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Our experience of pediatric epilepsy surgery

Kostiantyn R. Kostiuk, Viacheslav M. Buniakin

Department of Functional
Neurosurgery and Neuromodulation,
Romodanov Neurosurgery Institute,
Kyiv, Ukraine

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Address for correspondence:

Kostiantyn R. Kostiuk, Department
of Functional Neurosurgery and
Neuromodulation, Romodanov
Neurosurgery Institute, 32 Platona
Maiborody st., Kyiv, 04050, Ukraine,
e-mail: kostiuk.neuro@gmail.com

Objective: to evaluate the effectiveness and safety of different operations in children with drug-resistant epilepsy.

Materials and Method. 91 children with drug-resistant epilepsy were enrolled in a retrospective study. Mean age was 10.3 ± 5.1 years. Anterior temporal lobectomy was performed in 16 (57.1%) patients, lesionectomy – in 9 (10.0%), microsurgical callosotomy in 18 (19.8%), stereotactic callosotomy in 7 (7.7%), multifocal resections in 4 (4.4%), functional hemispherotomy in 14 (15.6%). Stereotactic radiofrequency callosotomy was performed on a CRW Stereotactic frame (Radionics Inc., USA). Ultrasound navigation and neuronavigation were used in 6 (7%) and 14 (15%) cases correspondingly. Intraoperative corticography was applied in 8 (9%) cases. Postoperative long-term follow-up lasted from 1 to 17 years (mean – 8.2 ± 2.1 years).

Results. An epileptogenic zone within single hemisphere was identified in 66 (72.2%) cases, while bilateral epileptiform activity was observed in 25 (27.5%) children. The most common etiologies of epilepsy included hypoxic-ischemic encephalopathy, intracerebral hemorrhage, meningoencephalitis, Rasmussen syndrome, cortical dysplasia, tumors.

After surgery 51 (56%) patients became seizures free (Engel 1), 14 (15.4%) patients had rare auras or focal seizures (Engel 2). In 25 (27.5%) cases, seizure frequency reduction was less than 75% or did not change significantly. The most favorable outcomes were associated with resection procedures, resulting in complete seizure control in 46 (69.7%) out of 66 children, with significant improvement observed in 9 (13.6%) cases. After callosotomy drop-attacks stopped in 14 (78%) out of 18 who had them before surgery. Operative complications were encountered in 6 (6.6%) cases, postoperative mortality occurred in 1 (1.1%) case.

Conclusions. The key to the effectiveness of surgical treatment of childhood epilepsy is early surgical intervention, which leads to the control of epileptic seizures, correction of psychological and cognitive emotional disorders and improvement of quality of life. The combination of resection procedures and disconnections contributes to the reduction of epileptogenic neurons and suppression of epileptic discharges.

Key words. pediatric epilepsy; anterior temporal lobectomy; lesionectomy; callosotomy; hemispherotomy

Introduction

Pediatric epilepsy has unique characteristics in terms of disease progression, diagnostic approaches, and treatment strategies. According to epidemiological studies, epilepsy is most often observed in children under one year of age. The prevalence of the disease at this age ranges from 100 to 233 cases per 100,000 population. In adolescents, the prevalence of epilepsy decreases to 60 cases per 100,000 population, in young men and adults – to 30–40 new cases per 100,000 population. Currently, about 10.5 million children suffer from epilepsy. The annual incidence varies from 61 to 124 cases per 100,000 population in developing countries, and from 41 to 50 cases per 100,000 population in developed countries [1–3].

Pediatric epilepsy is characterized by a high frequency of severe, disabling epileptic seizures, high resistance to antiepileptic therapy, the presence of gross structural changes in the brain, rapid development of epileptic encephalopathy, cognitive impairment, and psychoemotional disorders. A majority of children with epilepsy have comorbid conditions (mental retardation, learning difficulties, behavioral disorders, attention deficit and psychosocial problems) [4, 5].

The task of surgical treatment of pediatric epilepsy is not only to stop epileptic seizures, reduce the number and doses of antiepileptic drugs (AEDs), prevention of side effects of long-term continuous drug therapy, as well as the development of epileptic encephalopathy, which is the main factor that worsens social life of

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children and their relatives. Factors that play a leading role in the development of epileptic encephalopathy (high frequency of epileptic seizures, constant interictal epileptiform activity of the brain, development of secondary epileptogenesis, long-term use of AEDs) have been established. Therefore, in case of a rapid course of epilepsy or the development of a pharmacoresistant form is predicted, surgical intervention should not be delayed [6, 7].

Unlike adults, children's brain has powerful plastic properties. It has been proven that when functionally important areas are affected, other brain areas can perform their functions, ensuring the quality of life of patients. Such high plasticity of the brain substantiates the possibility of safe multilobar resections, functional hemispherotomies and resections of large epileptogenic brain areas [8–10].

