OUTCOMES OF SURGICAL TREATMENT OF DRUG RESISTANT EPILEPSY

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Abstract:

Background. Pharmacoresistant epilepsy (PRE) remains one of the most challenging neurological conditions, often unresponsive to pharmacological therapy. Surgical intervention is considered the most effective treatment option for selected patients.

Objective. This article summarizes current approaches and outcomes of surgical treatment for PRE, highlighting prognostic factors, surgical techniques, neuropsychological outcomes, and quality of life (QoL) considerations.

Methods. A review of contemporary literature was conducted, analyzing prospective and retrospective studies, meta-analyses, and clinical trials evaluating outcomes after anterior temporal lobectomy with amygdalohippocampectomy (ATL+AH), selective amygdalohippocampectomy (SAH), and minimally invasive techniques, including MRI-guided laser interstitial thermal therapy (MgLiTT), stereoelectroencephalography-guided radiofrequency thermocoagulation (SEEG-guided RFTC), and neuromodulation procedures (vagus nerve stimulation, deep brain stimulation, and responsive neurostimulation). Favorable surgical outcomes are strongly associated with concordant neuroimaging and EEG findings, as well as the extent of resection of the epileptogenic zone. ATL+AH remains the gold standard, demonstrating seizure freedom in up to 70–80% of patients, while SAH offers comparable seizure control with improved preservation of neurocognitive functions. Minimally invasive techniques and neuromodulation provide alternative options for patients with multifocal or surgically inaccessible lesions. Neuropsychological assessments indicate that surgery can halt cognitive decline associated with ongoing seizures and improve QoL, although risks of postoperative deficits remain, particularly with left-sided resections. Multiple studies confirm significant postoperative improvement in QoL scores (QOLIE-31), especially in seizure-free patients.

Conclusion. Surgical treatment of PRE is superior to long-term pharmacotherapy in carefully selected patients, providing seizure freedom, stabilization of cognitive functions, and improved QoL. Early identification of pharmacoresistance and timely surgical referral are crucial for optimizing long-term outcomes.

Keywords: Pharmacoresistant epilepsy; Epilepsy surgery; Anterior temporal lobectomy; Selective amygdalohippocampectomy; Laser interstitial thermal therapy; Neuromodulation; Cognitive outcomes; Quality of life.

ИСХОДЫ ХИРУРГИЧЕСКОГО ЛЕЧЕНИЯ ФАРМАКОРЕЗИСТЕНТНОЙ ЭПИЛЕПСИИ

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Аннотация:

Актуальность. Фармакорезистентная эпилепсия (ФРЭ) остаётся одной из наиболее сложных неврологических проблем, часто не поддающихся медикаментозной терапии.

Хирургическое вмешательство считается наиболее эффективным методом лечения у тщательно отобранных пациентов.

Цель. В статье представлены современные подходы и результаты хирургического лечения ФРЭ с акцентом на прогностические факторы, хирургические техники, нейропсихологические исходы и качество жизни (КЖ).

Методы. Проведён обзор современной литературы, включающий проспективные и ретроспективные исследования, метаанализы и клинические испытания, оценивающие результаты после передней височной лобэктомии с амигдалогиппокампэктомией (ПВЛЭ+АМГЛЭ), селективной амигдалогиппокампэктомии (САГЭ), а также малоинвазивных методик, включая лазерную интерстициальную термотерапию под контролем МРТ (MgLiTT), радиочастотную термокоагуляцию под контролем стерео-ЭЭГ (SEEG-RFTC) и методы нейростимуляции (стимуляция блуждающего нерва, глубокая стимуляция мозга, адаптивная стимуляция). Благоприятные хирургические исходы тесно связаны с согласованностью данных нейровизуализации и ЭЭГ, а также с объёмом резекции эпилептогенной зоны. ПВЛЭ+АМГЛЭ остаётся «золотым стандартом», обеспечивая свободу от приступов у 70–80% пациентов, тогда как САГЭ демонстрирует сопоставимые результаты при лучшем сохранении когнитивных функций. Малоинвазивные методы и нейростимуляция расширяют возможности лечения пациентов с многоочаговыми или труднодоступными для резекции формами. Нейропсихологические исследования подтверждают, что хирургия может остановить когнитивный спад, связанный с резистентной эпилепсией, и улучшить КЖ, хотя сохраняются риски послеоперационных нарушений, особенно при левосторонних вмешательствах. Многочисленные исследования подтверждают значительное улучшение КЖ по шкале QOLIE-31, особенно у пациентов, достигших свободы от приступов.

