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Eating epilepsy. A narrative review

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Abstract

Eating epilepsy (EE) is rare reflex epilepsy in which seizures are triggered by mechanisms related to the eating process. In this narrative review, we analyzed case series and case reports found in the literature and describe sociodemographic, semiological, and radiological characteristics of patients with EE in the general population. Our analysis revealed that this epilepsy is more common in male patients and usually presents with focal onset seizures. There is wide variability in clinical presentation and there is not enough evidence to affirm that there is a specific food or diet that triggers the seizures. Temporolimbic and suprasylvian areas of the frontal and temporal lobes, particularly the insular and opercular cortex, play an important role in the pathophysiology of EE as found in neuroradiological and neurosurgical studies. As for the treatment, there is a high prevalence of pharmacoresistance and clobazam was the most used antiepileptic drug, usually as an add-on therapy.

Key words: *Eating epilepsy. Eating seizures. Reflex epilepsy. Reflex seizures.*

Epilepsia refleja por alimentación. Una revisión narrativa

Resumen

La epilepsia por alimentación es un tipo de epilepsia refleja poco frecuente, en donde las crisis epilépticas son detonadas por mecanismos relacionados con el proceso de alimentación. En esta revisión narrativa analizamos reportes y series de casos de este tipo de epilepsia en la población general y detallamos características sociodemográficas, semiológicas y radiológicas. Nuestro análisis reveló que la epilepsia por alimentación es más prevalente en el sexo masculino y generalmente se presenta como crisis convulsivas focales. Existe una alta variabilidad en la presentación clínica y no hay evidencia suficiente para afirmar su asociación con algún tipo de alimento o dieta específica. En los estudios complementarios se encontró relación clínico-radiológica y quirúrgica en áreas temporolímbicas y suprasilvianas de los lóbulos frontal y temporal, particularmente la corteza insular y opercular, recalcando su importante papel en la fisiopatología de esta epilepsia. En cuanto al tratamiento, hay una alta prevalencia de farmacorresistencia y el clobazam fue el antiepiléptico más utilizado, generalmente en conjunto con otros fármacos.

Palabras clave: *Epilepsia por alimentación. Crisis epilépticas por alimentación. Epilepsia refleja. Crisis epilépticas reflejas.*

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Introduction

Reflex epilepsy (RE) or reflex seizures refers to epileptic syndromes characterized by focal or generalized seizures elicited by a specific stimulus or activity. These stimuli can be simple (visual, auditive, proprioceptive, or tactile) or complex (while eating, talking, tooth-brushing, bathing, etc.)[1,2]. RE estimated prevalence represents 4-7% of all epilepsies and 21% of idiopathic generalized type, being photosensitive epilepsy the most common[3].

Eating epilepsy (EE) is a rare form of RE with a prevalence of 1:1000-2000 of all patients with epilepsy, although it ranges higher in Asia[3-6]. EE is more common in males and usually presents as focal seizures with impaired awareness which can occur before, during, and/or after eating[3,4,7].

In this critical review, we aimed to answer the following questions: which are the sociodemographic, semiological, and radiological characteristics of EE in the general population?

Background

Eating is a complex mechanism that includes olfactory, taste, somatosensory, and other interoceptive inputs, which activate brain structures such as the insular cortex, frontal operculum, orbitofrontal cortex, and the amygdala[8]. The hypothalamus and other components of the autonomic nervous system regulate central and peripheral homeostasis of digestion and metabolism[9]. These structures are of particular interest in the study of hunger, satiety, obesity, as well as eating and body image disorders such as anorexia and bulimia. Moreover, all of the aforementioned structures are well recognized as trigger zones of EE in various studies[8,10].

Although the pathophysiology of EE is not clear, according to case reports and small case series in the literature, plausible mechanisms for its appearance have been proposed. A genetic involvement is shown in subjects with mutations in genes *SYNGAP1*[2], *MECP2*[11]; as well as familial EE[5], associated with Rett[12], Cri du Chat,[13,14] and congenital or acquired bilateral opercular syndromes[15,16]. Ethnic origin and environmental factors such as chemical composition of food, culinary habits, feeding behavior, and emotional and psychological involvement may be important in EE etiology[7,17]. EE can present with other epileptic syndromes, structural pathologies (malformations, tumors), and/or brain injury (hypoxic brain damage, gliosis, encephalomalacia, and meningoencephalitis)[4,7,17]. Therefore, it has been proposed that EE may be a long-term manifestation of an initial precipitating event in the past[7,17].

