La Insulectomía podría ser un abordaje ideal para crisis insulares y peri-insulares?

Insulectomy for insular and peri-insular seizures could be an ideal and safe approach?

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Resumen

La insulectomía es una técnica microquirúrgica establecida para el tratamiento de la epilepsia refractaria al tratamiento farmacológico. El origen insular de la epilepsia es inusual, sin embargo, con la investigación a través de electrodos híbridos este tipo de epilepsia ha incrementado su diagnóstico. Los autores hacen hincapié en las funciones insulares, así como los puntos de referencia anatómicos para la cirugía. Se discuten las principales complicaciones y las bases fisiológicas para las indicaciones de cirugía.

Palabras clave: Insula, Insulectomía, epilepsia del lóbulo temporal, electrodos híbridos.

Abstract

Insulectomy is an established microsurgical technique for treatment of insular epilepsy refractory to clinical management. The insular origin of epilepsy is unusual, however with depth investigation through hybrids electrodes such kind of epilepsy is increasing its diagnosis. The authors emphasizes the insular functions as well as the anatomical landmarks for surgery. The main complications are discussed and physiological basis for indications.

Key words: Insula, Insulectomy, Temporal lobe epilepsy, hybrid electrodes.

Introduction

The insula is the only cortical part of the brain which that could not be visible on the surface of the hemisphere. It is totally covered by the fronto-parietal and temporal opercula.

Many patients with temporal epilepsy could not be cured by surgery due to their insular component, therefore insular exploration is mandatory. In order to minimize risks intra-operative direct cerebral stimulation[3,4] and precise anatomical knowledge helps the surgeon to guide the extent of resection and avoid structural damage when operating within the insula.

The role of the insula in some epilepsies was recently investigated by means of depth electrode recordings made following Talairach's[16] stereoelectroencephalography (SEEG) methodology.

Ictal signs associated with an insular discharge are very similar to those usually attributed to mesial temporal lobe seizures.

Ictal symptoms associated with insular discharges are characterized by visceral symptoms (abdominal or chest constrictions), respiratory rhythm changings, or oroalimentary automatisms (swallowing or chewing) seizures. Seizures arising from the temporal lobe may invade the insular region in the majority of the patients, but in approximately 10% of cases, the seizures may be originated in the insular cortex itself[3,4].

Electrophysiological investigation

The role of the insular lobe in temporal lobe epilepsy (TLE) has often been suggested but never directly demonstrated[9].

The observation of this clinical sequence at the onset of seizures on video-EEG recordings in patients with TLE showed important doubts where the seizure begins. Many electrophysiological records showed that the results strongly suggest that the seizure-onset zone is located not in the temporal lobe but in the insular region[6,7,8]. Recording directly from the insular cortex through multiple hybrid electrodes should be performed before making any decision regarding epilepsy surgery[6,7,8]. Therefore an isolated temporal lobectomy was a higher risk of leaving residual epileptogenic foci so the surgical approach maybe reconsidered[14].

Penfield and Jasper in 1954 were the first ones to use intra operative interictal stimulation of hidden surfaces under the frontal and parietal opercula as well as recording the insula activity after temporal lobectomy[12].

Isnard et al 2000, 2004[6,7] were the first to publish intracerebral recordings of insular seizures using depth electrodes inserted orthogonally (ie, along a horizontal axis) through the opercula with a Talairach type of stereotactic frame[16]. Afif et al, 2008[1], advocated a frame-based stereotactic depth implantation along an oblique axis through the frontal and the parietal lobes, for that an conventional angiography is extremely useful in order to avoid vascular injury. Those two techniques of stereotactic depth implantation of electrodes are minimally invasive and show a low complication rate.

The insular seizure when suspected may be investigated by means of hybrid depth and superficial electrodes[2,15] or by means of parassagital transinsular electrodes for stereo-EEG in temporal and insular lobe epilepsies using stealth station with an entry point in the parieto-occipital junction[13]. The senior author published before that combined depth and subdural electrode scan that may be used safely to investigate complex insular/perisylvian refractory epilepsy, however choice of implantation scheme should be individualized according to pre-surgical data and functional localization[2].