The key to high efficiency of surgical treatment of epilepsy is resection of the epileptogenic zone and the focal structural brain lesion responsible for the onset of epilepsy. The epileptogenic zone consists of neurons that, for various reasons, generate epileptic discharges that spread in individual areas or throughout the brain and lead to the development of epilepsy [11, 12]. Modern neuroimaging and electrophysiological techniques make it possible to determine with high accuracy the epileptogenic zone and the pathways of spreading paroxysmal activity [13, 14].

In the world, and in particular in Ukraine, the number of neurosurgical centers and specialists who perform various surgeries in the treatment of pediatric epilepsy is increasing. The key to effective surgical treatment is the possibility of conducting comprehensive clinical and instrumental preoperative examination, the use of modern neurosurgical technologies and the implementation of a multidisciplinary approach to determining the indications and type of neurosurgical intervention.

Objective: to evaluate the effectiveness and safety of different operations in children with drug-resistant epilepsy.

Materials and methods

Study participants

91 children with various forms of epilepsy were included in the retrospective study. All these children underwent surgery at the Institute of Neurosurgery named after Acad. A.P. Romodanov of the National Academy of Sciences of Ukraine in the period from 2006 to 2022.

Informed and voluntary written consent to participate in the study was obtained from all patients.

The study was approved by the Committee on Ethics and Bioethics of the Institute of Neurosurgery named after Acad. A.P. Romodanov of the National Academy of Sciences of Ukraine (Minutes No. 2 dated April 15, 2019).

Inclusion criteria

Candidates for surgical treatment were patients with structural brain lesions of various etiologies, frequent epileptic seizures, resistant to antiepileptic

therapy, and progressive psychoemotional disorders. The patients underwent comprehensive clinical and instrumental examination to determine the localization of epileptogenic zone of the brain and spread of epileptic activity. Based on the obtained data, indications and type of surgical intervention were determined, its efficacy was predicted, and the risk of possible complications was assessed.

Characteristics of the group

The age of children ranged from 1 year 3 months to 18 years (mean age – 10.3 ± 5.1 years). The following surgical interventions were performed: anterior temporal lobectomy (ATL) – 39 (43.3%) patients, epileptogenic zone removal, lesionectomy (LE) – 9 (10.0%), microsurgical callosotomy (MC) – 18 (19.8%), stereotactic callosotomy (SC) – 7 (7.7%), multifocal resections (MFR) – 4 (4.4%), functional hemispherectomy (FH) – 14 (15.6%). Anterior temporal lobectomy was supplemented by resection of the amygdalohippocampal complex in 26 (66.7%) cases. The indication for such an operation was the presence of a structural lesion in the mediobasal divisions of the temporal lobe. In 13 (33.3%) patients who had neocortical (lateral) temporal lobe epilepsy, surgery was limited to the removal of the pole, inferior, middle and anterior sections of the superior temporal gyri. Anterior extended MC, during which the knee and two-thirds of the trunk of the corpus callosum were transected, was performed in 7 patients, the rest underwent total MC, which involved a transection of the knee, the entire trunk and the corpus callosum splenium. Four children who underwent anterior MC were reoperated to transect the posterior part of the corpus callosum. In two cases, MC was performed by microsurgery, and in another two - by the method of stereotactic radiofrequency (RF) destruction.

Study design

Standard preoperative examination involved history taking, neuropsychological examination, electroencephalography (EEG) and magnetic resonance imaging (MRI) of the brain according to the "Epilepsy" protocol (1.5 T). Long-term video-EEG monitoring was used in 42 (46%) children, high-field MRI (3.0 T) - in 22 (24%). MRI tractography (8 (9%) cases), single-photon emission computed tomography (8 (9%)), SISCOM (6 (7%)), positron emission tomography (6 (7%)), MRI spectroscopy (2 (2%)) were performed when necessary.

Radiofrequency SC was performed using a CRW Radionics stereotactic frame (Radionics Inc., USA). Destruction target planning was performed using ImageFusion, AtlasPlan, (Radionics Inc., USA) and ELEMENT (Brainlab, Germany) software. During microsurgical interventions, ultrasound navigation was used in 6 (7%) cases, neuronavigation - in 14 (15%), intraoperative corticography - in 8 (9%).

The effectiveness of surgical intervention was assessed using the Engel scale [15]. For the most objective assessment of the surgical outcome, antiepileptic therapy was not changed during the first 6 months after surgery. In most observations, the efficacy of treatment was evaluated 6 months, 1 and 2

This article contains some figures that are displayed in color online but in black and white in the print edition.

years after surgery. Thereafter, follow-up examinations were performed annually. Postoperative follow-up was conducted over a period ranging from 1 to 17 years (average - (8.2 ± 2.1) years): in 3 years after the surgery - in 90 (98.9%) patients, in 5 years - in 82 (90.0%) patients.

Statistical analysis

Statistical data processing was performed using traditional methods of parametric statistics. Arithmetic mean value, its standard error and root mean square deviation were calculated. The critical value of statistical significance level was taken as 0.05 (5%).

