Austin Journal of Neurological Disorders & Epilepsy

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Austin Publishing Group

Research Article

Descriptive Analysis of Surgical Treatment Efficacy Based on A Novel Categorical Scale for Patients with Epilepsy Accompanying Mental Symptoms

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Received: July 11, 2024
Accepted: July 31, 2024
Published: August 07, 2024

Abstract

Objective: To compare the effects of different surgical strategies in patients with various types of epilepsy accompanying mental symptoms.

Methods: The clinical and follow-up data of 65 patients with epilepsy accompanying mental symptoms admitted to our department from January 2014 to December 2016 were retrospectively analyzed. Patients were categorized into two types using self-made evaluation scales based on the degree of correlation between their mental symptoms and seizures. Type I (n=28) exhibited a high correlation and was treated with a combined craniotomy, while Type II (n=37), characterized by a low correlation, underwent treatment using multi-target stereotactic radiofrequency thermocoagulation.

Results: (1) the ORR was 90.77%, while the RR was 89.29% and 91.89% in type and type patients, respectively; (2) the ORR for epilepsy treatment was 86.15%, the RR was 89.29% and 83.78% in patients of type and respectively; (3) the total scores significantly decreased in BPRS, SAPS, and SANS after surgery, and there were significant statistical differences compared with those before surgery (P<0.05).

Conclusion: (1) Active surgical treatment significantly reduces the frequency of epileptic seizures, alleviates mental symptoms, and improves quality of life for patients with epilepsy accompanying mental symptoms; (2) The self-made evaluation scale contributes to selecting the appropriate surgical method and predicts a favorable prognosis.

Keywords: Epilepsy; Mental symptoms; Stereotactic Radiofrequency Thermocoagulation; Surgical treatment.

Introduction

Epilepsy accompanying mental symptoms is a type of mental disorder closely related to epileptic seizures, with psychiatric symptoms that may occur before, during, after, or between seizures [1-3]. Currently, there is no complete consensus, both domestically and internationally, on how to classify epilepsy accompanying mental symptoms. There is currently no standardized classification system based on the strength of the correlation between epileptic seizures and psychiatric symptoms [4,5]. We believe that such a system would be highly beneficial in guiding treatment methods, including surgical procedures. In previous treatment concepts, epileptic mental disorders were mainly addressed with anti-seizure and anti-psychotic medications, which could help most patients achieve a good prognosis [6]. However, some patients still experience stubborn seizures and mental disorders that are challenging to treat. In recent years, with the advancement of inspection techniques such as EEG and fMRI, abnormal manifestations in local blood flow and metabolism of brain tissues can be detected more sensitively and effectively, thereby significantly improving surgeons' ability to locate epileptic foci [7,8]. Based on this, with changes in treatment concepts, the application scope of stereotactic radiofrequency thermocoagulation has continuously expanded, providing a new treatment option for patients with epileptic mental disorders [9,10]. In this study, we used a self-made rating scale to classify patients with epileptic mental disorders and select surgical plans accordingly. The clinical practicality of the

Citation: Zou Y, Liu J, Wang Q, Zhang K, Sun J, et al. Descriptive Analysis of Surgical Treatment Efficacy Based on A Novel Categorical Scale for Patients with Epilepsy Accompanying Mental Symptoms. Austin J Neurol Disord Epilepsy. 2024; 10(1): 1054.

self-made rating scale and the effectiveness of surgical treatment of epileptic mental disorders were discussed by analyzing the impact of different surgical plans on patient prognosis.

Data and Methods

Patient Data

Sixty-five patients with epilepsy accompanying mental symptoms who underwent surgical treatment in our department from January 2014 to December 2016 were selected as the study subjects. The inclusion criteria were as follows: (1) the presence of psychiatric symptoms for more than 5 years, severe or with a history of suicidal tendencies for more than 3 years, taking at least three different types of antipsychotic drugs, each in sufficient dosage and duration; (2) experiencing at least two epileptic seizures per month, receiving formal treatment with at least three first-line antiepileptic drugs, with prescribed blood drug concentrations and without serious drug side effects, and still being unable to control epileptic seizures that affect daily life after more than 5 years of continuous treatment; (3) age between 18 and 60 years; (4) no apparent mental decline or brain atrophy; (5) no other major diseases that would prevent surgery; (6) the patient and family members agreed to undergo surgical treatment. This study has been approved by the hospital ethics committee (refer to Table 2 for specific patient information).