Заключение. Хирургическое лечение ФРЭ превосходит длительную медикаментозную терапию у тщательно отобранных пациентов, обеспечивая контроль приступов, стабилизацию когнитивных функций и повышение качества жизни. Раннее выявление фармакорезистентности и своевременное направление на хирургическое лечение имеют решающее значение для оптимизации долгосрочных результатов.

Ключевые слова: фармакорезистентная эпилепсия; хирургия эпилепсии; передняя височная лобэктомия; селективная амигдалогиппокампэктомия; лазерная интерстициальная термотерапия; нейростимуляция; когнитивные исходы; качество жизни.

FARMAKOREZISTENT EPILEPSIYANI JARROHLIK DAVOLASH NATIJALARI

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Annotatsiya:

Dolzarbligi. Farmakorezistent epilepsiya (FRE) ko‘pincha dori vositalariga javob bermaydigan eng murakkab nevrologik kasalliklardan biridir. Jarrohlik aralashuvi tanlab olingan bemorlar uchun eng samarali davolash usuli hisoblanadi.

Maqsad. Ushbu maqolada FREni jarrohlik davolashning zamonaviy yondashuvlari va natijalari umumlashtiriladi, prognoz omillari, jarrohlik usullari, neyropsixologik ko‘rsatkichlar va hayot sifatiga (HQ) ta’siri yoritiladi.

Usullar. Zamonaviy adabiyotlarga sharh berildi, unda prospektiv va retrospektiv tadqiqotlar, meta-tahlillar va klinik sinovlar o‘rganildi. Tadqiqotlar oldingi chakka lobektomiyasi va amigdalo-gippokampektomiya (ATL+AH), selektiv amigdalo-gippokampektomiya (SAH), shuningdek, kam invaziv usullar — MRT nazorati ostida lazerli interstitsial termoterapiya (MgLiTT), stereo-EEG nazorati ostida radiochastotali termokoagulyatsiya (SEEG-RFTC) va neyrostimulyatsiya usullari (vagus nervini stimulyatsiya qilish, miya chuqur stimulyatsiyasi, adaptiv stimulyatsiya) natijalari baholandi. Ijobiy jarrohlik natijalari neyrovizualizatsiya va EEG ma’lumotlarining mosligi, shuningdek epileptogen zonaning yetarli rezektsiyasi bilan chambarchas bog‘liq. ATL+AH «oltin standart» bo‘lib qolmoqda va bemorlarning 70–80%ida tutqanoqsiz hayotni ta’minlaydi. SAH esa shunga yaqin natijalarni ko‘rsatadi, lekin kognitiv funksiyalarni yaxshiroq saqlab qoladi. Kam invaziv usullar va neyrostimulyatsiya ko‘p o‘choqli yoki jarrohlik jihatdan xavfli joylashgan o‘choqlarga ega bemorlar uchun qo‘shimcha imkoniyatlar beradi. Neyropsixologik tadqiqotlar jarrohlik amaliyoti kognitiv pasayishni to‘xtatishi va HQni yaxshilashi mumkinligini ko‘rsatadi, biroq chap tomonlama operatsiyalardan keyin qo‘shimcha buzilishlar xavfi saqlanib qoladi. Ko‘plab tadqiqotlar, ayniqsa tutqanoqdan xoli bo‘lgan bemorlarda, QOLIE-31 shkalasi bo‘yicha HQ ko‘rsatkichlarining sezilarli yaxshilanishini tasdiqlaydi.

Xulosa. FREni jarrohlik davolash tanlab olingan bemorlarda uzoq muddatli farmakoterapiyadan ustun bo‘lib, tutqanoqlarni nazorat qilish, kognitiv funksiyalarni barqarorlashtirish va hayot sifatini oshirish imkonini beradi. Farmakorezistentlikni erta aniqlash va bemorlarni vaqtida jarrohlikka yo‘naltirish uzoq muddatli natijalarni optimallashtirish uchun hal qiluvchi ahamiyatga ega.

