

Glossario EEG e basi metodologiche per la refertazione

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4° CORSO RESIDENZIALE
EEG e POTENZIALI EVOCATI
22 – 27 NOVEMBRE 2021

Con il Patrocinio di



Dichiarazione sul Conflitto di Interessi

Dichiaro che negli ultimi due anni ho avuto i seguenti rapporti anche di finanziamento (compensi per relazioni/moderazioni a Congressi, FAD, Expert Meeting, etc) con soggetti portatori di interessi commerciali in campo sanitario:

- Arvelle/Angelini
- BIAL
- EISAI
- GW
- Lusofarmaco
- Sanofi
- UCB

O. Mecarelli (22.11.2021)

Il linguaggio globale

Linguaggio: forma di condotta comunicativa atta a trasmettere informazioni e a stabilire un rapporto di interazione che utilizza simboli aventi identico valore per gli individui appartenenti a uno stesso ambiente socioculturale. (Dizionario Treccani)

Stiamo assistendo alla nascita di un nuovo linguaggio globale, in continua evoluzione, che affianca e talvolta soppianta i vocabolari, le grammatiche e le sintassi tradizionali.

Un effetto dei fenomeni di deterritorializzazione è la diffusione e l'uso dell'**inglese-americano**, che si è imposto come lingua globale



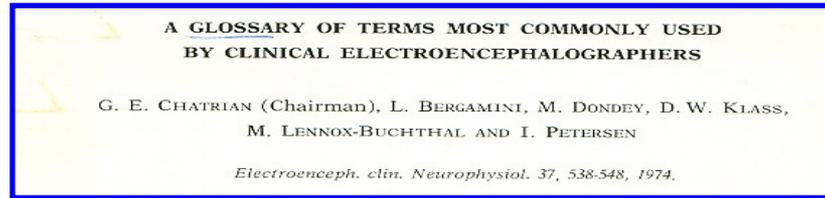
GLOSSARIO

Raccolta di vocaboli propri di una determinata disciplina, accompagnati dalla spiegazione del significato o da altre osservazioni

Perché è necessario un GLOSSARIO universale in EEG:
perché la descrizione e classificazione di un determinato pattern deve essere

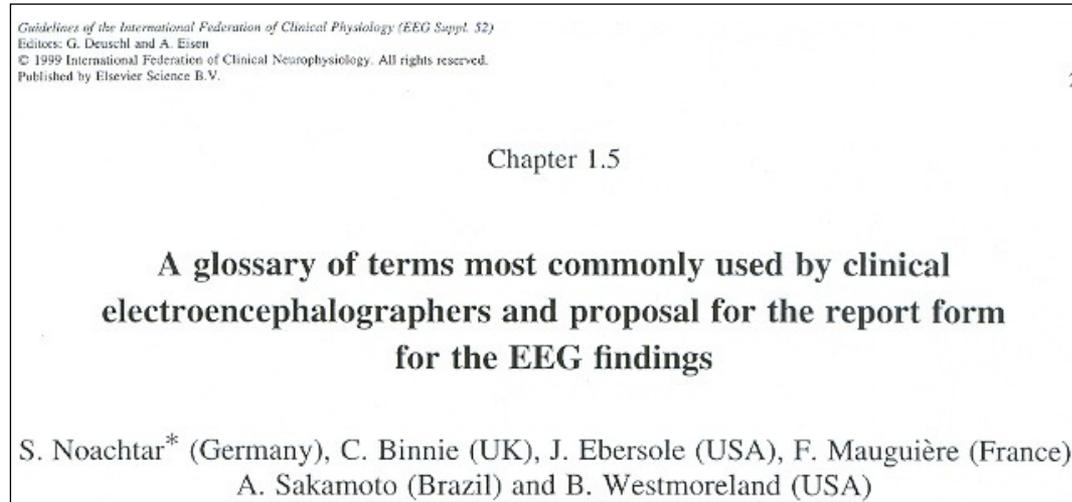
- completa ed accurata ma semplice
- univoca (non ambigua)

1974 1° Glossario EEG accettato a livello internazionale



Traduzione Italiana a cura della
Società di EEG e Neurofisiologia Clinica

1999





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



A revised glossary of terms most commonly used by clinical electroencephalographers and updated proposal for the report format of the EEG findings. Revision 2017



Nick Kane^{a,*}, Jayant Acharya^b, Sandor Beniczky^c, Luis Caboclo^d, Simon Finnigan^e, Peter W. Kaplan^b, Hiroshi Shibasaki^f, Ronit Pressler^a, Michel J.A.M. van Putten^g

Definizioni dei pattern EEG - esempi

Breach rhythm: EEG activity recorded over or nearby a defect in the skull vault (for example after a fracture, burr hole or craniotomy), of increased amplitude when compared to homologous areas on the opposite side of the head (usually by a factor of less than 3). The rhythm is composed of fast activity with a spiky appearance along with alpha and/or mu rhythms, due to lack of attenuation and distortion by the skull. Comment: a physiological variant to be distinguished from epileptiform activity, although it may be associated with underlying brain injury and therefore a liability to focal seizures.

Vertex sharp transient or vertex sharp wave (V wave): A normal graphoelement. Sharply contoured wave with duration <0.5 s, maximal at the vertex, negative relative to other areas, apparently occurring spontaneously during light sleep or in response to a sensory stimulus (usually auditory). Vertex sharp waves may be single or repetitive. Amplitude varies but rarely exceeds $250 \mu\text{V}$. (See light sleep, K complex).

Epileptiform pattern: Describes transients distinguishable from background activity with a characteristic morphology typically, but neither exclusively nor invariably, found in interictal EEGs of people with epilepsy. Epileptiform patterns have to fulfill at least 4 of the following 6 criteria:

- (1) Di- or tri-phasic waves with sharp or spiky morphology (i.e. pointed peak).
- (2) Different wave-duration than the ongoing background activity, either shorter or longer.
- (3) Asymmetry of the waveform: a sharply rising ascending phase and a more slowly decaying descending phase, or vice versa.
- (4) The transient is followed by an associated slow after-wave.
- (5) The background activity surrounding epileptiform discharges is disrupted by the presence of the epileptiform discharges.
- (6) Distribution of the negative and positive potentials on the scalp suggests a source of the signal in the brain, corresponding to a radial, oblique or tangential orientation of the source (see dipole). This is best assessed by inspecting voltage maps constructed using common-average reference.

Synonyms: interictal epileptiform discharge, epileptiform activity.

Photomyogenic response: A non-cerebral response to intermittent photic stimulation characterized by the appearance in the record of brief repetitive muscle spikes (electromyography artifact) over the anterior regions of the head. These often increase gradually in amplitude as stimuli are continued and cease promptly when the stimulus is withdrawn. Comments: (1) this response is frequently associated with flutter of the eyelids and vertical oscillations of the eyeballs and sometimes with discrete jerking mostly involving the musculature of the face and head, (2) it is a physiological artifact contaminating the EEG.

Photoparoxysmal response (PPR): Abnormal response to intermittent photic stimulation characterized by spike-and-slow-wave or polyspike-and-slow-wave complexes. Responses are subclassified in to 4 phenotypically different types, from focal occipital spikes (type 1 PPR) time-locked to the flashes to generalized (type 4 PPR) epileptiform discharges, which may outlast the stimulus by a few seconds. Comment: only the more generalized spike-and-wave responses (type 3 and 4 PPRs) show a strong association with epilepsy.

Burst suppression: Pattern characterized by paroxysmal bursts of theta and/or delta waves, at times intermixed with sharp and faster waves, alternating with intervening periods of attenuation or suppression (below $10 \mu\text{V}$) lasting more than 50% of the record. Comments: EEG pattern that indicates either severe brain dysfunction or is typical for some anesthetic drugs at certain levels of anesthesia. Comment: burst suppression pattern with identical bursts after anoxic brain injury has been reported to portend a poor neurological prognosis.

Isoelectric: (1) The record obtained from a pair of equipotential electrodes (see equipotential). (2) Use of term discouraged when describing record of electrocerebral inactivity (see electrocerebral inactivity).



Electrocerebral inactivity: Absence over all regions of the head of identifiable electrical activity of cerebral origin, whether spontaneous or induced by physiological stimuli or pharmacological agents. Comment: strict technical recording standards should be observed in suspected cerebral death (Stecker et al., 2016). Tracings of electrocerebral inactivity should be clearly distinguished from low voltage EEGs (see low voltage EEG). Synonyms: electrocerebral silence, flat or isoelectric EEG (use of terms discouraged).

American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2012 version

*L. J. Hirsch, S. M. LaRoche, N. Gaspard, E. Gerard, A. Svoronos, S. T. Herman, R. Mani, H. Arif, N. Jette,
Y. Minazad, J. F. Kerrigan, P. Vespa, S. Hantus, J. Claassen, G. B. Young, E. So, P. W. Kaplan,
M. R. Nuwer, N. B. Fountain, and F. W. Drislane*

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L. J. Hirsch, *et al.*

Standardized Critical Care EEG Terminology

clinicalneurophys.com

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ACNS GUIDELINE

American Clinical Neurophysiology Society's Standardized Critical Care EEG Terminology: 2021 Version



ACNS Standardized Critical Care EEG Terminology: 2012 version Reference Chart

Main term 1	Main term 2	Plus (+) Modifier
<p>G Generalized - Optional : Specify frontally, midline or occipitally predominant</p>	<p>PD Periodic Discharges</p>	<p>No +</p>
<p>L Lateralized - Optional: Specify unilateral or bilateral asymmetric - Optional: Specify lobe(s) most involved or hemispheric</p>	<p>RDA Rhythmic Delta Activity</p>	<p>+F Superimposed fast activity – applies to PD or RDA only</p>
<p>BI Bilateral Independent - Optional: Specify symmetric or asymmetric - Optional: Specify lobe(s) most involved or hemispheric</p>	<p>SW Rhythmic Spike and Wave OR Rhythmic Sharp and Slow Wave OR Rhythmic Polyspike and Wave</p>	<p>+R Superimposed rhythmic activity – applies to PD only</p>
<p>Mf Multifocal - Optional: Specify symmetric or asymmetric - Optional: Specify lobe(s) most involved or hemispheric</p>		<p>+S Superimposed sharp waves or spikes, or sharply contoured - applies to RDA only</p>
		<p>+FR If both subtypes apply – applies to PD only</p>
		<p>+FS If both subtypes apply – applies to RDA only</p>

ACNS Standardized Critical Care EEG Terminology: 2012 version Reference Chart

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		<p>+FR If both subtypes apply – applies to PD only</p>
		<p>+FS If both subtypes apply – applies to RDA only</p>

Major modifiers										Minor modifiers		
Prevalence	Duration	Frequency	Phases ¹	Sharpness ²	Absolute Amplitude	Relative Amplitude ³	Polarity ²	Stimulus Induced	Evolution ⁴	Onset	Triphasic ⁵	Lag
Continuous ≥90%	Very long ≥1h	≥4/s	>3	Spiky <70ms	High ≥200μV	>2	Negative	SI <i>Stimulus Induced</i>	Evolving	Sudden ≤3s	Yes	A-P <i>Anterior-Posterior</i>
		3.5/s	3									
Abundant 50-89%	Long 5-59min	3/s	2	Sharp 70-200ms	Medium 50-199μV	≤2	Positive	Sp <i>Spontaneous only</i>	Fluctuating	Gradual >3s	No	P-A <i>Posterior-Anterior</i>
		2.5/s										
Frequent 10-49%	Intermediate duration 1-4.9min	2/s	1	Sharply contoured >200ms	Low 20-49μV		Dipole	Unk <i>Unknown</i>	Static			No
		1.5/s										
Occasional 1-9%	Brief 10-59s	1/s					Unclear					
		0.5/s										
Rare <1%	Very brief <10s	<0.5/s										

NOTE 1: Applies to PD and and SW only, including the slow wave of the SW complex
NOTE 2: Applies to the predominant phase of PD and the spike or sharp component of SW only
NOTE 3: Applies to PD only
NOTE 4: Refers to frequency, location or morphology
NOTE 5: Applies to PD or SW only

Sporadic Epileptiform Discharges	Background									
	Symmetry	Breach effect	PDR	Background EEG frequency	AP Gradient	Variability	Reactivity	Voltage	Stage II Sleep Transients	Continuity
Prevalence										
Abundant ≥1/10s	Symmetric	Present	Present Specify frequency	Delta	Present	Present	Present	Normal ≥20μV	Present and normal	Continuous
Frequent 1/min-1/10s	Mild asymmetry ≤50% Amp. 0.5-1/s Freq.	Absent	Absent	Theta	Absent	Absent	SIRPIDs only	Low 10-20μV	Present but abnormal	Nearly continuous: ≤10% periods of suppression (<10μV) or attenuation (≥10μV but <50% of background voltage)
Occasional 1/h-1/min	Marked asymmetry >50% Amp. >1/s Freq.	Unclear		≥Alpha	Reverse	Unclear	Absent	Suppressed <10μV	Absent	Discontinuous: 10-49% periods of suppression or attenuation
Rare <1/h							Unclear			Burst-suppression or Burst-attenuation: 50-99% periods of suppression or attenuation
										Suppression

TABLE 1. New Terms for Older Terms

OLD Term		NEW Term
Triphasic waves, most of record	=	continuous 2/s GPDs (with triphasic morphology)
PLEDs	=	LPDs
BIPLEDs	=	BIPDs
GPEDs/PEDs	=	GPDs
FIRDA	=	Occasional frontally predominant brief 2/s GRDA (if 1-10% of record)
PLEDS+	=	LPDs+
SIRPIDs* w/ focal evolving RDA	=	SI-Evolving LRDA
Lateralized seizure, delta frequency	=	Evolving LRDA
Semirhythmic delta	=	Quasi-RDA

*SIRPIDs = stimulus-induced rhythmic, periodic or ictal discharges.