Clinical presentation of EE is diverse. Seizures usually present as focal onset with impaired awareness and less commonly with generalized onset, including atonic, myoclonic, or even autonomic types[3,4,7,17]. EE occurs more frequently in the context of temporal or frontal lobe epilepsies[4] and it usually is symptomatic or associated with imaging abnormalities in these locations (Tables 1 and 2).

In patients with EE, seizures can be caused by diverse and heterogeneous stimuli; nevertheless, all of them are related to the feeding process, either just before, during, or after it. These triggers may involve visual and olfactory stimuli (sight and smell), digestive and autonomic functions (salivating, chewing, swallowing, gastric distention, and gastric acid secretion), proprioceptive stimuli, thinking about food, bulky meals rich in carbohydrates, and gastroesophageal reflux[2,12,17-20]. Moreover, association of EE to vasovagal syncope attacks has been reported, suggesting a vagal mechanism[7].

Electroencephalographic (EEG) findings can be normal or present focal or diffuse epileptiform abnormalities[3]. Magnetic resonance imaging (MRI) can also be normal or present structural abnormalities specifically in temporolimbic or suprasylvian areas, particularly in the insular and opercular cortex[3,4,7,12]. A clinical neurotopographic correlation can be made with EEG finding and/or imaging findings.

Although identification and avoidance of stimulus in some patients could aid in seizure control, in EE, this is not always possible, except in very specific associated situations[3]. Some patients respond and benefit from antiepileptic drugs. Although management of choice has not yet been established, intake of clobazam before meals may be effective as add-on therapy in the management of EE[3,4]. Kokes et al. suggest that seizures that originate from the left temporal region may be more resistant to antiepileptic management[7]. Some patients with therapy resistance may benefit with surgical treatment[21] or vagus nerve stimulation[22], especially those with imaging abnormalities[21].

Methods

This article is based on unsystematic research in *Google Scholar* and *PubMed* for original manuscripts about “Eating epilepsy,” “Eating reflex seizures,” “Eating seizures,” “Reflex eating epilepsy,” and “Reflex eating

Table 1. Clinical characteristics, diagnosis, and treatment of main case report series of patients with eating epilepsy *(Continued)*

Author/year	Ahuja, 1980[23]	Nagaraja, 1984[24]	Koul, 1989[25]	Senanayake, 1990[5]	Loreto, 2000[26]	Nakazawa, 2002[27]	Seneviratne, 2003[28]	Labate, 2005[29]	Cukiert, 2010[22]
n	3	13	50	20	3	2	28	2	3
Sex (M/F)	3/0	8/5	ND	13/7	2/1	2/0	13/15	2/0	2/1
Eating epilepsy mean age onset (year)	22	14	15.2	17	22.6	9.5	18.6	8.6	11
Triggers	Eating	Chewing, drinking (water), eating, snacks	Chewing, swallowing	ND	Eating	Chewing, eating, swallowing	Eating	Eating	Eating
Meal of the day	ND	ND	ND	Lunch	Meals, lunch	ND	ND	ND	ND
Moment of eating/meal	After, during	At the middle, at the end	During	After (30 min post main meal), during	At sight, beginning, during	After, before, during	After, during	Beginning, during	During
Quality or quantity of meal	ND	Bulky meals, conventional Indian meals	ND	ND	ND	ND	ND	ND	ND
Aura (focal aware)	Numbness	ND	Forced thinking and memorizing, visual hallucination	ND	ND	ND	ND	ND	ND
Eating reflex seizure type	At, FBTC, FOIA	FBTC, FO GTC	FBTC, FOA, FOIA	FBTC, FOA, FOIA	FBTC, FOIA	FOA, FOIA, FTBC, GT	FBTC, FOIA GTC	FOIA, GT	FOIA
Radiological abnormal findings (CT/MRI/PET/SPECT)	ND	ND	NR	ND	MRI: L ventriculomegaly, R retrotrigonal hyperintensity SPECT: Me-RT lobe focal hyperperf.	MRI: none SPECT: R-F hyperperfusion and R-striate body hypoperf.	ND	MRI: poor operculum formation with thickened Co	MRI: B perisylvian polymicrogyria
Electroencephalographic abnormal findings	Interictal EEG: R-H: diffuse, unilateral Spk and Shw. Generalized discharges.	EEG: L-FT Slw Shw. R-T Swv bursts. Generalized Spk.	Interictal EEG: "positive", ED.	Interictal EEG: B-MT, B-PoT Shw and Slw.	vEEG: low voltage slowed background Ictal vEEG: high voltage Slw + diffuse Slw; R-Po Sh-Slw Interictal vEEG: R-TF, L-T paroxysm; R-T ED	Ictal vEEG: high amplitude delta or theta Interictal EEG: R-F Sp and Shw; R-O Sp	ND	Ictal EEG: diffuse Spw, ED + diffuse attenuation Interictal EEG: generalized Spk or poly-Spw; R-T slowing and high amplitude Shw Slw	Ictal EEG: B-T lobe onset Interictal EEG: B-T spiking; L-FC Spk