Preoperative Assessment and Classification

Preoperative imaging and Video Electroencephalogram (VEEG) examinations were conducted on patients to accurately locate the epileptic focus. Mental symptoms were evaluated using the Brief Psychiatric Rating Scale (BPRS), Positive and Negative Syndrome Scale (PANSS), Scale for the Assessment of Negative Symptoms (SANS), and Mini-Mental State Examination (MMSE) [11-14]. Based on our department's self-made classification scale for epilepsy accompanying mental symptoms (Table 3), patients with epilepsy accompanying mental symptoms were divided into two types: Type I, with a total score of 7-9 and a strong correlation between the appearance of mental symptoms and epileptic seizures, underwent combined craniotomy surgery; Type II, with a total score of 3-6 and an inability to locate the epileptic foci accurately, underwent stereotactic multi-targeted radiofrequency ablation surgery.

Surgical Methods

The combined craniotomy surgery consists of various procedures, including seizure focus resection or Anterior Temporal Lobectomy (ATL), anterior callosotomy, and medial cingulate cauterization [12,15,16]. Stereotactic radiofrequency thermocoagulation: all type II patients routinely undergo a standard procedure that includes comprehensive ablation of the bilateral amygdala, bilateral corpus callosum, and bilateral anterior cingulate gyrus. Additionally, the unilateral hippocampus or Forel-H area is ablated simultaneously based on the patient's EEG changes and seizure characteristics [10,17,18]. The criteria for selecting whether to destroy the unilateral hippocampus or Forel-H area are as follows: (1) The presence of spikes or spike-and-slow waves in the frontal or temporal lobe on one side, along with partly generalized seizures, indicates that the ipsilateral hippocampus is the target. (2) If spikes or spike-and-slow waves are manifested on both sides but primarily on one side in patients with generalized seizures, the ipsilateral Forel-H area is selected. In contrast, the ipsilateral hippocampus is chosen in patients with partial seizures. (3) When the EEG displays diffuse alterations on both sides, the Forel-H area on the right side may be affected [19].

Evaluation of Treatment Effectiveness

After a 36-month follow-up, the surgical efficacy was evaluated from three aspects: overall efficacy, therapeutic efficacy of epilepsy, and efficacy in treating psychiatric symptoms. (1) Referring to the *Requirements for Modern Neurosurgical Treatment of Psychiatric Disorders* formulated by the National Neurosurgery Collaboration Group of China and The Global Assessment Scale (GAS), the evaluation of overall efficacy was classified into five categories: 1) recovery, 2) significant improvement, 3) improvement, 4) ineffective, 5) deterioration [20] (Table 1). For statistical analysis, recovery, significant improvement, and improvement were grouped to indicate treatment effectiveness. (2) According to the criteria proposed by the International League Against Epilepsy (ILAE) (Table 4) [21,22], the postoperative treatment efficacy of epilepsy was divided into five categories: satisfactory (ILAE class 1-2), significant improvement (ILAE class 3), improvement (ILAE class 4), no improvement (ILAE class 5), and deterioration (ILAE class 6). (3) Patients' Cognitive function, mental status, and intellectual level were evaluated using BPRS, SAPS, SANS, and MMSE scales and compared with the preoperative state [23].

Statistical Methods

All data were analyzed using SPSS 23.0 statistical software. Metric data were presented in the form of mean ± standard deviation and compared using a t-test, while count data were tested using a chi-square test. A significance level of $P<0.05$ indicates statistical significance.

Result and Conclusion

Comparison of overall treatment efficacy between two types of patients.

Table 1: Classification of Overall Efficacy.

