Original article

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Peri-ictal water drinking: a rare automatic behaviour in temporal lobe epilepsy

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ABSTRACT – Peri-ictal water drinking (PIWD) has been reported as the action of drinking during or within two minutes of an electroclinical seizure. It is considered a peri-ictal vegetative symptom, evident both during childhood and adulthood epilepsy. The aim of this paper was to describe the clinical and electroencephalographic features of two new adult subjects suffering from symptomatic temporal lobe epilepsy with episodes of PIWD recorded by VIDEO-EEG and to review literature data in order to better define this peculiar event during seizures, a rare and probably underestimated semiological sign. To date, 51 cases with focal epilepsy and seizures associated with PIWD have been reported. All patients presented with temporal lobe epilepsy. All cases but one had symptomatic epilepsy. Most of the patients had an involvement of the right hemisphere. Water drinking was reported as an ictal sign in the majority of patients, and less frequently was reported as postictal. We believe that PIWD might be considered a rare automatic behaviour, like other automatisms. Automatisms are more frequently described in patients with temporal lobe epilepsy. PIWD was reported also to have lateralizing significance in the non-dominant temporal lobe, however, because of its rarity, this finding remains unclear.

Key words: peri-ictal drinking, temporal lobe epilepsy, epilepsy/seizure and drinking/thirst, temporal lobe epilepsy

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Drinking behaviour is controlled by information from peripheral receptors processed in the preoptic area, the organum vasculosum of the lamina terminalis, the median preoptic nucleus, and the subfornical organ of the hypothalamus (Denton *et al.*, 1996). Moreover, the hippocampus and the amygdala are connected to the hypothalamus by a variety of multisynaptic reciprocal pathways that have been implicated in water balance and drinking behaviour (Gloor, 1997).

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While the osmoreceptive role of these brain regions has been established, the anatomical network involved in thirst is not clear. Neuroimaging studies, however, showed that also cortical areas play a key role in the thirst mechanism. Activation during functional MRI has been reported for the anterior cingulated, parahippocampal gyrus, inferior and middle frontal gyri, insula, striatum and cerebellum. Furthermore, PET revealed significant activations observed in the anterior and posterior cingulate, parahippocampal and orbital frontal gyri, insula, claustrum, thalamus, and cerebellum (Denton *et al*., 1999).

Drinking has been reported as an ictal sign in epileptic seizures (Rémillard *et al*., 1981; Trinka *et al*., 2003; Janszky *et al*., 2007; Szucs *et al*., 2007; Musilova *et al*., 2010). Epileptiform activity generated in the temporal lobe may propagate into the hypothalamus and other structures involved in thirst and water regulation, producing ictal manifestations of abnormal water-seeking behaviour.

Peri-ictal water drinking (PIWD) was described as the action of drinking during or within two minutes of an electroclinical seizure (Trinka *et al*., 2003). It is considered a peri-ictal vegetative symptom, evident both during childhood and adulthood epilepsy.

PIWD was firstly described in the early 1900s by Lennox and Cobb (1933), but it has been largely underestimated because drinking water *per se* is a very common event, and rarely patients or witnesses recognize it as part of an epileptic seizure. Different reports have been published describing PIWD in patients affected by temporal lobe epilepsy, mainly of symptomatic aetiology. In some of them, a possible lateralizing value has been hypothesized (Trinka *et al*., 2003; Musilova *et al*., 2010).

The recognition and interpretation of this ictal sign may be important to better define the epileptic syndrome, which was originally described in epilepsy surgery candidates (Loddenkemper and Kotagal, 2005).

The aim of this article was to review literature data in order to better define this peculiar event during seizures and describe the clinical and electroencephalographic features of two new adult patients suffering from symptomatic temporal lobe epilepsy (TLE) with episodes of PIWD recorded by video-EEG.