Periodic Lateralised Epileptiform Discharges (PLEDS)



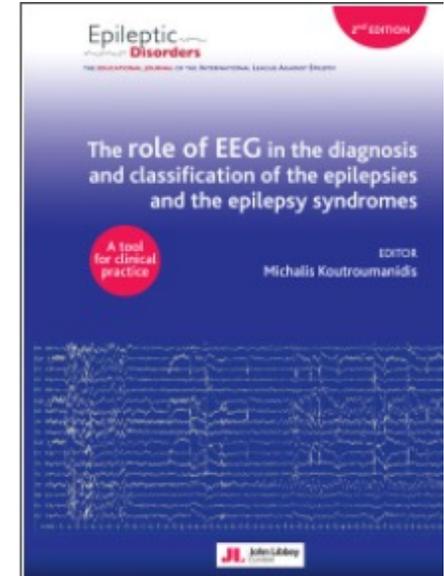
Lateralized Periodic Discharges (LPDs) (formerly "periodic lateralised epileptiform discharges", PLEDs)

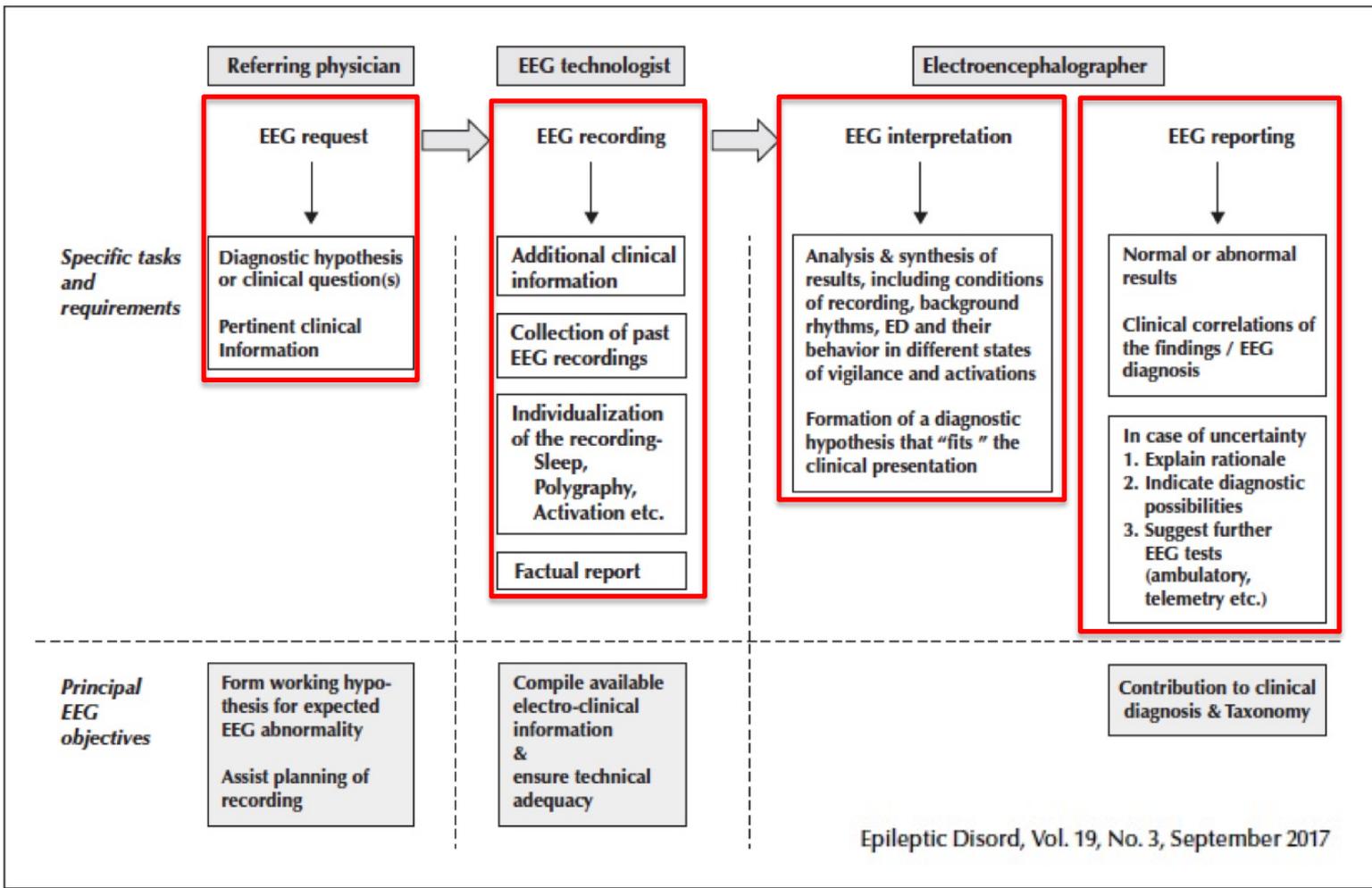


The role of EEG in the diagnosis and classification of the epilepsy syndromes: a tool for clinical practice by the ILAE Neurophysiology Task Force (Part 1)*

The role of EEG in the diagnosis and classification of the epilepsy syndromes: a tool for clinical practice by the ILAE Neurophysiology Task Force (Part 2)*

Michalis Koutroumanidis¹, Alexis Arzimanoglou^{2,3}, Roberto Caraballo⁴, Sushma Goyal⁵, Anna Kaminska⁶, Pramote Laoprasert⁷, Hirokazu Oguni⁸, Guido Rubboli⁹, William Tatum¹⁰, Pierre Thomas¹¹, Eugen Trinka¹², Luca Vignatelli¹³, Solomon L. Moshé¹⁴





Refertazione dell'Esame EEG

il Referto EEG dovrebbe dare una Risposta alle esigenze cliniche del richiedente. Il Report dovrebbe quindi indicare:

Informazioni riguardo la situazione clinica del paziente
(diagnosi, terapia, quesiti clinici)

Informazioni tecniche riguardo le modalità di registrazione e lo stato del paziente (livello di vigilanza, collaborazione, etc)

Descrizione dettagliata dei ritmi e dei grafoelementi fisiologici e/o patologici, sia in basale che durante le prove di attivazione

Conclusione (Interpretazione): giudizio sul grado di normalità o anormalità della registrazione EEG e correlazione con il contesto clinico, con risposta chiara ai quesiti posti

Introduction

This section of the report should include:

History

- Reasons for referral
- Relevant medical and neurological history
- Acute or chronic intake of CNS drugs
- Neuroimaging results
- Note of any previous cranial operations

Technical description

- EEG type (e.g., standard EEG, sleep EEG)
- Technical features (electrode array, EEG duration)
- Patient's level of vigilance and consciousness

Descrizione in base
dell'attività di fondo
e della reattività del
tracciato

EEG Description

The description section should include all the EEG findings, both normal and abnormal, reported in the most objective way possible, avoiding any judgement on their meaning.

The aim is to produce a complete and objective report, to allow other electroencephalographers to draw conclusions on the normality or the degree of abnormality of the EEG on the basis of the written report, ideally without even the need to look at the EEG tracing.

The EEG report should start by describing the background activity should be described, starting from the posterior dominant rhythm. Following features should be reported:

- Frequency (Hz)
- Quantity (persistent or intermittent)
- Localization

- Amplitude (μV)
- Symmetry/asymmetry
- Rhythmicity
- Irregularity

Other nondominant rhythms should be described according to the features reported above.

The reactivity of the EEG upon eye opening-closing or other types of stimulation should be reported, and limb movements or other sources of artifacts should be noticed. When the tracing shows a marked interhemispheric asymmetry, the EEG characteristics of each hemisphere should be described separately.

ARTEFATTI

The artifacts should be mentioned only when they are debatable (i.e., when there is the doubt that they represent an underlying brain activity), when they are unusual or interfere with the interpretation of the tracing, or when they provide clues to the diagnosis (e.g., myokymia, nystagmus).

Descrizione delle anomalie

Any abnormality should be described specifying:

- Morphology (spike, sharp wave, slow wave, etc.)
- Distribution (diffuse or focal)
- Localization
- Symmetry
- Synchrony (Intra and interhemispheric)
- Amplitude
- Timing (Continuous, intermittent, episodic, paroxysmal, etc.)
- Quantity.

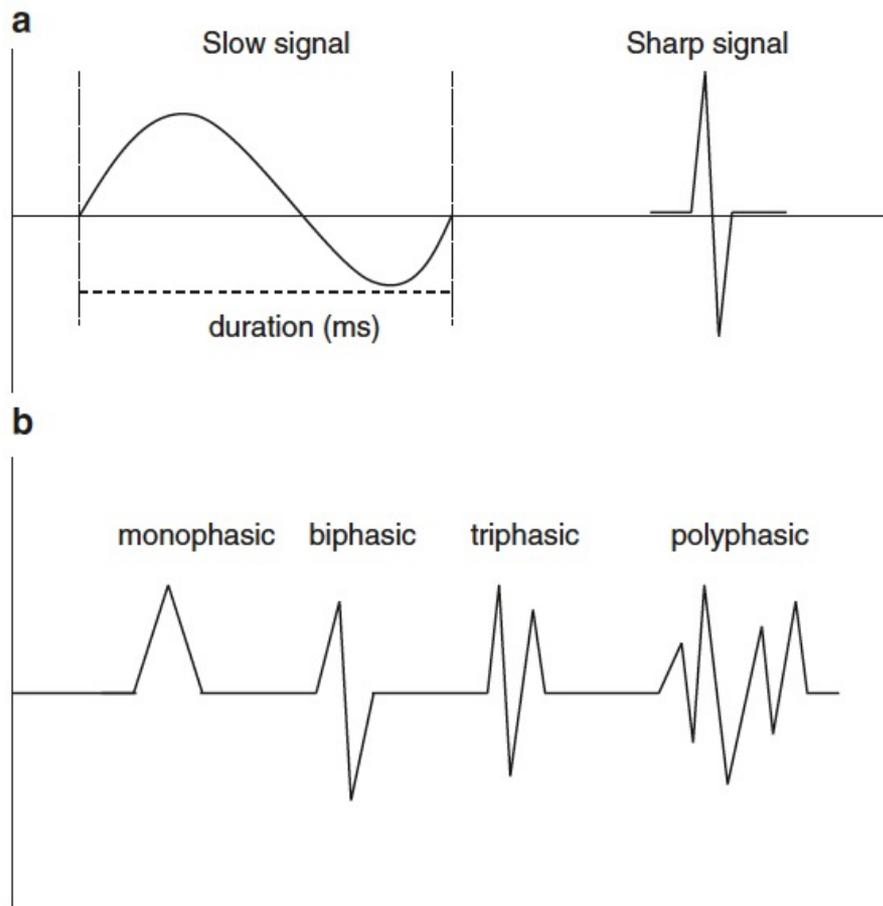


Fig. 9.1 Morphologic characteristics of EEG signals (a) Signal with slow or sharp shape. (b) Various types of signals, differentiating by their phases

