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Quality control of elective surgery for drug-resistant epilepsy in a German reference centre—A long-term outcome study

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ABSTRACT

Purpose: Resective epilepsy surgery is the recommended treatment for a well-defined group of patients with drug-resistant epilepsy. Long-term outcome studies are an appropriate quality control to assess the value of elective surgical procedures ethically and economically. This paper reports the long-term post-surgical follow-up of adult patients of the Kork Epilepsy Centre.
Method: Data collection was performed by means of a questionnaire to obtain updated information about postsurgical outcome, frequency and postsurgical seizure semiology in case of relapse, postsurgical use of antiepileptic drugs, social issues and satisfaction rates. We classified seizure outcome according to the ILAE surgery outcome scale (OC 1–OC 6).
Results: Outcome data of 340 adult patients were obtained. Mean post-operative follow-up was 6.7 years (range 1.0–21.6 years). Seizure remission was 67% if comprising patients with postoperative auras only (OC 1 + OC 2). Sixty-two per cent of patients were completely seizure free. The majority of patients (78%) underwent temporal lobe resections. Sixty-four per cent of these and 52% of the patients with extra-temporal resections became completely seizure-free (OC 1). Only 34% of the patients with negative MRI achieved complete seizure-freedom.
Conclusion: In line with others our huge cohort sample that covers decades of experience with epilepsy surgery revealed satisfying long-term outcome results. Best results were obtained in lesional temporal lobe epilepsy, least favourable results in MRI-negative epilepsy.

1. Introduction

In spite of all achievements of modern antiepileptic drug (AED) treatment, still approximately 30–35% of patients with epilepsy suffer from drug-resistant epilepsy.[1,2] In these patients epilepsy surgery may be the first-line treatment option. The rate of seizure freedom strongly depends on the epilepsy syndrome, the brain region of interest and the presence of a MRI detectable lesion.[2] Patients with epilepsy due to hippocampal sclerosis, focal cortical dysplasia (FCD) or dysontogenetic neuroepithelial tumours who underwent anterior temporal lobe resection or lesionectomy in the temporal lobe are estimated to have a chance of seizure remission of 60–80%.[3–6] MRI-negative epilepsy is associated with a worse outcome.[4,7–13] At the Kork Epilepsy Centre, epilepsy surgery in adults was initiated more than two decades ago and has been consequently continued until today. The responsible staff and the keystones of the programme remained very stable. In terms of quality control it is necessary to rely not only on external data and standards but also to assess the quality of presurgical diagnostics and epilepsy surgery at our centre compared to others and internally over the long-term. It is even more important to evaluate the quality of our surgical activity because of the character of an elective and irreversible resection of brain tissue and its possible consequences such as neuro-functional or neuro-cognitive deficits. Thus, our aim was to improve our knowledge about long-term results of epilepsy surgery in our own series.

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2. Methods

2.1. Patients and data collection

Our database includes all adult patients ($n = 440$) of the Kork Epilepsy Centre who have undergone epilepsy surgery since 1988. Eighty-five per cent of these patients have been operated by one of us (JZ) and his team at the Neurosurgical Department at the University of Freiburg, Germany.

In all of these patients clinical data were collected in detail. Presurgical investigations took place in our tertiary epilepsy centre. In each patient we performed long-term scalp-video-EEG-monitoring, magnetic resonance imaging (MRI), neuropsychological testing and – if necessary – further exams such as fluordesoxyglucose-positron-emission-tomography (FDG-PET), high-field MRI (1.5–3.0 T), voxel-based morphometry, functional MRI (language and motor), Wada-test, ictal and interictal single photon emission computed tomography (SPECT) or magnetoencephalography (MEG). Patients were investigated with invasive recordings (subdural and depth electrodes), when non-invasive presurgical evaluation did not allow proper definition of the limits of resection or to identify eloquent cortex. Invasive recordings were performed at the University of Freiburg.

A special case conference designated to surgical candidates was held to discuss the results of the presurgical evaluation and to decide the extent and limits of resection in each particular case.

Postoperative controls included clinical examination, evaluation of seizure remission or relapse, interictal EEG, MRI and neuropsychological testing in each patient and were routinely performed three months and one year after surgery. If a patient was not seizure-free, long-term video-EEG with ictal recordings was performed again.