Methods

The electro-clinical characteristics in two adult patients are first described in detail. The review of the literature was performed on PubMed using the words: "peri-ictal drinking", "peri-ictal water drinking", "epilepsy/seizure" and "drinking/thirst". To date, 51 cases with focal epilepsy and seizures associated with PIWD have been reported (Rémillard *et al*., 1981; Despland *et al*., 1985; Cascino and Sutula, 1989; Crapanzano *et al*., 1993; Trinka *et al*., 2003; Szucs *et al*., 2007; Musilova *et al*., 2010; Errguig *et al*., 2013). Of these, seven cases reported by Janszky *et al*. (2007) were excluded from the analysis of data due to poor documentation (three patients with right-sided and four patients with left-sided TLE). For the same reason, 14 cases reported by Musilova *et al*. (2010) were excluded. The review was performed on 30 cases (*table 1*).

Case studies

Case 1

The first subject was a right-handed, 42-year-old male, suffering from recent onset of symptomatic focal epilepsy. At the last observation, he mainly presented two different seizure types: apparently generalized tonic-clonic (mostly during sleep) and sudden events of air hunger, facial flushing, and fear, without loss of consciousness. During these events, he was able to speak even if he appeared slightly disoriented. At the end of these episodes, he repetitively asked for water to drink. This latter aspect was so significant that when he experienced multiple seizures per day, he even developed water intoxication.

Ictal video-EEG showed rhythmic theta activity intermingled with spikes over the right temporal region, spreading over the right frontal and central regions, lasting for about 40 seconds. The episode was characterized by air hunger, facial flushing, and confusion in the first part; after 20 seconds, he started to drink water for the next two minutes (*figure 1A*). The semiology of seizures was similar to previous seizures, except that PIWD was now only sometimes reported. The patient was diagnosed as suffering from paraneoplastic limbic encephalitis involving bilateral temporal regions and the diencephalon (*figure 2A*). The primary cause was a testicular seminoma. It was not possible to rule out the presence of left temporal lobe seizures, however, during video-EEG monitoring, we recorded only right temporal-onset seizures.

Case 2

The second subject was a right-handed, 76-year-old woman, affected by epileptic seizures since 1 year of age. Seizures were characterized by a sudden and brief cacosmia, sometimes preceded by sensation of epigastric constriction and followed by PIWD. A few months after the onset, she presented with status epilepticus (SE) characterized by confusion, incongruous behaviours, and repetitive water drinking requests; laboratory findings ruled out the presence of a dehydration state.

Table 1. Literature review of published cases.

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
Szucs *et al.* (2007)	38/M	NR	R-handed	NR	Ictal	Symp-tomatic	Inde-pendent bitemporal spike focus	Right temporal rhythmic theta	Right hip-pocampal sclerosis (MRI)	R	Surgery	Engel class I/II
	37/F	NR	R-handed	NR	Postictal	Symp-tomatic	Right temporal sharp waves	Right anterior desynchroniza-tion and rhythmic activity	Right temporal oligo-astrocytoma (MRI)	R		
	36/F	NR	R-handed	NR	Ictal	Symp-tomatic	Right anterior temporal spikes	Crescendo right temporal rhythmic activity	Bilateral, R>L hip-pocampal sclerosis (MRI)	R		
	25/F	NR	R-handed	NR	Ictal	Crypto-genic	Bitemporal > left spikes	Left temporal desynchroniza-tion and rhythmic activity	Normal (MRI)	L		
	38/M	NR	R-handed	NR	Ictal	Symp-tomatic	Left anterior temporal spikes	Left temporal rhythmic crescendo pattern	Left hip-pocampal sclerosis (MRI)	L		
	34/F	NR	R-handed	NR	Postictal	Symp-tomatic	Left temporal sharp waves	Left temporal theta rhythm	Left hip-pocampal sclerosis (MRI)	L		