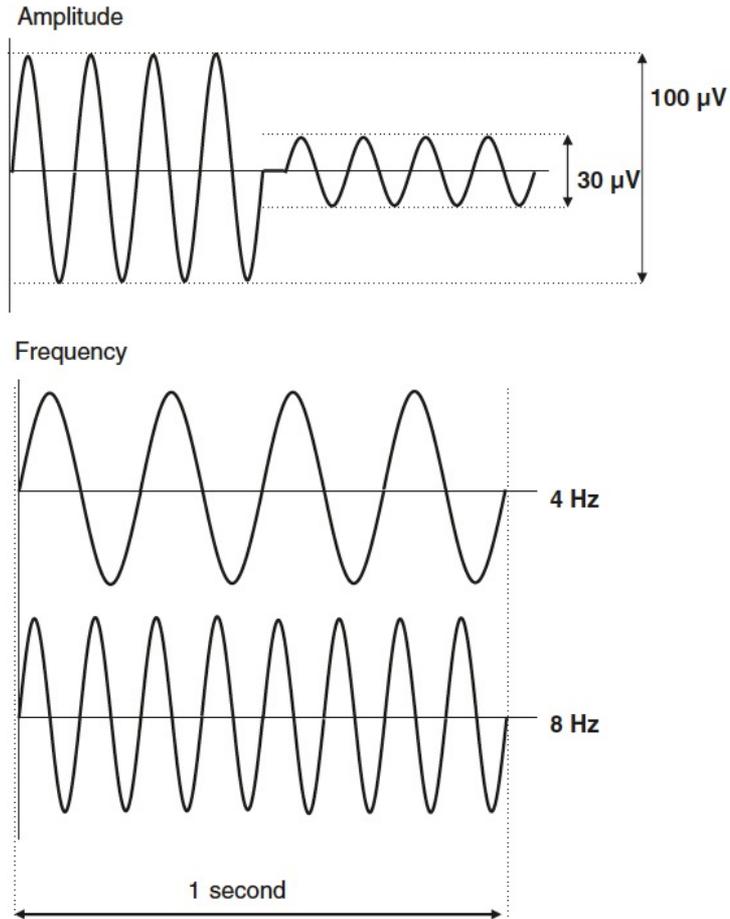


Fig. 9.2 Different amplitude and frequency of EEG rhythm

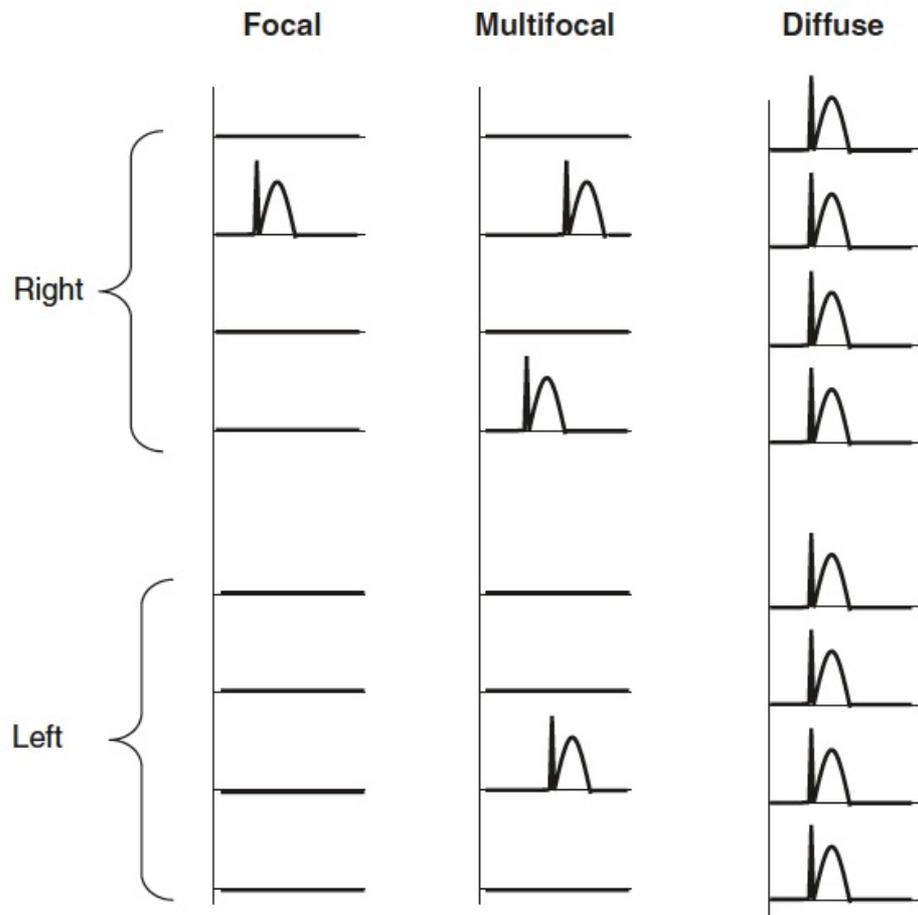


Fig. 9.3 Different localization of EEG signals on two cerebral hemispheres

Epileptiform Abnormalities

Fig. 13.2 Graphic representation of epileptiform abnormalities: (a) spike, (b) polyspikes (c) sharp wave, (d) Spike-and-Slow-Wave complex (SSWc), (e) polyspikes-and-slow-wave complex, (f) sharp-and-slow-wave complex, (g) typical SSWc (3 Hz), (h) atypical slow SSWc (<3 Hz)

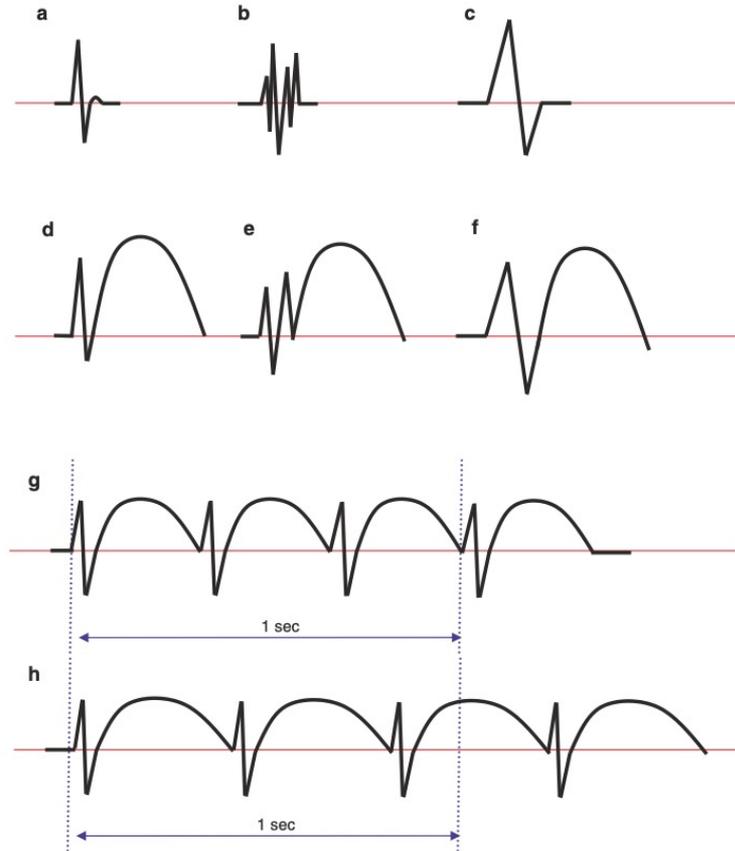
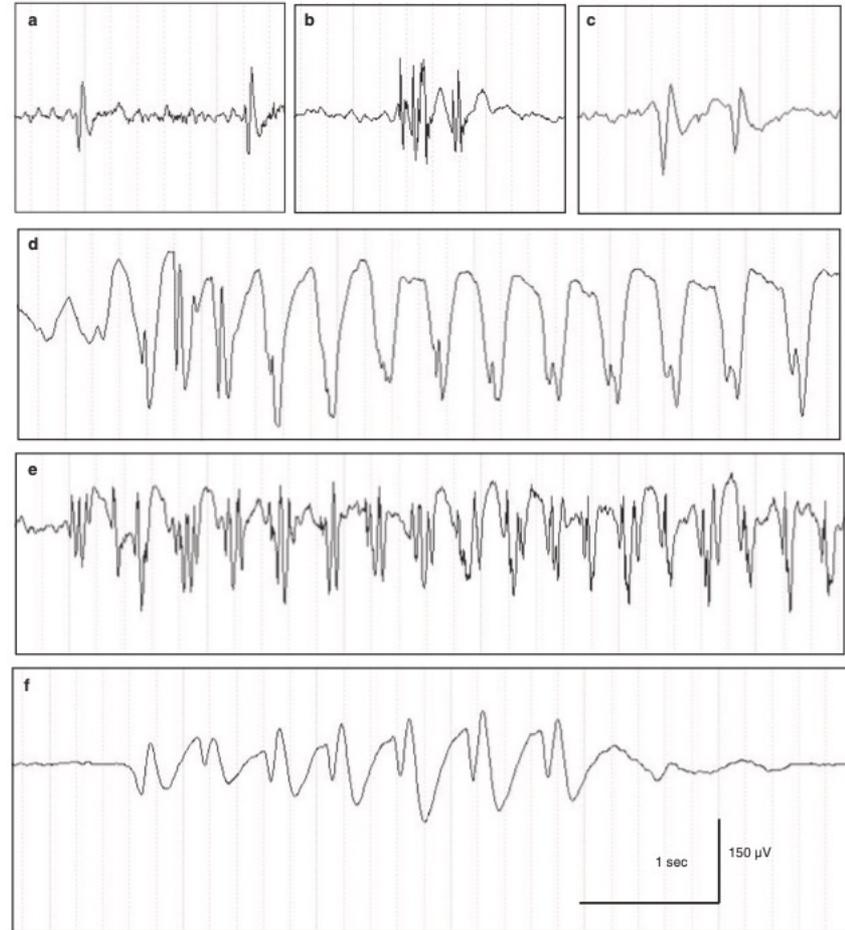
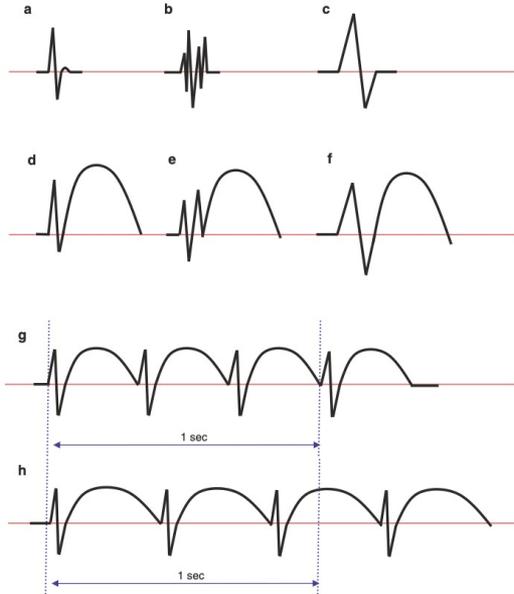


Fig. 13.2 Graphic representation of epileptiform abnormalities: (a) spike, (b) polyspikes (c) sharp wave, (d) Spike-and-Slow-Wave complex (SSWc), (e) polyspikes-and-slow-wave complex, (f) sharp-and-slow-wave complex, (g) typical SSWc (3 Hz), (h) atypical SSWc (<3 Hz)



- Spike: a transient with pointed peak, clearly distinguished from the background activity, and with a duration from 20 to less than 70 ms (1/50–1/14 s). Amplitude is variable, but typically $>50 \mu\text{V}$. As regards to morphology, the spike can be mono- or multiphasic, with a dominant negative component.
 - Polyspike complex: a sequence of two or more spikes.
 - Sharp wave: an epileptiform transient clearly distinguished from the background activity, with pointed peak and a duration of 70–200 ms (1/14–1/5 s). Usually, the sharp wave (di-triphasic) has a variable amplitude (100–200 μV): the main component is negative and the ascending phase is steeper when compared to the descending phase. The term “sharp wave” does not apply to vertex sharp transients of sleep, lambda waves, positive occipital sharp transients of sleep and sharp transients poorly distinguished from the background activity.
 - Spike-and-Slow-Wave complex (SSWc): single or multiple epileptiform patterns consisting of a spike and an associated following slow wave, clearly distinguished from the background activity. Based on the frequency, it is necessary to distinguish the classical (typical) SSWc at 3 Hz from the slow (atypical) SSWc at 1.5–2.5 Hz.
 - Polyspikes-and-slow-wave complex: an epileptiform pattern consisting of two or more spikes associated with one or more slow waves.
 - Sharp-and-slow-wave complex: an epileptiform pattern (single or multiple) consisting of a sharp wave and an associated following slow wave, clearly distinguished from the background activity.
- The characteristics of various types of epileptiform abnormalities are showed in Figs. 13.2, 13.3, 13.4, 13.5 and 13.6.

Prove di attivazione

The report of the EEG recorded under basal conditions should be followed by the description of EEG during routine activation tests (photostimulation, hyperventilation), specifying the degree of patient's cooperation. The effects of photostimulation and hyperventilation should be described by reporting both normal and abnormal responses. If hyperventilation and/or photostimulation are not performed, the reasons should be mentioned (for example, tests not required for medical reasons or not performed due to lack of collaboration).

The lack of physiological patterns characteristic of wakefulness and/or sleep should be specified, avoiding phrases such as “absence of focal abnormalities” or “absence of epileptic abnormalities” (which should be included in the interpretation section).

Conclusioni o Interpretazione:

è destinata al medico richiedente e quindi dovrebbe essere succinta e comprensibile!

1. Impressione:

EEG Normale o Patologico

(se EEG patologico che tipo di anomalie e loro grado;

confronto con eventuali esami precedenti)

Impression

The electroencephalographer should provide a judgement (impression) on the normality or abnormality of the tracing.

While the EEG description is mainly written for the electroencephalographer (who will use it for subsequent comparisons) or for other experts (and therefore should be detailed and objective), the impression (or interpretation) is written primarily for the referring physician, and should therefore be as succinct and readily understandable as possible. Many clinicians are aware that they would not get much additional information by reading the detailed description of the report. If the conclusion it is too long and without explicit correlation to the clinical picture, the whole report in its entirety may appear scarcely useful for the referring physician.

If the EEG is considered abnormal, the degree of abnormality should be scored to facilitate comparison with subsequent tracings. Since this part of the report is largely subjective, the grading will vary from one laboratory to another, but the different degrees should be defined appropriately and the definitions should be used consistently.

After commenting on the normality or degree of abnormality of the EEG tracing, the reasons that led to the conclusion should be briefly reported. When different types of abnormalities have been found, only the most salient should be listed (preferably no more than three or four, otherwise the risk is that the most relevant ones are not adequately emphasized). Confusing and technical terminology should be avoided, and only terms understandable to clinicians of any level of expertise or specialty should be used. If previous EEG tracings are available, a comparison with previous reports should always be included.

