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Trans-middle temporal gyrus selective amygdalohippocampectomy for medically intractable mesial temporal lobe epilepsy in adults: Seizure response rates, complications, and neuropsychological outcomes

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ABSTRACT

Objective: Selective amygdalohippocampectomy (AHC) has evolved to encompass a variety of techniques to resect the mesial temporal lobe. To date, there have been few large-scale evaluations of trans-middle temporal gyrus selective AHC. The authors examine a large series of patients who have undergone the trans-middle temporal gyrus AHC and assess its clinical and neuropsychological impact.
Methods: A series of 76 adult patients underwent selective AHC via the trans-middle temporal gyrus approach over a 10-year period, 19 of whom underwent pre- and postoperative neuropsychological evaluations.
Results: Favorable seizure response rates were achieved (92% Engel class I or II), with very low surgical morbidity and no mortality. Postoperative neuropsychological assessment revealed a decline in verbal memory for the left AHC group. No postoperative memory decline was identified for the right AHC group, but rather some improvements were noted within this group.
Conclusions: The trans-middle temporal gyrus selective AHC is a safe and effective choice for management of medically refractory epilepsy in adults.

1. Introduction

The selective amygdalohippocampectomy (AHC) was first proposed in 1958 by Niemeyer [21]. The technique was originally developed to spare unaffected brain tissue from surgery, thus minimizing the cognitive consequences of a full temporal lobe resection. With the evolution of functional imaging and progression of anatomic research, there has been a new appreciation for the white matter tracts within the temporal lobe. This has elevated the appreciation for preservation of functional cortex and its deeper connections [17,18,24,33]. Since the AHC's initial inception, there have been several variants on the surgical approach for the selective resection of this region. The earliest approach, described by Niemeyer, was the trans-middle temporal gyrus, transventricular approach to the mediobasal temporal lobe. In an attempt to preserve the neocortex, Yasargil later proposed a transsylvian approach in 1982 [32]. This approach, however, may increase the risk for a vascular injury as it requires splitting the Sylvian fissure and exposing the distal middle cerebral artery branches. Still another approach was the subtemporal approach proposed by Hori in 1993 [11]. This approach was thought to have a functional advantage by penetrating the subtemporal cortex via the parahippocampal gyrus but can involve undue cortical retraction and manipulation of large cortical veins. It is important to note that all approaches to a greater or lesser degree breach the cortical surface and white matter to arrive at the resectional targets of the procedure (i.e., the hippocampus, amygdala, and parahippocampal gyrus). The transventricular approach transects the lateral surface of the middle temporal gyrus to gain access to the mesial structures. The transsylvian and subtemporal approaches both transect the cortex at the limen insula from either a medial or an inferior trajectory, respectively (see Fig. 1).

Regardless of the approach utilized, the selective AHC has been shown to provide durable clinical outcomes and decreased seizure burden for patients living with medically refractory epilepsy [12,20,23,29,30,31,35,36]. Though the trans-middle temporal gyrus approach was initially described in 1958, there have been only a limited number of modern clinical series that have assessed its clinical impact

Abbreviations: AHC, amygdalohippocampectomy; IFOF, Inferior Occipitofrontal Fasciculus; EEG, electroencephalogram; FDG-PET, Fluorodeoxyglucose Positron Emission Tomography; IQ, Intelligence Quotient; WTAR, Wechsler Test of Adult Reading; CVLT-II, California Verbal Learning Test—Second Edition; WMS-III LM, Wechsler Memory Scale—Third Edition Logical Memory subtest.

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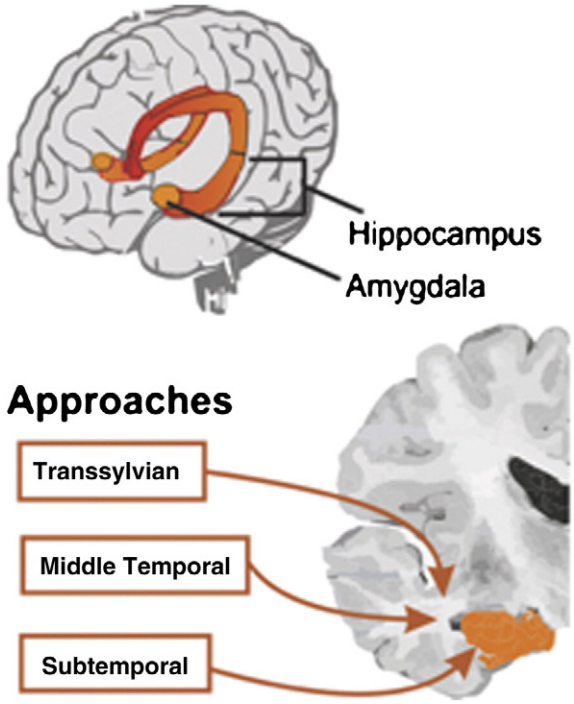

Fig. 1. Comparison of the transsylvian, subtemporal, and trans-middle temporal gyrus approaches to the resectional targets of the selective amygdalohippocampectomy within the mediobasal temporal lobe.

as measured by postoperative Engel classification, neuropsychological consequences, and surgical complications [1,22,26]. Herein, we have evaluated the trans-middle temporal approach to evaluate seizure response rates, neuropsychological outcomes, and complications for consideration as a safe and effective choice with regard to seizure control and functional outcome.

