of other pathophysiology, such as atherosclerosis or vasculitis. These were seemingly different from the typical "string of beads" appearance in the left PCA. Nonetheless, a conventional angiography was carried out in consideration of the patient's clinical aspects, such as sex, age, and symptomatic manifestations, which revealed findings indicative of FMD diagnosis. Thus, upon encountering young patients with an ischemic stroke, without the risk factors for atherosclerosis, along with a positive finding of intracranial arterial lesion(s) from a screening test, such as TOF-MRA, clinicians should envision performing a conventional angiography in consideration of the possible diagnosis of FMD.

4. Conclusion

Typical intracranial FMD with the "string of beads" appearance is rare. Particularly, cases of isolated intracranial FMD, without the intracranial extension of extracranial FMD, arterial aneurysm or dissection, are irrefutably uncommon. Nevertheless, in young patients without the risk of atherosclerosis, clinicians should always consider intracranial FMD as a pathophysiology that can lead to a stroke. Thereby, a conventional angiography should be performed for a differential diagnosis as necessary due to the fact that the characteristics of intracranial FMD may not always be distinctive in screening tests, such as TOF-MRA.

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Does unilateral insular resection disturb personality? A study with epileptic patients

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ABSTRACT

The insula is now regarded as a potential site of epileptogenesis in drug-resistant epilepsy, and the advent of microsurgical techniques has allowed insular cortectomy to become a treatment of choice when the insular cortex is involved in the seizure focus. However, considering the evidence of an insular role in socio-emotional processing, it remains unknown whether these cortical resections disturb personality and social behavior as experienced in daily life. We examined such changes in a group of patients (n = 19) who underwent epilepsy surgery involving partial or complete resection of the insula, and compared them to a group of patients who underwent standard temporal lobe epilepsy (TLE) surgery (n = 19) as a lesion-control group. Participants were assessed on the Iowa Scales of Personality Change, filled by a close relative at least six months after surgery. While postoperative changes did not significantly differ between groups on any of the ISPC items, insular resections were associated with mild but significant increases in irritability, emotional lability, anxiety, and frugality postoperatively, which, apart from anxiety, were not significant among TLE patients. Our results are congruent with the idea that the insula contributes to emotion processing. To our knowledge, this study is the first to systematically assess personality changes in a consecutive sample of patients with insular resections.

1. Introduction

The insula has long been perceived solely as a somatic-visceral region based on early findings from direct electro-cortical stimulation studies in awake patients undergoing neurosurgery [1]. Since then, however, there has been an accumulation of evidence suggesting an insular role in complex sensory, cognitive, and emotion processing functions [7]. Neuroimaging studies have reported insular activation in response to social and affective stimuli [2] and during risky decision-making [3], and have also related the insula to disorders involving emotional dysregulation, such as anxiety, depression, and drug addiction [4,5]. On the other hand, given

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the low prevalence of isolated insular cortex injuries, only a few lesion studies have offered direct clinical support for an insular role in socio-emotional processing [6]. A large study using voxel-based lesion-symptom mapping among veterans with traumatic brain injury related insular lesions to apathy, anxiety, as well as deficits in emotion recognition, empathy, and emotional intelligence [7,8].

In epileptic patients with drug-resistant seizures originating from the insula, insular cortex resection has been associated with good outcomes in terms of seizure control and cognitive sequelae [9]. However, using experimental neuropsychological tasks, we recently documented mild impairments in social cognition and risky decision-making in a consecutive sample of epileptic patients who underwent unilateral insulectomy [10,11]. Using an observer-rated measure, the present study sought to determine whether insular cortex resection leads to emotional, social behavior and personality disturbances, as experienced in day–to–day life.

2. Method

2.1. Participants and procedure

All adult patients ($n = 19$) who underwent partial or complete insular resection for drug-resistant epilepsy in our epilepsy service during the period extending from 2004 to 2014 were invited, and all accepted to participate. Thirty-four adult patients who underwent temporal lobe epilepsy (TLE) surgery between 2005 and 2015 were also recruited to form a lesion-control group. Participants were given one questionnaire to be filled by a close relative in frequent contact with them and whom they knew for $\geq$1 year presurgery, as well as two questionnaires to fill out themselves. This study was approved by our institutional Ethics committee.