Clinical Correlation

2. Correlazione elettroclinica

The clinical correlation represents the attempt to explain how the EEG tracing relates to the clinical picture and to the reason for referral. The referring physician may not be familiar enough with EEG; hence, a detailed, clear, and accurate terminology readily understandable to clinicians of any level of expertise or specialty should be used.

An abnormal EEG is indicative of cerebral dysfunction. However, the term “cerebral dysfunction” should be used only when abnormalities are relevant and when there is sufficient clinical information to draw conclusions based on the clinical context. Alternatively, a conclusion such as “tracing shows minimal irregularities in brain function” might be more appropriate.

Some types of EEG patterns may be more or less suggestive of specific clinical conditions (e.g., focal delta waves could indicate a structural injury; some types of spikes or sharp waves could suggest a potential epileptogenic focus).

On the other hand, EEG anomalies can be consistent with the clinical information, pointing to the presence of a particular clinical condition: in these cases it can be concluded that the EEG is consistent with or supports the clinical diagnosis.

The Standardized Computer-Based Organized Reporting of EEG (SCORE)

The best way of reporting an EEG has always been a matter of discussion and a difficult issue. Obviously, adopting a universally accepted glossary represents the first fundamental requirement.

Over the years, several guidelines and recommendations on EEG reporting have been proposed by different scientific societies.

Recently, a standardized computer-based organized reporting of EEG (SCORE) has been developed under the auspices of the International Federation of Clinical Neurophysiology (IFCN) and the International League Against Epilepsy (ILAE) [9, 10].

The SCORE-EEG software can be downloaded for free at following link: <http://holbergeeg.com>.

Holberg SCORE EEG

Home Tools Admin

Help Support Normal EEG Delete New finding: Background activity Posterior dominant rhythm

Modulators/procedures (2)

- 1: Hyperventilation
- 2: Intermittent photic stimulation

Background activity (1)

- Posterior dominant rhythm**

Sleep and drowsiness

Interictal findings (1)

- Epileptiform interictal activity (1)

Rhythmic & periodic patterns in critical ill patients

Episodes (1)

- Generalized seizure - Absence - Typical

Physiologic patterns

Pattern of uncertain significance

EEG artefacts

Polygraphic channels

Trend analysis

Diagnostic significance (1)

- Abnormal recording supporting: Generalized idiopathic epilepsy

Workflow

Patient - Test, Patient 11/10/2009

Recordings - StandardEEG [11/10/2016]

Findings (9)

Report (14/10/2016)

Search

Finding details

Finding summary

Posterior dominant rhythm

Properties: Normal activity . . . 9.0 - 10.0 Hz . . . Medium amplitude (20-70µV) . . . Symmetrical amplitude . . . Reactive to eye opening . . . Normal organization . . . Symmetrical frequency . . .

Name Properties

Significance

- Not scored
- Normal [Free text](#)
- No definite abnormality
- Abnormal
- Not possible to determine

Frequency

- Not scored
- Frequency [Free text](#) [Frequency 9.0-10.0](#)

Amplitude

- Not scored
- Low (<20)
- Medium (20-70) [Free text](#)
- High (>70)
- Not possible to determine

Amplitude asymmetry

- Not scored
- Symmetrical [Free text](#)
- L<R
- R<L
- Asymmetry not possible to determine

Reactivity to eye opening

- Not scored
- Yes [Free text](#)
- Reduced left side reactivity
- Reduced right side reactivity
- Reduced reactivity both sides
- Not possible to determine

Organization

- Not scored
- Normal [Free text](#)
- Poorly organized
- Disorganized
- Markedly disorganized

Frequency asymmetry

- Not scored
- Symmetrical [Free text](#)
- #Hz lower left
- #Hz lower right

Caveat

- Not scored
- No
- Only open eyes during the recording
- Sleep-deprived
- Drowsy

Absence of posterior dominant rhythm (PDR)

- Not scored
- Artefacts
- Extreme low voltage
- Eye-closure could not be achieved
- Lack of awake period
- Lack of compliance
- Other causes (+ free text)

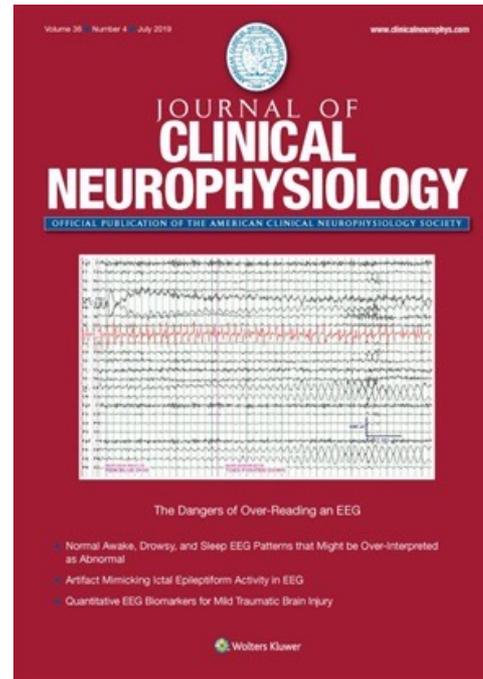
- Attivazione con Hp-S.L.I. non praticata.
 Esame eseguito su soggetto in stato di sonno.

ANALISI DELL'E.E.G.		
<p>Attività di fondo</p> <p><input checked="" type="checkbox"/> Di tipo alfa <input type="checkbox"/> Rapida <input type="checkbox"/> Lenta <input type="checkbox"/> Polimorfa <input type="checkbox"/> Voltaggio: basso-medio-elevato <input checked="" type="checkbox"/> Stabile <input type="checkbox"/> Instabile <input type="checkbox"/> Regolare <input type="checkbox"/> Irregolare <input checked="" type="checkbox"/> Simmetrica <input type="checkbox"/> Asimmetrica (dx an) <input type="checkbox"/> Modulata: bene-male-poco</p> <p>Ritmo alfa</p> <p><input type="checkbox"/> Occipitale <input checked="" type="checkbox"/> Diffuso <input type="checkbox"/> Atipico <input type="checkbox"/> Regolare <input type="checkbox"/> Irregolare <input type="checkbox"/> Disomogeneo <input type="checkbox"/> Raro <input type="checkbox"/> Reazione d'arresto positiva <input checked="" type="checkbox"/> Reazione d'arresto parziale <input type="checkbox"/> Reazione d'arresto negativa</p> <p>Ritmo theta</p> <p><input checked="" type="checkbox"/> Tracce anteriori <input checked="" type="checkbox"/> Tracce temporali <input checked="" type="checkbox"/> Tracce tempo-posteriori <input type="checkbox"/> Abbondante <input type="checkbox"/> Dominante</p> <p>Ritmi arciformi o puntuti</p> <p><input type="checkbox"/> Tracce <input type="checkbox"/> Abbondanti</p>	<p>Ritmi rapidi e beta</p> <p><input type="checkbox"/> Tracce anteriori <input type="checkbox"/> Tracce temporali <input type="checkbox"/> Tracce tempo posteriori <input type="checkbox"/> Saltuari (parisincroni) <input type="checkbox"/> Abbondanti <input type="checkbox"/> Dominanti</p> <p>Depressione sul tracciato</p> <p><input type="checkbox"/> Ritmo conservato <input type="checkbox"/> Aritmia</p> <p>Asimmetria del tracciato</p> <p><input type="checkbox"/> In un'area <input type="checkbox"/> In un emisfero (Dx Sn)</p> <p><input type="checkbox"/> Presenza di artefatti</p> <p style="text-align: center;">*****</p> <p>REPERTI A RIPOSO</p> <p>Onde lente</p> <p><input type="checkbox"/> Anteriori <input type="checkbox"/> Temporali <input type="checkbox"/> Centro-posteriori <input type="checkbox"/> Isolate <input type="checkbox"/> In treni <input type="checkbox"/> Abbondanti <input type="checkbox"/> Dominanti</p> <p>Iperincronismi</p> <p><input type="checkbox"/> Occasionali <input type="checkbox"/> Ripetuti <input type="checkbox"/> Frequenti <input type="checkbox"/> Medio voltaggio <input type="checkbox"/> Alto voltaggio</p>	<p>REPERTI ALL'IPERPNEA E S.L.I.</p> <p><input checked="" type="checkbox"/> EEG Immodificato <input type="checkbox"/> Rallentamento modesto <input type="checkbox"/> Onde lente sparse <input type="checkbox"/> Onde lente focali <input type="checkbox"/> Iperincronismi di media entità <input type="checkbox"/> Iperincronismi notevoli <input type="checkbox"/> Attivazione epilettica focale <input type="checkbox"/> Attivazione epilettica generalizzata <input type="checkbox"/> Alterazioni persistenti oltre l'iperpnea - S.L.I.</p> <p style="text-align: center;">*****</p> <p>Alterazioni focali</p> <p><input type="checkbox"/> Foci frontali <input type="checkbox"/> Foci temporali <input type="checkbox"/> Foci centro-parietali <input type="checkbox"/> Foci occipitali <input type="checkbox"/> A destra <input type="checkbox"/> A sinistra <input type="checkbox"/> Bilaterali asimmetrici</p> <p>Alterazioni epilettiche generalizzate</p> <p><input type="checkbox"/> Scariche di punta-onde 3 c/s <input type="checkbox"/> Scariche di punta-onde atipiche <input type="checkbox"/> Scariche di punta o polipunte <input type="checkbox"/> Scariche polimorfe <input type="checkbox"/> Scariche asimmetriche</p> <p>Intensità delle alterazioni epilettiche</p> <p><input type="checkbox"/> Notevole <input type="checkbox"/> Media <input type="checkbox"/> Scarsa <input type="checkbox"/> Assente</p>
SINTESI DELL'E.E.G.		
<p><input type="checkbox"/> Nei ai limiti <input type="checkbox"/> Diaritmia <input type="checkbox"/> Prevalenza ritmi rapidi <input type="checkbox"/> Immaturità bioelettrica <input type="checkbox"/> Diaritmia sottocorticale</p>	<p><input checked="" type="checkbox"/> Diaritmia cortico-sottocorticale <input type="checkbox"/> Ipersensibilità all'iperpnea Epilessia <input type="checkbox"/> Epilessia grande male <input type="checkbox"/> Epilessia piccolo male</p>	<p><input type="checkbox"/> Epilessia centro-encefalica <input type="checkbox"/> Epilessia focale <input type="checkbox"/> Epilessia multifocale <input type="checkbox"/> Sofferenza</p>

DEDUZIONI Disritmia cerebrale diffusa.

The Dangers of Over-Reading an EEG

S. R. Benbadis* and P. W. Kaplan†



Journal of Clinical Neurophysiology Volume 36, Number 4, July 2019

Normal Awake, Drowsy, and Sleep EEG Patterns That Might Be Overinterpreted as Abnormal

Ali A. Asadi-Pooya*† and Michael R. Sperling*

Normal Variants Are Commonly Overread as Interictal Epileptiform Abnormalities

Joon Y. Kang* and Gregory L. Krauss*

Artifacts That Can Be Misinterpreted as Interictal Discharges

Sally V. Mathias and Meriem Bensalem-Owen

Artifact Mimicking Ictal Epileptiform Activity in EEG

Jake H. McKay and William O. Tatum

Patterns Specific to Pediatric EEG

Raj D. Sheth

The Role of EEG in the Erroneous Diagnosis of Epilepsy

Ushtar Amin and Selim R. Benbadis

Department of Neurology, University of South Florida, Tampa, Florida, U.S.A.

Summary: Errors in diagnosis are relatively common in medicine and occur in all specialties. The consequences can be serious for both patients and physicians. Errors in neurology are often because of the overemphasis on "tests" over the clinical picture. The diagnosis of epilepsy in general is a clinical one and is typically based on history. Epilepsy is more commonly overdiagnosed than underdiagnosed. An erroneous diagnosis of epilepsy is often the result of weak history and an "abnormal" EEG. Twenty-five to 30% of patients previously diagnosed with epilepsy who did not respond to initial antiepileptic drug treatment do not have epilepsy. Most patients misdiagnosed with epilepsy turn out to have either psychogenic nonepileptic attacks or syncope. Reasons for reading a normal EEG as an abnormal one include over-reading normal variants or simple fluctuations of background rhythms.

Reversing the diagnosis of epilepsy is challenging and requires reviewing the "abnormal" EEG, which can be difficult. The lack of mandatory training in neurology residency programs is one of the main reasons for normal EEGs being over-read as abnormal. Tests (including EEG) should not be overemphasized over clinical judgment. The diagnosis of epilepsy can be challenging, and some seizure types may be underdiagnosed. Frontal lobe hypermotor seizures may be misdiagnosed as psychogenic events. Focal unaware cognitive seizures in elderly maybe be blamed on dementia, and ictal or interictal psychosis in frontal and temporal lobe epilepsies may be mistaken for a primary psychiatric disorder.

