Seizure 22 (2013) 493–501

Contents lists available at SciVerse ScienceDirect

Seizure

journal homepage: www.elsevier.com/locate/yseiz

Review

Reoperation after failed resective epilepsy surgery

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ARTICLE INFO

Article history:
Received 28 February 2013
Received in revised form 25 April 2013
Accepted 26 April 2013

Keywords:
Temporal lobe epilepsy
Frontal lobe epilepsy
Epilepsy surgery
Hippocampal sclerosis
Hypothalamic hamartoma

ABSTRACT

Purpose: Resection of the seizure focus leads to sustained seizure-freedom in intractable focal epilepsy in up to 80% of selected populations. However, surgery fails to help in a considerable proportion of patients. Reevaluation and reoperation may be considered in a selected group of patients with an unfavorable postsurgical outcome. Here, we reviewed 15 case series on reoperation after failed resective epilepsy surgery in adults in order to identify factors associated with a good chance of benefitting from a second operation.

Methods: Literature review of case series describing the outcome of epilepsy surgical re-operations.

Results: Overall, 3.8–14% of all patients who had resective epilepsy surgery underwent a second operation. A total of 402 reoperated patients were included. Reoperation was performed in average between 2 and 5.5 years after the first surgery. 36.6% of all patients were seizure-free with a minimal follow-up of 6 months to 4 years after the second operation. Postsurgical complications were observed in 13.5% and mainly consisted of visual field defects and, less frequently, of hemiparesis. The causes of failed first epilepsy surgery were heterogeneous and included incorrect localization or incomplete resection of the seizure focus, presence of additional seizure foci or progression of the underlying disease. Some features appear to indicate successful reoperation, such as concordance of postsurgical imaging and electroclinical findings as well as absence of brain trauma and cerebral infection prior to epilepsy onset.

Conclusion: Reoperation after thorough assessment of all available clinical, imaging and EEG findings can be an efficacious and reasonably safe treatment option which can achieve sustained seizure control after failed resective epilepsy surgery.

1. Introduction

Resective epilepsy surgery can lead to sustained seizure control in up to 70–80% of selected patients with medically refractory focal epilepsy.[1] This means, in turn, that up to 20–30% of operated patients will suffer from recurrent seizures after surgery. Epilepsy surgery is commonly considered as a failure if patients continue to have disabling seizures (more than "rarely" occurring disabling seizures, usually classified as class III and IV according to the Engel classification or outcome class 3–6 according to the ILAE classification).[2] People with recurrent postsurgical seizures, however, may achieve full seizure control later on whether spontaneously by the "running down" phenomenon,[3] by continuation, reinstitution or modification of anticonvulsant drugs as well as by alternative treatment options such as vagal nerve stimulation or stimulation of the anterior thalamic nucleus.[4–8] Given this variability in the disease course after a first operation, it appears difficult to define after how many seizures and after what time interval following surgery one can assume recurrence of epilepsy. The situation is further complicated by the sparse knowledge of the best time point of reevaluation and reoperation, of selection criteria for appropriate candidates, of potential indicators and predictors for favorable and unfavorable seizure-outcome after second surgery, and of efficiency and safety of a second surgery.

Taken together, it remains to be elucidated which diagnostic and therapeutic strategy is appropriate in people after failed epilepsy surgery. Here, we reviewed pertinent literature and suggest a practical approach which may allow efficient work-up and may help in the clinical decision-making when facing people after surgical failure.

2. Methods

We have considered articles in peer-reviewed scientific journals published between January 1980 and January 2013 in English dealing with reoperation after failed resective epilepsy surgery in adult patients with medically refractory focal epilepsy.

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http://dx.doi.org/10.1016/j.seizure.2013.04.020

Abstracts and book chapters have not been included in this review. The following terms were searched on PubMed: reoperation, second operation, failed epilepsy surgery, focal epilepsy, refractory epilepsy, and human.

3. Review of the literature

3.1. General characteristics, reevaluation and reoperation rates

Fifteen case series with a total of 402 reoperated patients fulfilled inclusion criteria and were analyzed in this review. Overall, 3.8–14% of all patients in whom a resective epilepsy surgery was performed underwent a second operation.[9–16] The time interval between the first and second surgical intervention ranged in average between 2 and 5.5 years (Table 1). Most patients suffered from temporal lobe epilepsy (TLE) and frontal lobe epilepsy (FLE) of heterogeneous etiologies as well as hypothalamic hamartomas in one series (Table 1). Neurosurgical techniques for the first epilepsy surgery varied according to epilepsy type and underlying pathology (Tables 1 and 2). Following failed resective epilepsy surgery (commonly reported as class III and IV according to the Engel classification or ILAE classification class 3–6), 32–100% of the patients were reevaluated.[9,12,15,17] Of these, 22.1–73.3% patients proceeded to a second operation,[6,9,12,15,17] leading to reoperation rates between 35.9 and 65.2% in patients with unfavorable outcome after epilepsy surgery.[9,12,15,17] The reasons for not performing a reoperation included the presence of inconsistent MRI and EEG findings, bilateral independent interictal epileptiform discharges (IED), a widespread seizure focus, overlap of the seizure focus with eloquent cortex, a compulsory intracranial study before second surgery (which was considered difficult or refused by the patient) or simply because the patient did not want a second surgery.