Kalit so‘zlar: farmakorezistent epilepsiya; epilepsiya jarrohligi; oldingi chakka lobektomiyasi; selektiv amigdalo-gippokampektomiya; lazer interstitsial termoterapiya; neyrostimulyatsiya; kognitiv natijalar; hayot sifati.

INTRODUCTION

The priority method for the treatment of pharmacoresistant epilepsy (PRE) is surgical intervention. Currently, data are being accumulated on the long-term outcomes of surgical treatment in patients with PRE following various types of operative procedures [1]. However, there is no unified viewpoint on the effectiveness of different treatment techniques or on the risk factors for favorable and unfavorable surgical outcomes. Surgical treatment of epilepsy is usually performed in young patients who require careful evaluation of risks and long-term results of the operation.

Prognostic factors for a favorable surgical outcome in epilepsy include the presence of structural brain changes revealed by neuroimaging (mesial temporal sclerosis, mass lesions), and the absence of focal cortical dysplasias or other congenital cortical malformations. In addition, it is important to consider the “concordance” between neuroimaging findings and electroencephalographic monitoring, as well as to ensure a sufficient extent of surgical resection of the epileptogenic focus [2–4].

The traditional surgical approach is anterior temporal lobectomy. Anterior temporal lobectomy with amygdalohippocampectomy (ATL+AH) involves resection of the medial complex, which includes the amygdala, hippocampus, and parahippocampal gyrus. In addition, uninvolved neocortical tissue is also resected. Numerous studies have demonstrated that ATL+AH

is superior in seizure control compared to long-term pharmacotherapy in patients with PRE [5,6]. Currently, other surgical techniques are also being utilized.

MAIN PART

These techniques include stereotactic radiosurgery, magnetic resonance imaging–guided laser interstitial thermal therapy (MgLiTT, MRI-guided laser interstitial thermal therapy), and stereoelectroencephalography-guided radiofrequency thermocoagulation (SEEG-guided RFTC) [7]. In some cases, surgical treatment of PRE is not feasible. The limitations are associated with the presence of multiple epileptogenic foci, the inability to localize the focus, or the presence of a pathological substrate located in areas that render any surgical intervention unsafe (proximity to functionally significant regions). For such patients, neuromodulation approaches are used, including vagus nerve stimulation (VNS), deep brain stimulation (DBS), and responsive neurostimulation (RNS) [7,8].

The central epileptogenic role of mesial temporal structures in temporal lobe epilepsy has been demonstrated both in animal models of temporal epilepsy and in structural cerebral pathology under the guidance of electrophysiological and neuroimaging studies. Therefore, more targeted mesial temporal resections sparing the temporal neocortex—selective amygdalohippocampectomy (SAH)—have been considered as a possible means of achieving equivalent seizure control with fewer neuropsychological consequences [9,10].

According to a large study (prospective and retrospective), which included 745 and 766 patients respectively who underwent SAH and ATL+AH, the proportion of Engel Class I outcomes in the overall cohort was 68%. For SAH, this figure was 66%, and for ATL+AH—71%. A meta-analysis demonstrated a statistically significant reduction in the likelihood of seizure freedom in patients who underwent SAH compared to those who underwent ATL+AH [11]. Another study reported seizure control in 78.2% of cases with SAH and 85.7% with ATL+AH [12]. Another investigation highlighted favorable seizure control and Engel Class I outcomes in PRE patients: 72% after ATL+AH and 71% after SAH [13]. In another meta-analysis, no statistically significant differences in outcomes were found between ATL+AH and SAH [14].

In our study, we found that patients who underwent ATL+AH demonstrated favorable outcomes in seizure control. Outcomes of surgical treatment were assessed in 31 patients at 6 months post-surgery, in 21 patients at 1 year, and in 2 patients at 2 years. The proportion of patients with significant improvement (Engel Classes I and II) was 87.1%, 76.2%, and 50%, respectively, for the observation periods [15]. Typically, after surgery, patients remain on reduced doses of antiepileptic drugs, which diminishes the expected effect of the operation and requires further monitoring of somatic and psychological functions with pharmacotherapy adjustment or withdrawal [16].