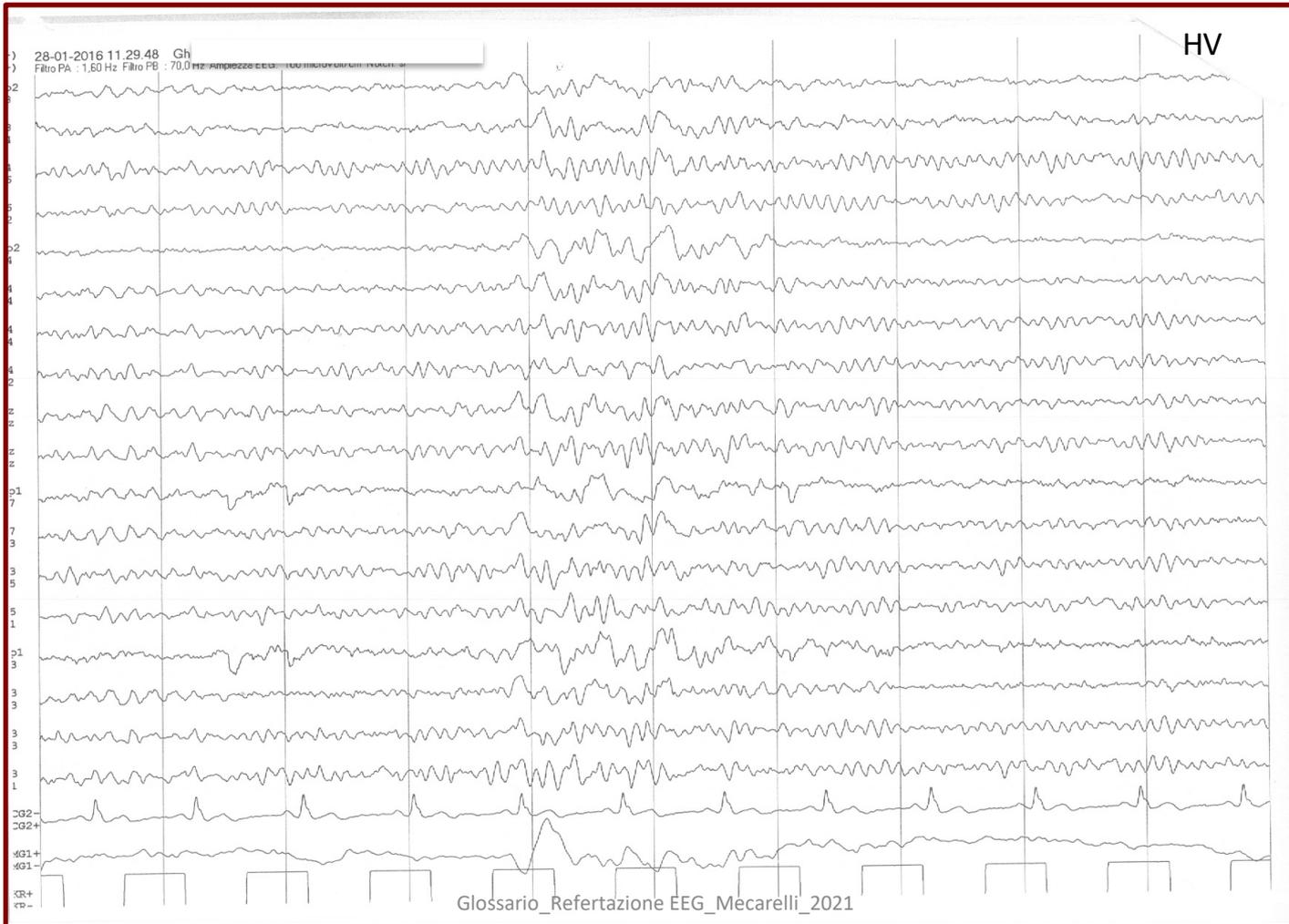
Key Words: Seizures, Epilepsy, Misdiagnosis, EEG.

(J Clin Neurophysiol 2019;36: 294–297)

27 aa, m, sportivo

2 episodi sincopali (bradicardia, ipotensione a., lieve insuff mitralica)





Esame Elettroencefalografico

ID pz 15707 Data esame 28/01/16
Cognome Nome Eta 27
Data di Nascita 27/10/88
Provenienza Num 28538

Descrizione: Ritmo di fondo a 8 c/s di medio voltaggio, stabile, regolare, simmetrico, reagente. Modica quantità di attività beta sulle regioni medio-anteriori. Si registrano sulle regioni temporo-parieto-occipitali bilaterali prevalentemente a sn bouffées di potenziali a 5-6 c/s con frequente aspetto aguzzo che tendono ad aumentare in numero, durata ed ampiezza e con diffusione generalizzata durante l'iperpnea. La sli non induce attivazioni patologiche.

Conclusioni Anomalie bioelettriche irritative sulle regioni temporo-parieto-occipitali bilaterali prevalenti a sn con tendenza all'incremento e alla diffusione generalizzata in Hp.

P. I., f, 18 anni

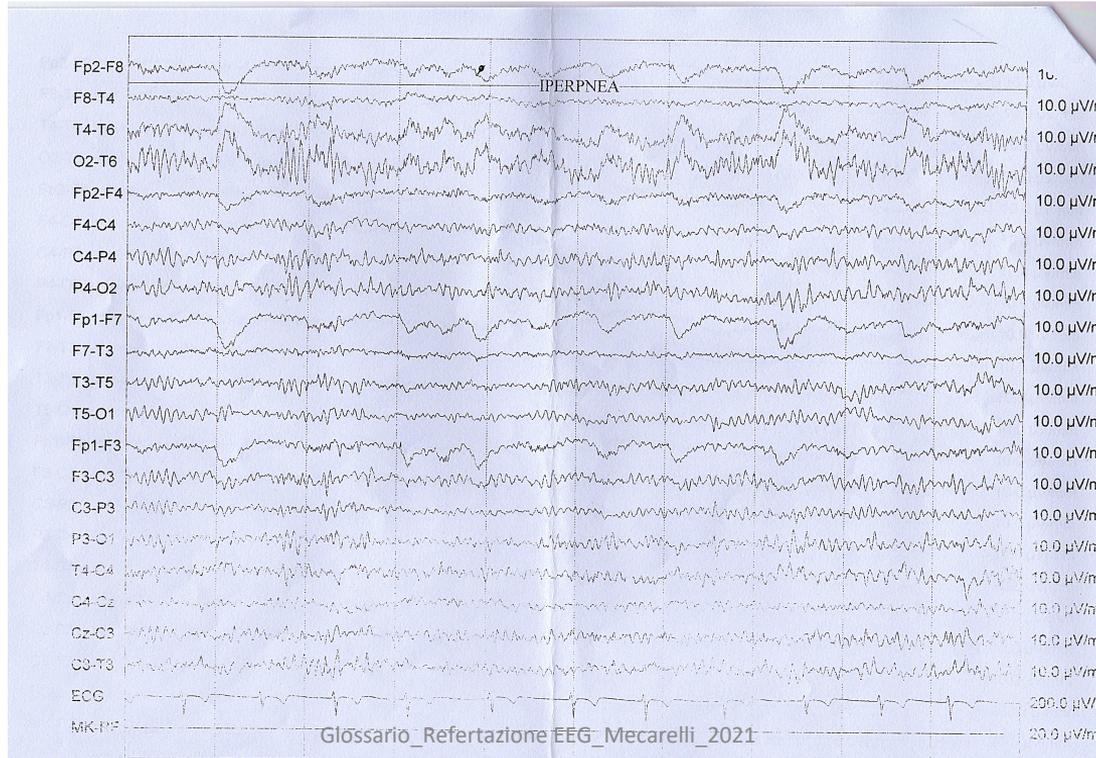
Madre con epilessia idiopatica in età infantile. Dall'età di 12 anni (dopo un grave episodio di violenza) "sviene", sempre e solo in situazioni stressanti.

1° EEG 21/5/2014

Descrizione: ...Sulle regioni occipitali (dx>sin) alcuni elementi a tipo onda aguzza, sincroni ed asincroni...

Conclusioni: Anomalie parossistiche intercritiche focali, scarsamente attive.

Terapia: LEV 1000 mg/die

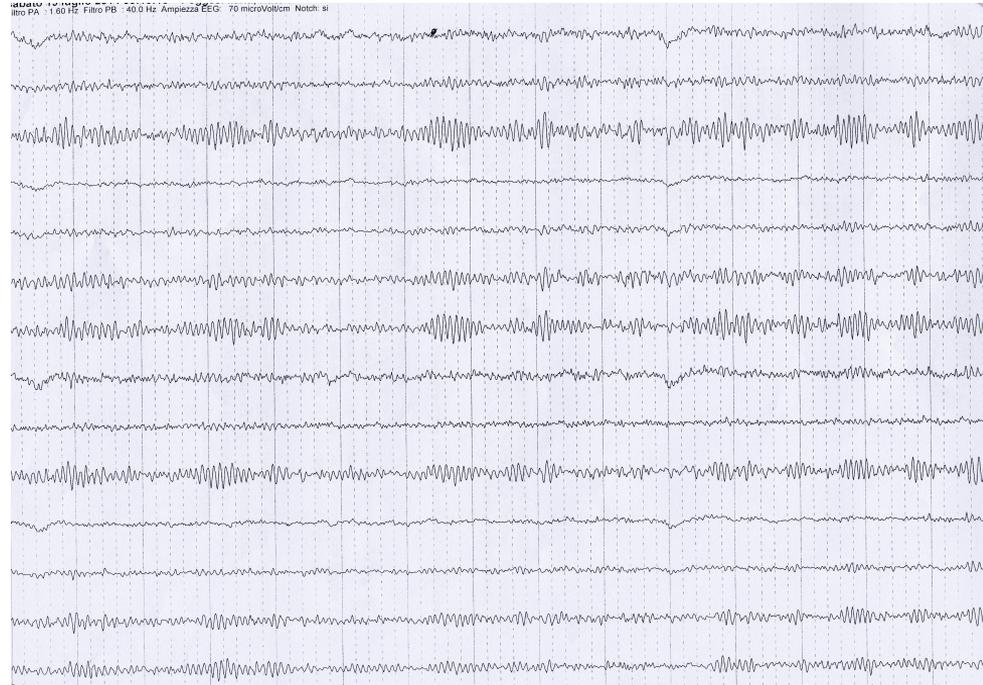


2° EEG 19/7/14

Descrizione:In corso di HV bouffés di grafoelementi tipo PO e SW sulle regioni temporali e parieto-occipitali bilateralmente, sincroni e simmetrici.

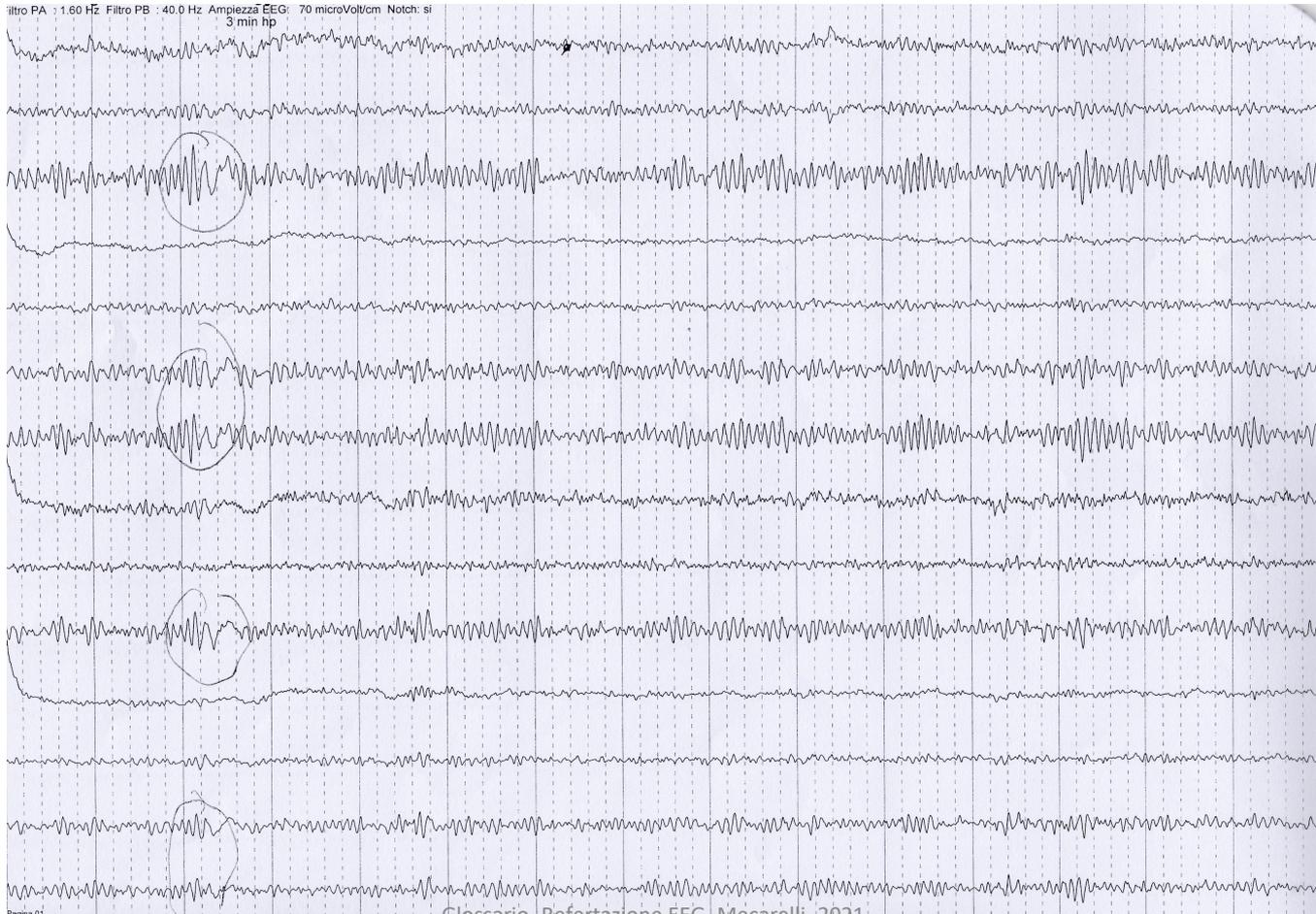
Conclusioni: Anomalie bioelettriche sottoforma di bouffés di grafoelementi PO e SW sulle regioni temporali e parieto-occipitali bi-emisferiche in corso di registrazione di veglia durante l'iperpnea.

