Language Reorganization in Temporal Lobe Epilepsy: A Cortico-cortical Evoked Potential Study

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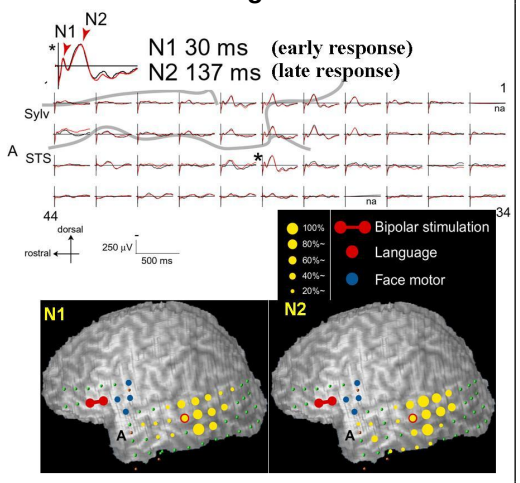
Fig.1



CCEPs in Broca's area stimulation

Introduction

It is well known that epilepsy is likely to cause atypical language organization.

Our group applied cortico-cortical evoked potential (CCEP) to physiological language network (Matsumoto et al., 2004). We revealed a bidirectional connection between anterior language area (ALA) and posterior language area (PLA) in the patients with typical language distribution. The PLAs were identified within CCEP responses elicited by the electrical ALA stmulation (Fig.1). However, the reorganized language area was not analyzed in the previous report and the connectivity associated with the reorganized language network is still unclear.

The purpose of this study is to investigate the connectivity associated with the reorganized language network in patients with temporal lobe epilepsy (TLE).

Patients

Six patients with intractable TLE who underwent chronic intracranial electrode placement and revealed an atypical distribution of PLAs were studied.

The ''typical'' PLA: the language area located in the middle and posterior part of superior temporal gyrus, in the posterior part of middle temporal gyrus and in the lower part of supramarginal gyrus.

The anterior border: 1 cm behind the junction of the rolandic and sylvian fissures

The posterior border: 5.5-6 cm behind this junction.

The lowest and highest borders: 3 cm below and 2-2.5 cm above this junction (Schaffler et al., 1996).

The ''atypical'' PLA: the PLA identified outside of this area

CCEP analysis

Alternating 1 Hz electrical stimuli were delivered to the ALAs. CCEPs were recorded by averaging electrocorticograms time-locked to stimuli from the subdural electrodes. We calculated the root mean square (RMS) of CCEP responses between 10 and 300 ms (1 ms slide).

Table1

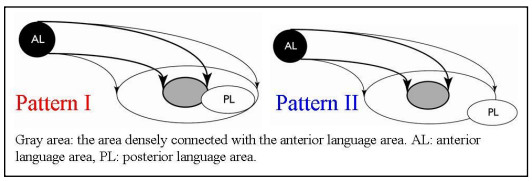
Pt	age, sex (onset age)	language dominance (handed)	epilepsy	ictal onset zone	surgery	etiology/ pathology	postsurgical language dysfunction	Engel's classification (follow up)
1	44F (11)	Lt. (Rt.)	Lt. T-OLE	Lt. T-O junction	Lt. T-O partial resection	Lt. T-O low grade glial/glioneural tumor	-	Ia (2 years)
2	20F (9)	Lt. (Rt.)	Lt. TLE	Lt. amygdala	Lt. ATL	Gliosis (Lt. lateral and mesial T)	-	IIb (3 years)
3	20M (8)	Lt. (Rt.)	Lt. TLE	Lt. posterior lateral & basal T Lt. hippocampus	Lt. ATL	Lt. HS, gliosis	-	Ia (1.5 years)
4	31F (5)	Lt. (Rt.)	Lt. T-PLE	Lt. T-P junction	Lt. T-P partial resection	Left T-P encephalomalacia	+	Ia (3 months)
5	34M (7)	Bil. (Lt.)	Rt. TLE	Rt. posterior lateral & basal T Rt. hippocampus	Rt. Lateral T partial resection	CD (Lt. lateral T)	+	IIb (6 years)
6	21F (9 mo)	Lt. (Lt)	Lt. T-OLE	Lt. T-O junction	Lt. T-O partial resection	CD (Lt. T-O junction)	-	IIIa (5 years)

ATL: anterior temporal lobectomy, CD: cortical dysplasia, F: female, HS: hippocampal sclerosis, Lt: left, M: male, mo: month, Rt: right, Sz: seizure, T: temporal, Pt: patient, TLE: temporal lobe epilepsy, T-O: temporooccipital, T-OLE: temporooccipital lobe epilepsy T-PLE: temporoparietal lobe epilepsy.

Patient profile

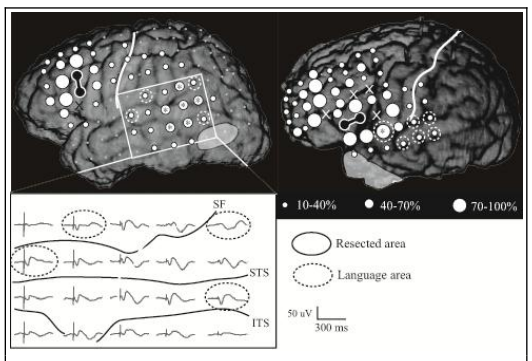
Results

CCEP responses were observed in various areas within the temporal, temporo-parietal or temporo-occipital area. The correlation between CCEP distributions and PLAs revealed two patterns.



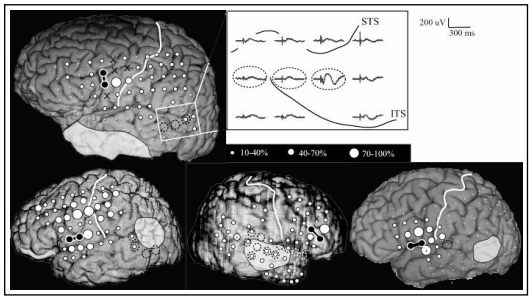
Gray area: the area densely connected with the anterior language area. AL: anterior language area, PL: posterior language area.

Pattern I: The PLAs were located within CCEP distribution, but out of the maximum responses in the temporal lobe in two patients.



CCEP waveform and RMS percentage distribution

Pattern II: Parts of the PLAs were outside CCEP-positive areas in four patients.



Discussion

Pattern I indicate that the patient's PLA is located outside of the cortical area densely connected from the ALA, but still within the anterior-posterior language connection. On the other hand, Pattern II suggests that the core of language areas could shift to the surrounding language processing area, resulting from cortical plasticity or compensation in patients with chronic temporal lobe epilepsy.

Pattern I and II might reflect the process of the language reorganization. We hypothesize that PLAs may initially shifts from the densely connected area to the sparcely connected area (Pattern I). Thereafter, it may shift to the surrounding cortex outside of the anterior-posterior language connection (Pattern II).

Conclusion

Our results suggest that language reorganization might be associated with a functional shift from the termination of anterior-posterior language connection to the surrounding cortices. It should be noted that language areas can be identified outside the anterior-posterior language connection.

References

Matsumoto, R. et al. Functional connectivity in the human language system: a cortico-cortical evoked potential study. Brain 2004

Schaffler, L., Let al. Quantitative compar-ison of language deficits produced by extraoperative electrical stimulation of Broca's, Wernicke's, and basal temporal language areas. Epilepsia 1996