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Short communication

Incidence and localizing value of vertigo and dizziness in patients with epilepsy: Video-EEG monitoring study

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ABSTRACT

Vertigo and dizziness are common neurological complaints that have long been associated with epilepsy. However, studies of patients with epileptic vertigo or dizziness with concurrent EEG monitoring are scarce. We performed the present study to investigate the incidence and localizing value of vertigo and dizziness in patients with epilepsy who had confirmation of EEG changes via video-EEG monitoring. Data of aura and clinical seizure episodes of 831 consecutive patients who underwent video-EEG monitoring were analyzed retrospectively. Out of 831 patients, 40 patients (4.8%) experienced vertigo or dizziness as aura (mean age, 32.8 ± 11.8 years), all of whom had partial seizures. Eight had mesial temporal, 20 had lateral temporal, four had frontal, one had parietal, and seven had occipital lobe onset seizures. An intracranial EEG with cortical stimulation study was performed in seven patients, and the area of stimulation-induced vertigo or dizziness coincided with the ictal onset area in only one patient. Our study showed that vertigo or dizziness is a common aura in patients with epilepsy, and that the temporal lobe is the most frequent ictal onset area in these patients. However, it can be suggested that the symptomatogenic area in patients with epileptic vertigo and dizziness may not coincide with the ictal onset area.

1. Introduction

Vertigo and dizziness are common neurological complaints with a lifetime prevalence of 20%-30% in the general population, and it accounts for approximately 3.5% of the patients who visited an emergency room (Crespi, 2004; Neuhauser et al., 2008). The differential diagnosis in patients with vertigo includes various peripheral causes, including benign paroxysmal positional vertigo, vestibular neuritis, and Menière disease, but several central causes should be considered, such as cerebrovascular diseases, vestibular migraine, and epilepsy-related vertigo, because the presence of central causes may be life-threatening and require emergency management (Karatas, 2008).

Vertigo and dizziness in association with epilepsy have been recognized since ancient times, although the meaning of "epileptic vertigo" was somewhat different from the current use to describe aberrant psychic behaviors that were commonly believed to afflict people with epilepsy (Bladin, 1998). Although vertigo and dizziness in patients with epilepsy may be related to adverse effects of antiepileptic drugs or linked to a non-epileptic comorbid disease, vertigo and dizziness can occur at the onset of a seizure itself (i.e., presenting as an aura) or often be felt as a sole manifestation of epilepsy. Cortical stimulation studies of patients with epilepsy identified both the temporal and parietal lobes as vestibular cortical areas (Guldin and Grusser, 1998; Kahane et al., 2003; Hewett and Bartolomei, 2013); however, epileptic discharges in patients with epileptic vertigo were observed in more expansive areas, including the frontal and temporo-parieto-occipital junctional areas, suggesting either processing of vestibular-related input across large cortical regions or spread of excitation to or from nearby areas (Kogeorgos et al., 1981; Erbayat Altay et al., 2005; Lopez et al., 2010; Hewett et al., 2011). Nevertheless, the results of cortical stimulation cannot have the same clinical implication as the spontaneous electrical activation that occurs during clinical seizures because cortical stimulation may induce dysfunction, rather than a functional activation of the stimulation site. Furthermore, many previous clinical studies identified patients with epileptic vertigo based on history taking and the results of interictal EEG, which has the risk of inclusion of patients with a non-epileptic origin. The objective of the

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present study was to estimate the incidence of vertigo and dizziness as an epileptic aura in patients who underwent video-EEG monitoring. We also evaluated the distribution of epileptogenic foci in these patients.

2. Methods

This study protocol was approved by the Institutional Review Board of the Seoul National University Hospital. Data from the clinical seizure episodes of 831 consecutive patients (391 females; age range, 13–85 years; mean age, 31.7 ± 11.6 years) who were admitted to the epilepsy monitoring unit at the Seoul National University Epilepsy Center for diagnostic reasons or for presurgical evaluation. The inclusion criteria were: (1) at least one habitual epileptic seizure recorded during the video-EEG monitoring; (2) presence in the medical records of written descriptions of the vertigo or dizziness as an aura and of clinical seizure (descriptions of the aura and clinical seizure were obtained from the patients and their caregivers); and (3) confirmation by the patients and their caregivers that the video recording containing the patients' habitual seizures matched those included in the description. Vertigo was defined as a sensation of self-motion when no self-motion is occurring, and dizziness was defined as a sensation of disturbed or impaired spatial orientation (Tarnutzer et al., 2015); however, we used the term "vertigo or dizziness" for both conditions because it was frequently difficult to differentiate them based on the history taking. We excluded nonspecific cephalic symptoms or an abnormal sensation from epileptic vertigo, although the patients described the symptoms as "vertigo or dizziness". Information regarding auras and subsequent ictal semiology was acquired using a semi-structured questionnaire on admission.

