive deficits correlate significantly with disturbances in the emotional and motivational area. In broad terms, these can be divided into primary and secondary ones. Primary emotional disorders, like cognitive disorders, may be triggered by the factor that caused epilepsy, may be caused by damage to the CNS in the course of epilepsy or be associated with pharmacological treatment. Secondary emotional disorders emerge as a result of inadequate reactions in the child's environment, especially from parents and peers. Thus, emotional disorders may be of organic and/or situational-environmental aetiology (Mojs, Gajewska, Głowacka, Samborski 2007: 82).

In the source literature, the most frequently quoted disorders include personality, mood, anxiety and behaviour disorders (Kanner, Soto, Gross-Kanner 2004). In the Polish source literature, the personality disorders that are typical of

epilepsy are known as *epileptoid characteropathy* [*charakteropatia epileptoidalna*] The features of *epileptoid characteropathy* encompass diminished cognitive activity, limited interests, suggestibility, rigid and retarded thinking, prolixity of speech, pedantry, and, in the emotional area, fussiness, irritability, quick temper, mood swings, persistence of emotions, egocentricity and hypochondriacal attitude (see Harris, Barraclough 1997; Kościelska 1971: 207). However, the once commonly-held view that epilepsy sufferers have “epileptic personality” has been abandoned.

Depression is the most commonly diagnosed mood disorder in epilepsy sufferers. The percentage of depression sufferers among patients with epilepsy is significantly higher than in the general population, it can thus be assumed that the factors connected with epilepsy increase the risk of depression. In the case of depressive disorders, there is also a higher risk of suicidal thoughts and attempts. Different types of anxiety disorders, mood swings and inadequate emotional reactions are significantly more common in epileptic patients than in the general population (Mojs 2011: 71).

Primary emotional disorders are strictly linked to the disturbances in the functioning of the brain. The pathological symptoms of emotional disorders in epileptic children, such as behaviour disorders, mood swings, psychomotor hyperactivity, irritability, aggression and others, are also quoted in the descriptions of the consequences of other disorders associated with organic brain damage. Ewa Mojs’s research results confirm that children with epilepsy of specific aetiology experience disturbances in the emotional area more frequently and to a larger extent than those with idiopathic epilepsy. The duration of the disorder significantly influences the development of emotional disturbances in terms of such traits as shyness and anger. The epileptic patients undergoing monotherapy display higher levels of fear understood as the state at the time of testing than the group treated with two drugs. The early onset epilepsy with a long history of treatment is a risk factor in the emergence of difficulties in interpersonal relationships (Mojs 2011: 71).

The dynamics of the child’s emotional development are affected by the disorders caused not only by biological factors, but also by the attitudes of people in his close environment. Epileptic children more frequently display emotional lability, high levels of aggression and psychomotor hyperactivity if their parents and other people around them adopt negative attitudes, such as overprotectiveness, inconsistency or rejection.

Research results reveal a correlation between the development of cognitive functions and emotions: cognitive disorders cause an increase in emotional disturbances, whereas disturbances in emotional states adversely affect the development of cognitive functions (Davidson, Irwin 1999).

3.3 Mental disorders

Not infrequently, the symptoms of epileptic seizures take the form of mental disorders. A distinction must be made between neurologically-based and psychogenic mental symptoms, as, although they are similar, their causes and mechanisms differ. Some psychopathological syndromes are to a greater or lesser extent characteristic of epilepsy; the most common being psychogenic pseudo-epileptic seizures and dysthymic disorders. However, the majority of psychiatric problems occur independently of the development of epilepsy although even in such cases it is impossible to exclude the influence of factors connected with the sufferer's life circumstances, etc. Such problems include: depressions, delusional states, personality disorders as well as the abuse of alcohol and psychoactive substances (Rajna, Baran, Farkas, Veres 2005).

Mental disorders can co-occur with epilepsy, but may also be caused by recurring seizures and/or inadequate antiepileptic treatment. Factors increasing the risk of the development of mental disorders associated with epilepsy and its treatment include (Huć et al. 2005: 322):

A. a group of factors independent of epilepsy – the occurrence of mental disorders in the patient's history, genetic predisposition (the occurrence of mental disorders in the patient's family), psychosocial predisposition that is stronger in the patient than in the rest of society;

B. a group of factors connected with epilepsy – the duration of epilepsy, the frequency and severity of seizures, the type and origin of epilepsy syndrome as well as the location of the epileptic focus.