Our database contained information about the kind of surgery, histopathology and postsurgical complications.

2.1.1. Assessment of update post-operative outcome data

We used a standardized questionnaire to obtain updated information about postsurgical outcome as seizure-remission, frequency and kind of seizures when relapse in comparison to the pre-operative seizure frequency, information about AED treatment as well as patient's satisfaction and actual social and professional situation. This questionnaire permitted us to reach 320 of the total 440 operated patients who live far away from our centre. Two hundred and twenty patients filled in the questionnaire and sent it back in between 3 months. If the questionnaire was not filled out correctly, we called patients and their relatives to clarify our questions. In addition, those 120 patients who had been identified by means of the database mentioned above and lived close to our centre were seen together with family members or friends between March and May 2011 in our outpatient's department. Each patient gave us individual consent to use the data for study purpose.

2.2. Seizure outcome classification

We classified seizure outcome at the time of the post-surgery follow-up evaluation (most recent observation, means March–May 2011) according to the ILAE (International League Against Epilepsy) surgery outcome scale (OC 1–OC 6).[14,15] According to this, patients had at least been seizure-free (OC 1) in the previous year before the time of the last recent observation.

ILAE outcome scale (OC)[14]

- OC 1: completely seizure free, no auras
- OC 2: only auras, no other seizures
- OC 3: one to three seizure days per year ± auras
- OC 4: four seizure days per year to 50% reduction of baseline seizure days ± auras
- OC 5: less than 50% reduction of baseline seizure days to 100% increase of baseline seizure days ± auras
- OC 6: more than 100% increase of baseline seizure days ± auras.

2.3. Statistical analysis

The total number and percentage were achieved for the non-parametric variables.

For qualitative variables, the statistical differences were calculated using the chi-square test. For continuous values, one-way analysis of variance (ANOVA) was run with Statistica (Statsoft®, version 8.0).

3. Results

3.1. Demographic data

Out of a total of 440 patients we were able to obtain complete outcome data of 340 patients at the last observation carried forward. One-hundred patients could not be included due to a loss of current addresses, a lack of motivation to participate, interfering confounding factors such as psychogenic seizures or death ($n = 5$).

Mean follow-up since surgery was 6.7 years (range 1–21.6 years).

174 male and 166 female patients participated in this study. Mean duration of epilepsy until surgery was 24.9 years (range 1–56 years); mean age at the time of surgery was 38.6 years (range 18–69). Neither the age at the time of surgery nor the duration of epilepsy had any influence on the post-operative outcome in our series as illustrated in Figs. 1 and 2, even if we addressed subgroups (duration of epilepsy before epilepsy surgery: 1–10 years; >10 < 20 years; >20 years).

3.2. Post-operative outcome in the whole population

At the time of the last recent observation in May of 2011, 211 patients (62%) were completely seizure-free (OC 1) for at least one year. Including patients who have had seizure remission except auras (OC 1 + OC 2) the number increased to 228 (67%). If surgery had taken place less than 7 years ago ($n = 194$), the percentage of

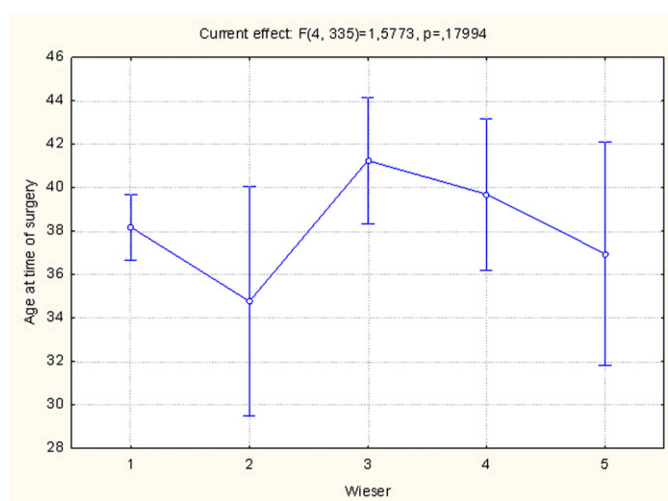

Fig. 1. Influence of the age at the time of surgery on the postsurgical outcome Wieser 1–5 (ILAE OC 1–5[14]) – no significant influence was shown with one-way analysis of variance (ANOVA).