Anatomy of insula

The Insula is correlated physiocologically to emotional and autonomic activities, therefore crises that has it origin within the insula are very specific charceterized by changes in blood pressure, cardiac frequency, anxiety, as well as in visceromotor and sensitive control and function. There is considerable evidence for the involvement of the insula as a somesthetic area, including a major role in the processing of nociceptive inputs[3,4]. The insula has a triangular shape, and is separated from the opercula by the anterior, superior, and inferior peri-insular sulci (Figure 1A)[17,18]. The insula is composed of two portions, one anterior and other posterior. The anterior is connected with frontal lobe and the posterior is connected with parietal and temporal. The insula is a paralimbic structure, which consti-

Figure 1A. 1- Central Sulcus; 2- pars opercularis; 3- Short gyrus of insula; 4- Central Sulcus of Insula; 5- Long Gyrus of Insula; 6- Middle temporal gyrus (Thomas Frigeri).

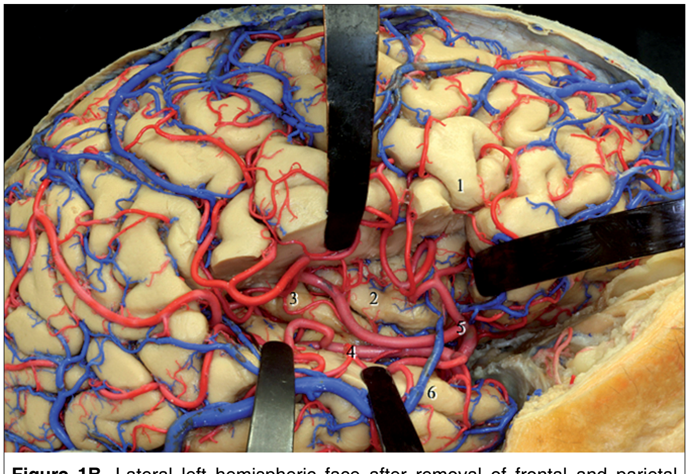

Figure 1B. Lateral left hemispheric face after removal of frontal and parietal operculum: 1- pars triangularis; 2- short gyrus of insula; 3- long gyri of linsula; 4- inferior branch of middle cerebral artery (M2 Segment), Middle cerebral artery trifurcation; 6- superior temporal gyrus (Thomas Frigeri).

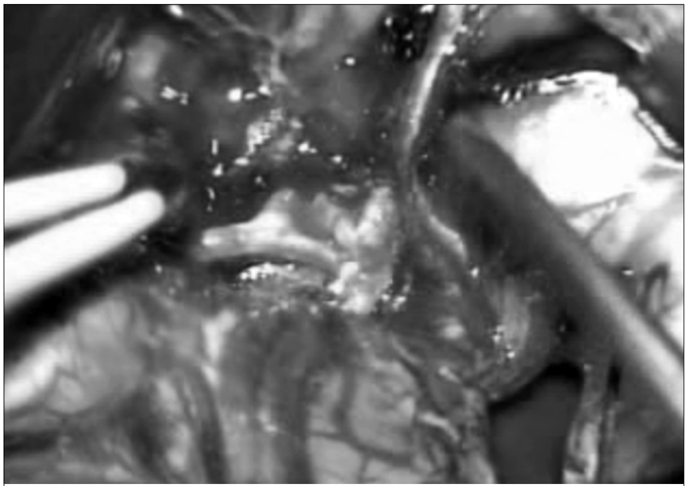

Figure 3. Microsurgical view of insulectomy after removal of surface of anterior insula, and we can observe the M2 and branches.

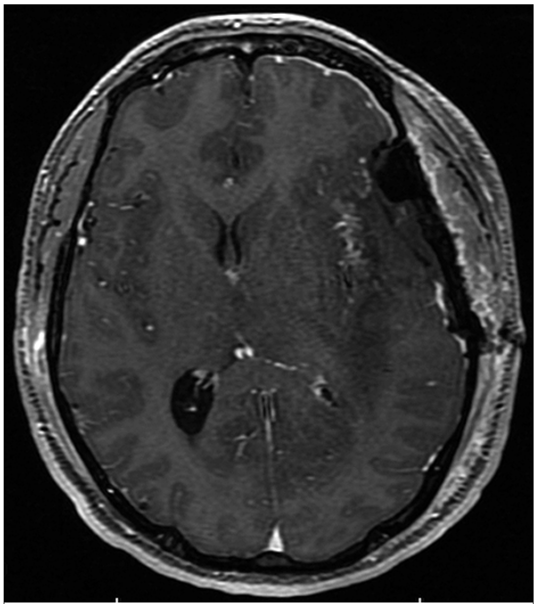

Figure 4. MRI showing partial removal of anterior portion of insula.