Results and their discussion

All patients suffered from pharmacoresistant epilepsy. In most cases, there was a severe course of the disease, which was manifested by frequent, sometimes serial epileptic seizures, recurrent status epilepticus, cognitive and psychoemotional disorders (**Table 1**).

The most severe course of epilepsy was observed in children who underwent callosotomy. Most of them had daily polymorphic, often traumatic seizures occurring during the first months of life, distinct psychomotor developmental delays, and cognitive impairment, whereas in children who underwent FH and MFR, cognitive and psychoemotional disorders were minimal or absent, despite the significant duration of epilepsy and high frequency of seizures. In children with temporal lobe epilepsy who underwent ATL, emotional disorders in the form of behavioral disturbances, aggressiveness were predominant, and cognitive disorders appeared to be a moderate hypomnesic syndrome.

An epileptogenic zone within single hemisphere was identified in 66 (72.5%) patients, while bilateral epileptiform activity was observed in 25 (27.5%) children. These 25 patients underwent palliative surgery - callosotomy, the purpose of which was to block the spread of epileptiform activity from one hemisphere to the other.

The most common etiologies of epilepsy included perinatal hypoxic-ischemic encephalopathy, consequences of intracerebral hemorrhage and

meningoencephalitis (viral, bacterial), median temporal sclerosis, temporal lobe pole atrophy, Rasmussen's encephalitis, lesions due to disorders of neuronal and glial proliferation (cortical dysplasia, hemimegalencephaly) (**Table 2**).

The best results were obtained in patients who underwent resection operations aimed at removing the epileptogenic zone with the maximum number of neurons generating paroxysmal epileptiform activity. In 46 (69.7%) out of 66 such patients epileptic seizures ceased (Engel 1), 9 (13.6%) showed significant improvement (Engel 2), and in 5 (7.6%) the surgical intervention was ineffective (Engel 3 and 4). Almost complete cessation of seizures was recorded in 4 (100%) patients after MFR and FH. After ATL, control of epileptic seizures (Engel 1 and 2) was achieved in 34 (87.2%) of 39 patients, the surgery was ineffective (Engel 3 and 4) in only 5 (12.8%) cases (**Table 3**). After LE, complete cessation of seizures or significant improvement (Engel 1, 2) was noted in 7 (77.8%) observations. In 2 (22.2%) cases, the surgery was ineffective. In these patients, the cause of epilepsy was diffuse cortical dysplasia. In our opinion, the low efficacy of the surgery is associated with incomplete removal of the epileptogenic zone.

After callosotomy, complete cessation of seizures was achieved in 2 (8%) of 25 operated children. The operation was ineffective (Engel 3 and 4) in all children who underwent anterior MC, so 4 of them underwent extended total callosotomy as the second stage, which contributed to a significant improvement of the patients' condition in 3 observations. Cessation of seizures in the form of drop attacks was recorded in 14 (78%) of 18 children in whom they occurred before surgery. This is a high rate justifying the expediency of callosotomy, since such attacks are traumatic. Children with drop attacks suffer repetitive head injuries, so they require constant supervision. Another favorable outcome of callosotomy is the regression of psychoemotional and cognitive disorders, attributed to the suppression of persistent interictal epileptiform activity and the prevention of secondary epileptogenesis.

Table 1. Clinical characteristics of patients (M \pm m)

Indicator	Type of surgery						
	ATL (n=39)	LE (n=9)	MC (n=18)	SC (n=7)	MFR (n=4)	FH (n=14)	Total (n=91)
Mean age, years	12,8 \pm 4,0	8,7 \pm 4,4	5,8 \pm 4,2	11,0 \pm 3,8	10,5 \pm 4,9	8,8 \pm 3,9	10,3 \pm 5,0
Mean duration of epilepsy, years	7,0 \pm 2,0	5,5 \pm 3,3	5,5 \pm 3,8	7,3 \pm 3,7	4,8 \pm 3,0	6,7 \pm 2,7	5,1 \pm 3,0
Daily seizures	27 (69%)	4 (44%)	17 (94%)	7 (100%)	4 (100%)	11 (79%)	70 (77%)
History of epileptic status	8 (21%)	1 (11%)	12 (67%)	6 (86%)	3 (75%)	9 (64%)	39 (43%)
Epileptic encephalopathy	1 (3%)	1 (11%)	15 (83%)	4 (57%)	0	1 (7%)	22 (24%)
Average number of AEDs	4,0 \pm 2,1	4,6 \pm 2,2	5,0 \pm 2,8	4,2 \pm 2,1	4,5 \pm 2,4	4,9 \pm 2,0	4,5 \pm 3,1