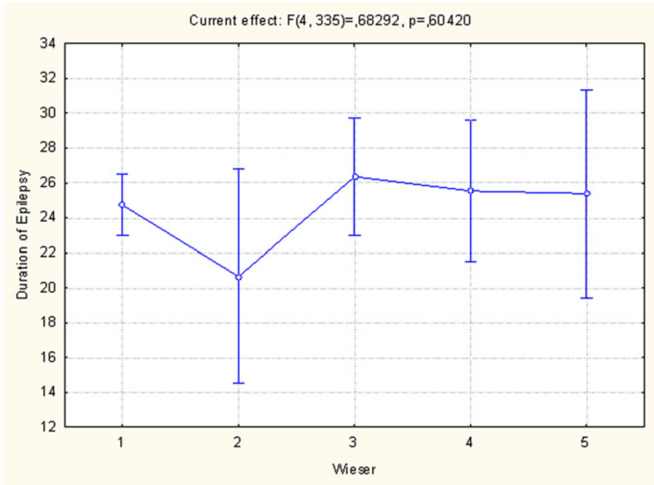

Fig. 2. Influence of the duration of epilepsy on the postsurgical outcome Wieser 1–5 (ILAE OC 1–5[14]) – no significant influence was shown with one-way analysis of variance (ANOVA).

complete seizure remission was 60% (63% OC 1 + OC 2). In the group of patients who had undergone surgery more than 7 years ago (7–21 years postoperatively) (*n* = 146) the rate of seizure-freedom was 65% (OC 1) and 72% (OC 1 + OC 2).

Fig. 3 shows the number and percentage of patients in the different postsurgical outcome categories (ILAE outcome classification).[14]

In 39 patients (11.5%) seizures (including auras) still had been documented during the first year after surgery but had not been reported anymore at the time of the last recent observation.

Thirty-three (85%) of these patients had undergone temporal lobe resections, 5 frontal lobe resections and one patient had a multilobar resection.

AED treatment was changed post-operatively in 17 of these 39 patients. Thirteen patients received levetiracetam additionally to their pre-operative AEDs or in exchange with one of the pre-operative AEDs. In four further patients other AEDs than levetiracetam were contributed. In six of the 39 patients, pre-operative AEDs were reduced or even discontinued regardless of initially continuing seizures. Sixteen patients remained on their pre-operative AEDs.

Otherwise, 25 patients (7%) did not have any seizures in the first year after surgery but seizure relapse (OC 3; 4; 5) was noted at the time of the last recent observation.

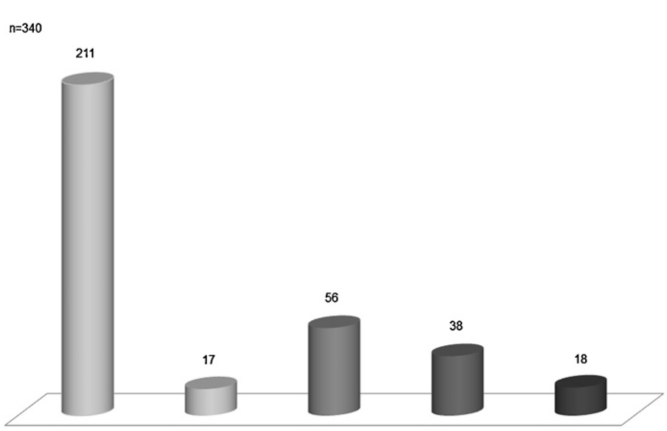

Fig. 3. Outcome after epilepsy surgery at last recent observation in May 2011; in total 340 patients. Number of patients in the different categories OC 1–OC 5 (ILAE-outcome classification[14]). None of the patients was classified OC 6.

3.3. Post-operative outcome in elderly patients

Twelve patients were 60 years or older (range from 60 to 69 years) at the time of surgery. Six patients were resected in the left temporal lobe, five in the right temporal lobe and one patient had a right frontal resection. Four patients got completely seizure-free, one patient reported occasional auras only. Three patients had a significant seizure reduction. Four patients did not benefit.