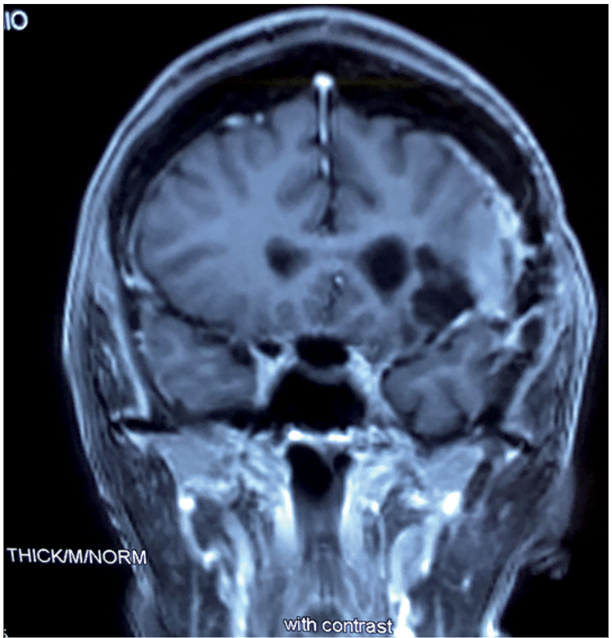

Figure 4B. Coronal MRI showing Insulectomy.

tutes the invaginated portion of cerebral cortex. The opercula cover and enclose the surface of insula. The peri-insular sulci (anterior, superior, and inferior) define the limits of the frontorbital, frontoparietal, and temporal opercula. The anterobasal portion of insula, in the depth of Sylvian fissure is the limen of insula.

The insula is also composed by a central sulci, 3 short gyri (anterior, middle and posterior) as well as long insular giri. The posterior portion of insula is composed of two long gyri of insula, and the postcentral insular sulcus which separetes them[17,18]. (Figure 1A) All this should be in mind when planning a surgical approach through it. The orbital gyri of frontal lobe has direct correlation with anterior portion of insula. The vascular supply of the insula in general provided by the M2 segments of the middle cerebral artery (Figure 1B). One important point is that in the majority of the cases the insular arteries primarily supply the insular cortex, extreme capsule, and, occasionally, the claustrum and external capsule, but not the putamen, globus pallidus, or internal capsule, which are vascularized by the lateral lenticulostriate arteries (LLAs), although some thicker branches from M2 may anastomose with the LAAs. See Figure 1B for topographic anatomy of the insula.

Surgical technique

Insulectomy is a relatively new procedure, and it can be done partialy and totally, guided by neuronavigation[10,11]. Resection of the epileptogenic insular cortex is surgically challenging. Other methods as radiosurgery has been attempted with same purposes revealing promissor results[5].

Wide opening of the Sylvian fissure is mandatory in order to identify the M2 branches e insular anatomical landmarks. Begin the suction of few milimeters of the apex cortex, keeping the integrity of the arteries in insular sulci. The resection is carried out from anterior to posterior, from the short gyrus to the long gyrus.

Ischemic images in the depth may be observed until the putamen in postoperative MRI since M2 perforators must be sacrificed during the resection of the insular cortex. This should not be prob-

lematic for the global result, differently if any of the M1 perforators (proximal to the limen insula) suffers any injury.
The bifurcation M1/M2 can be located near by the limen insula in the majority of the cases showing the importance of this anatomical landmark (Figure 1, Figure 3).
The resection must be employed with suction and bipolar, with meticulous hemostasis. Some times complete hemostasis can be accomplished with a hemostatic matrix, Floseal (Baxter, USA).

Complication and outcome

Minor transient hemiparesis may be observed in the patients in postoperative period, and the majority of patients achieve Engel I after the surgery, as Malak et al, 2009 demonstrated in 6 of 7 patients submitted to insulectomy with 0% of mortality according to Montreal University experience at this time. Now a days, with an unpublished data of 34 cases operated by the main author (AB) showing low morbidity and also 0% of mortality[10]. Post operative CT must be employed to verify the extension of resection (Figure 4).

Conclusions

Resection of insula is an optimal approach for periinsular and insular refractory epilepsy, but the anatomical landmarks must be taken in concerna and potential vascular complications also must be considered.

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