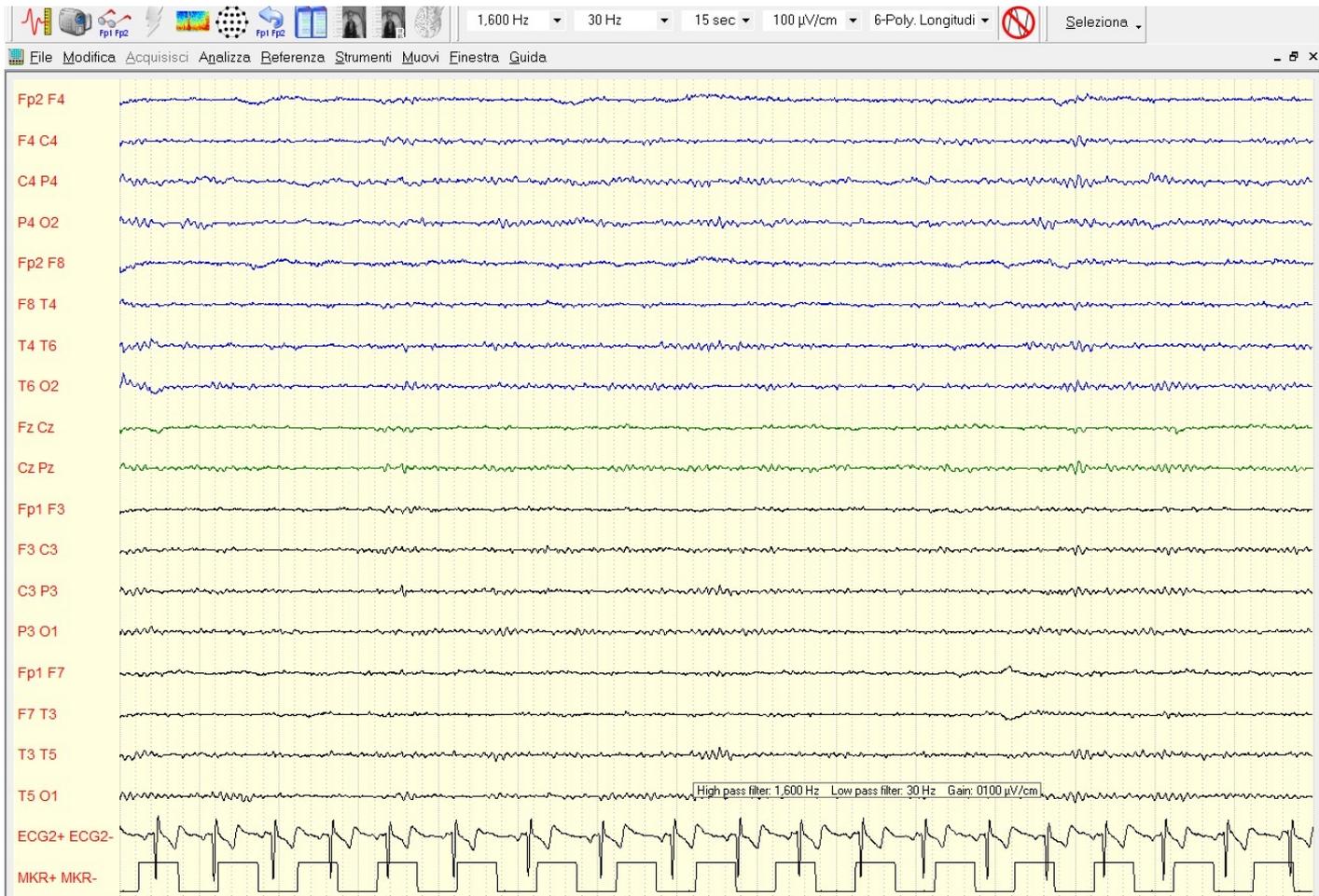
Da un anno terapia con LEV 1000 mg/die (la ragazza continua a “svenire”)



Glossario_Refertazione EEG_Mecarelli_2021

Filtro PA : 1.60 Hz Filtro PB : 40.0 Hz Ampiezza EEG: 70 microVolt/cm Notch: si
3 min hp