(Continues)

Table 1. Clinical characteristics, diagnosis, and treatment of main case report series of patients with eating epilepsy *(Continued)*

Author/year	Ahuja, 1980[23]	Nagaraja, 1984[24]	Koul, 1989[25]	Senanayake, 1990[5]	Loreto, 2000[26]	Nakazawa, 2002[27]	Seneviratne, 2003[28]	Labate, 2005[29]	Cukiert, 2010[22]
Treatment	CBZ, PB, PHT	CBZ, PB, PHT, PMD. Avoidance of bulky meals.	CBZ, PB, PHT. Use of left hand and/or spoon.	CBZ, CLB, PHT, PMD	CBZ, CLB, GBP, GVG, LTG, PB, VPA	CBZ, CLB, CLZ, PHT, VPA, ZNS, Fed by another person, reduced attention to the meal	CBZ, VPA	ACTH, CBZ, CLZ, GVG, NZ, PB, VPA	CBZ, CLB, PB, OXC, VPA. + Vagus nerve stimulation
Pharmacoresistance	ND	Present in 10	ND	None	Present in 1	Present in 1	ND	ND	Present in three
Surgery	None	None	ND	None	ND	ND	None	ND	R-TO resection; L-F resection
Author/year	**Bae, 2011[30]**	**Gujjar, 2012[21]**	**Patel, 2013[31]**	**Kokes, 2013[7]**	**Shirai 2015[14]**	**Jagtap, 2016[32]**	**Von Stülpnagel, 2019[2]**	**Singh, 2019[4]**	**Atalar, 2020[33]**
n	2	5	6	6	2	47	8	12	2
Sex (M/F)	1/1	4/1	3/3	4/2	1/1	41/6	4/4	11/1	1/1
Eating epilepsy mean age onset (year)	39.5	23.6	20.6	20	10.5	16	3	13.5	20
Triggers	Eating	Eating	Eating, though of food	Chewing (prolonged), drinking, swallowing, taking food to the mouth	Chewing, eating	ND	Chewing, eating, orofacial stimuli	Eating	Eating
Meal of the day	ND	Lunch, midday meal	ND	Breakfast, dinner, lunch. Particularly Sundays	Breakfast, dinner, lunch	ND	ND	Dinner, lunch, no predilection	ND
Moment of eating/meal	After (immediately), during	At the middle, at the end, during	Beginning, at the middle	Beginning, during	Beginning, during	After, beginning, at the end	ND	ND	ND
Quality or quantity of meal	ND	ND	Rice made food	Overeating, pastry/salty food, solid food	ND	Rice, wheat-based diet	ND	ND	ND

(Continues)

Table 1. Clinical characteristics, diagnosis, and treatment of main case report series of patients with eating epilepsy *(Continued)*

