International Journal of Surgery 36 (2016) 411–419

Contents lists available at ScienceDirect

International Journal of Surgery

journal homepage: www.journal-surgery.net

Mesial temporal lobe epilepsy – An overview of surgical techniques

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HIGHLIGHTS

- Hippocampal sclerosis is the most common cause of mesial temporal lobe epilepsy.
- Anterior temporal polar focal cortical dysplasia is often missed on a routine MR protocol. A 3T MR imaging is necessary with an experienced MR radiologist.
- Diffuse cortical dysplasia and severely sclerotic hippocampus can pose surgical challenge.
- A Standard but extended anterior temporal lobectomy is appropriate in the Indian subcontinent due to various cultural and socioeconomic considerations.
- Comprehensive epilepsy care team in a tertiary care academic is paramount for the success of the epilepsy care program.

ARTICLE INFO

Article history:
Received 11 July 2016
Received in revised form
16 October 2016
Accepted 18 October 2016
Available online 20 October 2016

Keywords:
Anterior temporal lobectomy
Drug resistant epilepsy
Mesial temporal lobe

ABSTRACT

Mesial temporal lobe epilepsy is one of the commonest indications for epilepsy surgery. Presurgical evaluation for drug resistant epilepsy and identification of appropriate candidates for surgery is essential for optimal seizure freedom. The anatomy of mesial temporal lobe is complex and needs to be understood in the context of the advanced imaging, ictal and interictal Video_EEG monitoring, neuropsychology and psychiatric considerations. The completeness of disconnection of epileptogenic neural networks is paramount and is correlated with the extent of resection of the mesial temporal structures. In the Indian subcontinent, a standard but extended anterior temporal lobectomy is a viable option in view of the diverse socioeconomic, cultural and pathological considerations. The maximum utilization of epilepsy surgery services in this region is also a challenge. There is a need for regional comprehensive epilepsy care teams in a tertiary care academic hospital to form centers of excellence catering to a large population.

1. Introduction

Epilepsy surgery is one of the most gratifying neurosurgical subspecialties. It offers a potential cure for chronic drug resistant epilepsy. There are about three hundred thousand patients in India who are potential candidates for epilepsy surgery [1]. It remains an underutilized service due to various socioeconomic and cultural factors. The awareness about the benefits from surgery in selected patients need to be emphasized. The potential candidates with refractory seizure disorder should undergo early presurgical evaluation and counseling for surgery. A comprehensive epilepsy surgery involving the epileptologist, epilepsy surgeon, radiologist, psychiatrist and neuropsychologist in a tertiary care center are paramount for long-term success of the program. It is imperative that the seizure disorder and its outcome should be discussed with the patient and his family. The goal of epilepsy surgery is to ensure maximal seizure freedom, no added neurological deficit and gradual withdrawal of antiepileptic drugs. Patients who do not achieve complete seizure freedom or need antiepileptic drugs post operatively are quite dissatisfied.

Mesial Temporal Sclerosis (MTS) is the most common cause of medically refractory Temporal Lobe Epilepsy (TLE). The treatment is

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http://dx.doi.org/10.1016/j.ijsu.2016.10.027

predominantly surgical [2–4]. The complete disconnection of the epileptogenic neural networks in the mesial temporal lobe determines the success of resective surgery. Surgical approaches for temporal lobectomy have several technical variations. They include standard anterior temporal lobectomy, anteromedial temporal lobectomy, selective amygdalohippocampectomy and stereotactic approaches [1–7]. Selective resections of the amygdala and hippocampus, via a variety of approaches are presumed to minimize the disturbance of temporal language regions. However, the access to the amygdala, hippocampus, and entorhinal cortex is limited. There is a concern that it could lead to incomplete resections and poorer outcome.

Standard Anterior Temporal Lobectomy (ATL) is the most commonly performed surgical procedure. It involves the removal of most of the hippocampus; amygdala and variable portions of the anterior and lateral temporal neocortex.

2. Surgical considerations in mesial temporal lobe epilepsy surgery

Surgery for mesial temporal lobe requires an elaborate understanding of the anatomy of mesial temporal lobe structures. It is not akin to a temporal lobectomy, which is routinely performed for trauma or tumor surgery. The surgery involves an intraventricular subpial microdissection of mesial temporal lobe structures. Specialized training and expertise is paramount to perform epilepsy surgery procedures.

2.1. Middle temporal gyrus approach for standard extended anterior temporal lobectomy

The surgical hallmark of our approach is small craniotomy for adequate exposure, no need to expose sylvian fissure, safeguarding the Vein of Labbe, no damage to optic radiation, limited resection of the lateral temporal neocortex, minimal retraction of the later temporal lobe and safeguarding of major arterial and venous channels. The lateral neocortical resection, apart from the standard resection is guided by intraoperative electrocorticography. It includes the temporal pole as well. The tail of the hippocampus is also resected.