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
Szucs *et al.* (2007)	30/M	NR	R-handed	NR	Ictal	Symp-tomatic	Bitemporal indepen-dent spikes	Left temporal and frontal desynchroniza-tion and crescendo rhythm	Left hip-pocampal sclerosis (MRI)	L		
	30/F	NR	R-handed	NR	NR	Symp-tomatic	Left temporal spikes	Left temporal rhythmic pattern	Left temporal cavernoma (MRI)	L		
Trinka *et al.* (2003)	41/M	5	L speech (Wada test)	Unresponsiveness, right hand automatism, dystonic posturing left upper extremity	Postictal	Symp-tomatic (Ammon's horn sclerosis)	Spikes (R/L → 60:40)	Bitemporal	Right hip-pocampal sclerosis (MRI)	R	Surgery	NR
	52/F	50	L speech (Wada test)	Unresponsiveness, oroalimentary and right hand automatisms, dystonic posturing left upper extremity	Postictal	Symp-tomatic (gangli-oglioma)	Right spikes	Right temporal	Right temporal tumour (MRI)	R		NR
	30/M	13	L speech (Wada test)	Motionless stare, unresponsiveness, oroalimentary and right upper extremity automatism, ictal water drinking, secondary generalization	Ictal	Symp-tomatic (end-folium sclerosis)	Right spikes	Right temporal	Right hip-pocampal atrophy (MRI)	R		NR

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
Trinka *et al.* (2003)	43/F	8	L speech (Wada test)	Unresponsiveness, oroalimentary and right hand automatisms, dystonic posturing left upper extremity	Postictal	Symp-tomatic (Ammon's horn sclerosis)	Right spikes	Right temporal	Right hip-pocampal atrophy (MRI)	R		NR
	42/M	13	L speech (Wada test)	Unresponsiveness and right hand automatisms	Postictal	Symp-tomatic (Ammon's horn sclerosis)	R/T (90:10)	Right temporal	Right hip-pocampal sclerosis (MRI)	R		NR
	49/F	3	L speech (Wada test)	Unresponsiveness, oroalimentary and right hand automatisms, dystonic posturing left upper extremity	Postictal	Symp-tomatic (Ammon's horn sclerosis)	Right spikes (?)	Right temporal	Right hip-pocampal sclerosis (MRI)	R		NR
	36/F	32	L speech (Wada test)	Motionless stare, unresponsiveness, oroalimentary and right hand automatism, ictal water drinking, dystonic posturing left upper extremity	Ictal	Symp-tomatic (fibrillary astrocy-toma)	Right spikes (?)	Right temporal	Right fron-totemporal tumour (MRI)	R		NR

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
Rémillard *et al.* (1981)	33/M	2,5	R-handed	Confusion, trembling, ictal water drinking	Ictal	Symp-tomatic	Bilateral temporal epileptic activity (R>L)	EEG flattening and rhythmic spike discharges (L>R) (deep electrodes)	Enlargement of the left lateral ventricle, particularly of the temporal horn (PEG)	(L)	NR	NR
	19/M	1	Ambidextrous	Staring, disorientation, head and eyes right deviation, salivation, chewing, hyperventilation, papillary dilatation, right upper extremity automatism	Pre-postictal	NR	Independent bitemporal epilepti-form activity	Fast rhythmic activity starting in the L hippocampus (deep electrodes)	NR	(L)	NR	NR
	44/M	34	R-handed	Dizziness, nausea, difficulty hearing, "bars of an English waltz"	Ictal	Symp-tomatic	Right temporal focus	NR	Diffuse atrophy with asymmetry (> right frontal and temporal horns) (PEG)	(R)	NR	NR
	21/F	10	L-handed (preserved ictal speech during his seizures)	Loss of contact, looking around, pronation and retropulsion of right arm	Ictal/postictal	NR	Left temporal epilepti-form activity	Left frontal and temporal spikes	NR	(L- non-dominant hemi-sphere)	NR	NR

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
	9/F	1,8	R-handed	Running about asking for water, confusion, hyperventilation, left limb stiffness	Ictal	Symp-tomatic	Right temporal focus	Right temporal high-voltage sharp waves with or without slow waves	Right hemi-spheral atrophy, enlarged R lateral ventricle (skull radiograms)	(R)	NR	NR
Rémillard *et al.* (1981)	24/F	15	L-handed	Feelings of not being well, trembling, chewing, swallowing, lip-puckering, flushing of the face, apprehension, hyperventilation	Ictal	NR	Right infer-omesial temporal area rhythmic theta activity	Generalized rhythmic theta activity, some right frontotemporal sharp waves and delta activity	NR	(R)	NR	NR
	50/F	Ado-lescent	NR	Odd sensation in the head, water drinking	Pre?	NR	Right cen-troparietal dysfunction without clear epilepto-genic activity	NR	NR	(R)	NR	NR

