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Ictal body turning in focal epilepsy

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ABSTRACT

Despite the explanations of many lateralization findings, body turning in focal epilepsy has been rarely investigated. One of the aims of this study was to evaluate the role of ictal body turning in the lateralization of focal epilepsies. The records of 263 patients with focal epilepsy (temporal lobe epilepsy (TLE), n = 178; extratemporal lobe epilepsy (ETLE), n = 85) who underwent prolonged video-EEG monitoring during presurgical epilepsy evaluation were reviewed. Preoperative findings (TLE, n = 16; ETLE, n = 6) and postoperative outcomes (TLE, n = 7) of patients with focal epilepsy with ictal body turning were assessed. For the evaluation of ictal body turning, two definitions were proposed. Nonversive body turning (NVBT) was used to denote at least a 90° nonforced (without tonic or clonic component) rotation of the upper (shoulder) and lower (hip) parts of the body around the body axis for a minimum of 3 s. Versive body turning (VBT) was used to denote at least a 90° forced (with tonic or clonic component) rotation of the upper (shoulder) and lower (hip) parts of the body around the body axis for a minimum of 3 s. Nonversive body turning was observed in 6% (n = 11) of patients with TLE and 2% (n = 2) of patients with ETLE. For VBT, these ratios were 5% (n = 8) and 7% (n = 6) for patients with TLE and ETLE, respectively. Nonversive body turning was frequently oriented to the same side as the epileptogenic zone (EZ) in TLE and ETLE seizures (76% and 80%, respectively). If the amount of NVBT was greater than 180°, then it was 80% to the same side in TLE seizures. Versive body turning was observed in 86% of the TLE seizures, and 55% of the ETLE seizures were found to be contralateral to the EZ. When present with head turning, NVBT ipsilateral to the EZ and VBT contralateral to the EZ were more valuable for lateralization. In TLE seizures, a significant correlation was found between the head turning and body turning onsets and durations. Our study demonstrated that ictal body turning is a rarely observed but reliable lateralization finding in TLE and ETLE seizures, which also probably has the same pathophysiological mechanism as head turning in TLE seizures.

1. Introduction

The most important phase of surgical treatment decisions in focal epilepsies is the detection of the epileptogenic zone (EZ). Therefore, many semiologic and neuroimaging studies have focused on the detection of the EZ. Investigating different clinical symptoms and electroencephalography (EEG) recordings of the cortical areas activated by the EZ has revealed relationships between these behaviors and localization and lateralization of the EZ [1,2]. However, there are not enough data on the occurrence of body turning during seizures of patients with focal epilepsy, and only a few studies have investigated the role of EZ detection in ictal body turning [3–5]. Seizures containing ictal body turning are known as rotatory, volvular, circling, and gyratory seizures in the literature. Most of the data were collected from case reports, and there is no consensus about the definition [6–8]. These seizures were observed by Gastaut et al. in primarily generalized epilepsy and were defined as turning of half of the body. However, some authors have stated that these seizures can also occur in focal epilepsy and defined them as at least a 180° rotation around the body axis [3,9].

The goals of this study were to 1) investigate the role of ictal body turning in focal epilepsies during the localization and lateralization of the EZ, 2) report the results of the presurgical and postsurgical evaluations, and 3) form an opinion on the pathophysiological mechanism of these seizures.

2. Methods

2.1. Patient data

Two hundred and sixty-three patients with focal epilepsy were admitted to the Gazi University Faculty of Medicine (GUFOM) between 2009 and 2014 for three to seven days, on whom video-EEG monitoring was performed and who were included in the study (temporal lobe epilepsy (TLE), n = 178; extratemporal lobe epilepsy (ETLE), n = 85). After all of the videos were examined, patients with ictal body turning

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(n = 22) were evaluated for their clinical history, video-EEG monitoring, magnetic resonance imaging (MRI), [18F]-fluorodeoxyglucose (FDG) positron emission tomography (PET), pathology findings, and postoperative outcomes. The study was approved by the local ethics committee of the GUFOM.

2.2. Epileptic syndrome classification and seizure analysis

Seizures and epileptic syndromes were classified according to the International League Against Epilepsy (ILAE) diagnostic criteria [10]. The video-EEG results and clinical symptoms were reassessed by at least two experienced epileptologists at the same time. Epileptogenic zone localization was determined based on their epilepsy surgery council decisions. Patients with focal epilepsy with ictal body turning were separated into two groups: TLE (n = 16) and ETLE (n = 6). Ictal body turning was present during complex partial seizures (CPSs) (n = 39) and/or secondarily generalized tonic–clonic seizures (sGTCSs) (n = 23).

2.2.1. Body turning terminology and inclusion–exclusion criteria

Because there are insufficient data on the definition of ictal body turning in the literature, two definitions, nonversive body turning (NVBT) and versive body turning (VBT), were proposed in our study. Nonversive body turning was used to denote at least a 90° nonforced (without tonic or clonic component) rotation of the upper (shoulder) and lower (hip) parts of the body around the body axis for a minimum of 3 s. Versive body turning was used to denote at least a 90° forced (with tonic or clonic component) rotation of the upper (shoulder) and lower (hip) parts of the body around the body axis for a minimum of 3 s.

