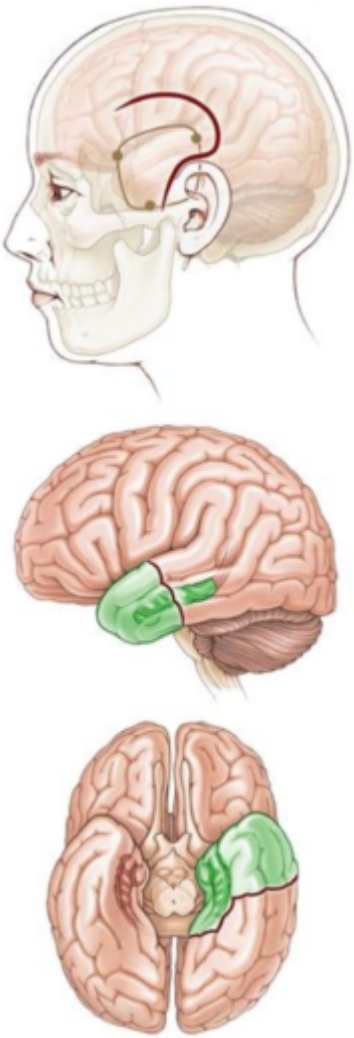
Anterior temporal lobectomy for Epilepsy



Anterior temporal lobectomy for mesial temporal sclerosis is a very effective measure to control seizures, and the probability of being seizure-free is approximately 70-90%. However, 30% of patients still experience seizures after surgery.

In neurosurgery there are several situations that require transgression of the temporal cortex. For example, a subset of patients with temporal lobe epilepsy require surgical resection (most typically, en-bloc anterior temporal lobectomy). This procedure is the gold standard to alleviate seizures but is associated with chronic cognitive deficits. In recent years there have been multiple attempts to find the optimum balance between minimising the size of resection in order to preserve cognitive function, while still ensuring seizure freedom. Some attempts involve reducing the distance that the resection stretches back from the temporal pole, whilst others try to preserve one or more of the temporal gyri. More recent advanced surgical techniques (selective amygdalohippocampectomy) try to remove the least amount of tissue by going under (sub-temporal), over (trans-Sylvian) or through the temporal lobe (middle-temporal), which have been related to better cognitive outcomes. Previous comparisons of these surgical techniques focus on comparing seizure freedom or behaviour post-surgery, however there have been no systematic studies showing the effect of surgery on white matter connectivity. The main aim of this study, therefore, was to perform systematic 'pseudo-neurosurgery' based on existing resection methods on healthy neuroimaging data and measuring the effect on long-range connectivity. We use anatomical connectivity maps (ACM) to determine long-range disconnection,

which is complementary to existing measures of local integrity such as fractional anisotropy or mean diffusivity. ACMs were generated for each diffusion scan in order to compare whole-brain connectivity with an 'ideal resection', nine anterior temporal lobectomy and three selective approaches. For en-bloc resections, as distance from the temporal pole increased, reduction in connectivity was evident within the arcuate fasciculus, inferior longitudinal fasciculus, Inferior fronto-occipital fascicle, and the uncinate fasciculus. Increasing the height of resections dorsally reduced connectivity within the uncinate fasciculus. Sub-temporal amygdalohippocampectomy resections were associated with connectivity patterns most similar to the 'ideal' baseline resection, compared to trans-Sylvian and middle-temporal approaches. In conclusion, we showed the utility of ACM in assessing long-range disconnections/disruptions during temporal lobe resections, where we identified the subtemporal resection as the least disruptive to long-range connectivity which may explain its better cognitive outcome. These results have a direct impact on understanding the amount and/or type of cognitive deficit post-surgery, which may not be obtainable using local measures of white matter integrity [1].

Anterior temporal lobectomy (ATL) with amygdalohippocampectomy (ATLAH) has been shown to be more efficacious than continued medical therapy in a randomized, controlled trial [2].

Minimally invasive approaches to treating MTLE might achieve seizure freedom while minimizing adverse effects.

Anterior temporal lobectomy as described by Penfield and Baldwin [3]. is the most established neurosurgical procedure for temporal lobe epilepsy, for those in whom anticonvulsant medications do not control epileptic seizures.

It consists in the complete removal of the anterior portion of the temporal lobe of the brain.

Knowledge of the temporomesial region, including neurovascular structures around the brainstem, is essential to keep this procedure safe and effective [4].

The techniques for removing temporal lobe tissue vary from resection of large amounts of tissue, including lateral temporal cortex along with medial structures, to more restricted anterior temporal lobectomy (ATL) to more restricted removal of only the medial structures (selective amygdalohippocampectomy, SAH).

Limits of resection

The measurements are made along the middle temporal gyrus.

Dominant temporal lobe: Up to 4-5 cm may be removed

Non Dominant: 6- 7 cm.

Nearly all reports of seizure outcome following these procedures indicate that the best outcome group includes patients with MRI evidence of mesial temporal sclerosis (hippocampal atrophy with increased T-2 signal.) The range of seizure-free outcomes for these patients is reported to be between 80 and 90%, which is typically reported as a sub-set of data within a larger surgical series.