Table 2. Etiology of epilepsy

Cause of epilepsy	Type of surgery						
	ATL (n=39)	LE (n=9)	MC (n=18)	SC (n=7)	MFR (n=4)	FH (n=14)	Total (n=91)
Median temporal sclerosis	8	0	0	0	0	0	8 (8,8%)
Perinatal hypoxic-ischemic encephalopathy	2	0	3	2	1	3	11 (12,1%)
Consequences of intracerebral hemorrhage	1	0	3	1	1	2	8 (8,8%)
Consequences of meningoencephalitis	0	1	4	2	0	1	8 (8,8%)
Rasmussen's encephalitis	0	0	0	0	1	4	5 (5,5%)
Cortical dysplasia	8	3	2	0	1	3	17 (18,7%)
Brain tumors	12	3	1	0	0	1	17 (18,7%)
Cavernoma	4	2	0	0	0	0	6 (6,6%)
Sturge-Weber syndrome	0	0	2	0	0	0	2 (2,2%)
Microcephaly	0	0	1	1	0	0	2 (2,2%)
Atrophy of the pole of the temporal lobe	4	0	0	0	0	0	4 (4,4%)
Unknown (MRI result negative)	0	0	2	1	0	0	3 (3,3%)

Table 3. Results of operations after 3 years

Indicator	Type of surgery						
	ATL (n=39)	LE (n=9)	MC (n=18)	SC (n=7)	MFR (n=4)	FH (n=14)	Total (n=91)
Engel 1	28	5	2	0	3	13	51 (56,0%)
Engel 2	6	2	4	1	1	0	14 (15,4%)
Engel 3	3	1	8	2	0	0	14 (15,4%)
Engel 4	2	1	4	4	0	0	11 (12,1%)
Operative complications	3	0	1	0	0	2	6 (6,6%)
Postoperative mortality	0	0	0	0	0	1	1 (1,1%)

Surgical complications developed in 6 (6.6%) cases. They were temporary in 2 (2.2%) cases, resulted in persistent neurological deficit in 3 (3.3%), and in 1 (1.1%) they led to the death of the child (postoperative mortality was 1.1%). After ATL, surgical complications leading to persistent neurological deficit occurred in 3 (7.7%) cases. Contralateral homonymous hemianopsia developed in 1 case, contralateral hemiparesis due to damage to the anterior choroidal artery in 2 cases. One

complication (chronic subdural hematoma) occurred 5 months after MC. The hematoma was removed and did not lead to neurological deficit. After FH, surgical complications were registered in 2 (14.3%) children. In one case, hydrocephalus occurred, requiring repeated CSF bypass surgeries. Another 4-year-old child had a pneumothorax and cardiac arrest during the last stages of surgery. Emergency resuscitation measures made it possible to restore cardiac activity, but posthypoxic

ischemic encephalopathy and homeostasis disorders occurred leading to death 2 months after surgery. No surgical complications were recorded after SC, LE and MFR.

Clinical observation 1

Patient K., 4 years old (**Figures 1 and 2**). Diagnosis: structural focal epilepsy with focal seizures and seizures with transition to bilateral tonic-clonic, focal cortical dysplasia of the posterior parts of the right posterior frontal area. The onset of epilepsy at the age of 2 years. Valproic acid, carbamazepine, levetiracetam, Synakthen® Depot (Novartis), topiramate was taken, but the disease progressed, seizures were daily, up to 60 per day. During the last 6 months, mnestic disorders progressed. Surgery was performed - resection of the epileptogenic zone (LE) using neuronavigation and MRI tractography. Postoperative catamnesis - 9 years.

Epileptic seizures have ceased (Engel 1A). No AEDs use for the last 2 years, no psychoemotional and cognitive disorders.

Clinical observation 2

Patient M., 3 years old (**Figures 3 and 4**). Diagnosis: MRI-negative epilepsy, Lennox-Gastaut syndrome with daily drop attacks, generalized myoclonic, focal clonic seizures, epileptic encephalopathy. The onset of epilepsy at the age of 11 months. She took valproic acid, levetiracetam, carbamazepine, lamotrigine, topiramate. However, the disease progressed, the attacks were daily, up to 45 per day. The operation was performed - radiofrequency stereotactic total callosotomy. Postoperative follow-up is 2.5 years. The frequency of drop attacks decreased by more than 50%, generalized myoclonic and focal clonic epileptic seizures persisted (Engel 3).