Aniela Popielarska divides mental disorders occurring in epileptic children into acute and chronic mental disorders. The acute disorders are most commonly connected with the location of the epileptic focus in the temporal lobe. "The multitude of connections determines the diversity of symptoms; these include: perception disorders, intellectual difficulties, affective and emotional problems, disturbed sense of time and psychomotor symptoms" (Popielarska, Popielarska 2000: 302–306). Psychoses are rare in epileptic children; if they do occur, they are usually connected with the damage to the structure of the CNS, especially located in the temporal lobe, and with the co-existing mental impairment.

3.4 Psychomotor disorders

Epilepsy makes it impossible for the child to do exercise and improve fitness. Epileptic children do not participate in peer play, school clubs, trips and camps; they are exempt from Physical Education classes. Additionally, they are frequently hospitalised and their parents tend to impose restrictions on their activity, which weakens stimulation that is necessary for normal motor development. The children who do not have any physical activity achieve poorer results in fitness tests, display disturbed motor coordination and balance, and move clumsily.

The neurobiological origin of the pathological process causes lower resistance to stimuli, especially the strong and lasting ones. This, consequently, leads to the child withdrawing from any activity. Increased fatigability and motivation disorders cause additional difficulty during rehabilitation.

In comparison to their healthy siblings and peers, epileptic children display dyspraxia-type motor disorders more frequently. The most common symptoms of dyspraxia include: incoordination, problems with fine and gross motor skills, disturbed proprioception, impaired kinesis, deficits in visual-motor coordination, disturbances in the development of perception-motor integration. From the logopedic point of view, this type of dyspraxia causes problems with articulation, which is connected with limited mobility of the articulatory apparatus and difficulties in acquiring reading and writing skills. According to some authors, almost 50 per cent of the children have poor graphomotor skills, while 20 per cent have been diagnosed with dyslexia- or dysgraphia-type disorders (Mojs, Gajewska, Głowacka, Samborski 2007: 83). These disorders are also characterised by slowness, lack of flexibility in behaviour and a poor level of general activity.

The characteristic motor disorders encompass different types of paresis: hemiparesis, paresis of lower or upper limbs, and paresis of facial muscles. These may be temporary if they are connected with seizures (they may precede a seizure or continue for some time after the seizure), or permanent if they result from organic damage to the brain. In the latter case, they require long, multi-specialist rehabilitation.

3.5 Language and communication disorders

Language and communication disorders are widespread among epileptic children, but their severity differs and is not comparable: the onset of epilepsy at various stages of speech development leads to different consequences for the child's linguistic functioning. Research results indicate that 20 per cent of epileptic children display language difficulties, "most commonly, problems with speech generation and comprehension, phonological processing and verbal fluency" (Nieminen, Eriksson 2009: 378). Learning difficulties typical of epileptic children affect reading, writing, reading comprehension and mathematical skills.

Language and communication disorders, like the developmental disorders in all the above-described areas, may be divided into paroxysmal and permanent. Some focal seizures in which the epileptogenic focus is located near the speech centre involve speech disturbances. "These seizures fall into two groups. The so-called dysphasic seizures consist in bioelectric charges spreading from the area of the cerebral cortex in which language centre is located and cause disturbances in speech production or comprehension. The other category refers to epileptic speech arrests caused by disturbances in bioelectric activity in the lower part of the central sulcus (the fissure of Rolando) or in the supplementary motor area. In

the latter case, the patient is unable to utter words but is capable of comprehension and inner speech” (Dowżenko 1980: 421). Permanent language disorders are caused by long-lasting disturbances in bioelectric brain activity, by brain damage or by the applied antiepileptic treatment.

Language disorders among school-age epileptic children vary, and, according to the logopedic typology of speech disorders, they belong both to the group of deficits connected with undeveloped language competence and to the category of articulation disorders; in many cases they are also connected with the loss of acquired language and communication competence (Grabias 2001). Depending on the relationship between the time the disorders manifest themselves and the time of epilepsy onset, they can be divided into primary and secondary ones. Primary language disorders are caused by the same factors as epilepsy, namely disturbances in the functioning of the nervous system or damage to the nervous system. The second category includes disturbances in the development of language and communication secondary to epilepsy and occurring due to factors connected with it.