Epileptic seizures were largely divided into generalized and partial seizures, and patients with partial seizures were further classified according to the ictal onset areas as frontal, mesial temporal, lateral temporal, parietal, and occipital onset seizures. The detailed procedure used for the analysis of aura and clinical seizure was described previously (Kim et al., 2015).

3. Results

Among the 831 patients included in the study, 55 had generalized seizures, 775 had partial seizures, and one had special syndrome (hypothalamic hamartoma). While 457 patients did not experience aura, 374 patients reported at least one aura. Seventy-five patients reported second auras, and 10 patients reported third auras. Vertigo or dizziness was the most frequently encountered first aura (36 patients), followed by paresthesia (35 patients), unrealistic feelings (27 patients), a feeling of fear (25 patients), and nausea (23 patients). Four patients experienced vertigo or dizziness as a second aura (the first aura was gastric aura in two patients, visual illusion in one patient, and visual hallucination in another patient). All but one patient who had vertigo as an second aura experienced vertigo or dizziness during the video-EEG monitoring. The mean age of the patients was 32.8 ± 11.8 years. The incidence of epileptic vertigo or dizziness as an aura was 4.8% (40/831) in all epilepsy patients, and 5.2% (40/775) when considering patients with partial seizures only. All 40 patients with epileptic vertigo or dizziness had partial seizures; eight had mesial temporal, 20 had lateral temporal, four had frontal, one had parietal, and seven had occipital lobe onset seizures.

An intracranial EEG with cortical stimulation study was performed in seven patients (Table 1). Vertigo or dizziness was the first aura in all patients. MRI was normal in four patients, showed non-localizing abnormalities in two patients, and localized to the left temporal lobe in one patient. Ictal onset areas during the habitual seizures were localized to the lateral temporal lobe in four patients, to the mesial temporal lobe in two patients and to the parieto-occipital junction in one patient (this patient was originally classified as having occipital lobe seizure). Interestingly, only one patient experienced epileptic vertigo of habitual seizure during the cortical stimulation of the ictal onset area (patient No. 7). One patient with right temporal lobe seizure felt vertigo or dizziness during the stimulation of the right frontal area, and another patient with right mesial temporal lobe seizure felt vertigo or dizziness during the stimulation of the right superior temporal area. In four patients, vertigo or dizziness was not produced during the cortical stimulation (Table 1, Fig. 1). Surgical treatment was performed in all patients who underwent the intracranial EEG study, and the surgical outcome after at least 2 years of follow-up was seizure free in four patients and auras only in another one patient. The pathological diagnosis was focal cortical dysplasia in five patients, focal cortical dysplasia with hippocampal sclerosis in one patient, and unusual glioneuronal tumor in the remaining patient.

4. Discussion

A recent systemic review estimated the incidence of epileptic vertigo or dizziness in epilepsy patients at 8.4%, with a slightly higher incidence in children than in adults. The most frequent location of the epileptic focus on EEG was the temporal area (approximately 80% of patients), followed by the parietal, occipital, and frontal areas. We also observed that the temporal lobe was the most common epileptogenic area in patients with epileptic vertigo or dizziness, albeit with a lower incidence (4.8% of all epileptic patients) than that described in the systemic review (Tarnutzer et al., 2015). This lower incidence may be related to the strict inclusion criteria of our study, because we only included patients who experienced epileptic vertigo with the concomitant EEG change during the events and excluded nonspecific cephalic symptoms or abnormal sensation.

Studies of epileptic vertigo and dizziness have focused on the understanding of the cortical structure that is involved in the production of vertigo or dizziness during the cortical stimulation in epilepsy patients, and previous studies using cortical stimulation demonstrated different forms of vertigo or dizziness could be observed during the stimulation of different cortical areas (Kahane et al., 2003; Bartolomei et al., 2011). Although cortical stimulation can be useful for the accurate identification of the cortical area from which interference with vestibular processing can be obtained, it may induce dysfunction, rather than a functional activation of the stimulation site; therefore, the area of vertigo or dizziness as determined by cortical stimulation would not correspond to the symptomatogenic area of the epileptic vertigo or dizziness. In our study, cortical stimulation of the ictal onset area produced vertigo or dizziness of the habitual seizure in only one patient, and even failed to produce vertigo in four patients. Therefore, it can be suggested that the symptomatogenic area in epileptic vertigo may not coincide directly with the ictal onset area or the area of vertigo or dizziness determined by cortical stimulation; rather, it may depend on various factors that affect the generation of the epileptic aura, such as the anatomical location of eloquent areas, the pattern of ictal spreading, co-activation or deactivation of neuronal networks, and inter- and trans-areal propagation of ictal discharge (Chauvel and McGonigal, 2014).

Our study shows that temporal areas are the most common ictal onset area in epileptic vertigo and dizziness. This may be associated with the higher proportion of temporal lobe seizures in adult patients with epilepsy, but it may also suggest that the network involving the hippocampus and para-hippocampal area plays an important role in the generation of vertigo or dizzi-