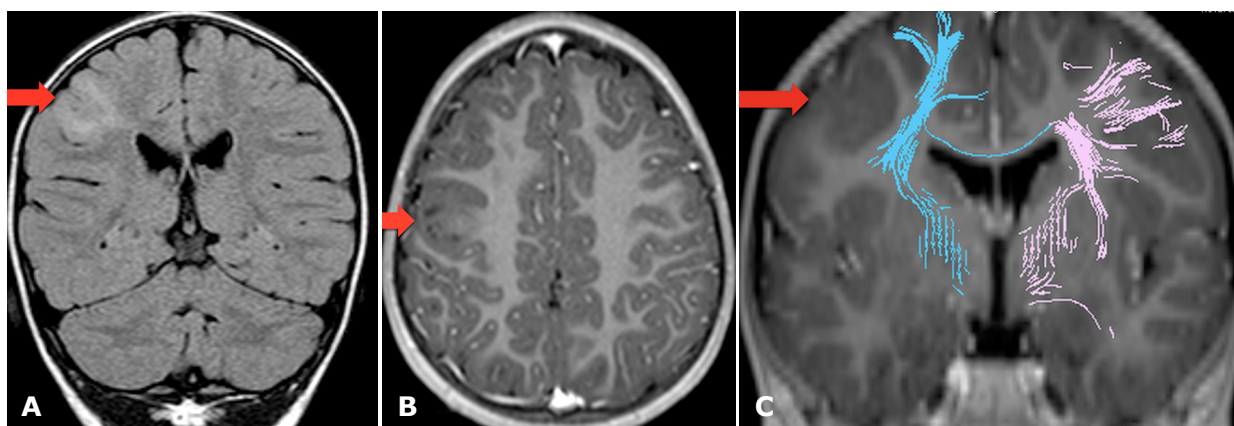


Fig. 1. Preoperative MRI of patient K.: A – axial image; B – coronal image; C – MRI-tractography. Focal cortical dysplasia of the posterior area of the right frontal lobe

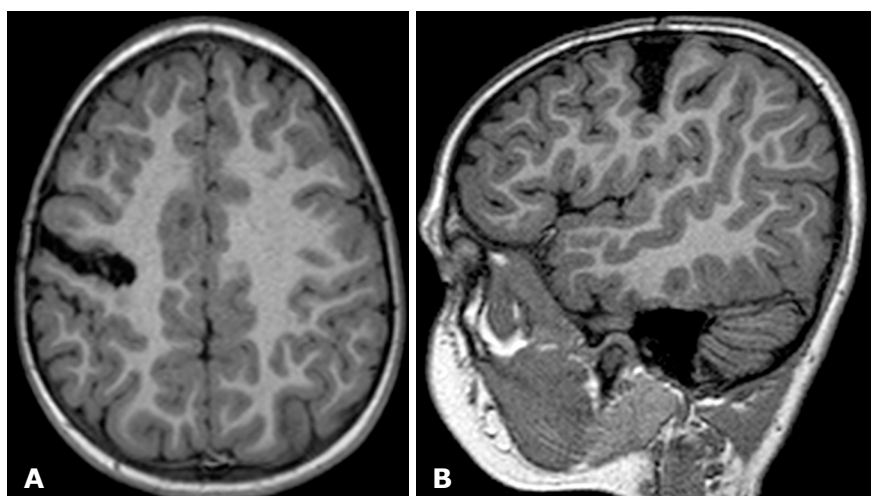


Fig. 2. Postoperative MRI of patient K. one year after surgery: A – axial image; B – sagittal image. The area of resected epileptogenic zone

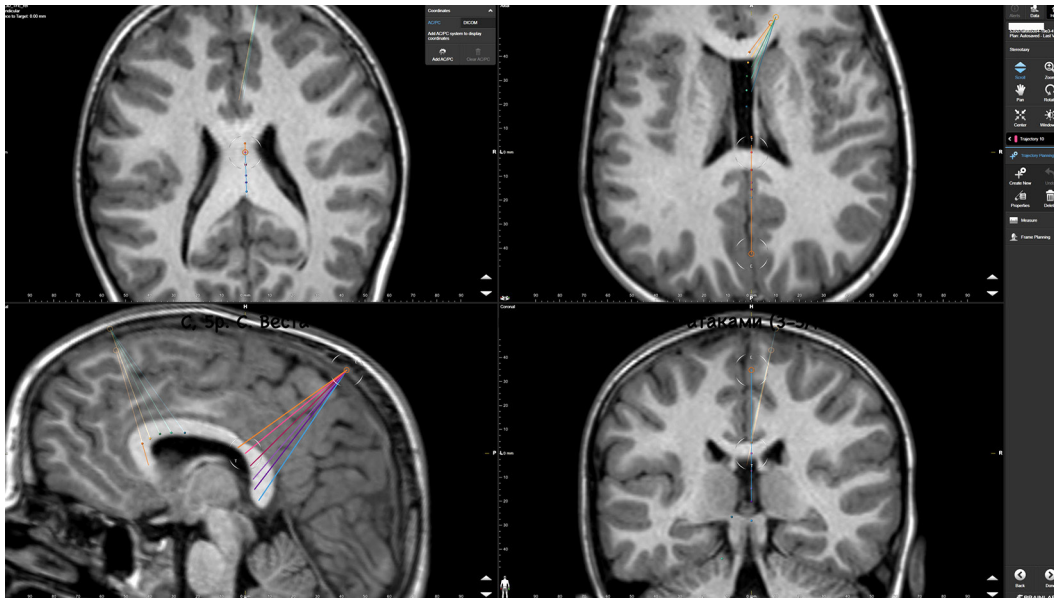


Fig. 3. Surgical planning of radiofrequency (RF) destruction of the corpus callosum using ELEMENT (Brainlab) software