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
	50/F	0,8	R-handed	Awakening, need of water; GTCS; heaviness and loss of balance	Ictal	NR	"disturbance of cerebral activity in the left temporal and anterior sylvian regions"	NR	NR	(L)	NR	NR
Rémillard *et al.* (1981)	18/F	4	R-handed	Frightening, swallowing, staring, left arm stiffness, head and eyes left deviation automatisms	Ictal	Symp-tomatic	Anterior right temporal lobe epilep-togenic activity	NR	Smaller left hemicra-nium with enlarge-ment of L lateral ventricle (PEG)	(R)	NR	NR
	53/F	5	R-handed	Dizziness, swallowing, loss of consciousness, tonic-clonic seizures	Ictal	NR	Anterior and midtempo-ral right temporal lobe epilep-togenic activity	Right anterior and midtemporal epileptic focus	NR	(R)	NR	NR

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
Cascino and Sutula (1989)	39/F	11	R-handed	Motionless stare, lip smacking, heat turning to the left. Lightheadedness and palpitations, urge to drink	Ictal	Symp-tomatic	Intermittent epilepti-form activity in right anterior region	Right anterior temporal electrographic seizure activity	Enlargement of the right temporal horn of the lateral ventricle suggesting atrophy of the right parahip-pocampal gyrus (MRI)	R	Anterior temporal lobectomy	Seizure freedom since surgery
Crapanzano *et al.* (1993)	35/F	24	R-handed	Staring, disorientation, drinking	Ictal	Symp-tomatic	Right temporal sharp waves	Right temporal onset with maximally diffuse high-amplitude bursts	Right hip-pocampal atrophy (MRI)	R	NR	CBZ, VPA
Despland *et al.* (1985)	51/M	51	R-handed	Anxious behaviour, chewing, weakness	Post	Symp-tomatic (Glioma)	Right theta rhythm	Right temporal rhythmic activity and spikes	Right fronto-temporal tumour	R	NR	Death
Errguig *et al.* (2013)	42/F	30	R-handed	Epigastric aura, staring, unresponsiveness, oro-alimentary automatisms, dystonic posturing of the left hand, ictal water drinking.	Ictal	Symp-tomatic	Epileptic discharges in the right anterior temporal lobe	Right anterior temporal electrographic seizure activity	Right hip-pocampal sclerosis (MRI)	R	Surgery	Engel I

Table 1. (*Continued*)

Reference	Age/ sex	Age at onset (y)	Handedness/ speech dominance	Seizure semiology	Water drinking	Aetiology	Interictal EEG	Ictal EEG	Neuro-imaging findings	Side	Treat-ment	Follow-up
Errguig *et al.* (2013)	36/F	8	R-handed	Epigastric aura, tachycardia, staring, hypersalivation, motor and verbal automatisms with feeling of thirst.	Ictal	Symp-tomatic	Epileptic discharges in the right anterior temporal lobe	Right anterior temporal electrographic seizure activity	Right hip-pocampal sclerosis (MRI)	R	Awaiting surgery	NR
Case 1 (this study)	42/M	42	R-handed	Air hunger, facial flushing, fear, without loss of consciousness, able to speak, he repetitively asked water to drink	Ictal	Symp-tomatic	Bilateral temporal epileptic activity	Rhythmic theta activity intermingled with spikes over right temporal region	Paran-eoplastic limbic encephalitis involving bitemporal regions and dien-cephalon (testicular seminoma	?	Primary tumour surgery	Seizure freedom
Case 2 (this study)	76/F	75	R-handed	SE characterized by confusion, incongruous behaviours, and repetitive WD requests	Ictal	Symp-tomatic	Right temporal theta rhythm	Rhythmic spikes over right temporal region	Right temporal glioblas-toma	R	i.v. AEDs	Death