3. Positioning of the patient

The patient is in supine position with head turned to the opposite side. The head is elevated 10–20° on the neck and extended 10° to allow access to the temporal base and minimize temporal lobe retraction. It also allows the operating surgeon to align microsurgical dissection along the lie of the temporal horn and the hippocampus.

4. Incision and craniotomy

A standard question mark incision is taken starting 1–1.5 cm from the tragus curving above the pinna and extending along the superior temporal line. The superficial temporal artery and the frontal branch of facial nerve need to be safeguarded. Hence, dissection is avoided in the fascial layers and the incision is deepened until temporalis fascia is incised. The scalp flap is reflected along with the temporalis fascia. The temporalis muscle is defined appropriately from the superior temporal line till the zygomatic base inferiorly. A sharp cut is made along the superior temporal line and the entire fan shaped temporalis muscle is reflected inferiorly and anteriorly till the anteroinferior temporal base is exposed. The temporalis muscle is hitched and secured to the parieties. Temporalis muscle is reflected by blunt dissection with help of periosteal elevators to minimize the tissue necrosis. The profuse bleeding from the deep temporal arteries can be secured by pressure and if needed, bipolar coagulation. Monopolar coagulation is avoided since it can precipitate tissue necrosis. Craniotomy is performed so that an anterior and inferior basal exposure is obtained. The petrous temporal bone air cells may be opened and should be heavily waxed. Superior extent of the craniotomy lies in at the level of the superior temporal line in close relation to the sylvian fissure.

The duramater is opened in a cruciate manner and the temporal lobe is exposed in such that the middle temporal gyrus forms the center of the craniotomy. A corticectomy is done on the middle temporal gyrus at approximately 4 cm above the midpoint of the zygoma. At this level, the temporal horn is relatively accessible at the shortest distance from the cortex. The corticectomy is deepened and the temporal horn is identified at a distance of about 3–3.5 cm. The dissection should be performed directed inferiorly and laterally towards the tentorial edge to avoid exposure to critical neurovascular structures. If the dissection is carried superiorly, it can injure the sylvian vessels and the basal ganglionic region. The identification of the temporal horn is the most important landmark in mesial temporal lobe surgery. The amygdala and hippocampus lie within it. The white matter around the temporal horn is thin. Hence, a less resistance is encountered due to the buoyancy of the CSF in the temporal horn. The differential use of suction pressure helps to locate this least resistant white matter region around the temporal horn. The use of neuronavigation to determine the location of temporal horn is optional, depending upon the comfort of the surgeon. It may of help in patients who have diffuse cortical dysplasia affecting major portion of the temporal lobe and the temporal horn is small or chinked.

The temporal horn is opened widely. The choroid plexus is identified and the tip of the choroid plexus forms the superior choroidal point, medially being the amygdala and laterally the head of hippocampus. The microsurgical dissection is performed in the hippocampal and the collateral sulcus directed towards the tentorium to prevent injury to the Meyer's loop as well as accidental injury to the insular, thalamic and the basal ganglionic region. The temporal horn is opened posteriorly till the tail of hippocampus is visualized wherein it curves to form the fornix. The choroid plexus in the temporal horn enters into the atrium. The hippocampal tail is incised, disconnected and the dissection is carried forwards in the hippocampal sulcus, which separates the parahippocampal gyrus from the dentate gyrus and brainstem medially. Anteriorly, the dissection is carried superolateral to the amygdala in an arbitrary line separating from the basal ganglia. The amydala and the uncus are disconnected till the leptomeninges over the carotid cistern is seen. The dissection is further carried in the hippocampal sulcus subpially till the entire head body and tail are disconnected. The parahippocampus– hippocampus complex is subpially dissected by peeling it from the collateral sulcus piamater using the Penfield dissectors. The entire hippocampus is subpially dissected between collateral eminence and fimbria. The venous drainage into the basal vein of Rosenthal is also disconnected, more towards the hippocampus. Since the entire disconnection is subpial, the anterior choroidal and posterior cerebral artery and its perforators as well as the third nerve, cerebral peduncle is visualized through the piamater. During the entire procedure, the choroid plexus is the most important landmark and the entire mesial temporal resection is performed superolateral to it and directed towards the tentorial edge.

The lateral temporal neocortex along with the temporal pole is then removed subpially enbloc alongwith the amygdala and the hippocampus. The posterior limit of resection is at the level of the cerebral peduncle or the quadrigeminal cistern. Anteriorly, the temporal pole is resected alongwith the lateral neocortex including