Author/year	Ahuja, 1980[23]	Nagaraja, 1984[24]	Koul, 1989[25]	Senanayake, 1990[5]	Loreto, 2000[26]	Nakazawa, 2002[27]	Seneviratne, 2003[28]	Labate, 2005[29]	Cukiert, 2010[22]
Aura (focal aware)	Blurred vision, *jamais-vu*, palpitations, unpleasant fear.	ND	ND	Dyscognitive, "experiential"	ND	Cephalic sensation, *déjà vu*, epigastric rising sensation, fear, somatosensory, vertigo, visual,	ND	Cephalic sensation, epigastric sensation, giddiness, uneasiness,	Epigastric, visual, vertigo,
Eating reflex seizure type	A, FBTC	FBTC, FOIA GTC	FO	FBTC, FOA, FOIA	FOA	FBTC, FOIA, "HD"	Ab, At, EM, GTC, M, Oc, To	FBTC, FOIA, GT	FBTC, FOIA
Radiological abnormal findings (CT/MRI/PET/SPECT)	MRI: none	CT: none MRI: L-MeT sclerosis, L-T: atrophy, cortical lesion, R-T horn dilatation.	MRI: L-FP perisylvian cortical dysplasia, R and L Sylvian and perisylvian gliosis, LF calcified granuloma. SPECT: F hypoperf.; F, T + P-insular hyperperf.	MRI: L-F-EA meningioma, L-H sequel lesions. PET: L-MeT, L-LaT, O, and multifocal hypo-metabolism.	MRI: pontine and cerebellar hypoplasia	MRI: PoTPO polymicrogyria. Peritrigonal hyperintensities, pachygyria, gliosis. Me-T sclerosis. T cavernoma. F dysplasia. B perisylvian,	MRI: F dilatation of external spaces of CSF.	MRI: B: perisylvian gliosis. L-I-F gliosis. R-F perisylvian sclerosis, R-T sclerosis.	MIR: "non-specific" SPECT: L-T, L-I-F, and R-S-F hypoperf. PET: R-T hypometabolism.
Electroencephalographic abnormal findings	Ictal EEG: L-T onset of generalized rhythmic theta and delta activity. Interictal vEEG: B-T: Spk.	Interictal vEEG: L-MT onset of isolated discharges. Interictal EEG: R-FT, R-TP generalized Spk, Shw.	Ictal EEG: L-PT, L-FC, R-FTC slowing. R-FCT beta, theta activity. L-FCT Shw Interictal EEG: L-C theta wv, L-FC Shw.	Ictal EEG onset: L-FT, L-TP. Interictal EEG: L-FT, L-PT, and L-T Spk and slowing, L-H slowing. R-TO Spk and slowing.	Ictal EEG: Slw (>T); negative-positive potentials (>F, midline) Interictal EEG: ED (>MT, PoT), Spw	Ictal vEEG Diffuse, F-C, PoTPO and T ED. Interictal vEEG: Lateralized, uncertain, and diffuse ED.	vEEG: B (>O), B-PO Spw, B-O slowed background activity (theta). Diffuse Spk and Spw. PO slowing.	Interictal EEG: B-Po ED, B perirolandic Spk. L-FT ED, L-PoT ED with secondary generalization, L-T Spk. R-CT ED, R-Po Spk.	Ictal/Interictal: R-FT slow and Spw
Treatment	CBZ, LEV	CBZ, CLZ, LEV, LMT, PB, TPM, VPA	ND	ND	CBZ, CLB, LTG, LEV, TPM, VPA, ZNS	ND	CLB, ESM, LEV, LTG, TPM, VPA, ZNS	CBZ, CLB, LEV, LCM, OXC, PHB, PHT, TPM, VPA	CBZ, LCM, LEV

(Continues)

Table 1. Clinical characteristics, diagnosis, and treatment of main case report series of patients with eating epilepsy *(Continued)*

Author/year	Ahuja, 1980[23]	Nagaraja, 1984[24]	Koul, 1989[25]	Senanayake, 1990[5]	Loreto, 2000[26]	Nakazawa, 2002[27]	Seneviratne, 2003[28]	Labate, 2005[29]	Cukiert, 2010[22]
Pharmacoresistance	ND	Present in 1	ND	Present in 5	Present in 2	Present in 16	Present in 6	ND	ND
Surgery	None	L-T lobectomy + amygdalohippocampectomy	Lesionectomy	None	ND	Yes (in 2)	None	ND	None

