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The different patterns of seizure-induced aphasia in temporal lobe epilepsies

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ABSTRACT

Objectives: Ictal language disturbances may occur in dominant hemisphere temporal lobe epilepsy (TLE), but little is known about the precise anatomoelectroclinical correlations. This study investigated the different facets of ictal aphasia in intracerebrally recorded TLE.
Methods: Video-stereoelectroencephalography (SEEG) recordings of 37 seizures in 17 right-handed patients with drug-resistant TLE were analyzed; SEEG electroclinical correlations between language disturbance and involvement of temporal lobe structures were assessed. In the clinical analysis, we separated speech disturbance from loss of consciousness.
Results: According to the region involved, different patterns of ictal aphasia in TLE were identified. Impaired speech comprehension was associated with posterior lateral involvement, anomia and reduced verbal fluency with anterior mediobasal structures, and jargonaphasia with basal temporal involvement. The language production deficits, such as anomia and low fluency, cannot be simply explained by an involvement of Broca's area, since this region was not affected by seizure discharge.
Significance: Assessment of language function in the early ictal state can be successfully performed and provides valuable information on seizure localization within the temporal lobe as well as potentially useful information for guiding surgery.

1. Introduction

It has long been known that seizures arising from the dominant temporal lobe of the language-dominant hemisphere may elicit speech disturbances. Paroxysmal dysphasia was associated with left hemisphere lesions by Jackson [1]. In the premonitoring era, this phenomenon was described in a patient with left temporal lobe epilepsy who became seizure-free after temporal lobectomy [2]. Later, based on video-EEG recordings, seizures arising in left temporal lobe were shown to be strongly associated with postictal language disturbance [3,4], but ictal aphasia or dysphasia was not precisely characterized.

In addition, the overlap between loss of consciousness and language disturbance is a difficult problem, which is not easy to resolve, and may explain why in some studies left TLE have been more frequently associated with loss of consciousness than right TLEs [5].

In the last ten years, detailed evaluation of consciousness using multiple criteria scales have been proposed to evaluate loss of consciousness and distinguish this from language impairment [6–8]. The different proposed consciousness rating scales included (1) nonverbal response (orientation, gestural interaction), (2) verbal response (e.g., ability to follow commands requiring verbal answers, naming), and (3) the ability to recall events that occurred during the seizure.

Although aphasia may be the most prominent or sole manifestation of seizures [9,10], the description of its semiology remains vague, and even if changes in semiological terminology have been made, recommending that partial seizures should be now described according to their "dyscognitive" features [11], ictal aphasia has been included in the automatism section. "Dysphasic seizure" is, thus, described as "impaired communication involving language without dysfunction of relevant primary or sensory pathways manifested as impaired comprehension, anomia, paraphasic errors, or a combination of these" [12]. No distinction has yet been proposed between the different patterns of ictal aphasia, as it has been described in stroke [13].

Abbreviations: TLE, temporal lobe epilepsy; TL, temporal lobe; EZ, epileptogenic zone; SEEG, stereoelectroencephalography; TP, temporal pole; A, the amygdala; H, hippocampus; PRh, perirhinal cortex; aOTS, anterior part of the occipitotemporal sulcus; pOTS, posterior part of the occipitotemporal sulcus; SMG, supramarginal gyrus; AG, angular gyrus; IFG, inferior frontal gyrus; MFG, middle frontal gyrus; SFG, superior frontal gyrus; alns, anterior part of insula.

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In a review of ictal aphasia, Benatar pointed out that the literature on this topic is relatively scant and most of the papers included in the review dealt with status epilepticus [9]. On the basis of several well-studied reported cases, the author concluded that potentially any type of aphasia might occur as an ictal sign. In addition, seizures do not seem to predominantly produce any single type of aphasia. Finally, it is difficult to establish a straightforward correlation between the type of aphasia and location of the epileptogenic zone.

The lack of data about ictal aphasia could be explained by the difficulty of testing and evaluating language during the brief and transient state of a seizure.

The aims of the present study were (1) to describe the different patterns of ictal aphasia in temporal lobe seizures and (2) to identify precise anatomoelectroclinical correlations using intracerebral recordings (stereoelectroencephalography, SEEG) defining the contribution of different regions (including temporal lobe regions but also frontal and insular regions) involved in temporal lobe seizures with ictal aphasia. The SEEG approach allows sampling of multiple distant areas included in the network language with high spatial and temporal resolution. To differentiate loss of consciousness from speech disturbance, we selected seizures with early clinical testing and with preserved non-verbal interaction (that is, excluding seizures with significant loss of consciousness using the operant definition). The aim was to establish specific electroclinical patterns.