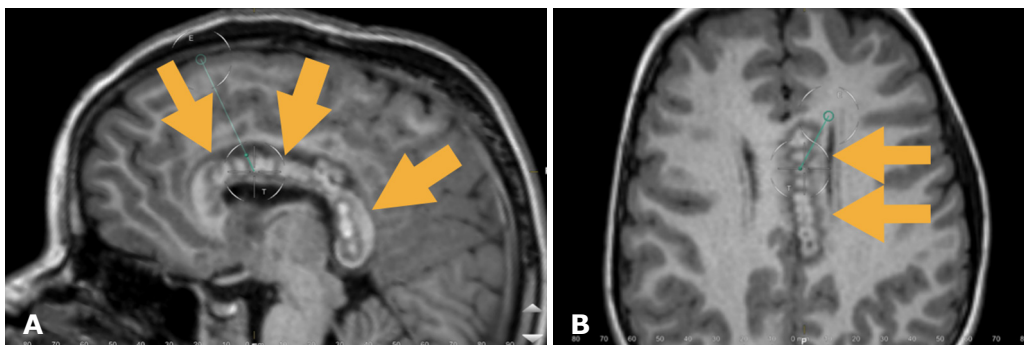


Fig. 4. Postoperative MRI of patient M. one and a half years after the surgery: A – sagittal image; B – axial image. The area of RF destruction

Clinical observation 3

Patient T., 7 years old (**Figures 5 and 6**). Diagnosis: structural focal epilepsy with focal seizures with transition to bilateral tonic-clonic, *epilepsia partialis continua*, pharmacoresistant form, left-sided spastic hemiparesis, diffuse cortical dysplasia of the frontal-temporal-parietal area. The onset of epilepsy at the age of 1 year. She took valproic acid, carbamazepine, oxcarbazepine, topiramate, levetiracetam. However, the disease progressed. A right-sided functional periinsular hemispherotomy was performed. Postoperative follow-up is 4.5 years. Epileptic seizures stopped (Engel 1A) (**Fig. 7**).

Unlike epilepsy surgery in adults, the primary objective of surgical treatment in children is not solely focused on stopping epileptic seizures. It also encompasses the prevention of secondary epileptogenesis and epileptic encephalopathy, which often manifest as cognitive and psychoemotional impairments along with behavioral disruptions. These conditions can lead to social disadaptation of children

and significantly impact the quality of life of patients and their relatives, as such children require ongoing external supervision. In case of diagnosed pharmacoresistant epilepsy, early surgical intervention increases the chances of achieving a positive effect by controlling epileptic seizures and preventing the development of cognitive, emotional and behavioral disorders [16–18].

Resection surgeries (lobectomy, LE, multilobar resections), disconnection surgeries (callosotomy, anterior and posterior quadrant disconnections) and their combinations (FH) are the most common in the treatment of pediatric epilepsy due to their high efficacy. The technique of performing such operations does not differ significantly from surgical interventions in adults, but the frequency of their performance is much higher compared to adult patients. Unlike adults, palliative interventions, specifically neuromodulatory approaches, are infrequently employed in the treatment of pediatric epilepsy. [8,19]. Almost the entire range of modern operations for the treatment of severe forms of pediatric epilepsy has been implemented in Ukraine.

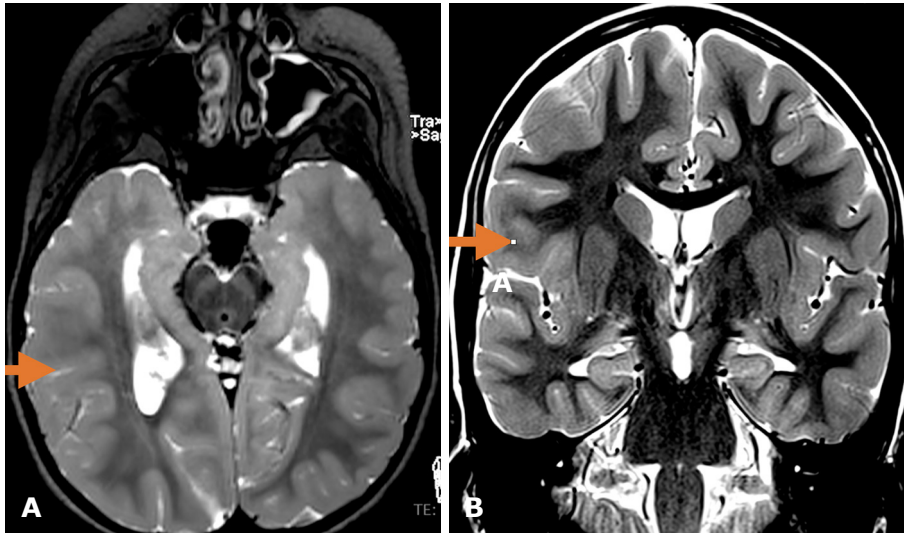


Fig. 5. Preoperative MRI of patient T.: A – axial image; B – coronal image. Diffuse cortical dysplasia of the right frontal-temporal-parietal area