Open surgical procedures such as ATL have inherent risks including damage to the brain (either directly or indirectly by injury to important blood vessels), bleeding (which can require re-operation), blood loss (which can require transfusion), and infection. Furthermore, open procedures require several days of care in the hospital including at least one night in an intensive care unit. Although such treatment can be costly, multiple studies have demonstrated that ATL in patients who have failed at least two anticonvulsant drug trials (thereby meeting the criteria for medically intractable temporal lobe epilepsy) has lower mortality, lower morbidity and lower long-term cost in comparison with continued medical therapy without surgical intervention.

The strongest evidence supporting ATL over continued medical therapy for medically refractory temporal lobe epilepsy is a prospective, randomized trial of ATL compared to best medical therapy (anticonvulsants), which convincingly demonstrated that the seizure-free rate after surgery was ~ 60% as compared to only 8% for the medicine only group.

Furthermore, there was no mortality in the surgery group, while there was seizure-related mortality in the medical therapy group. Therefore, ATL is considered the standard of care for patients with medically intractable mesial temporal lobe epilepsy.

Surgical resection is the gold standard treatment for drug-resistant focal epilepsy, including mesial temporal lobe epilepsy (MTLE) and other focal cortical lesions with correlated electrophysiological features. Anterior temporal lobectomy with amygdalohippocampectomy (ATLAH) has been shown to be more efficacious than continued medical therapy in a randomized, controlled trial [5].

The most common surgical procedure for the mesial temporal lobe is the standard anterior temporal resection or what is commonly called the anterior temporal lobectomy. There are, however, a number of other more selective procedures for removal of the mesial temporal lobe structures (amygdala, hippocampus, and parahippocampal gyrus) that spare much of the lateral temporal neocortex. Included in these procedures collectively referred to as selective amygdalohippocampectomy are the transsylvian, subtemporal, and transcortical (trans-middle temporal gyrus) selective amygdalohippocampectomy [6].

The ATL group scored significantly worse for recognition of fear compared with selective amygdalohippocampectomy (SAH) patients. Inversely, after SAH scores for disgust were significantly lower than after ATL, independently of the side of resection. Unilateral temporal damage impairs facial emotion recognition (FER). Different neurosurgical procedures may affect FER differently [7].

Outcome

Anterior temporal lobectomy for Epilepsy Outcome.

Complications

see Anterior temporal lobectomy complications.

Case series

Of 1214 patients evaluated for surgery in the epilepsy Center of Faculdade de Medicina de São Jose do Rio Preto (FAMERP), a tertiary Brazilian epilepsy center, 400 underwent ATL for MTS. Number and type of auras was analyzed and compared with Engel Epilepsy Surgery Outcome Scale for outcome.

Analyzing the patients by the type of aura, those who had extratemporal auras had worst result in post-surgical in Engel classifcation. While mesial auras apparently is a good prognostic factor. Patients without aura also had worse prognosis. Simple and multiple aura had no difference. In order to identify the most appropriate candidates for ATL, is very important to consider the prognostic factors associated with favorable for counseling patients in daily practice [8].

Boucher et al. compared preoperative vs. postoperative memory performance in 13 patients with selective amygdalohippocampectomy (SAH) with 26 patients who underwent ATL matched on side of surgery, IQ, age at seizure onset, and age at surgery. Memory function was assessed using the Logical Memory subtest from the Wechsler Memory Scales - 3rd edition (LM-WMS), the Rey Auditory Verbal Learning Test (RAVLT), the Digit Span subtest from the Wechsler Adult Intelligence Scale, and the Rey-Osterrieth Complex Figure Test. Repeated measures analyses of variance revealed opposite effects of SAH and ATL on the two verbal learning memory tests. On the immediate recall trial of the LM-WMS, performance deteriorated after ATL in comparison with that after SAH. By contrast, on the delayed recognition trial of the RAVLT, performance deteriorated after SAH compared with that after ATL. However, additional analyses revealed that the latter finding was only observed when surgery was conducted in the right hemisphere. No interaction effects were found on other memory outcomes. The results are congruent with the view that tasks involving rich semantic content and syntactical structure are more sensitive to the effects of lateral temporal cortex resection as compared with mesiotemporal resection. The findings highlight the importance of task selection in the assessment of memory in patients undergoing TLE surgery [9].

Case reports

Georgia country is a Caucasian low- to a middle-income country with a remarkable effort to deal with epileptic diseases, but without an appropriate epilepsy surgery program. To address the needs for such a service in this country, two joint German-Georgian projects were initiated in 2017 and 2019. In the framework of these projects, a productive exchange program involving German and Georgian experts was undertaken in the past two years. This program included training and mentoring for Georgian clinical colleagues, as well as a joint case conferences and workshops with the aim of optimizing presurgical diagnostics and preparing for an epilepsy surgery program in Georgia. Finally, a postsurgical medium- and long-term follow-up scheme was organized as the third component of this comprehensive approach. As a result of the efforts, the first patients underwent anterior temporal lobectomy and all of them remain seizure-free up to the present day. Hence, epilepsy surgery is not only feasible but also already available in Georgia. In a report, Dugladze et al. aimed to share their experiences in the initiation and implementation of surgical epilepsy intervention in Georgia and illustrate the recent endeavor and achievements [10].

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