Outcome classification	GAS	Definition
I. Recovery	91-100	The symptoms have completely resolved, and normal neurological function has been restored, allowing for the ability to adapt to daily life without further treatment.
II. Significant improvement	71-90	Symptoms significantly subsided, and nerve function has largely returned to normal, enabling adaptation to daily life without necessitating any further treatment. Alternatively, maintenance medication, equivalent to a daily dose of 100mg Clozapine, can be administered to achieve Class I levels.
III. Improvement	51-70	The symptoms may only be alleviated, neurological deficits may manifest, difficulties in adapting to daily life may arise, or a class II level of improvement can be achieved with higher dosages of medication.
IV. Ineffective	21-50	The symptoms remain unchanged.
V. Deterioration	1-20	The exacerbation of symptoms.

Table 2: Basic Information of 65 Patients with Epilepsy accompanying Mental Symptoms.

		Type I	Type II	P value	Total
Gender	Male	17(60.71%)	23(62.16%)	0.14	40(61.54%)
	Female	11(39.29%)	14(37.84%)		25(38.46%)
Age		28.36 ± 8.34	29.22 ± 7.58	0.67	28.85 ± 7.86
Duration		9.29 ± 3.38	10.14 ± 4.20	0.38	9.77 ± 3.83

Table 3: Self-made Classification Scale for Epilepsy accompanying Mental Symptoms.

Item	Definition	Assignment	Score	Total score
A. The relationship between psychiatric manifestations and epileptic seizures	A1 No relation: Interictal psychoses	1		
	A2 Alternative: Para-ictal psychoses (Forced normalization)	2		
	A3 Close relation: Peri-ictal psychoses (including preictalictal and postictal psychoses)	3		
B. Imaging examination	B1 No definite abnormalities	1		
	B2 Bilateral abnormalities that cannot be clearly located as the epileptogenic focus or unilateral abnormalities that are inconsistent with the EEG	2		
	B3 Unilateral abnormality consistent with the EEG	3		
C. Electroencephalogram	C1 No definite abnormalities	1		
	C2 Bilateral abnormalities or inability to locate the epileptic focus.	2		
	C3 Unilateral abnormality with clear epileptogenic focus localization	3		

Type I, with a total score of 7-9; Type II, with a total score of 3-6. If the total score calculation results in A3+B2+C2 still being classified as Type II.

Table 4: The International League Against Epilepsy Classification of Outcome.

Outcome classification	ILAE	Definition
Satisfaction	1	Completely seizure free; no auras
	2	Only auras; no other seizures
Significantly improvement	3	One to three seizure days per year; ± auras
Improvement	4	Four seizure days per year to 50% reduction of baseline seizure days; ± auras
No improvement	5	Less than 50% reduction of baseline seizure days to 100% increase of baseline seizure days; ± auras
Deterioration	6	More than 100% increase of baseline seizure days; ± auras

The overall effective rate of treatment for a cohort of 65 patients was 90.77%. The effective rate for Type I patients was 89.29%, whereas for Type II patients, it was 91.89% (Refer to Table 5).

Comparison of the treatment efficacy of epilepsy

The overall effectiveness rate of epilepsy control in 65 patients was 86.15%, with a rate of 89.29% for type I patients and 83.78% for type II patients (Refer to Table 6).

Comparison of therapeutic efficacy for psychiatric symptoms

Two weeks after surgery, the patients' BPRS, SAPS, and SANS scores were all lower than pre operation, with significant statistical differences ($P<0.001$), indicating a considerable remission in postoperative psychiatric symptoms. There was no significant difference in the score of the Mini-Mental State Examination between pre-operation and post-operation ($p=0.158$), indicating that the surgery did not significantly affect patients' intelligence.

The complete control rate of epilepsy in Type I patients undergoing combined craniotomy surgery was 42.86% (12/28), which was higher than that of Type II patients who underwent stereotactic surgery (16.22%, 6/37), with a significant statistical difference ($p<0.05$). The composition disparity between the two types of patients bears a close relation to this result. Those patients who underwent craniotomy surgery presented with less complex conditions, including a brief medical history, a single focus of epilepsy, and distinct localization. Removing the epilepsy focus is proven to be more effective in managing epilepsy compared to destructive or blocking surgeries. These findings align with prior research and suggest that combined craniotomy surgery is a viable option when the localization of epilepsy is clear. The complete control rate for the mental symptoms of Type II patients who underwent stereotactic surgery was 32.43% (12/37), higher than that of Type I patients who underwent combined craniotomy surgery (17.86%, 5/28). However, after performing the chi-square test, this difference was not statistically significant ($P>0.05$). Nonetheless, the group that underwent stereotactic surgery still showed a relatively high success rate in controlling mental disorder symptoms. Notably, patients selected for stereotactic surgery had more severe symptoms and less accurate localization of the epileptic focus. This suggests that the two surgical techniques have different priorities and that choosing the appropriate surgical method is crucial.