2. Materials and methods

2.1. Patients

Among stereoelectroencephalographic (SEEG) recordings obtained from patients between 2008 and 2014 who underwent presurgical evaluation of drug-refractory temporal lobe epilepsy in our epilepsy monitoring unit, we retrospectively selected seizures according the following inclusion criteria: (1) occurrence of ictal speech disturbance; (2) early ictal examination of patient permitting assessment of consciousness and language during the 30 first seconds of seizure; (3) consciousness level permitting clinical evaluation using items from a previously described Consciousness Seizure Scale [6] such as (a) visual interaction, patient presenting adequate visual response to external stimuli (e.g., the patient looks at the examiner during examination); (b) interaction with the examiner; (c) appropriate behavior.

A total of 37 seizures from seventeen patients fulfilled these criteria. The mean age of patients at the time of intracranial EEG monitoring was 30 years (12–52 years), 11 patients were women, and 6 were men. Eight patients were MRI-negative. Curative surgery was subsequently performed in nine patients (5 IA, 1 IB, and 3 II). Clinical data are available in Table 1. All right-handed patients had left hemispheric dominance for language. The assessment included (1) recording of auditory evoked potential in auditory cortex in response to French-language voiced stop consonant (/ba/) and voiceless stop consonant (/pa/) (for the method see [14]); we recorded in all patients the specific temporal processing of acoustic cues in auditory cortex; (2) functional mapping of language using direct electrical stimulations: stimulations performed in left hemisphere induced language deficit in all patients; (3) fMRI or WADA test. Interictal language assessments are shown in supporting information (Supporting Table Is). No interictal aphasia was noted.

All patients signed informed consent prior to participation. This study was approved by the institutional Review Board of the French Institute of Health (IRB00003888, FWA00005831).

2.2. SEEG recordings and anatomic localization of electrode positions

The SEEG recordings were performed using intracerebral multiple contact electrodes (10 to 15 contacts, length: 2 mm, diameter: 0.8 mm, 1.5 mm apart from edge to edge) implanted according to Talairach's stereotactic method [15]. The strategy of electrode positioning was established in each patient based upon hypotheses concerning the localization of the epileptogenic zone (EZ), with the aim of defining

Table 1
Clinical data and semiology of the patients.

	Sex	Age	MRI	EZ lateralization	EZ location	Surgery[a]	Outcome (2 years)	Number of seizure analyzed	Number of seizure with motor sign	Motor sign	Vegetative sign or other sign
Pat1	M	52	Negative	L	MTLE	No[a]		1	1	Oroalimentary automatism, right upper limb dystonia	Facial flushing
Pat2	F	33	Negative	L	MTLE	Yes	IB	3	0	x	No
Pat3	M	12	Hippocampal atrophy	L	MTLE	Yes	IA	3	2	Hypomotor	Mydriase
Pat4	F	22	Temporal dysplasia	L	L and M TLE	Yes	II	1	0	x	Hypersudation
Pat5	M	36	Negative	L& R	posterior LTLE and right LTLE	No[b]		3	2	Upper limb movement "elaborate", touch nose and eyes	
Pat6	F	19	Negative	R	MTLE	Yes	IA	2	0	x	Staring, fear
Pat7	M	52	Vascular lesion	L	LTLE	No[b]		1	1	Upper and lower limb automatism, subtle oroalimentary automatism	
Pat8	F	52	Negative	L	MTLE	Yes	II	4	4	Oroalimentary automatism, right upper limb dystonia, palpebral clonic episode	
Pat9	F	27	Negative	L	MTLE	Yes	IA	4	0	x	
Pat10	F	36	DNET	L	MTLE	No[a]		2	0	x	Nausea, facial disgust
Pat11	F	14	DNET	L	Lateral and mesial TLE	Yes	IA	4	0	x	
Pat12	F	23	Negative	L	MTLE	Yes	IA	1	1	Oroalimentary automatism	
Pat13	F	25	Negative	L& R	Temporobasal TLE	No[b]		2	0	x	
Pat14	F	16	DNET	L	LTL	No[b]		2	0	x	
Pat15	F	37	Hypothalamic hamartoma	L& R	Lateral and mesial TLE	No[b]		1	0	x	
Pat16	M	31	Negative	L	Lateral and mesial TLE	Yes	II	1	0	x	
Pat 17	M	33	Cavernoma	L	frontotemporal	No		2	0	x	

[a] Surgery refusal by patient.
[b] Contraindication because of large EZ in dominant hemisphere.