3.4. Post-operative outcome in relation to the resected brain region

3.4.1. Temporal lobe resections

Two-hundred and sixty-six (78%) patients underwent temporal lobe resections. The seizure-free rate (OC 1) in this group was 64% (*n* = 171). Taking completely seizure-free patients and patients with only persisting auras in account (OC 1 + OC 2), seizure remission was reported in 69.5% (*n* = 185). Forty-three (16.2%) patients were classified as OC 3, 27 (10.2%) as OC 4 and 11 as OC 5 (4%).

Table 2 shows the number and percentage of seizure-free patients after selective amygdalo-hippocampectomy (sAHE) and standard anterior temporal lobe resection (ATL) + amygdalo-hippocampectomy.

A small group of eight patients with subtle blurring of the temporal pole without MRI-signs of hippocampal sclerosis underwent anterior temporal lobe resection without removal of the hippocampus. Six patients have remained seizure-free (OC 1). Thirty-four patients with clear MRI lesions as, for example, dysontogenetic neuroepithelial tumours or Taylor type dysplasia underwent temporal lesionectomies with a seizure-free rate of 62% (OC 1).

3.4.2. Extra-temporal lobe resections

Forty-eight patients had extra-temporal resections among which 37 patients were resected in the frontal, 2 in the basal central region, 5 in the parietal lobe, 2 in the occipital region and another 2 in the insula. Fifty-two per cent (*n* = 25) of patients with extra-temporal resections were seizure-free (OC 1; 56%: OC 1 + OC 2). Twelve patients were considered as MRI-negative.

Only four of these remained seizure free (OC 1).

3.4.3. Multilobar resections and hemispherotomies

If multilobar resections (*n* = 21) were performed, 52.4% of the patients became seizure-free (OC 1; 57%: OC 1 + OC 2).

3.4.4. Hemispherotomies

Five adult patients with hemispherotomies were completely seizure-free (OC 1). This series has already been described elsewhere.[16]

3.5. Postsurgical outcome in relation to the histopathological result

In resections that comprised temporal lobe tissue, the histopathological examination revealed 208 cases of hippocampal sclerosis, 88 focal cortical dysplasias (including combinations with tumours and/or hippocampal sclerosis) and 28 tumours (dysontogenetic neuroepithelial tumours, ganglioglioma, gangliocytoma; low-grade oligodendroglioma and astrocytoma, hamartoma, ependymoma) as well as 11 vascular malformations (cavernoma, haemangioma, meningoangiomatosis). In 68 cases hippocampal sclerosis and FCD were combined. Following Palmini's classification[17] the histopathological result showed 9 FCD type Ia, 21 FCD type Ib, 29 FCD type IIa and one FCD type IIb as well as 8 not specifically classified FCDs in combination with hippocampal sclerosis. The rate of seizure freedom (OC 1) was 68% (72%: OC 1 + OC 2) in these patients with dual pathology. In the subgroup of patients only with hippocampal sclerosis, the seizure-free rate (OC 1) reached 67% (70%: OC 1 + OC 2). For extra-temporal lobe resections, histopathology showed in total 29 FCD, 18 FCD type II and 11 FCD type I as well as 9 tumours, 3 cavernomas, and 7 cases of gliosis.

Interestingly, the rate of seizure freedom in type I and type II dysplasias was the same in these small groups (9 patients OC 1 in FCD type II group; $n = 18$ and 5 patients in FCD type I group; $n = 11$).

3.6. MRI-negative patients

Only 26 (7.6%) patients were classified as MRI-negative. All MRIs were performed according to the epilepsy protocol with 1.5-T or 3.0-T (since 2005) systems including thin coronal T2- and fluid-attenuated inversion recovery (FLAIR)-weighted sections as well as thin T2, T1 and FLAIR-weighted axial and sagittal images, MPRAGE (magnetization-prepared rapid gradient echo) sequences and 3-dimensional T1 data sets. Axial images were acquired with a modified angulation parallel to the long axis of the temporal lobe. Since 2004 we have used post-processing (voxel-based morphometric MRI-analysis) for the detection of subtle signs of FCD.[18] In all these patients invasive video-EEG recording had been performed mainly with subdural electrodes or combinations of subdural and depth electrodes prior to surgery.