Each of the patients who turned to their side to notify others of the seizure turned from the side to lie on her/his back during their aura, and those with partial consciousness who turned while watching a relative or when she/he heard a sound were excluded. The start of the rotation in the shoulder in NVBT and VBT was accepted as the onset of ictal body turning, and the end of the movement acceleration or the start of the movement to the opposite side was accepted as the ending of ictal body turning. All onsets and durations of the ictal body turning were calculated for each NVBT and VBT seizure.

2.2.2. Lateralizing motor signs

Nonversive head turning (NVHT) is defined as at least a 30° involuntary head rotation lasting longer than 2 s without a forced deviation within the first 60 s of the seizure, whereas versive head turning (VHT) is defined as an involuntary and forced head rotation lasting longer than 5 s accompanied with clonic or tonic activity [11–14]. In this study, an involuntary head rotation of at least 45° from the midline (chin and sternum line) for a minimum of 3 s was regarded as NVHT. Versive head turning was assessed based on the definition in the literature. The inclusion and exclusion criteria of body turning were also applied for head turning. The onsets and durations of NVHT and VHT were calculated in the same manner as those of NVBT and VBT.

Other lateralization symptoms from focal seizures that occurred besides ictal body turning, such as unilateral tonic posturing, unilateral hand automatisms, postictal nose wiping, figure-of-4 sign, and asymmetric ending of clonic jerks, were also assessed [15].

2.3. Video-EEG and neuroimaging

Continuous scalp video-EEG monitoring using 32 channels was performed with surface electrodes (with additional temporal electrodes) placed according to the international 10–20 system. Not only ictal EEG recordings during body turning but also interictal and postictal EEG changes were assessed in patients with TLE and ETLE [16].

Possible etiologic diagnoses of patients without pathology results were made using imaging. For all patients (n = 22), radiologic assessment was performed via high-resolution magnetic resonance imaging (MRI) at 3 T using a standardized epilepsy protocol. For mesial temporal sclerosis (MTS), diagnosis of hippocampal atrophy, loss of distinction between gray matter and white matter, and a hippocampal signal increase were considered major findings [17]. The MTS diagnosis was further supported using magnetic resonance spectroscopy (MRS) findings, such as the reduction of the NAA peak and/or reduced NAA/Cho + Cr ratio. The blood flow in the parahippocampal regions were virtually assessed using perfusion MRI and regional brain hypometabolism with 18F-FDG PET (n = 19). The dominant hemisphere for language was determined using functional MRI (n = 10). Surgical outcomes of the patients who underwent lesionectomy or anterior temporal lobectomy were assessed by Engel's classification [18].

2.4. Statistical analyses

The data were analyzed using SPSS version 15.0 for Windows. The chi-square test or Fisher's exact test, where appropriate, was used to compare the clinical or video-EEG monitoring data of patients with TLE and ETLE. The Mann–Whitney U test was performed in comparison of unequally distributed parametric variables including age, age at seizures onset, duration of epilepsy, and the body turning characteristics between both groups. Spearman's correlation was used to assess the correlation between NVBT and NVHT and VBT and VHT. p values of less than 0.05 are reported as statistically significant.

3. Results

3.1. Demographic data

Sixteen patients with TLE (9%) and six patients with ETLE (7%) had at least one 90° ictal body turning in their CPSs and/or sGTCSs. Seven patients with TLE (4%) and two patients with ETLE (2%) had greater than 180° ictal body turning during at least one seizure (180°–540°). Fifty-nine percent of the patients had seizures starting from the left hemisphere; this rate was 89% for patients (TLE, n = 6; ETLE, n = 2) with greater than 180° of body turning.

No significant difference was observed between patients with TLE and ETLE regarding age, age at seizure onset, epilepsy duration, and risk factors ($p > 0.05$). The history of febrile convulsion and aura was more frequent in patients with TLE compared to patients with ETLE; however, this difference was not statistically significant ($p > 0.05$). Patients with TLE had autonomic (n = 7), psychic (n = 4), and vertiginous (n = 1) auras, while patients with ETLE had visual (n = 2) auras. In patients with ETLE, sGTCSs were more frequent, although this observation just missed statistical significance (p = 0.056) (Table 1). While

Table 1
Clinical data of the patients.

	TLE (n = 16)	ETLE (n = 6)	p value
Gender (female/male)	10/6	1/5	0.740
Age[a]	26,5 (17–42)	24 (22–42)	0.630
Age at seizure onset, years[a]	10,5 (2–23)	7,8 (4–13)	0.297
Duration of epilepsy, years[a]	15 (8–31)	16,5 (11–35)	0.711
Focal epilepsy with left hemisphere onset	11 (69%)	2 (33%)	0.178
Risk factors			
History of febrile convulsions	11 (69%)	1 (17%)	0.560
History of perinatal complications	2 (13%)	1 (17%)	1.000
History of head trauma	3 (19%)	3 (50%)	0.283
History of CNS infections	0	0	
Family history of epilepsy	4 (25%)	3 (50%)	0.334
Consanguinity among parents	3 (19%)	2 (33%)	0.585
Aura	12 (75%)	2 (33%)	0.137
Seizure type frequency			
>4/month (CPSs)	11 (69%)	5 (83%)	0.634
>1/year (sGTCSs)	5 (31%)	5 (83%)	0.560

TLE, temporal lobe epilepsy; ETLE, extratemporal lobe epilepsy; sGTCSs, secondarily generalized tonic–clonic seizures; CPSs, complex partial seizures; CNS, central nervous system.

[a] Median (IQR).