2. Methods

2.1. Patient population

The authors present a retrospective review of 76 consecutive adult patients with age ranging from 20 to 65 years who underwent selective AHC via the trans-middle temporal gyrus approach for medically refractory mesial temporal lobe epilepsy over a 10-year period between 1997 and 2007. All patients had at least 1 year of follow-up available for review. A subset of 19 of these patients underwent both pre- and postoperative neuropsychological evaluations. All patients underwent standard preoperative evaluation including MR imaging, inpatient video-EEG monitoring with requirement for at least one electroclinical seizure captured during the monitoring period, interictal FDG-PET, and neuropsychological evaluation. The patients were selected for a selective AHC without further invasive monitoring if, following multidisciplinary review of their cases, seizure semiology, scalp EEG, and imaging data were concordant, suggesting a unilateral mesial temporal lobe onset due to hippocampal sclerosis. Radiographic criteria used to identify evidence of hippocampal sclerosis on MRI include hippocampal atrophy, hyperintensity on T2-weighted imaging or fluid attenuated inversion recovery (FLAIR) sequences, and/or mesial temporal lobe hypometabolism on PET imaging. A single surgeon performed all operations (JD).

2.2. Surgical technique

The trans-middle temporal gyrus approach was utilized to reach the mesial temporal lobe structures. This approach was selected by the operating surgeon (JD) based solely on training experience. The surgical technique for this procedure has been previously described by Niemeyer and, in great detail, by Wheatley [28]. Briefly, utilizing neuronaviation (StealthStation, Medtronic, Minneapolis, MN), the surgical incison and craniotomy is planned to allow posteriorly and inferiorly directed access to the mediobasal structures of the temporal lobe through a 15–20mm corticectomy within the anterior middle temporal gyrus. Once the ventricle is accessed, the microscope is brought in for high power magnification and illumination allowing identification of the lateral ventricular sulcus and the choroidal fissure, both of which serve as important reference landmarks during resection. Ultrasonic aspiration (CUSA, Integra Radionics, Burlington, MA) continues anteriorly extending to the medial pia to allow subpial resection of the uncus and the amygdala. Once resection is carried down over the tentorial edge, the 3rd cranial nerve and ipsilateral posterior communicating and posterior cerebral arteries are visualized through the medial pia. Focus is then turned posteriorly to allow resection of the hippocampus and the parahippocampal gyrus back to the level of the colliculi.

2.3. Neuropsychological assessment

A total of 19 patients underwent pre- and postsurgical neuropsychological assessments. All 76 patients underwent preoperative neuropsychological assessment, but those available for postoperative assessment were limited, frequently because of travel time constraints and the fact that many had returned to work postoperatively. Postsurgical assessments were completed approximately eight months postsurgery (mean: 8.84 months, range: 6–21 months). The patients' intellectual ability (IQ) was estimated by their scores on the Wechsler Test of Adult Reading (WTAR; 2001). Verbal memory was assessed by the California Verbal Learning Test—Second Edition (CVLT-II; 2000) and by the Wechsler Memory Scale—Third Edition Logical Memory subtest (WMS-III LM; 1997). The CVLT-II is a list learning and memory test that requires a patient to learn a 16-item word list across 5 learning trials and then recall and recognize the learned list after a 20-minute delay. For this study, total raw scores for trials 1-5, short delay free recall, short delay cued recall, long delay free recall, long delay cued recall, recognition false positives, and recognition correct scores were calculated. The WMS-III LM subtest is a test requiring a patient to recall two stories immediately after they are read and to recall and recognize information from the stories after a 30-minute delay. Total immediate and delayed recall scores were calculated (LM I and LM II). Visual memory was assessed by the WMS-III Visual Reproduction subtest that is a test requiring the patient to recall five pictures of designs immediately after their presentation and after a 30-minute delay. Total immediate and delayed recall scores were calculated (VR I and VR II).

2.4. Data analysis and statistics

Patient data were organized in a database (Excel, Microsoft Corporation, Seattle, WA). The data were then analyzed using the Statistical Analysis Software (SAS Institute Inc., Cary, NC). Neuropsychological data were analyzed with repeated measures ANOVAs on the two groups (left AHC and right AHC) preoperatively and postoperatively. Statistics were considered significant if p-values were less than 0.05.

3. Results

3.1. Demographics

Table 1 demonstrates the demographic profile of the patients included in this study. Our patient population was composed of 62% female patients and 38% male patients with an average age of 41 years at the time of surgery, with an age range of 20–65 years. The average duration of preoperative seizure activity was 28 years with a range of