Only 34.6% of MRI-negative patients had complete (OC 1) and 38.5% almost complete seizure-remission (OC 1 + OC 2). Twelve patients had extra-temporal resections, nine temporal and five multilobectomies. Histopathology showed FCD types Ia and Ib in 18, FCD + hippocampal sclerosis in six and undefined tissue abnormalities in two cases.

3.7. Palliative surgery

Fourteen patients were operated based on a "palliative" perspective. We considered surgery to be palliative if it was performed primarily to reduce seizures or to suppress very disabling seizures (tonic seizures with falls, tonic–clonic seizures, etc.). We were aware that complete seizure freedom would be difficult to achieve because of multi-focal seizure onset, large seizure onset zones or extent of the seizure onset zone to eloquent cortex. There were five resections in the temporal lobe (3 sAHE, one lesionectomy and one AHE + ATL). The rest were frontal, central and occipital lesion- and lobectomies as well as two multilobectomies. In eight patients multiple subpial transsections were additionally performed and in eight patients invasive video-EEG recordings preceded the resection. Four patients became seizure-free.

One patient was classified as OC 2, another one as OC 3, five patients as OC 4 and three as OC 5.

3.8. Postsurgical outcome in patients with invasive recordings

Seventy-three (21.5%) of the 340 patients had obtained invasive video-EEG recordings with subdural and/or depth electrodes prior to resection. Thirty-five (48%) patients were classified as OC 1 at the time of last recent observation, 42 (57.5%) as OC 1 + OC 2. Thirty-six patients underwent temporal resections after invasive recordings. Twenty-one frontal/fronto-central resections were performed. The remaining 16 extra-temporal resections were parietal, insular and partially or completely multilobar procedures. OC 1 + OC 2 was achieved in 64% of temporal and in 51% of extra-temporal resections.

3.9. Surgical complications

Twenty of the 340 patients (5.9%) had peri-operative complications (haemorrhage, infection). Most of these patients had only transient deficits and 50% became seizure-free (ILAE outcome classification: OC 1). The complication rate for permanent deficits (hemiparesis, aphasia and neurocognitive deficits) was 1.8%.

Six of 73 patients (8.1%) who had undergone invasive video-EEG recordings with subdural electrodes had complications (five subdural bleedings, one subdural bleeding and abscess) with transient deficits.

No deaths occurred.

3.10. Post-operative AED treatment

Forty-one patients (12%) had discontinued AEDs at the last time of observation and have remained seizure-free. In ten further patients seizure relapse occurred after drug-withdrawal. One-hundred and thirty-seven patients continued one AED, 134 two and 29 even three or more AEDs.

3.11. Post-operative satisfaction

295 (87%) patients declared to be satisfied about surgery and postsurgical outcome. 191 (66%) of these 295 satisfied patients had seizure remission.

4. Discussion

We evaluated the post-operative seizure outcome of our adult patients over the past twenty years. Although others have reported their series already, for reasons of internal and external (health insurances, caregivers) quality control it is crucial to assess the long-term outcome of epilepsy surgery at our centre which represents one of the largest tertiary referral centres in Germany. From a methodological point of view the main advantages of our series are clearly the homogeneous and stable staff and standardized diagnostic and therapeutic procedures over decades.

4.1. Epilepsy outcome

At the time of the last postsurgical follow-up, 211 patients (62%) were completely seizure-free corresponding to ILAE outcome classification 1 (OC 1).

This number increased to 228 (67%) if patients were included who had seizure-remission apart from auras (OC 1 + OC 2).

4.2. Seizure remission and relapse

Thirty-nine patients (11.5%), mainly with temporal resections had seizures in the first post-operative year, but were seizure-free at the last observation evoking a running down phenomenon, as described by Salanova, Rasmussen et al.[19] In 17 of these 39 patients, pre-operative AEDs were changed post-operatively. Levetiracetam was administrated postoperatively in 13 patients who finally became seizure-free in course of the years which might have had a positive impact on the long-term outcome as described in a recently published study.[20] Otherwise 16 patients remained on their pre-operative AED treatment and in six patients AEDs had even been reduced or discontinued before they became completely seizure-free. Thus the running down phenomenon cannot only be explained by changes in AED treatment. Other factors such as the size of the epileptogenic zone may also contribute.[19]

Twenty-five patients (7%) of the whole collective had seizure relapses at the last follow-up despite of stable AED treatment.