As is the case with psychomotor and emotional disorders, the severity and nature of the language disorders observed in epilepsy depend on the combination of many factors. However, what is of primary importance in the case of communication is the moment of the onset of seizures in relation to the degree to which communication skills have been acquired. Early onset epilepsy, which manifests itself in the first two years of life, i.e. during the prelingual stage, may lead to delays in the acquisition of language competence or even to the child’s inability to acquire it. The child does not develop speech or develops it more slowly. The assessment of intellectual development in an epileptic child must be conducted with utmost care as the pattern of disorders may be affected by both the current state of the brain’s functioning, which is disturbed by the morbid process, and by medication. Children with epilepsy whose onset occurred in the perilingual stage may not fully develop communication skills, which leads to aphasia-type speech underdevelopment (Panasiuk 2008). The underdeveloped perception skills in the functioning of analysers or phonemic hearing can cause speech disorders as well as difficulties in acquiring school skills, especially reading and writing.

According to Halina Spionek, 10 to 15 per cent of the Polish population suffer from dyslexia while according to Bogdanowicz the disorder affects 9 to 10 percent of Poles. When studying the diversity of neuropsychological changes in people whose abnormal EEG records showed spike discharges in the central-temporal area, the researchers diagnosed 30 per cent of the subjects with dyslexia (Wendorff, Wiśniewska 2006: 295). These authors assume that both focal epilepsy with discharges near the language centre and dyslexia are caused by genetic disturbances in the development of the cerebral cortex. Additionally, children with epilepsy and acquired damage to CNS structures may experience difficulties connected with the loss of reading and writing skills. Such difficulties are then diag-

nosed as acquired alexia/dyslexia and agraphia/dysgraphia.

The prolonged effect of pathogenic factors in children who have acquired language competence may lead to the arrest of cognitive development and occasionally even to the loss of the acquired skills. In such cases, in connection with the regression of language functions, the children are diagnosed with childhood aphasia. Language disorders (quasi-aphasic) in epileptic children can take various forms. In some cases they are temporary speech disturbances with hemiparesis, which is evidence of focal seizures with the epileptic focus located in the language centre. Such disturbances may occur suddenly and disappear as the seizure ends. In other cases, language disorders may begin suddenly or gradually and take the aphasia-specific form of disturbances in perception or expression, or both, which are relatively long-lasting and independent of the dynamics of seizures. A thorough analysis is necessary before an epileptic child can be diagnosed as suffering from aphasia. Epileptic children often display an atypical language organisation in the brain. "In epilepsy, while abnormal electrical activity, which may disrupt brain function, there may be reorganization of functional units over time so that cognitive ability is preserved" (Gross, Golby 2009: 162). The transfer of the speech centre depends on the patient's age and is determined, primarily, by the neuroplasticity of the brain and its capacity for compensation¹.

Milder language disorders manifest themselves in limited lexical-semantic skills, i.e. poor vocabulary and a restricted set of concepts, and in verbal fluency disorders. Furthermore, they also frequently affect the syntax, with patients building short simple sentences, often grammatically inaccurate. From the logopedic point of view, all the disorders and difficulties connected with language and communication skills are most evident in narrative. The observed irregularities include problems with the narrative structure, lack of coherence in the presented chain of events, tendency to digress and difficulties with the organisation of utterances, which, in turn, result in the utterances being inappropriate socially and/or morally.

In some other cases disturbances in linguistic competence and skills may gradually worsen in the course of the disorder, together with the deterioration of other cognitive functions. Eventually, the child loses the knowledge and skills they acquired. The temporal lobe is especially prone to bioelectric disturbances and also extremely sensitive to them.

Epileptic children tend to display additional articulation problems, especially dysarthria-type disorders and acquired stuttering, more frequently than the general population. Research results indicate that seriously reduced fluency of speech is observed in 50 per cent of patients with drug-resistant epilepsy (Grabowska-Grzyb 2005: 56). Such problems occur in patients with structural brain damage;

¹ Atypical organisation is more frequent in epileptic patients than in the general population, which supports the hypothesis that damage to the brain in epilepsy leads to language reorganisation.

however, their temporary form is also observed during seizures and in the perictal period (preceding the seizure and continuing for some time after the seizure ends) as an increase in muscle tone and/or convulsions in the face, throat and larynx.

Epilepsy and its treatment disturb the functioning of the brain, and consequently limit a person's capacity for cognition. This influence is especially significant in childhood, when individual skills are developed and perfected. A well-planned early therapy enables epileptic children to compensate for the deficits, regain the lost skills and, as a result, participate fully in social life.

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