Journal of Clinical Neuroscience 22 (2015) 1614–1618

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

Olfactory abnormalities in temporal lobe epilepsy

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ARTICLE INFO

Article history:
Received 4 July 2014
Accepted 8 March 2015

Keywords:
Smell identification
Temporal lobe epilepsy
University of Pennsylvania smell identification test

ABSTRACT

We studied olfactory function in a cohort of 25 temporal lobe epilepsy (TLE) patients and 25 healthy controls. Our objectives were to measure olfactory acuity in patients with right, left or bilateral TLE and compare them with age and sex matched controls, and to correlate olfactory acuity with duration of seizure, baseline seizure control and the number of drugs used. Olfactory impairment is common in neurological disorders and dysfunction of the temporo-limbic neural substrates involved in olfactory perception is noted in TLE. We measured olfactory acuity in 25 patients with TLE, nine with right, 10 with left and six with bilateral temporal lobe seizure activity, and compared them to the controls. Odor identification was assessed using the University of Pennsylvania Smell Identification Test (UPSIT) which is a 40 item olfactory test used to diagnose olfactory deficits. Our results showed that patients with TLE exhibited significant impairment in UPSIT performance compared to the controls. There was no significant difference in scores between the right and left TLE patients. The severity of olfactory impairment did not correlate with the duration of seizures, baseline seizure control and number of drugs used. We concluded that significant olfactory impairment is seen in both right and left TLE patients, unrelated to the duration and baseline frequency of seizures or drugs used.

1. Introduction

Temporal lobe epilepsy (TLE) is associated with a characteristic semiology of seizures, termed psychomotor seizures, and ictal epileptic discharges arising from mesial, and less commonly, lateral or neocortical temporal lobe regions. It may serve as a model for lateralized brain impairment, as brain function governed by temporal lobe structures (memory and language) shows differential impairment depending on the side of the epileptic focus [1].

The importance of temporal lobe structures in human olfactory function has been recognized since the nineteenth century with the observation that olfactory auras could precede paroxystic seizures in epileptic patients [2]. Many investigators then tried to determine the influence of TLE on olfactory function using behavioural studies. Olfactory sensitivity, assessed using detection or recognition threshold measurements, was usually reported to be in the normal range compared with healthy controls [3–6]. In contrast, a wide variety of tasks (for example, odour matching, discrimination, short and long term recognition, identification and naming) highlighted consistent deficits in higher olfactory functions [3–9]. Factors such as stimulation type (monorhinal or birhinal), stimulated nostril side (ipsi or controlaterally to the epileptogenic focus), and odorant nameability appeared to be determining factors in patient performance. Due to the methodological differences between various studies, it is difficult to determine deficit patterns in relation to the epileptogenic focus location, duration and frequency of seizures and the population studied.

We studied olfactory acuity in a selected group of TLE patients from South India using the University of Pennsylvania Smell Identification Test (UPSIT) kits. The objective of our study was to measure olfactory acuity in patients with right, left and bilateral TLE and compare that with healthy controls, and to correlate olfactory acuity with the duration of seizures, baseline seizure control and number of drugs used.

2. Materials and methods

2.1. Sample

This study was conducted in the Department of Neurology in a tertiary care center in South India. Twenty-five patients with TLE, nine with right, 10 with left and six with bilateral temporal lobe seizure activity participated in the study. Their performance was compared with 25 healthy age, sex and education matched controls.

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http://dx.doi.org/10.1016/j.jocn.2015.03.035
0967-5868/

Patients with other risk factors for hyposmia, including upper respiratory infection, head injury, liver, renal and thyroid abnormalities, and other neurological and psychiatric disorders were excluded from the study.

Diagnosis of TLE and focus lateralization were based on a comprehensive assessment which included seizure semiology obtained from eye witnesses or video recordings, interictal electroencephalogram (EEG) abnormalities in all, ictal video EEG findings in six patients and routine visual MRI analysis, the protocol of which included T1 and T2-weighted and fluid-attenuated inversion recovery sequences in axial and coronal planes.

The clinical diagnosis of TLE was based on the International League Against Epilepsy Commission Report from 2004 as follows: (1) seizure semiology consistent with TLE with abdominal, epigastric, psychic, or autonomic auras followed by behavioral arrest, progressive alteration of consciousness, oroalimentary, and manual automatisms; (2) interictal EEG and/or video EEG showing temporal spikes; (3) no lesions other than increased T2-weighted signal and/or atrophy in hippocampal formation identified by MRI.

2.2. Cross sectional case-control study design

Odor identification was assessed with the UPSIT [10]. This test uses encapsulated micro odorants which are released on scratching using a pencil on a standardized odor impregnated test booklet. Patients are asked to identify the odor from four choices provided for each question. The kit consists of four booklets, each containing ten questions. Hence, a maximum score is 40. This forced-choice standardized test is sensitive to a wide variety of olfactory defects [11].