Surgical Complications

The postoperative complications of 65 patients included (Refer to Table 8): 15 patients representing hyperthermia, with 6 categorized as Type I and 9 as Type II; 31 patients representing urinary incontinence, with 12 classified as Type I and 19 as Type II; 37 patients representing disorientation, with 15 categorized as Type I and 22 as Type II; 6 patients representing unilateral limb weakness, with 2categorized as Type I and 4 as Type II; there was only 1 patient of Type I representing aphasia. Most of the abovementioned complications were temporary and resolved within 3-10 days after the surgery. After stereotactic surgery, only one patient with unilateral limb weakness took longer to recover, which took about a month. However, no significant neurological problems were left after the craniotomy and stereotactic surgery.

Table 5: Comparison of overall postoperative efficacy in 65 patients with epileptic mental disorders.

	Effectiveness					Total	Response rate
	Recovery	Significant improvement	Improvement	Ineffectiveness	Deterioration		
Type	5	12	8	3	0	28	89.29%
Type	12	15	7	3	0	37	91.89%
Total	17	27	15	6	0	65	90.77%

Table 6: Comparison of the effect of postoperative epilepsy control in 65 patients.

	Effectiveness					Total	Response rate
	Satisfactory	Significant improvement	Improvement	No improvement	Deterioration		
Type	12	7	6	2	1	28	89.29%
Type	6	15	10	4	2	37	83.78%
Total	18	22	16	6	3	65	86.15%

Table 7: Comparison of the scores on psychological measurement scales before and 2 weeks after surgery.

Item	Pre-surgery	Post-surgery (2 weeks)	t value	p value
BPRS	61.94±13.68	41.89±7.77	10.28	<0.001
SAPS	68.49±13.20	29.69±4.69	22.33	<0.001
SANS	41.32±10.22	24.57±4.55	12.07	<0.001
MMSE	24.58±3.15	25.33±2.86	-1.42	0.158

Table 8: Postoperative complications of 65 patients.

Group	Complications n(%)				
	Hyperpyrexia	Urinary incontinence	Disorientation	Unilateral weakness	Aphasia
Type I	6(21.43)	12(42.86)	15(53.57)	2(7.14)	1(3.6)
Type II	9(24.32)	19(51.35)	22(59.46)	4(10.81)	0(0)
Total	15(23.08)	31(47.69)	37(56.92)	6(9.23)	1(1.54)

Discussion

The classification standards of epileptic mental disorders remain non-uniform at present. Some scholars have categorized patients as epileptic or non-epileptic based on the temporal relationship between psychiatric symptoms and seizures [24,25]. The selection of surgical programs is based on this classification. However, epileptic mental disorders present with a complex array of symptoms. Consequently, this simple classification system cannot fully reflect the clinical characteristics and treatment focus of the disease. To address this challenge, we created our own classification scale for mental disorders related to epilepsy. We assigned values to the correlation between psychiatric symptoms and epileptic seizures, imaging findings, and EEG results. Patients were classified into Type I and Type II based on the total score. This approach guided the selection of surgical methods. We utilized this scale to classify 65 patients with epileptic mental disorders in our research and developed surgical plans accordingly. Our approach has been proven highly effective, with a remarkable success rate of 90.77%. This demonstrates not only the efficacy of our strategy but also its practical applicability.