3.2. Reassessment after failed surgery

A common problem in clinical practice is to define recurrence of epilepsy after epilepsy surgery. Occurrence of the first and second postoperative seizure within 6 months after surgery along with an unprovoked initial recurrence and ipsilateral IED 6 months after surgery is associated with a poor postsurgical seizure outcome, and may therefore predict failed epilepsy surgery.[18] The decision to initiate reevaluation, however, is commonly taken on an individual basis and depends, among other factors, on the actual seizure control, seizure severity and the patients' wish. Reassessment requires a comprehensive review of pre- and postsurgical clinical, EEG and imaging findings.

The first step usually includes the reappraisal of clinical, MRI and EEG findings obtained prior to first surgery. A number of features are associated with the seizure-outcome after a first resective epilepsy surgery, potentially providing explanations for a failed surgery. For instance, the exclusive presence of ipsilateral IED, a clear pathology on brain MRI as well as the concordance of MRI and electroclincial findings predict a favorable outcome, whereas the presence of frequent contralateral IED, a normal brain MRI, disconcordant MRI and electroclinical findings as well as frequent secondarily generalized tonic-clonic seizures appear to predict an unfavorable outcome after a first surgery.[5,15,19–21] Importantly, the absence of specific neuropathological findings of the resected tissue is also associated with a poorer outcome.[22] Altogether, thorough revision of all findings related to the first surgery may give insights into the causes of insufficient postsurgical seizure control.

In a second step, postsurgical cerebral MRI is commonly performed to estimate the quality and extent of the first surgical intervention. In a high proportion of patients after a first failed epilepsy surgery, MRI demonstrated residual cerebral structures including retained mesial, lateral or posterior brain tissue in people with TLE.[9,11,13,15,23,24] It is often challenging to judge whether the neurosurgical intervention has been performed as intended based on MRI criteria. When the patient is seizure-free after epilepsy surgery, the seizure focus has obviously been successfully removed or the ictogenic network has been sufficiently disturbed by removal of a certain tissue volume. In mesial TLE, this "critical mass" appears to be rather individual, explaining the wide range of controversial findings of various authors and working groups investigating the optimal extent of resection.[25] There is, however, good evidence that e.g. in the case of selective amygdalohippocampectomy, a sufficient technique consists of removal of the major parts of the uncus and amygdala, the hippocampus and the parahippocampal gyrus with a posterior extent of about 2.5 cm.[26] The clinical value of further imaging studies using single-photon emission computed tomography (SPECT) or positron emission tomography (PET) remains to be confirmed, but first reports on the use of e.g. alpha-[^{11}C]methyl-L-tryptophan PET in the reevaluation after surgical failure are promising.[27,28]

Finally, video-EEG telemetry with seizure recording is repeated. To date, it remains to be elucidated after which time interval following the first operation and in whom video-EEG monitoring should be performed. Jehi and co-workers have addressed these issues in patients after unsuccessful TLE surgery and found that seizure recurrence within the first postoperative year along with a "higher" seizure frequency (at least 4 seizures per month) predict successful identification of the seizure focus.[6] Importantly, in those patients who displayed seizure recurrence within the first 6 months, the seizure focus was distant to the original site of surgery,[6] suggesting that the initial localization of the seizure generator was wrong or that additional seizure generators were present. Furthermore, patients with contralateral IED prior to a standard temporal lobectomy (first surgery) were more likely to have seizure recurrence from the contralateral temporal lobe, strengthening the importance of thorough reappraisal of all findings (see first step). In contrast to a standard temporal lobectomy, people with more limited resections were more likely to undergo repeat EEG recordings with intracranial electrodes (Table 2).[6] The use of intracranial electrodes was reported in 7.5–73.3% of the patients before second surgery without increased complication rates (Tables 1 and 2).[9,10,16,23,29] In some of the patients, intracranial EEG recordings were even performed during both the first and second pre-surgical assessment without difficulties.[30]

3.3. Success rates and indicators for favorable and unfavorable seizure outcome after reoperation

The success rates (defined as the proportion of seizure-free patients) following a second surgery varied considerably between the published case series and ranged from 9.5 to 57.1%.[11,15] Across all studies, 36.6% of the reoperated patients became seizure-free (Table 1). This relatively high success rate has to be considered with caution, because the case series included highly selected patients who were judged eligible for a second operation with a good chance of getting seizure free. The criteria for eligibility are likely to vary from center to center and may include type of epilepsy and underlying pathology as well as postsurgical MRI findings. For instance, it might appear more intuitive to reoperate a patient with retained mesial structures after a first surgery for mesial TLE with associated hippocampal sclerosis on brain MRI, than a patient suffering from a non-lesional mesial TLE assessed by intracranial video-EEG telemetry. It would be helpful to dispose of specific features which identify candidates with a good chance of getting seizure-free after reoperation, but unequivocal predictors