ACTH: adrenocorticotropic hormone; At: atonic; Ab: abscense; B: bilateral; C: centro; CBZ: carbamazepine; CES: cluster of epileptic spasms; CLB: clobazam; CLZ: clonazepam; Co: cortex; CSF: cerebrospinal fluid; CT: computerized tomography; DA: drop attacks; EA: extra-axial; ED: epileptiform discharges; EEG: electroencephalogram; EM: eyelid myoclonia; ESM: ethosuximide; F: frontal; FOA: focal onset aware; FOAI: focal onset impaired awareness; FBTC: focal to bilateral tonic-clonic; FC: fronto-central; fRMI: functional magnetic resonance imaging; GBP: gabapentin; GT: generalized tonic; GTC: generalized tonic-clonic; GVG: vigabatrin; H: hemisphere; HD: head drops; I: inferior; L: left; La: lateral; LCM: lacosamide; LEV: levetiracetam; LTG: lamotrigine; Me: mesial; M: myoclonic; MRI: magnetic resonance imaging; MT: mid-temporal; ND: no data; NR: no realized; NZ: nitrazepam; O: occipital; Oc: oculocephalics; OXC: oxcarbazepine; P: parietal; PB: phenobarbital; PET: position emission tomography; PHT: phenytoin; PNET: primitive neuroectodermal tumor; Po: posterior; PRM: primidone; R: right; sEEG: stereoelectroencephalography; Shw: sharp wave; Slw: slow wave; SPECT: single photon emission tomography; Sp: spikes; Spw: spike wave; S: superior; T: temporal; To: tonic; TPM: topiramate; vEEG: videoelectroencephalogram; VPA: valproate; vw: wave; ZNS: zonisamide.

seizures;" followed by a discretionary selection of publications. We included observational studies (such as case reports and case series) published between 1967 and 2020. Editorial notes, literature systematic reviews and clinical images were excluded from the study.

Results

In this review, we analyzed 18 case series and 23 case reports (Tables 1 and 2) and we included the case of a 40-year-old male patient with EE evaluated in our epilepsy clinic (Table 2).

Discussion

Due to the inherent limitations of the case report and case series, result heterogeneity is obvious, with the consequent weakness of the conclusions. Despite these limitations from the data not reported or specified, the following information is relevant. We found that out of 237 patients, 126 were male and 61 were female (the sex of 50 patients was not specified by the author) with a resulting 2:1 ratio, highlighting the predominance among men. The reason why there is a clear predominance in males is unknown; we wonder if it has to do with the diagnosis approach, or if women are underdiagnosed or if there is a more complex pathophysiological explanation.

As for the type of seizures, the most frequently reported were the focal type with or without impaired awareness (Tables 1 and 2).

In both the case series and the case reports, the most common and constant trigger was by definition the act of eating itself[2,4,11,13-19,21-24,26-31,33-38,42-46] but in some cases other stimuli were detailed such as chewing[2,7,14,18,24,25,27,34,36], swallowing[7,25,27,36], drinking[7,24], seeing[18,37,39,45], smelling[11,37,39], and even thinking[31,37] or talking[37] about food. Orofacial stimuli[2], taking food to the mouth[7], hunger alone[37], eating snacks[24], and tasting food[11] were also described.

In the case report series, other specific triggers to EE related to the type of food have also been described, including bulky meals, conventional Indian meals[24], wheat-based diet, and on a rice-based diet[31,32]. Only 4 patients had a preference for a specific type of food (spicy food[11], bread[17], strawberry syrup[42], and minced meat[45]). Furthermore, just a few authors specified the patient's diet, so it remains unclear if EE has a relation to specific diet type.

MRI and CT findings were variable. Some abnormalities were encephalomalacia, sclerosis,

Table 2. Clinical characteristics, diagnosis, and treatment of main case reports of patients with eating epilepsy