M: male; F: female; y: year; NR: not reported; R: right; L: left; CBZ: carbamazepine; VPA: valproic acid; SE: status epilepticus; iv: intravenous; AEDs: antiepileptic drugs. (R) or (L): data obtained indirectly; *see text for details.*

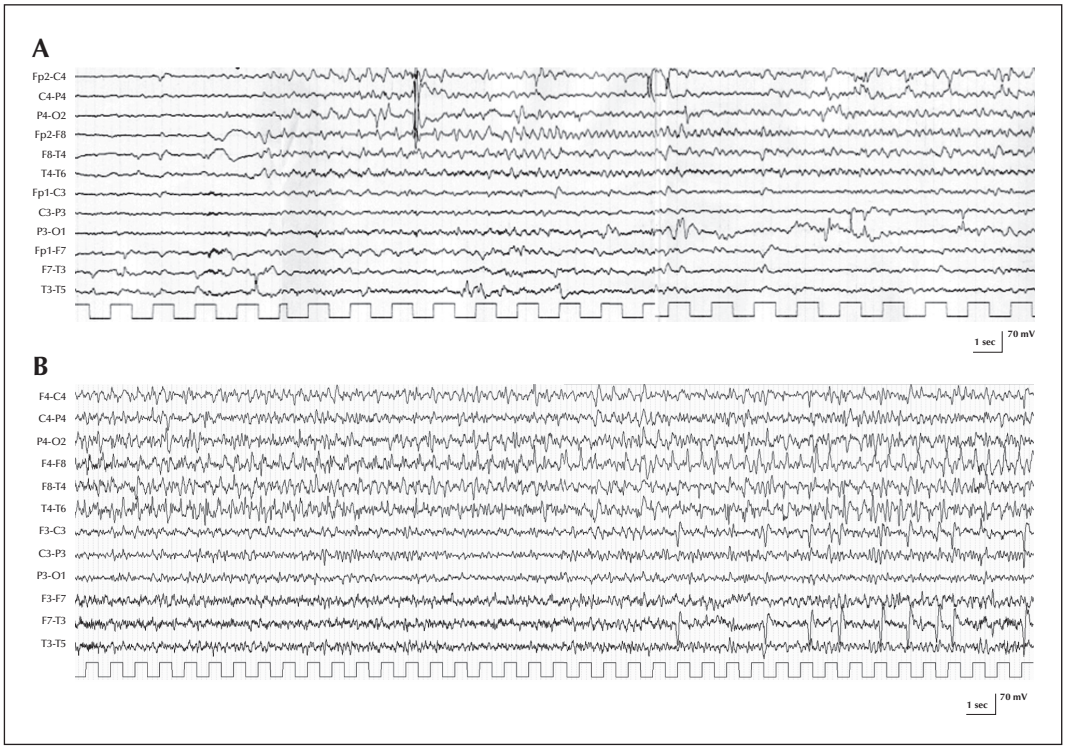

Figure 1. Ictal EEG of both patients. (A) Case 1 with limbic encephalitis. EEG shows a low-voltage fast activity over the right temporal region, followed by rhythmic spikes in the same region. (B) Case 2 with right temporal lobe glioblastoma. EEG shows rhythmic spikes over the right temporal and frontal regions.