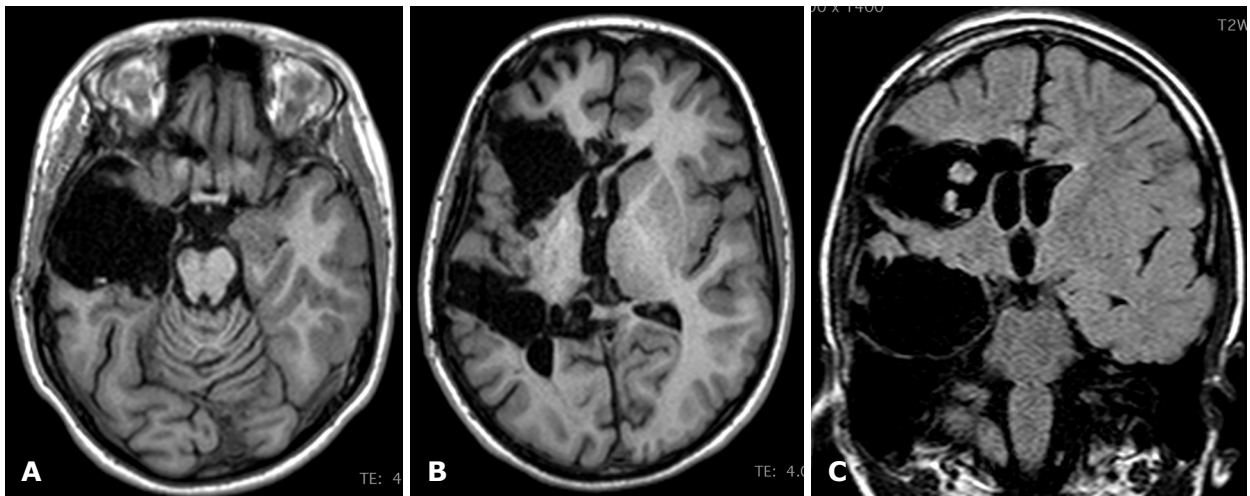


Fig. 6. Postoperative MRI of patient T. six months after undergoing right-sided functional hemispherectomy: A – axial image; B – coronal image

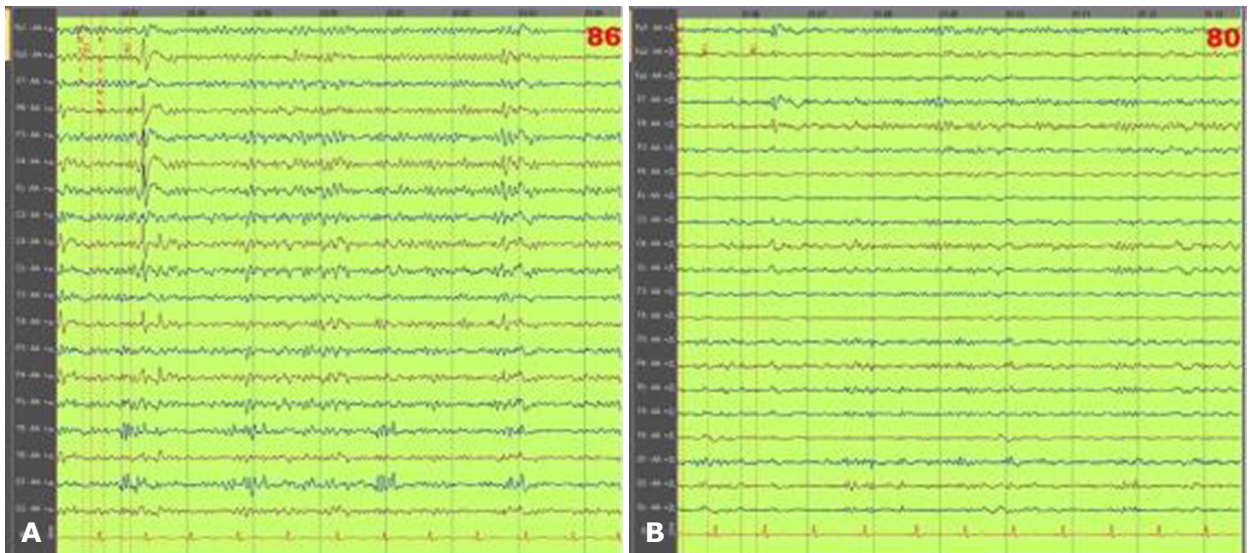


Fig. 7. Preoperative EEG (A) revealed interictal epileptiform activity in the right hemisphere; postoperative EEG (B) demonstrates a significant reduction of epileptiform activity

In the last 10 years, MFR, FH, callosotomy have been successfully performed [20,21]. The main problem is the late referral of patients to specialized neurosurgical departments dealing with surgical treatment of epilepsy. This leads to the fact that such children at the time of surgery have significant cognitive and psychoemotional disorders, which in most cases do not disappear even after the complete cessation of seizures after surgical treatment. This problem is also emphasized by foreign specialists. According to C.W. Beatty et al. (2021), only 1–11% of children with pharmacoresistant epilepsy undergo surgical treatment. The authors conducted a system analysis of publications within PubMed and EMBASE databases concerning the surgical treatment of epilepsy in children and identified several factors influencing late referral of patients to neurosurgeons. These factors include family members' misconceptions and insufficient awareness among specialists regarding epilepsy surgery and systemic health care controversies. The authors highlight the pivotal role of early surgical intervention in enhancing outcomes related to seizure control and facilitating the regression of cognitive and behavioral impairments [22].

