Epilepsy Research (2013) **104**, 94—104

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

Selective amygdalohippocampectomy versus standard temporal lobectomy in patients with mesial temporal lobe epilepsy and unilateral hippocampal sclerosis

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Received 31 May 2012; received in revised form 5 September 2012; accepted 9 September 2012
Available online 28 September 2012

KEYWORDS
Temporal lobe epilepsy;
Epilepsy surgery;
Amygdalohippocampectomy;
Temporal lobectomy;
Outcome;
Memory

Summary Several studies have demonstrated the positive effect of resective epilepsy surgery in drug-resistant temporal lobe epilepsy (TLE). However, it is still a matter of debate whether selective amygdalohippocampectomy (SAH) or standard temporal lobectomy (STL) are the most effective approaches concerning seizure outcome, quality of life and memory.

In each of the two centers participating in this study either SAH or STL was the neurosurgical standard procedure irrespective of contextual aspects. Thus, with this postoperative assessment of resected patients we sought to avoid any selection bias that usually impaired comparative trials of both surgical approaches. We finally identified and studied 95 adult patients who had undergone either SAH ($n = 46$) or STL ($n = 49$) between 1999 and 2009 and fulfilled the inclusion criteria, namely drug-resistant unilateral mesial TLE with hippocampal sclerosis without any further structural lesions. We assessed the postoperative seizure outcome according to the ILAE criteria and postoperative quality of life by means of standardized questionnaires. Finally, we compared postoperative neuropsychological performance in 60 completely seizure-free patients ($n = 27$ after SAH, $n = 33$ after STL) prior to, one year after surgery and at a long-term follow-up with a mean of seven years.

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0920-1211/$ — see front matter
http://dx.doi.org/10.1016/j.eplepsyres.2012.09.007

78.2% of SAH and 85.7% of STL were seizure-free at the last observation. Quality of life had improved in 95.6% of the SAH patients and 89.8% of the STL patients. These differences were not statistically significant. Left-sided TLE patients had a significantly worse verbal memory outcome irrespective of the surgical method. However, SAH patients had a significantly better outcome concerning visual encoding, verbal and visual short-term memory and visual working memory.

In this study, seizure outcome and quality of life did not differ depending on the surgical approach. However, a more selective resection led to better neuropsychological performances.

Introduction

Temporal lobe epilepsy (TLE) is the most common epilepsy syndrome with focal epileptic seizures (Engel, 1996). In many cases, TLE is associated with hippocampal sclerosis (HS). Typical seizure semiology, EEG findings and neuropsychological deficits define the characteristics of mesial TLE as a specific epileptic syndrome (Lüders et al., 2006). Mesial TLE with HS is often drug resistant. On the other hand it reflects one of the most appropriate conditions for resective epilepsy surgery (McIntosh et al., 2001; Wiebe et al., 2001; Steinhoff, 2004; Noachtar and Borggraefe, 2009).

Epilepsy surgery aims for best possible seizure outcome without additional postoperative deficits concerning the patient's quality of life and cognitive skills. Neurosurgical candidates should undergo complete presurgical investigations, in order to define the epileptogenic zone as precisely as possible, but also to address the functional deficit zone, its relation to the epileptogenic zone and thus to estimate the potential risk of postoperative impairment (Rosenow and Lüders, 2001; Kilpatrick et al., 2003; Helmstaedter, 2004; Uijl et al., 2008; Noachtar and Borggraefe, 2009).

In TLE, the neurosurgery has a better prognosis in cases with a restricted epileptogenic zone and a low probability of cognitive decline (Tonini et al., 2004). Presurgical memory deficits in TLE are typical and well described in the literature (Helmstaedter and Elger, 1996; Wilkinson et al., 2012). However, an additional decline after neurosurgery is another major burden beyond an unfavorable seizure outcome (Lee et al., 2002). For decades epileptologists and neurosurgeons attempted to obtain the best possible seizure outcome and to minimize the risk of postoperative additional burdens. Several studies (e.g., McIntosh et al., 2001; Morino et al., 2006; Tezer et al., 2008) addressed the neurosurgical impact in TLE and its relation to short and long-term seizure outcome. For many years, standardized temporal lobectomy (STL) represented the most frequently used neurosurgical technique in mesial TLE. This method consists of the resection of anterior parts of the TL including the amygdala, hippocampus and neocortical temporal cortex (Doyle and Spencer, 1997).

Due to the potential additional impairment of memory functions, other authors, Niemeyer (1958) and later Wieser and Yaşargil (1982) suggested a more selective approach, which was restricted to the mesial structures of the TL (i.e., amygdala, hippocampus and parahippocampal gyrus), while preserving the lateral parts of the temporal neocortex to reduce cognitive impairments. The major progress in temporal lobe epilepsy surgery was thus the introduction of selective amygdalo-hippocampectomy (SAH) with varying technical strategies including transcortical, transsylvian, transinsular or subtemporal approaches (Niemeyer, 1958; Yasargil, 1967; Yasargil et al., 1985; Vajkoczy et al., 1998; Olivier, 2000; Hori et al., 2007; Wheatley, 2008; Chabardès et al., 2011). These selective strategies were supposed to be as effective as STL with a better postoperative cognitive and memory outcome (Wieser and Yaşargil, 1982; Wieser et al., 1990; Helmstaedter et al., 2002; Morino et al., 2006; Paglioli et al., 2006; Grammaldo et al., 2009; Shin et al., 2009; Chabardès et al., 2011), although controversial data also exists (Lutz et al., 2004; Shin et al., 2009; Chabardès et al., 2011). Helmstaedter et al. (2008) noted a differential effect according to the side and the type of surgery. Verbal memory deficits were more pronounced after SAH on the left side compared with the STL. On the other hand, visual memory dysfunctions were more evident when STL was performed on the right side. Not every group agreed, Jones-Gotman et al. (1997) did not find a correlation between the surgical method and memory outcome. In fact, there were no significant differences concerning long-term memory after STL, SAH, and resections of the temporal neocortex. Left-sided neurosurgery was shown to be a risk factor for post-operative memory decline independently of the surgical methods (Gleissner et al., 2002; Alpherts et al., 2006). Most of the studies emphasized that the mesial temporal system would address different types of material-specific information, mostly in accordance with the pattern of cerebral language dominance. Verbal memory tasks would be more sensitive to uncover dysfunctions after left-STL in cases of typical speech liberalization (Lee et al., 2002). For visual memory functions the impact of the right temporal lobe and the suitable neuropsychological diagnostic tools are less clearly defined (Vaz, 2004; Wisniewski et al., 2012).

A methodological limitation of most studies that addressed SAH and STL is that randomized studies do not exist and that most of the other studies addressing this question had some drawbacks. For instance, monocentric studies often compared results after having changed strategies (Schramm and Clusmann, 2008) and multicenter comparisons also did not take into consideration that a selection bias may have influenced the choice of the surgical approach. To our best knowledge, none of them performed a comparative analysis of the consequences between STL and SAH in homogeneous patient-groups. Only one meta-analysis from Schramm and Clusmann (2008) based on the literature is currently available. It concluded that seizure outcome was not different dependent on the selectivity of the TLE surgery. However, SAH seemed more