Author/year	Lavizzari, 1967[18]	Cirignotta, 1977[19]	Robertson, 1978[34]	Fiol, 1986[35]	Mateos, 1995[15]	Kishi, 1999[16]
Sex	M	F	M	F	M	M
Eating epilepsy age onset (yr)	12	16	14	12	11	8
Triggers	At sight, chewing, eating	Eating	Chewing, eating	Eating	Eating	Eating
Meal of the day	ND	Meals *more frequent at breakfast	ND	More at breakfast	Meals	ND
Moment of eating/meal	ND	Beginning, during	ND	Beginning	ND	ND
Quality or quantity of meal	ND	ND	ND	None	ND	ND
Aura (Focal Aware)	ND	ND	Left upper limb numbness and left facial paresthesia.	ND	ND	ND
Eating reflex seizure type	FOA	FOIA, HD	FOA	FOIA, GTC	FO, FTBC	FOIA
Radiological abnormal findings (CT/MRI/PET/SPECT)	NR	NR	CT: R astrocytoma of basal ganglia.	CT: none.	CT/MRI: B rolandic opercula atrophy.	MRI: B perisylvian malformations, polymicrogyria.
Electroencephalographic abnormal findings	EEG: B-F sharp transients, positive spikes. Interictal EEG: generalized slow waves.	EEG: infrequent diffuse spike-wave discharges. Brief low-voltage fast activity and diffuse polyspike-wave discharges during sleep. Ictal EEG: diffuse sharp wave. B: low voltage fast activity. R-T: rapid activity medium voltage.	EEG: R-FT focal slowing. R-F delta focus, spikes, sharp waves.	Ictal vEEG: generalized low-voltage fast frequencies. L -T or R-T onset spikes. Interictal EEG: Generalized polyspike wave. R-Po, R-MT, L-Po, L-MT spikes, and sharp waves.	Interictal EEG: R-CT slow Spk, Slw.	Ictal vEEG: generalized low-voltage attenuation. Interictal EEG: B-CP synchronous Shw.
Treatment	PHT, PRM	ND	PB, PHT	CBZ, CZP, ESM, PB, PHT, VPA	CBZ, CLB, VPA	ND
Pharmacoresistance	No	Yes	ND	Yes	No	Yes
Surgery	No	No	Frontal craniotomy + subtotal resection of low-grade astrocytoma.	No	ND	ND

(Continues)

Table 2. continuation: Clinical characteristics, diagnosis, and treatment of main case reports of patients with eating epilepsy *(Continued)*

Author/year	Domizio, 2006[20]	D'Orsi, 2007[36]	El Bouzidi, 2010[37]	Manyam, 2010[38]	Martínez, 2011[12]	De Palma, 2012[11]
Sex	M	M	F	F	F	M
Eating epilepsy age onset (yr)	< 1	25	44	23	16	6
Triggers	Breastfeeding	Chewing, eating, swallowing	At sight, discussing cooking, eating, hunger thought or smell of food.	Eating	ND	Eating, smell, taste, * especially spicy food.
Meal of the day	ND	Lunch, breakfast, dinner	Dinner, lunch, meals, snacks	Meals	ND	ND
Moment of eating/meal	After drinking milk	ND	Beginning, during	ND	Beginning	ND
Quality or quantity of meal	Milk	ND	ND	ND	ND	ND
Aura (Focal Aware)	ND	ND	ND	ND	ND	ND
Eating reflex seizure type	Desaturation, cyanosis, increase in muscular tone.	At (generalized)	FBTC, FOA	FOIA	FOA	CES
Radiological abnormal findings (CT/MRI/PET/SPECT)	MRI/CT: none	MRI: B opercular dysplasia + corpus callosum hypoplasia.	MRI: L-F (precentral) hyperintensity.	MRI: post-surgical.	RMI: none	RMI: none
Electroencephalographic abnormal findings	EEG: R-MeT abnormal waves	Ictal EEG: B-An diffuse Slw Interictal EEG: diffuse alpha-like background + L-TPO theta activity and Spw.	Interictal EEG: none *Electrocorticography: L-F operculum epileptiform activity (anterior-inferior. to the MRI lesion)	Ictal EEG: delta activity (>F) Interictal EEG: L-H slowing, theta and delta activity. L-T Shw.	Interictal EEG: F, C ED.	Ictal EEG: diffuse slow-wave complex, > B-FC, followed by voltage attenuation.
Treatment	PB, antiacid therapy (GER)	CBZ, CLB, CLZ, LEV, LTG, OXC, VPA	CBZ, VPA	LTG, VPA	ESM, LEV, VPA	CLB, VPA, avoidance of spicy food.
Pharmacoresistance	No	Yes	Yes	No	No	Yes
Surgery	No	ND	-Subtotal resection of L-F operculum: Grade IV glioblastoma.	Post-resection left opercular PNET.	No	No

(Continues)

Table 2. continuation: Clinical characteristics, diagnosis, and treatment of main case reports of patients with eating epilepsy *(Continued)*