In the mid-20th century, the effectiveness of surgical treatment of epilepsy was mainly assessed by such indicators as complete or partial remission, reduction in seizure frequency, and the degree of changes observed in instrumental diagnostic methods. In recent years, however, the outcomes of epilepsy surgery have been evaluated not only in terms of reduction and/or cessation of seizures but also in terms of improvements in quality of life (QoL), neuropsychological status, and cognitive functioning of operated patients. Neuropsychological assessment of the functions of specific brain regions to be resected, as well as the evaluation of the patient’s cognitive reserve, allows for the prediction of postoperative cognitive impairment. A successful operation can halt the decline in intellectual abilities caused by drug-resistant epilepsy and reverse this negative trend by “releasing” functions that were secondarily impaired prior to surgery [17].

Nevertheless, surgery carries the risk of additional impairments, which, together with comorbid disorders, may accelerate the decline of cognitive functions, especially in older patients. From a neuropsychological perspective, the early identification of pharmacoresistance, along with early and complete seizure control while maximizing the preservation of functional tissue during surgery, plays a crucial role [21].

Many studies demonstrate the superiority of selective amygdalohippocampectomy (SAH) in preserving neurocognitive functions [18,19]. In the study by W. Chengxiong et al. (2018), comparable outcomes according to the Engel classification were reported for both SAH and anterior temporal lobectomy with amygdalohippocampectomy (ATL+AH), although ATL+AH was associated with worse neurocognitive outcomes [20]. In a large study, H. Clusmann reported better outcomes following SAH with regard to attention, verbal memory, and overall neuropsychological performance [22].

U. Gleissner et al. (2002) reported short- and long-term results in 140 patients who underwent SAH, evaluated at three months and again at one year. They noted that the more selective procedure may have important cognitive consequences. After three months, nearly half of the patients with left-sided SAH experienced significant verbal memory loss; functional deterioration was less pronounced in right-sided surgeries. Among 115 patients followed for one year, no substantial recovery of verbal memory compared with the earlier period was observed [23].

The issue of QoL in patients with PRE is related not only to the clinical manifestations of the disease but also to the need for continuous medication, patients' personal reactions to the illness, difficulties in social integration, and stigmatization. More than 80 questionnaires assessing QoL in epilepsy are available in the medical literature. Many of these evaluate the impact of epilepsy in general or its individual symptoms on patients' lives. A well-known specialized tool for epilepsy patients is the Quality of Life in Epilepsy Inventory (QOLIE), presented in various formats for adults (QOLIE-89, QOLIE-31, and QOLIE-10) [24–26].

According to a systematic review by A. Saadi et al. (2016), which included data from more than 7,000 patients with epilepsy, the mean QoL score on the QOLIE-31 was 59.8 points (maximum 100). Importantly, this indicator was significantly higher in high-income countries [27]. Other studies using different QoL instruments have also demonstrated the positive impact of epilepsy surgery on this parameter [28,29]. The study by V. Ives-Deliperi and J.T. Butler (2017) likewise reported significant improvements in QOLIE-31 scores in PRE patients after surgical treatment at 6 and 12 months, compared with patients who remained on medical therapy [30].

CONCLUSION

Surgical treatment is the most effective option for patients with pharmacoresistant epilepsy (PRE) when drug therapy fails. Anterior temporal lobectomy with amygdalohippocampectomy (ATL+AH) remains the gold standard, providing the highest rates of seizure freedom. Selective amygdalohippocampectomy (SAH) offers comparable seizure control with better preservation of memory and cognitive functions.

Minimally invasive methods such as MRI-guided laser interstitial thermal therapy (MgLiTT) and SEEG-guided radiofrequency thermocoagulation, along with neuromodulation techniques including vagus nerve stimulation (VNS), deep brain stimulation (DBS), and responsive neurostimulation (RNS), expand treatment options for patients unsuitable for resection. Concordance of neuroimaging and EEG findings, together with adequate resection of the

epileptogenic zone, are key prognostic factors. Neuropsychological assessment before surgery helps predict risks of cognitive decline and allows for individualized planning.

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