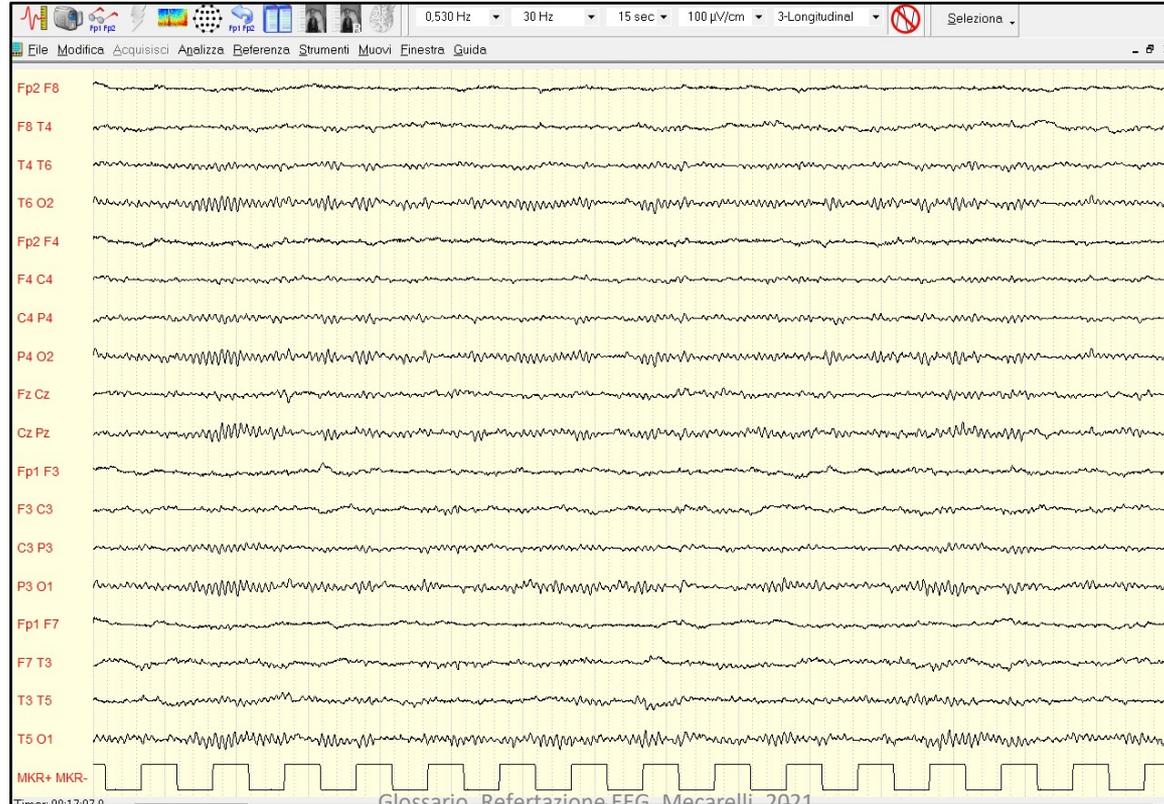




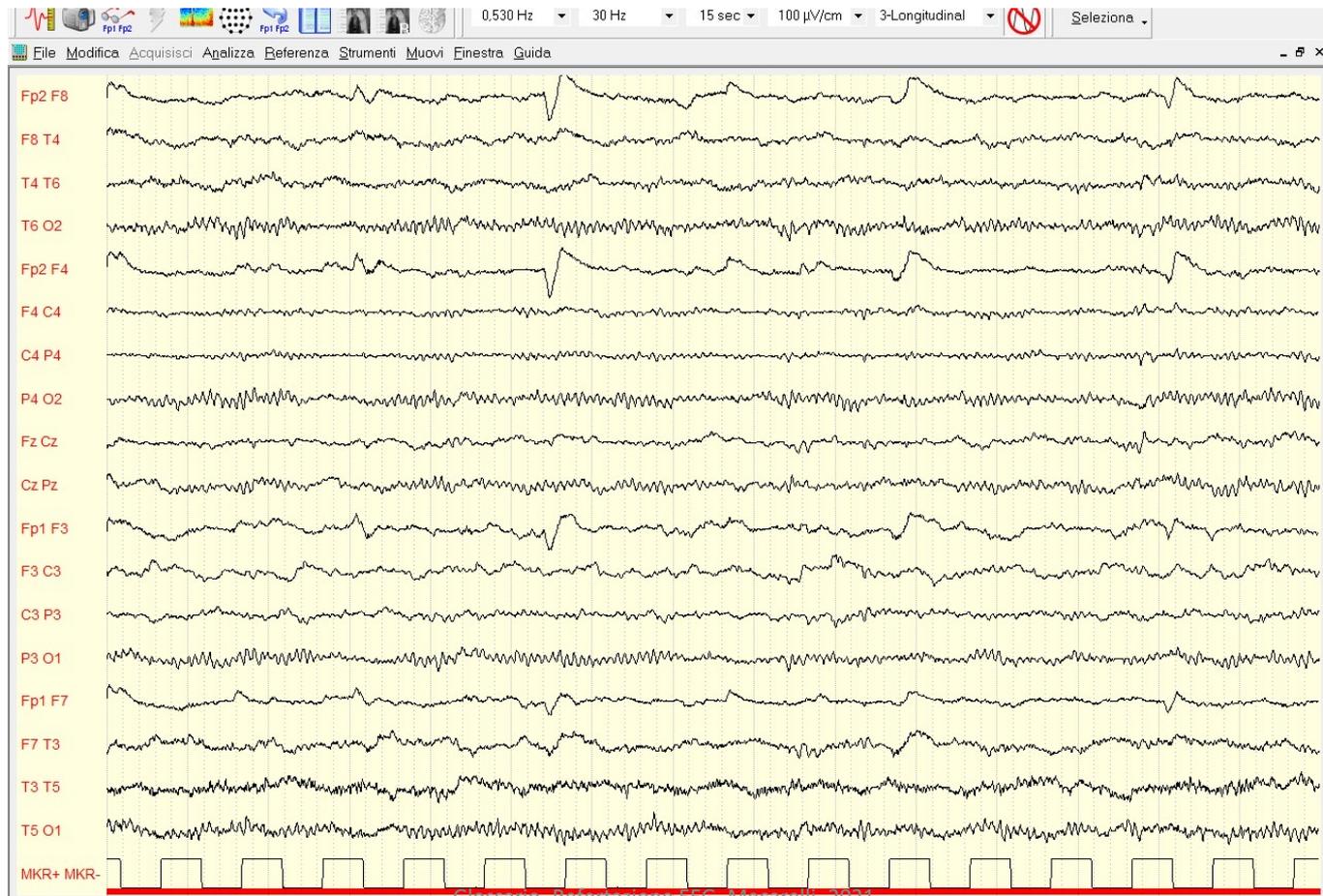
P. M., f, 23 aa

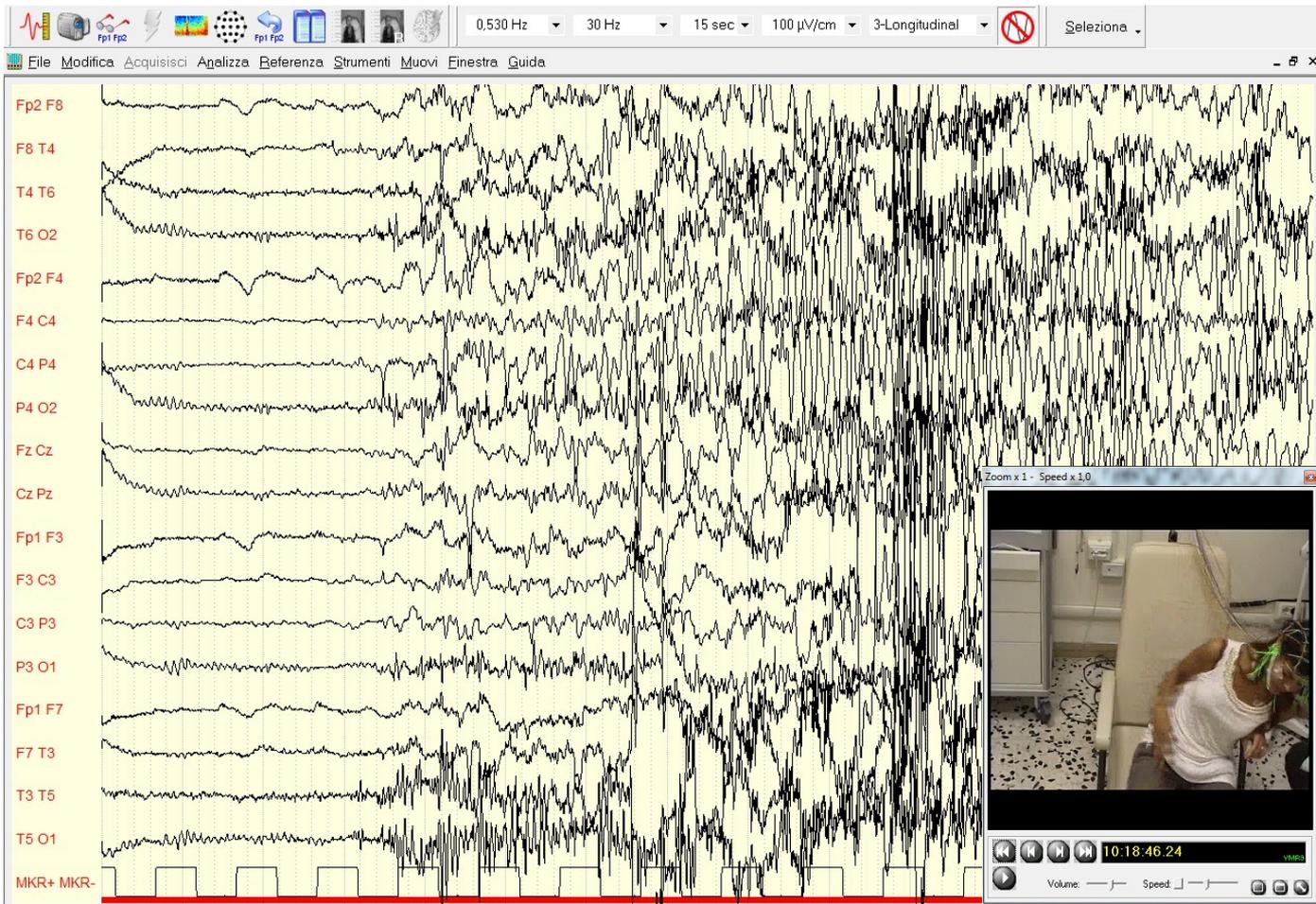
Fin da piccola “movimenti ripetuti AS ds”.

Da qualche mese – dopo un periodo molto stressante – crisi ipermotorie coinvolgenti > emilato destro. EEG in altro ambiente: “Anomalie lente, diffuse e bilaterali, di media-moderata entità”. Prescritto LEV 1000 mg/die.



EEG dopo privazione di sonno – “prova del cerotto”

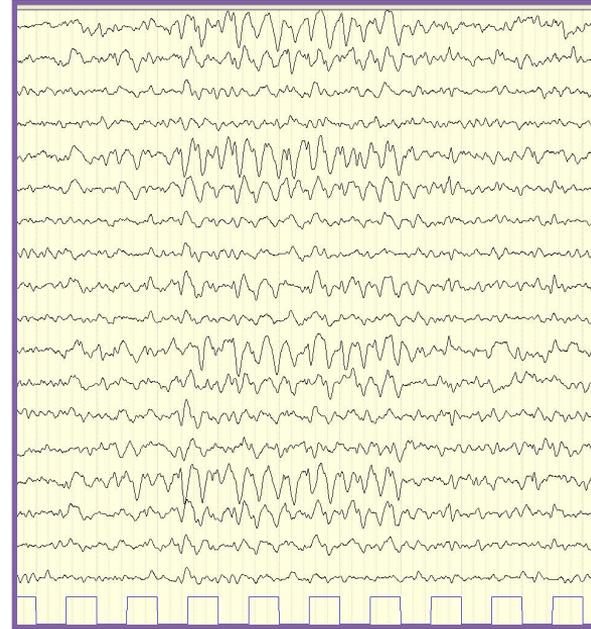
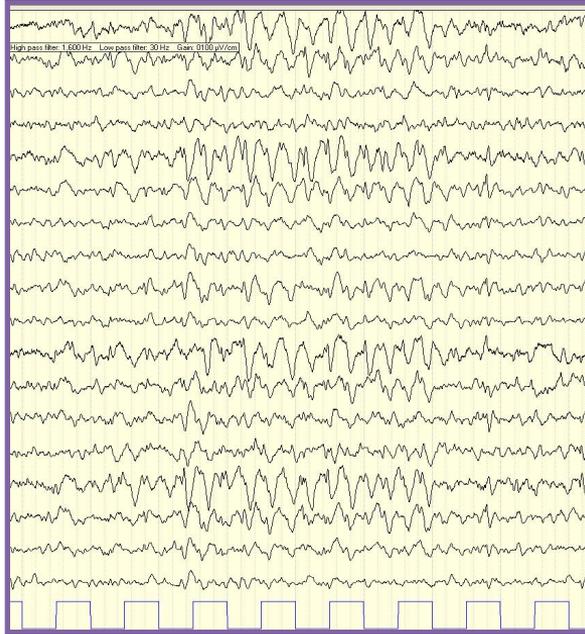






Descrizione: Brevi sequenze di onde a 1-3 e 3-5 c/s a sommità puntata, diffuse...**Conclusioni:** Alterazioni elettriche di grado discreto a diffusione biemisferica

3 Conclusioni diverse per lo stesso pattern EEG



- 1° - Gravi anomalie irritative specifiche di patologia comiziale.
- 2° - Tracciato globalmente rallentato con bouffées di anomalie a tipo P-O atipiche a 3-4 c/s, diffuse
- 3° - Anomalie di tipo epilettico diffuse, dominanti anteriormente, su tracciato di base globalmente rallentato e disorganizzato

Data di registrazione

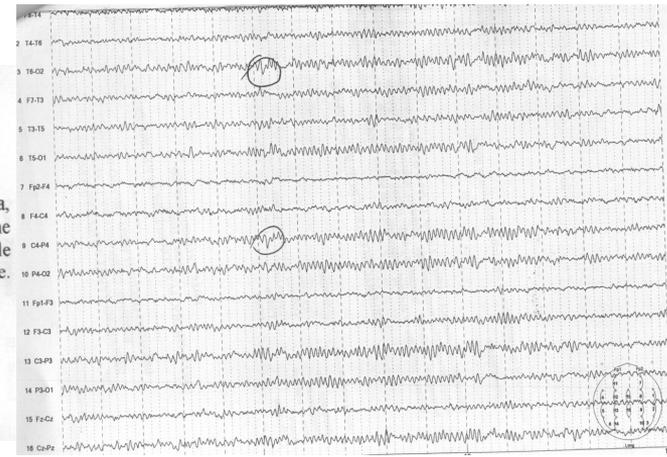
REFERTO ELETTROENCEFALOGRAFICO

Tracciato inquinato da artefatti, caratterizzato da attività fondamentale mal modulata, sincrona, simmetrica, reagente, dominante sulle regioni posteriori con tendenza alla diffusione anteriormente. Beta antero-centrale. Sporadici elementi a morfologia aspra e puntuta sulle regioni parieto-temporo-occipitali a destra. Le prove di attivazione confermano il quadro di base.

Conclusioni:

Note di disritmia aritmica sulle regioni posteriori a destra.

IL NEUROLOGO



Data di registrazione

REFERTO ELETTROENCEFALOGRAFICO

Tracciato inquinato da artefatti, caratterizzato da attività fondamentale mal modulata, sincrona, simmetrica, reagente, dominante sulle regioni posteriori con tendenza alla diffusione anteriormente. Beta antero-centrale. Sporadici e isolati elementi a morfologia puntuta sulle regioni parieto-occipitali a sinistra durante la fotostimolazione.

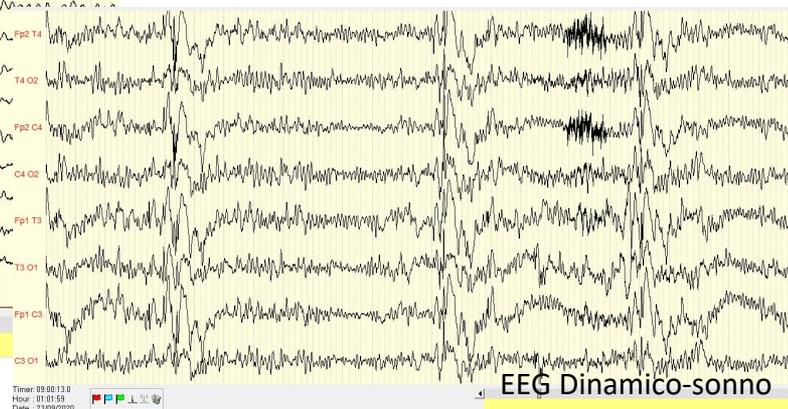
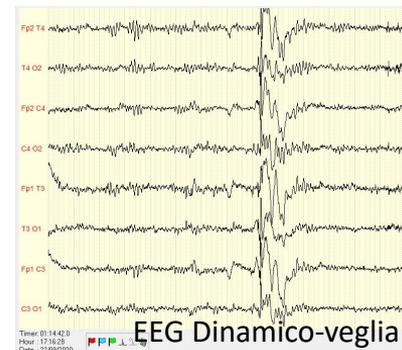
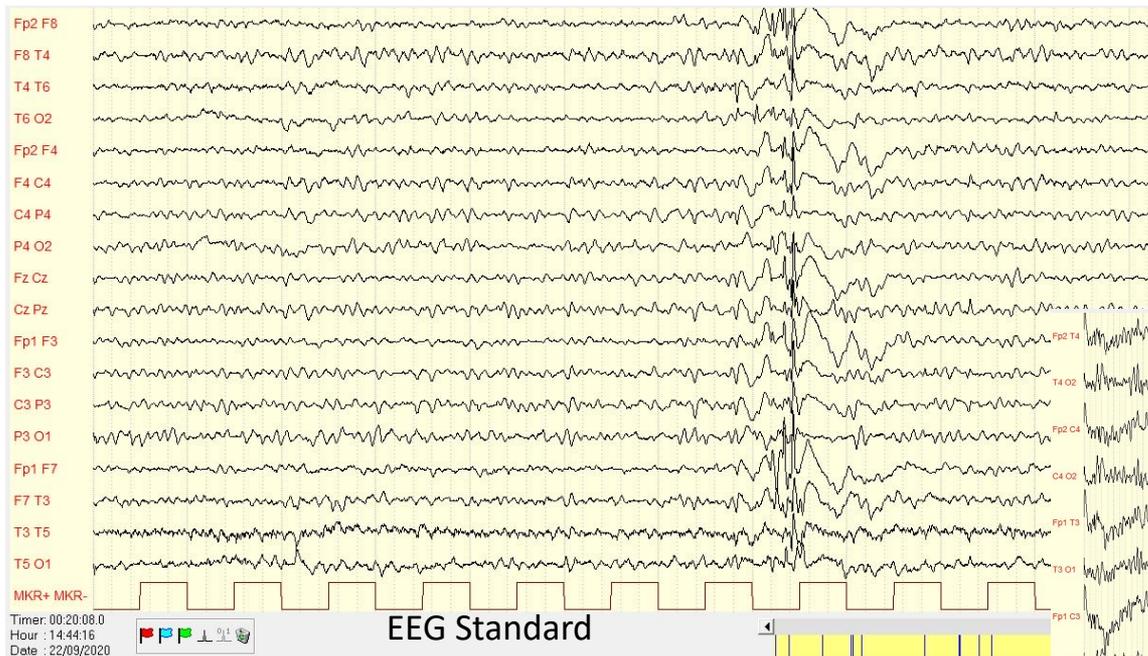
Conclusioni:

Note di ipereccitabilità in sede parieto-occipitale sinistra.

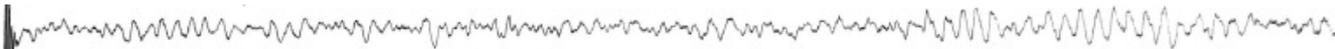
IL NEUROLOGO



D.M, 28 aa, m. 1 sola crisi due anni prima (GTC, al risveglio, dopo “notte brava”)
Vari EEG con scariche epilettiformi diffuse (> in HV e in sonno).



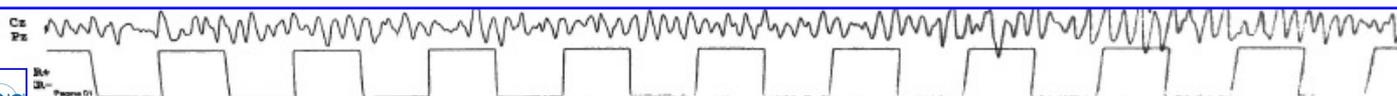
Terapia con VPA – EEG successivi privi di scariche

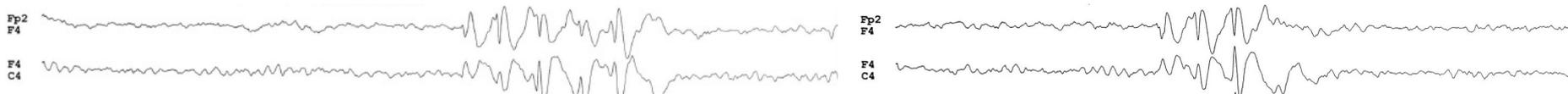


Descrizione:

Ritmo di fondo di medio-alto voltaggio, parzialmente esteso anche nelle regioni anteriori, simmetrico, con morfologia aspra, quasi puntuta, stabile, reagente. L'attività elettrica suddescritta permane pressochè invariata per quasi tutta la durata della registrazione, salvo subire una fisiologica attenuazione nel corso della SLI e presentare una fase di 2-3 secondi di diffusione di attività theta con morfologia puntuta alla fine dell'iperpnea

Conclusioni: minima attività epilettogena diffusa, priva di evidenti sorgenti focali.