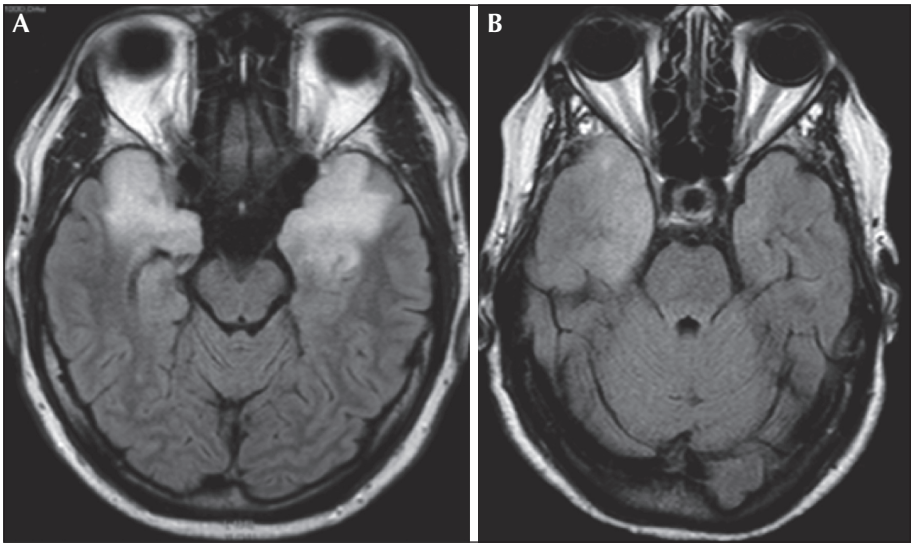

Figure 2. Brain MRI of both patients. (A) Case 1: FLAIR sequences showing bilateral temporal lobe hyperintensity, suggestive of limbic encephalitis. (B) Case 2: FLAIR sequences showing right temporal lobe hyperintensity.

She immediately underwent video-EEG monitoring which revealed rhythmic spikes over the right temporal region (*figure 1B*). Status persisted despite the use of i.v. antiepileptic treatment. Brain MRI, performed before SE, showed the presence of a right temporal glioblastoma (*figure 2B*). She died due to complications during the hospitalisation.

Review of previous reported cases and discussion

PIWD is a stereotyped behaviour not always recognized as an epileptic automatism. It can be observed as an ictal or postictal sign, and rarely it represents *per se* the clinical manifestation of an ictal

temporal discharge. In our patients, it was part of symptomatic TLE.

Lennox and Cobb (1933) firstly reported the urgent need to drink water as part of an epileptic seizure. In their review on aura in epilepsy, three patients asked for water for an undetermined reason, and three had a sensation of dryness of the mouth.

Based on an extensive review of patients with autonomic signs associated with TLE, PIWD was reported in 14.4% of patients (Musilova *et al*., 2010). Janszky *et al*. (2007) observed PIWD in 7% of patients, Szucs *et al*. (2007) in 14.5%, and Trinka *et al*. (2003) in 15.3%. In these cases, drinking was encountered in patients with TLE in the context of focal symptomatic epilepsy.

Table 1 summarizes the main clinical findings of all reported cases (Rémillard *et al*., 1981; Despland *et al*., 1985; Cascino and Sutula, 1989; Crapanzano *et al*., 1993; Trinka *et al*., 2003; Szucs *et al*., 2007; Errguig *et al*., 2013). All patients presented with TLE, and all but one had symptomatic epilepsy. Twenty-four of 32 cases (including our cases) had involvement of the right non-dominant hemisphere, and eight of the left hemisphere.

Twenty-one patients were reported to have ictal water drinking (WD); eight had postictal WD and two had ictal/postictal WD. Both our patients had ictal WD. Only in a few cases was the timing of PIWD reported to correlate with the EEG; in cases reported by Errguig *et al*. (2013), the onset of fast rhythms in the right anterior temporal lobe was coincident with sensation of thirst. In cases with postictal WD, it remains unclear whether this finding might reflect a kind of inhibition or release phenomenon of the network involved in thirst.

Nineteen patients had brain MRI and four had pneumoencephalography or analogue X-ray of the skull. Neuroimaging was not available in the other cases. Aetiology was hippocampal sclerosis in 14 cases, and temporal tumour in five cases. Both of our cases had brain MRI, and aetiology was paraneoplastic limbic encephalitis in one and glioblastoma in the other.

The lateralizing value of PIWD is a point of debate. Although there are several articles in the literature proposing that it might represent a lateralizing symptom in TLE, there is no sufficient evidence to confirm this hypothesis. It was firstly proposed that the presence of PIWD represents a clear sign of involvement of the non-dominant temporal lobe (Trinka *et al*., 2003; Musilova *et al*., 2010), but this result was not confirmed by successive studies (Rémillard *et al*., 1981; Janszky *et al*., 2007; Szucs *et al*., 2007).