2.2. Assessment

Personality and socio-emotional changes were assessed using the Iowa Scales of Personality Changes (ISPC) [12] filled by a partner, a family member or a friend of each patient. The French version [13] was used for all participants, except in four cases (two per group) who were native English speakers. The ISPC is a 30-item questionnaire containing 26 characteristics that are likely to change as a result of a neurological condition. It was shown to be sensitive to behavioral changes associated with ventromedial prefrontal cortex damage [14], neurosurgery for brain tumors [15] and traumatic brain injury [16].

2.3. Supplementary measures

Depressive symptoms were assessed with the Beck Depression Inventory-II [17], a self-reported instrument composed of 21 items representing a clinical symptom of depression. The severity of anxiety symptoms was assessed using the Beck Anxiety Inventory [18].

2.4. Statistical analyses

Between-group differences on basic demographic and surgery-related variables were tested using a series of analyses of variance (ANOVAs) for continuous variables (age at the time of diagnosis, age at the time of surgery, time elapsed since surgery) and non-parametric chi-square tests for categorical variables (gender, hemisphere of lesion, seizure control outcome). Because time elapsed since surgery was significantly longer among the lesion control group, each insular participant was matched with one participant of the TLE group using the number of years since surgery as the matching criteria in IBM's FUZZY command.

Differences between mean preoperative and postoperative ISPC ratings were first assessed separately for each group by using repeated measures ANOVAs (RM-ANOVA) with Time (pre- vs. post-surgery score) as a within-subject factor. Then, to examine whether these changes differed between groups, the RM-ANOVAs were rerun by adding Group (insular vs. temporal resection) as a between-subject factor in order to test interaction effects between Time and Site of resection. Frequency of individual improvement and worsening on each ISPC item ($\geq$1-point change) was also compared between groups using a set of chi-square analyses. All tests were carried out using SPSS 23.0 and differences were considered significant at $p < 0.05$.

3. Results

3.1. Sample characteristics

Sample characteristics are described in Table 1. Groups were comparable on gender, age, duration of epilepsy, years of education, time elapsed since surgery, hemisphere of resection and seizure control outcome (all $ps > 0.10$).

3.2. ISPC results

Mean scores on each ISPC item and results from the RM-ANOVAs are reported in Table 2. In the insular group, significant effects of Time were found for Irritability ($p = 0.028$), Lability/Moodiness ($p = 0.048$), Anxiety ($p = 0.028$), and Frugality ($p = 0.048$). In all cases, the postoperative rating was higher than the preoperative rating. Overall, 53% of insular patients had increased postoperative ratings for Irritability, 42% for Emotional lability, 37% for Anxiety, and 26% for Frugality.

In the temporal group, significant effects of Time (surgery) were observed on Anxiety ($p = 0.016$), Lack of stamina ($p = 0.030$) and Vulnerability to pressure ($p = 0.046$), with higher scores after surgery. Overall, 53% of temporal patients had postoperative increases in Anxiety, 42% in Lack of stamina, and 42% in Vulnerability to pressure. Social withdrawal ($p = 0.050$) and Apathy ($p = 0.056$) fell short of statistical significance.

The only significant Time $\times$ Group interaction was found for Apathy ($F_{(1,\ 36)} = 4.41$; $p = 0.043$). Bonferroni-adjusted pairwise comparisons showed that preoperatively, the temporal group presented a significantly lower apathy level when compared to the insular group ($p = 0.006$), raising substantially at the postoperative level, whereas apathy levels did not change significantly after surgery in the insular group ($p = 0.791$).

Proportions of individuals whose ISPC ratings improved or worsened following surgery in each group is illustrated in Fig. 1. A significantly higher proportion of patients from the temporal group worsened in Lack of stamina in comparison to the insular group ($\chi^2_{(1,N\,=\,38)} = 7.13$, $p = 0.019$). No other differences were observed when examining differences in frequency of individual improvement and worsening on each ISPC score.

3.3. Supplementary measures

There were no significant group differences in self-reported depression (mean ± SD BDI-II score: insular group = 10.79 ± 7.02; temporal = 10.63 ± 8.27; p = 0.950) and anxiety (mean ± SD BAI score: insular group = 6.84 ± 6.48; temporal = 7.58 ± 7.38; $p = 0.746$) scores.