Late recurrence after an initial seizure-free period of more than two years has often been reported. In a recently published cohort study of 615 adults, the seizure-remission rate was estimated using survival methods at 63% at two years after surgery, 52% at five years and 47% at ten years (OC 1 + OC 2; persisting auras included).[15] Sperling et al.[21] showed in a time to event analysis an annual relapse rate of 4% between 5 and 10 years after epilepsy surgery.

Our study does not provide a longitudinal year-by-year follow-up. Therefore we are not able to give the percentage of patients with seizure relapse depending on the time after surgery. Regarding data and study design, we are able to report on a subgroup who had undergone epilepsy surgery more than 7 years ago. Positive outcome rates were higher with 65–72% (OC 1/OC 1 + OC 2) compared with 62% in the more recently operated patients. This result may be due to a selection bias. At the beginnings of our epilepsy surgery programme we chose only the best candidates with clearly well-defined brain lesions and perfectly corresponding semiological and surface-EEG features. We lack to see those patients regularly recently. Hopefully good epilepsy surgery candidates with epilepsy onset in childhood or adolescence are identified earlier today and led to surgery. Furthermore the incidence of hippocampal sclerosis may be less important in well-developed countries nowadays thanks to the considerable progress in obstetrics.

4.3. Age at the time of surgery and duration of epilepsy

Conversely to previous outcome studies[22–24] neither the age at the time of surgery nor the duration of epilepsy were significantly influencing the post-operative outcome in our series, even not in a subgroup analysis. However the three different subgroups (see Table 1) enclosed a very unequal number of patients with only 52 patients in subgroup 1, 86 in subgroup 2 but 202 patients in subgroup 3 which renders the three different groups hardly comparable. McIntosh et al.[25] showed that age at surgery and duration of epilepsy had significant effect on univariate analysis but not on regression analysis after pre-operative pathology and pre-operative generalized seizures had been taken into account. Maybe these or other confounding factors were influencing our results.

Mean duration of epilepsy was long with 24.9 years and mean age at the time of surgery was 38.6 years.

Engel et al.[26] recently compared a medically treated group of patients with pharmaco-resistant epilepsy and a surgically treated one. They concluded that surgical plus AED treatment resulted in a lower probability of seizures, than AED treatment alone. Keeping in mind the results of this study, patients should be referred to surgery early after failure of two correctly administrated and well-established AEDs, which was apparently not the rule in our series.

4.4. Epilepsy outcome in the elderly

Even if the mean age at the time of surgery did not differ significantly, regarding the postsurgical outcome in the entire cohort, a qualitative analysis showed that patients with an age of 60 years or higher had a less favourable outcome. The group was small with only twelve patients. Four patients became completely seizure free at the time of last follow-up, one patient experienced only non-disabling auras. Most post-operative outcome studies of elderly patients did not show worse results compared to the outcome in younger age groups.[27–29] However, the older age group was defined as age >50 years which reflects an "old age group" quite young compared to our contemporary understanding of seniority. One recent study showed clearly a more favourable outcome in the younger age group <50 years.[30]

Table 1
Number of seizure-free patients in the different subgroups considering the duration of epilepsy-no significant differences in seizure outcome between the subgroups; subgroups 1 and 2, $p = 0.95$; subgroups 1 and 3, $p = 0.93$; subgroups 2 and 3, $p = 0.88$.

Subgroups: duration of epilepsy before surgery	Number of completely seizure-free patients (OC 1)	Number of seizure-free patients apart from auras (OC 1 + OC 2)
Subgroup 1 1–10 years $n = 52$	31 (60%)	34 (65%)
Subgroup 2 >10 < 20 years $n = 86$	51 (60%)	57 (66%)
Subgroup 3 >20 years $n = 202$	129 (64%)	137 (68%)

Table 2
Postsurgical outcome of selective amygdalo-hippocampectomy (sAHE) and classical anterior temporal lobe resection (AHE + ATL). OC 1 versus patients with persistent seizures: there is no significant effect based on the surgery method chi-square, $p = 0.36$. OC 1 + OC 2 versus patients with persistent seizures: there is no significant effect based on the surgery methods chi-square, $p = 0.17$.