The relatively small number of patients and seizures analysed, as well as the small number of patients investigated with stereo-EEG, are the two major issues to be highlighted when referring to the lateralizing value of PIWD.

Patients reported by Trinka *et al*. (2003) had a right (non-dominant) TLE, and this was documented through Wada testing performed for all of them. In the other published cases, the side of the temporal epileptogenic region was variable. Szucs *et al*. (2007) reported eight of 55 adult patients presenting with PIWD in the context of TLE; five had left and three right TLE, therefore the lateralization value of PIWD could not be confirmed.

In cases reported by Rémillard *et al*. (1981), the authors did not refer to any lateralizing value. However, 6 of 10 patients had epileptiform discharges on the right hemisphere. The other reported cases (Despland *et al*., 1985; Cascino and Sutula, 1989; Crapanzano *et al*., 1993; Errguig *et al*., 2013) had symptomatic TLE with involvement of the right non-dominant hemisphere. In our patients, one had bilateral TLE and the other right TLE, therefore no clear conclusion could be drawn.

Overall, outcome is good; seizure freedom was reported in 7 of 10 patients presenting with PIWD after resective surgery (Wieser's class I) (Trinka *et al*., 2003) and a favourable post-operative outcome was also achieved (Engel class I or II) in patients reported by Szucs *et al*. (2007). Two other patients were reported to be seizure-free after surgery (Cascino and Sutula, 1989; Errguig *et al*., 2013). In addition, one patient was reported to be under AED treatment (Crapanzano *et al*., 1993), one died (Despland *et al*., 1985), and another was awaiting surgical treatment (Errguig *et al*., 2013).

One of our patients died due to complications during the hospitalization and the other became seizure-free after surgery for testicular seminoma with remission of paraneoplastic limbic encephalitis.

Regarding the pathophysiology, it has been hypothesized that, in the context of a TLE, the propagation of mesial temporal epileptiform discharges via pathways between the hypothalamus and the mesial temporal structures might cause thirst, activating water seeking (Trinka *et al*., 2003). It was suggested that the lateralizing value of PIWD could be explained by asymmetric representation of the central autonomic network responsible for fluid control, thirst, and water-seeking behaviour (Denton *et al*., 1999).

The mechanism underlying PIWD was reported to be electrographically associated with seizures starting in the amygdala, hippocampus, and parahippocampal gyrus (Rémillard *et al*., 1981), but it can also be induced in rats by stimulation of the lateral hypothalamus (Mogenson and Stevenson, 1961). The hypothalamus is linked to limbic structures by a variety of multisynaptic pathways (Brodal, 1981). Efferent pathways from the hippocampus and amygdala that project to the hypothalamus have also been implicated in water balance and drinking behaviour (Martin and Reichlin, 1987).

Like ictal fear, ictal drinking may be the expression of epileptic activation of a behavioural mechanism integrated in temporo-limbic structures, which are related to some fundamental drive.

Seizure semiology of most of these patients was characterized by staring, sometimes preceded by aura, and followed by oral or motor automatisms, but motor phenomena were also reported (*see table 1*). Our cases presented with episodes of temporal aura, confusion or loss of contact, and then water request. Patients with TLE may react to an unpleasant feeling in the mouth or the feeling of thirst, resulting in a desire to drink.

We believe that PIWD, as part of an epileptic seizure, might be considered a rare automatic behaviour, like other automatisms frequently reported in epileptic seizures. Automatisms are more frequently described in patients with TLE, and involvement of the temporal lobe in most of the published cases might provide an explanation for this. On the other hand, complex motor behaviours require coordination of the motor nuclei of the brainstem, and an involvement of such structures cannot be ruled out. Hypothalamic activation, also, has been hypothesized as an explanation for drinking in the peri-ictal period (Trinka *et al*., 2003). It is possible that drinking within epileptic seizures is a release phenomenon rather than activation of distinct symptomatogenic cortex. Whether this rare event is the result of activation of particular areas of cortex or a release phenomenon is not clear. □

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