A Neuropsychological Experimental Paradigm to Detect Insular Cortex Dysfunction: Implication for Differential Diagnosis of Insular Cortex Epilepsy

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Prospective

Anatomically, there is persuasive evidence that the insular cortex has wide connections with the neocortex, basal ganglia, thalamus, limbic structures and olfactory cortex [1,2]. Klingler’s techniques and MRI-DTT (Magnetic Resonance Imaging-Diffusion Tensor Tractography) studying the white matter tracts emphasized the structural complexity of the insular lobe and its close relations with surrounding lobes, the limbic and paralimbic structures through white matter fibers tracts, providing evidence against the anachronistic view of the insula as an isolated island [3,4]. This intricate connectivity of the insular cortex may explain its multifunction processing character.

Insular cortex epilepsy is a localization-related epilepsy syndrome that frequently remains unrecognized, thus accounting for epilepsy surgery failure in patients suffering Temporal-Frontal- and Parietal-Lobe Epilepsy (TLE, FLE, PLE) given the presence of a subtle insular cortex involvement, while this is particularly true for most refractory TLE cases [5]. A 10% of TLE surgery fails to deliver any benefits and is therefore classified as intractable epilepsy, while the main reason for treatment failure may be insular cortex involvement, as simple temporal lobectomy did not resolve epileptic symptoms [6]. Penfield and Jaspers [7] and Penfield and colleagues [8] reported that seizures emanating from the insula may present a clinical semiology similar to TLE. Fifty percent of the patients with TLE manifest intermittentinsular cortex discharge intraoperatively under local anesthesia, as detected by electrocorticography and applied electric stimuli. Insular cortexstimulation also induce symptoms similar to those observed during routine ictal onset. It has thus been seen that the insular lobe cortex may also possess the epileptogenic potency, and insular epilepsy may be intermingled with TLE [9]. Moreover, the anatomical depth of insular cortex and the interposition of the lateral clustered middle cerebral artery make studying it via scalp EEG very hard. Since, to ascertain whether an identified epileptogenicity originates from the mesial temporal lobe territories and spreads to the insular lobe or vice versa is clinically tricky, a neuropsychological task tapping insular functioning becomes therefore highly desirable.

From a functional point of view, the insular cortex constitutes a kaleidoscopic integrative structure encompassing a great variety of functions (i.e., autonomic, sensory-motor, viscerosensitive, cognitive and emotional; [10]). One of the most relevant insular functions, made possible by the re-representation work of the anterior insular cortex [11], is corporal awareness [12] and representation (i.e., inner Body Image). In order to assess the ability to represent our inner body image, we set up inner Body Image (IBI) task. The IBI task consists in the presentation of pictures depicting internal organs (i.e., brain, heart, liver, intestine, stomach, etc.) within a reference background, consisting in a head silhouette, except for the brain, for which we use a left foot silhouette. The organs are presented in different sizes: medium: 100% consistently with the size of the silhouette; enlarged: 120% and reduced size: 80%. During the IBI task subjects are asked to press a push button when they attribute to themselves the organ displayed based on its size. The total number of self-attributions of each organ size (small, medium and large size) was recorded. Then we calculated the IBI score that can vary from negative to positive values - representing small to large organs self-attribution, respectively - through 0 corresponding to medium-sized organs self-attribution.

Understanding how people represent inner body would help to better define a sense of internal function [13], both in clinical and healthy populations, since that investigating how brain represents...
inner world can have important implications in facing up to disease and therapies.

We herewith propose to integrate the above experimental paradigm to the regular preoperative neuropsychological assessment as a clinical vehicle to diagnose insular dysfunction and hopefully contribute in defining the functional deficit zone from a neuropsychological point in the context of preoperative assessment protocols of epilepsy surgery candidates.

References