Patients were clinically stable at the time of olfactory testing, were medicated with standard doses of antiepileptic drugs and did not show any effects of recent seizures such as postictal confusion.

2.3. Statistical analyses

Data are expressed as the mean, median, standard error and range. Parametric and non-parametric comparisons were assessed by Levene's test for equality of variance and one way analysis of variance. Pearson's product-moment correlations were used to assess the relationships between concomitant variables. Statistical analyses were carried out using the SPSS software (version 20.0; IBM Corporation, Armonk, NY, USA). All variables were two tail tested and differences with $p \leqslant 0.05$ were considered significant.

3. Results

The TLE patients and healthy controls did not differ with regard to age ($F[1,48] = 4.03$; $p = 0.18$), sex (chi-squared = 2.64; degrees of freedom [df] = 2; $p = 0.80$), education ($F[1,48] = 2.81$; $p = 0.095$) or smoking status (chi-squared = 3.2; df = 4; $p = 0.16$). The patient and control demographics are summarized in Table 1, and clinical characteristics in Table 2.

The performances (UPSIT scores) for birhinal olfactory identification (mean ± standard error of mean) were as follows: patients with TLE (22.08 ± 0.868), including those with right TLE (21.33 ± 1.0), left TLE (21.4 ± 1.75) and bilateral TLE (24.33 ± 1.43), and the healthy controls (27.28 ± 0.567; Fig. 1).

With regard to odor perception, Levene's test for the quality of variance revealed a major effect of TLE diagnosis on UPSIT performance ($F[1,48] = 2.28$; $p = 0.0001$) but no effect on the duration of seizures ($p = 0.613$), baseline seizure frequency ($p = 0.149$) and the number of drugs used ($p = 0.149$; Fig. 2). The UPSIT scores of

Table 1
TLE patient and healthy control demographics

Demographics	TLE patients (n = 25)	Controls (n = 25)
Age, mean years (range)	28.2 (18–47)	28.8 (18–47)
Sex		
Male	15	15
Female	10	10
Education, mean years (range)	11.6 (4–16)	12.08 (5–16)
Smoking status		
Current smoker	0	0
Past smoker	3	4
Never smoked	22	21

TLE = temporal lobe epilepsy.

Table 2
TLE patient clinical characteristics

Characteristic	n = 25
Lateralization based on EEG discharges, n (M, F)	
Right	9 (4, 5)
Left	10 (7, 3)
Bilateral	6 (4, 2)
Seizure frequency per month over the past 2 years, mean (range)	2.4 (0.1–30)
Duration of seizures, mean years (range)	12.08 (2–32)
Antiepileptic drug use, n	
One drug	9
Two drugs	12
Three drugs	4
MRI brain abnormalities, n	
Right MTS	7
Left MTS	8
Bilateral MTS	2
Other lesions	2
Normal	7

EEG = electroencephalogram, F = female, M = male, MTS = mesial temporal sclerosis, TLE = temporal lobe epilepsy.

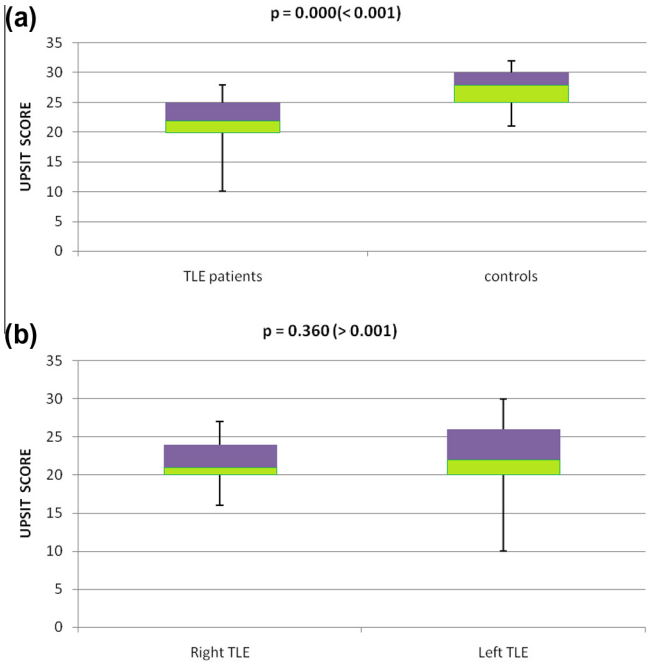

Fig. 1. Box plot comparing the distribution of the University of Pennsylvania Smell Identification Test (UPSIT) scores among: (a) temporal lobe epilepsy (TLE) patients *versus* healthy control group and (b) right TLE *versus* left TLE patients. This figure is available in colour at www.sciencedirect.com.