Author/year	Sandhya, 2013[39]	Koul, 2013[40]	Sillanpää, 2014[41]	Lodi, 2015[13]	Blauwblomme, 2015[42]	Kobayashi, 2016[43]
Sex	M	F	F	M	F	F
Eating epilepsy age onset (yr)	8	<1	<1	27	28	8
Triggers	Sight or smell of food	Breast feeding	Breast feeding	Eating	Eating	Eating
Meal of the day	ND	ND	ND	ND	ND	ND
Moment of eating/meal	At sight, before	Beginning, after	Beginning	ND	ND	Beginning, during
Quality or quantity of meal	ND	ND	ND	ND	Especially strawberry syrup	ND
Aura (Focal Aware)	ND	ND	Crying and coughing	ND	ND	ND
Eating reflex seizure type	ND	FO, GT	FBTC	CES	FOIA	CES
Radiological abnormal findings (CT/MRI/PET/SPECT)	MRI: none Interictal SPECT: L-FPO perfusion changes. Ictal SPECT: B-FTPO perfusion changes.	MRI: none	MRI: none	MRI: none	MRI: post-surgery cavity fMRI: activation of B insula, R-dorsolateral-F-Co and dorsolateral-P-Co.	MRI: corpus callosum dysgenesis, cerebellar hypogenesis, cerebral asymmetry, polymicrogyria, periventricular heterotopia, closed lip schizencephaly.
Electroencephalographic abnormal findings	Interictal vEEG: L-FT ED EEG-fMRI: ED, activation of L-FT lobes, B-P region, Me-structures (paracentral lobule, caudate, cingulate and medial frontal, lingual and medial occipital gyrus.	Interictal EEG: none EEG: R-PoT slowing	Interictal EEG: R asymmetric background activity of lower amplitude and repeated slow-wave discharges	Interictal EEG: slow background activity, poor organization Ictal EEG: F-C (>LH) diffuse irregular spike and slow-wave complex, some followed by delta rhythmic activity from L-FC and An vertex.	vEEG: An hippocampus spikes. An insular infrequent asynchronous spikes. sEEG: AnI insula high-amplitude spike followed by low-voltage high-frequency discharge with secondary spreading to hippocampus and TCo.	Interictal EEG: slow background activity with multifocal spikes L-H, R-CT region. Ictal EEG: diffuse large triphasic potentials >R-CTP region.
Treatment	ND	VPA	PB	CLB	ND	LTG, TPM, VPA
Pharmacoresistance	ND	No	No	Yes	Yes	ND
Surgery	No	No	No	No	-9 years before EE: Opercular-insular R- cavernoma resection -Epilepsy surgery: An insula resection.	ND

(Continues)

Table 2. continuation: Clinical characteristics, diagnosis, and treatment of main case reports of patients with eating epilepsy *(Continued)*

Author/year	Lee, 2016[44]	Mimura, 2017[45]	Kisli, 2018[17]	Aldosari, 2020[46]	Ruiz-León, 2020 (present case)
Sex	F	F	F	M	M
Eating epilepsy age onset (yr)	60	20	19	30	20
Triggers	Eating	At sight, eating	Eating	Eating	Eating
Meal of the day	ND	ND	ND	ND	No preference
Moment of eating/meal	ND	Before, during	Mostly at the beginning	Mostly at the beginning	Middle
Quality or quantity of meal	ND	Specially minced meat	Only while eating bread	ND	Only with solid food
Aura (Focal Aware)	Dizziness, impaired speech	ND	ND	ND	Dizziness
Eating reflex seizure type	FOA	FBTC, FOA	FOA	FBTC, FOIA	FOIA
Radiological abnormal findings (CT/MRI/PET/SPECT)	MRI: none PET: bitemporal hypometabolism (>L)	ND	MRI: B-PCo encephalomalacia area	MRI/PET: none	MRI: none
Electroencephalographic abnormal findings	ND	Ictal vEEG: L-F to MT: rhythmic theta activity followed by generalized seizure pattern.	Ictal EEG: R-FT sharp wave activity Interictal EEG: none.	vEEG: B-T ED. Ictal vEEG: R-T rhythmic activity with perisylvian spreading sEEG: R-AnMeT, insula, amygdala, hippocampus.	vEEG: Intermittent R-H slowing waves, predominantly F-C and with no epileptiform abnormality.
Treatment	ND	ND	LEV	ND	OXC
Pharmacoresistance	ND	ND	ND	Yes	No
Surgery	ND	ND	ND	R-An-T lobectomy including Me structures (amygdala, uncus, hippocampus) + partial inferior insulectomy.	No