The negative impact of long-term antiepileptic therapy on the body of children who, according to our data, took an average of 4.5 AEDs during 2/3 of life before surgery as monotherapy or polytherapy is worthy of attention.

The high cost of comprehensive instrumental examination of potential surgical candidates is also an important issue. Modern neuroimaging (positron emission tomography, magnetic encephalography) and invasive electrophysiological (invasive stereo-EEG monitoring) methods are highly informative in identifying the epileptogenic zone, determining its location in relation to functionally important brain areas (primarily in relation to movement and speech centers) and ways of spreading epileptogenic activity [23–25]. However, high-tech and expensive diagnostic techniques are not widely available in Ukraine, as they require significant financial support from the state.

In our study, the etiological factors causing bilateral epilepsy were identified, namely, perinatal hypoxic-ischemic injury and meningoencephalitis (viral in 4 cases, bacterial in 2). In patients with unilateral brain lesions who underwent FH, in 50% of cases the cause of epilepsy was diffuse cortical dysplasia and Rasmussen's encephalitis. Among the causes of temporal lobe epilepsy, brain tumor lesions (gliomas), predominantly of low degree of malignancy (8 (20.5%) cases) and dysembryoplastic neuroepithelial tumors (6 (15.4%)) were most often recorded. An equal number of cases (8 (20.5%)) were recorded when median temporal sclerosis and focal cortical dysplasia were the cause of epilepsy.

According to our data, early onset, long duration of epilepsy, high frequency of epileptic seizures, progressive epileptic encephalopathy, presence of multifocal epilepsy and bilateral epileptic paroxysmal brain activity are among the main factors that adversely affect the outcome of surgery. In most cases, these patients required palliative disconnections aimed at interrupting the spread of epileptic activity. The best results were obtained after resection surgeries, during which it was possible to completely remove

the epileptogenic zone. Epileptic seizures ceased in 46 (69.7%) of 66 patients who underwent resection of the epileptogenic zone. The control over epileptic seizures after such surgical interventions practically did not change in the long-term postoperative period (1–3 years). The best results were recorded in patients who underwent FH: children completely stopped having epileptic seizures.

The primary goal of callosotomy was to block bilateral epileptogenic paroxysmal activity and stop or reduce the frequency of traumatic attacks in the form of drop attacks. Callosotomy demonstrated highly effective control of drop attacks, which ceased in 14 (78%) of 18 children who had them before surgery. Stereotactic RF callosotomy was less effective compared to microsurgery, and can only be recommended in selected cases. The low efficacy of stereotactic callosotomy is due to incomplete crossing of interhemispheric commissural fibers. This type of surgery can be considered as an addition to subtotal microsurgical callosotomy in patients with low efficiency of the latter.

The modern advancement of computer and surgical technologies enables to perform effective surgical interventions with minimal brain trauma. The trend towards the use of minimally invasive and neuromodulating surgeries has been increasing over the last decade [26,27]. The efficacy of vagus nerve stimulation, laser thermal robot-assisted ablation, focused ultrasound destruction under MRI control has been proven [28,29]. Therefore, in the future, we do not plan to limit ourselves to the use of classic neurosurgical interventions and will introduce modern neurosurgical technologies in the treatment of severe forms of pediatric epilepsy. The key to achieving a high efficiency of surgical treatment lies in adopting a multidisciplinary approach to establishing indications for surgeries taking into account the data of neuropsychological, electrophysiological and neuroimaging studies, as well as sufficient training and experience of neurosurgeons.

Conclusions

The key to the efficacy of surgical treatment of pediatric epilepsy is early surgical intervention, leading to the management of epileptic seizures, correction of psycho-emotional disorders, improvement of quality of life and social adaptation.

The combination of resection procedures and disconnections contributes to the reduction of epileptogenic neurons and suppression of epileptic discharges.

For patients with bilateral brain lesion or MRI-negative epilepsy, with drop attacks as a primary symptom of the disease, microsurgical callosotomy stands as the preferred surgical procedures.

Disclosure

Conflict of interest

The authors declare no conflict of interest.

Ethical approval

All procedures performed on patients comply with the ethical standards of institutional and national ethics committees, the 1964 Declaration of Helsinki and its amendments or similar ethical standards.

Informed consent

Informed consent was obtained from each of the patients.

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