The primary surgical treatments for refractory focal epilepsy are Epilepsy Lesion Resection (ELR) or Anterior Temporal Lobectomy (ATL) [8,26,27]. Certain scholars propose that epileptic seizures are responsible for epileptic mental disorders [4,28]. Consequently, surgically removing the epileptic focus can ameliorate both the epilepsy and psychiatric symptoms of patients. Nevertheless, it is essential to keep in mind that there are still cases where simply resecting the epileptic focus may not suffice to effectively manage both the seizure and psychiatric symptoms [29]. Stereotactic surgery in psychosurgery frequently targets the corpus callosum and cingulate gyrus, as these structures have been found to be highly effective in controlling impulsive behavior, blocking the diffusion pathway of epileptic discharge, and reducing the frequency and severity of epileptic seizures, or even altering the type of seizure [23]. The destruction of these targets has been shown to significantly impact the clinical outcomes of patients with these conditions [16]. Therefore, the combined operation of ELR or ATL + anterior callosotomy + medial cingulate cauterization is used to treat type I epileptic mental disorders. This approach can effectively address epilepsy while controlling psychiatric symptoms and alleviate both conditions through only one operation. Additionally, the combined operation technology has become increasingly mature and basically does not increase additional complications. This significantly reduces the economic burden on patients and is more suitable for patients with a clear epileptic focus.

Patients categorized as Type II exhibit no discernible pattern regarding the time consistency between psychiatric symptoms and epileptic seizures [30]. The most salient feature of this patient subtype is the persistence of mental disorders. Even when epileptic seizures are in remission, psychiatric symptoms do not exhibit significant improvement and, in certain instances, may even gradually worsen. This may be attributed to prolonged seizures causing damage to brain function. The persistence of symptoms after the onset of mental disorders demonstrates only a weak correlation with subsequent seizures. Most patients do not show any abnormality in imaging examination, and their EEG shows diffuse changes on both sides, making it challenging to locate the epileptogenic focus accurately. Therefore, stereotactic radiofrequency thermocoagulation has become an alternative surgery for such patients. This method is more accurate in positioning and can achieve bilateral multi-targets simultaneously [31,32]. There is no uniform standard for selecting and combining targets for treating epileptic mental disorders. However, a scientific and reasonable selection and combination of targets can help improve surgical efficacy and clinical symptoms [33]. Korzenev utilized cingulate gyrus + anterior capsular + amygdala destruction in patients with epilepsy and intractable OCD, while Sramka employed anterior hypothalamus and amygdala destruction in patients with epilepsy and aggressive behavior [34,35]. In China, Liang Shuli et al. administered a multi-target combination of bilateral cingulate gyrus, amygdala, inner capsule forelimbs, hippocampus, or Forel-H region to address epileptic mental disorders [36]. We chose a combination of commonly targeted areas with positive outcomes. We destroyed the bilateral amygdala, bilateral corpus callosum, and cingulate gyrus for type II patients [37,38]. We also destroyed one side of the hippocampus or Forel-H region based on EEG changes and seizure characteristics [39,40]. The effective rates for treating epilepsy and mental disorders were 83.78% and 91.89%, respectively. These results indicate that stereotactic radiofrequency thermocoagulation is an effective method for controlling epilepsy and mental disorders.

Apart from surgical treatment for epilepsy patients with mental disorders, addressing their mental health issues is equally important [41,42]. Regrettably, some families exhibit a lack of attentiveness toward the psychological well-being of patients and may, in some cases, choose to abandon them. Due to long-term isolation from society, patients with epilepsy and mental disorders often face challenges in interpersonal communication, weak adaptability, language communication barriers, and other difficulties. Even if surgical intervention achieves positive results, it remains difficult for them to reintegrate into society in a short period. Reasonably increasing the time spent with caregivers and proactive psychological intervention are conducive to getting patients out of psychological difficulties, avoiding feelings of inferiority, reshaping the desire for a better life, establishing confidence in overcoming pain, and enabling them to actively cooperate with treatment to promote the recovery of disease Therefore, medical staff should prioritize the mental health of patients and provide timely psychological counseling during routine surgical treatment and clinical nursing. It is also essential to communicate with the patient's family members to explain the significance of family psychological intervention. This will guide the family members to provide more care and psychological support, reduce the possibility of accidents, and work together towards the patient's speedy recovery and return to society.

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