ACTH: adrenocorticotropic hormone; At: atonic; Ab: abscense; B: bilateral; C: centro; CBZ: carbamazepine; CES: cluster of epileptic spasms; CLB: clobazam; CLZ: clonazepam; Co: cortex; CSF: cerebrospinal fluid; CT: computarized tomography; DA: drop attacks; EA: extra-axtial; ED: epileptiform discharges; EEG: electroencephalogram; EM: eyelid myoclonia; ESM: ethosuximide; F: frontal; FOA: focal onset aware; FOAI: focal onset impaired awareness; FBTC: focal to bilateral tonic-clonic; FC: fronto-central; fRMI: functional magnetic resonance imaging; GBP: gabapentin; GT: generalized tonic; GTC: generalized tonic-clonic; GVG: vigabatrin; H: hemisphere; HD: head drops; I: inferior; L: left; La: lateral; LCM: lacosamide; LEV: levetiracetam; LTG: lamotrigine; Me: mesial; M: myoclonic; MRI: magnetic resonance imaging; MT: mid-temporal; ND: no data; NR: no realized; NZ: nitrazepam; O: occipital; Oc: oculocephalogyres; OXC: oxcarbazepine; P: parietal; PB: phenobarbital; PET: position emission tomography; PHT: phenytoin; PNET: primitive neuroectodermal tumor; Po: posterior; PRM: primidone; R: right; sEEG: stereoelectroencephalography; Shw: sharp wave; Slw: slow wave; SPECT: single photon emission tomography; Sp: spikes; Spw: spike wave; S: superior; T: temporal; To: tonic; TPM: topiramate; vEEG: videoelectroencephalogram; VPA: valproate; wv: wave; ZNS: zonisamide.

pachygyria, polymicrogyria, dysplasia, glioma, ventriculomegaly, meningioma, cavernoma, astrocytoma, and other lesions[2,4,7,14-16,21,22,26,29,31,32,34,36,37,43]. Four authors reported positron emission tomography; three presented hypometabolism[7,33,44], and one was normal[46]. Five authors reported single-photon emission computed tomography that showed perfusion changes[26,27,31,33,39]. Two authors reported functional MRI showing activation of both insula and dorsolateral frontal and parietal cortex[42] and the other showing left temporal, bilateral parietal, paracentral lobule, cingulate, medial frontal gyrus, and lingual and medial occipital gyrus abnormalities[39]. EEG findings were highly variable and different in each patient (Tables 1 and 2). Two authors detailed stereoelectroencephalography, finding affectation of the insula, hippocampus, and temporal cortex and/or amigdala[42,48]. One patient underwent electrocorticography with operculum activity[37]. Surgery was performed on 10 patients, consisting of left-temporal lobectomy and amygdalohippocampectomy[21], right-temporo-occipital resection, left-frontal resection[22], lesionectomy[31], subtotal resection of low grade astrocytoma[34], subtotal resection of left-frontal operculum (grade IV glioblastoma)[37], anterior insula resection[42], right-anterior-temporal lobectomy including mesial structures and partial inferior insulectomy[46], and non-specified in two patients. Only three patients underwent vagus nerve stimulation[22].

Furthermore, the presence or absence of pharmacoresistance was specified in 131 patients (55% of the reviewed patients), of which 45 (41%) presented pharmacoresistance although sex, age, or type of seizure predominance was not clear.

Conclusion

EE is not the most frequent type of RE and because it can coexist with other epileptic syndromes, we speculate that EE may be under-diagnosed, so RE should be investigated in all patients with known epilepsy. It is our belief that semiology and specific activities during the eating process should be specified in order to identify the possible physiological-etiological mechanism, which until the present day is unknown. Finally, EE can be a therapeutic challenge since each patient presents variability in age of onset, type of stimuli and seizure, clinical course, findings in complementary studies, and response to management.

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Conflicts of interest

None.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Supplementary data

Supplementary data are available at Revista Mexicana de Neurociencia online (www.revmexneurociencia.com). These data are provided by the corresponding author and published online for the benefit of the reader. The contents of supplementary data are the sole responsibility of the authors.

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