Outcome classification	sAHE $n = 124$	AHE + ATL $n = 100$
1	$n = 78$ (63%)	$n = 66$ (66%)
2	$n = 9$ (7%)	$n = 3$ (3%)
3	$n = 18$ (15%)	$n = 19$ (19%)
4	$n = 14$ (11%)	$n = 8$ (8%)
5	$n = 5$ (4%)	$n = 4$ (4%)

4.5. Significance of the brain region and presence of a lesion

In our series post-operative outcome was strongly depending on the presence of a MRI-visible lesion and its localization in the brain.

Post-operative seizure freedom in MRI-negative patients was only 34.6% (OC 1), which is in line with the literature.[31] Bien et al.[32] reported in a retrospective study of patients with MRI-negative epilepsy, only 38% seizure-free cases, whereas 66% of MRI-positive patients had seizure remission.

4.6. Temporal versus extra-temporal resections

The majority of patients ($n = 266$) underwent temporal lobe surgery. In this subgroup the seizure-remission rate was 69.5% including totally seizure-free patients and patients with only non-disabling auras at the last time of observation (mean post-operative follow-up 7.14 years). In the literature long-term outcome-rates after temporal lobe resection differ from 55 to 77% at two years follow-up, from 48 to 74% at five years follow-up and 41 to 72% at 10 years follow-up.[25,33–37]

In our series, 56% of patients who underwent extra-temporal resections achieved long-term seizure –freedom. In a recently published study the probabilities of seizure-freedom at one year follow-up were only 23.5% and at five years follow-up 14.7% after extra-temporal epilepsy surgery.[38] In a meta-analysis of 131 patients it was shown that outcome in extra-temporal lobe epilepsy is less favourable than in temporal lobe epilepsy.[39] Zentner et al.[40] reported on 54% of patients with extra-temporal resections who remained seizure-free over a four year follow-up period. Better outcome was achieved when a lesion had been detected before surgery.[40–42]

4.7. Continuation or withdrawal of AEDs

The number of patients with complete drug withdrawal after surgery was small (12%). If inacceptable side effects were not apparent, we did not begin with AED tapering in the first post-operative year. A recently published study showed that beginning of AED taper more than nine months after surgery was associated with a greater number of seizure-free cases.[43] Most of our patients wished to stay on AEDs, mostly for professional or social reasons such as the driver's licence. Ten patients had seizure relapse after AED withdrawal but regained seizure freedom after restarting AED treatment in line with one other report.[44] Seizure recurrence after AED withdrawal was described in one out of three patients rendered seizure free by epilepsy surgery.[45] We did not recommend AED-withdrawal in patients who presented with post-operative auras and/or interictal epileptiform discharges, incomplete resection, FCD type I or pre-operative negative MRI, respectively, since those factors are associated with an increased risk of seizure recurrence.[39,46–50]

4.8. Post-operative tonic–clonic seizures

Thirty-three per cent of patients who did not achieve seizure freedom (ILAE outcome classification OC 3–OC 5; $n = 112$) experienced mainly sleep-related tonic–clonic seizures which had not been their dominating semiology pre-operatively. Most of them had temporal lobe resections including neocortical tissue. Post-operative interictal EEG showed the irritative zone at electrodes placed over the resected region. Ictal EEG in those who were re-evaluated with scalp video-EEG registration revealed a remaining ictal onset zone around the resected brain area. This preponderance of tonic–clonic seizures may be due to a fast propagation pathway from remaining epileptogenic tissue in the vicinity of the temporal resection borders to suprasylvian areas.

In conclusion, our study shows satisfying postsurgical long-term outcome results in patients who had underwent surgery for medically intractable epilepsy. Best candidates remain patients with temporal lobe epilepsy in whom a MRI visible lesion is present. Information about postsurgical seizure outcome is crucial to reflect critically on the quality of our work, select patients carefully for a successful outcome and to be able to give a realistic prognosis to the individual patient. Data assessment for quality properties in health care may play an evermore important role to justify clinical activity such as elective surgical procedures in epilepsy.

Conflict of interest

None of the authors has any conflict of interest to disclose.

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