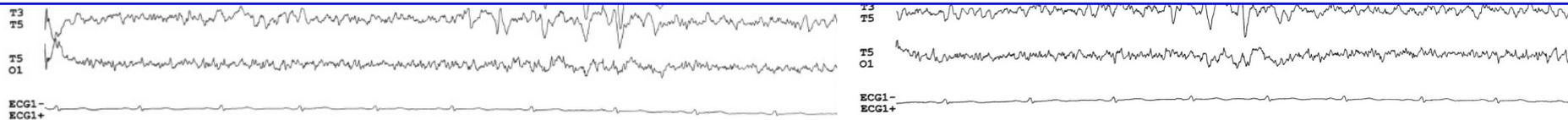
ATTIVITA' NORMALE Ritmo alfa parieto-occipitale stabile regolare simmetrico

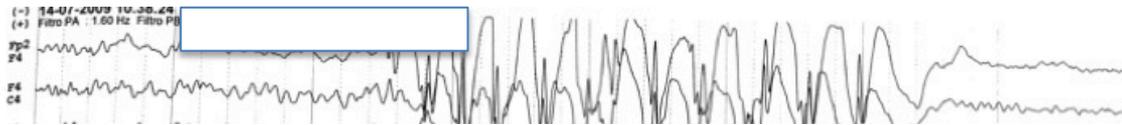
REAZIONE DI ARRESTO: presente

Isolate punte in ambito fronto temporale destro. Nel proseguo della registrazione, si evidenziano numerose brevi sequenze di complessi pinta-onda a 3.5 Hz ad espressione diffusa

PROVE DI ATTIVAZIONE L'iperpnea non modifica

OSSERVAZIONI Anomalie di specifico significato comiziale ad espressione diffusa, con verosimile prevalenza in ambito fronto-temporale destro.





REFERTO

Attività di fondo caratterizzata da ritmo alpha a 10-11 Hz, irregolare per componenti a 6-7 Hz, di medio voltaggio, poco stabile, simmetrico, differenziazione regionale discreta, reagente. Attività rapida diffusa.

Discrete punte, onde aguzze e complessi P-O atipici plurifocali, con chiara prevalenza in sede fronto-centro-temporale destra, tendenti alla diffusione.

L'iperpnea, ben eseguita per 4 minuti, accentua le anomalie, con comparsa di due sequenze brevi (4-5 s) di complessi P-O e PP-O di elevato voltaggio, apparentemente diffusi.

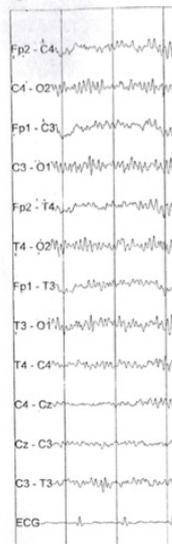
La SLI accentua le anomalie descritte a riposo.

Conclusioni. Anomalie specifiche plurifocali, tendenti alla diffusione, discretamente attive, accentuate da Hp e SLI.

Parametri registrati: EEG, ECG.

Elettrodi utilizzati: Fp2, C4, T4, O2, Fp1, C3, T3, O1, Cz.

Creation Date: 13:22:09 Jul 28, 2



La registrazione inizia alle ore 13:23 del 28/07/2020 e termina alle ore 10:26 del giorno successivo.

In veglia, sulle regioni posteriori, si registra un'attività di fondo alfa a 11 c/s, bilaterale, simmetrica, reagente all'apertura degli occhi.

Alle ore 23:41 S si addormenta e vengono registrati n° 1 cicli di sonno. Normalmente rappresentati gli elementi transitori fisiologici del sonno non-REM (POSTS, *spindles*, punte al vertice e k-complessi).

L'elemento caratteristico del tracciato è costituito dalla presenza nella fase 2 di sonno non-REM di occasionali onde lente delta localizzate su Fp1-T3, T3-O1.

Alle ore 7:22 S si sveglia ed il tracciato riassume le caratteristiche precedentemente descritte in veglia.

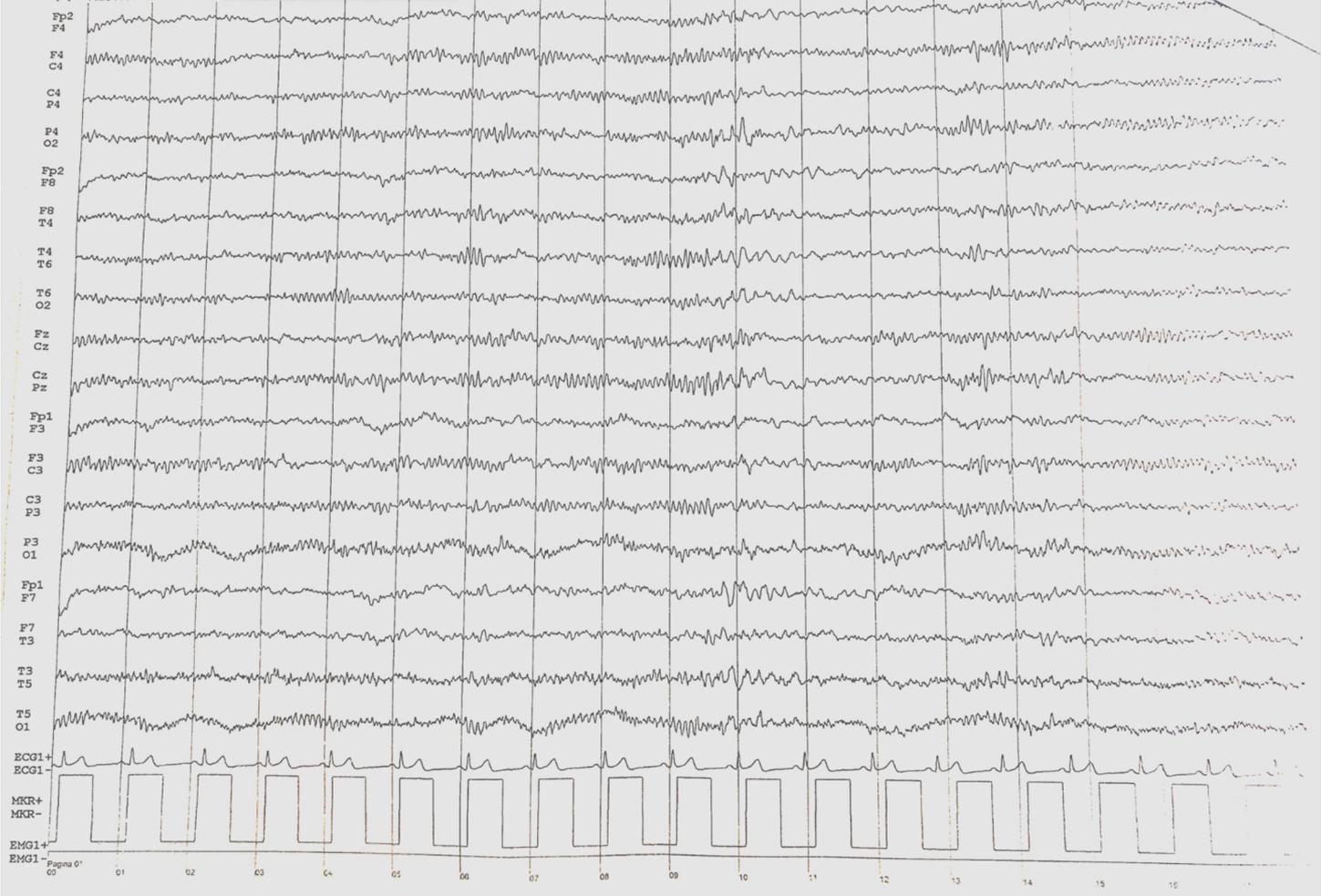


Conclusioni:

La registrazione ha evidenziato durante il sonno non-REM occasionali onde lente coinvolgenti la regione temporale dell'emisfero sinistro.

(-) 09/08/2019 13.04.04

(+) Filtro PA : 1.00 Hz Filtro PS : 20.0 Hz Ampiezza EEG : 70 microvolt/cm. Modch: si



Laboratorio di Elettroencefalografia

Paziente: <input type="text"/>	Data di Nascita: <input type="text"/> 1999
Provenienza: Pronto Soccorso	Data di esecuzione esa <input type="text"/> 12.56.1

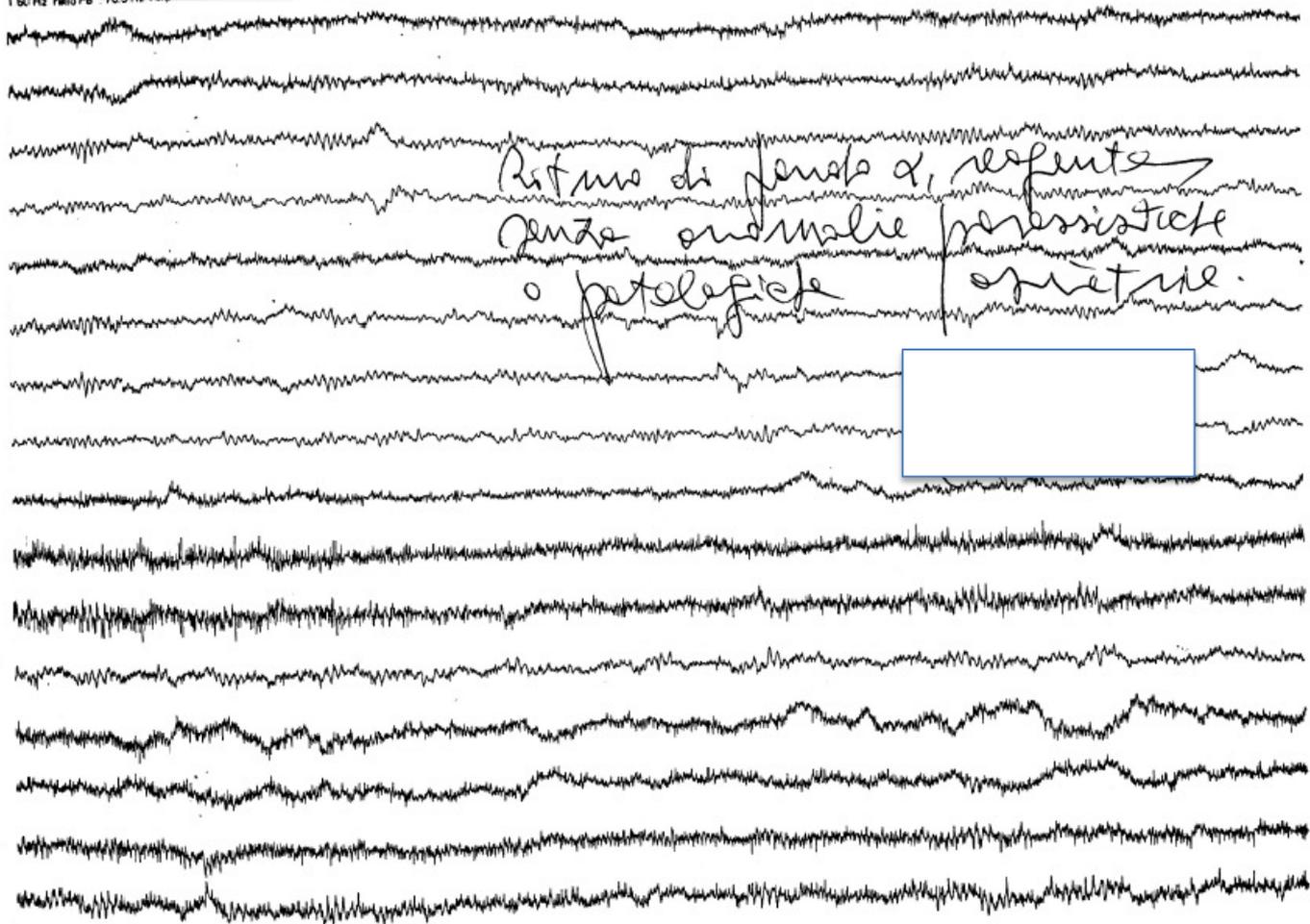
Registrazione EEG standard

Tracciato EEG caratterizzato dalla comparsa, sia in condizioni basali che nel corso della iperpernea, di attività teta-delta puntuta ed isolati abbozzi di complessi PO lenta di basso voltaggio ora nell'ambito emisferico sinistro ora a disposizione proiettata.

Segni elettrici di attività irritativa, anche con aspetti tipici di comizialità in sede emisferica sinistra ed a disposizione proiettata.

Si segnala inoltre la comparsa di fasi I -II -III di sonno.





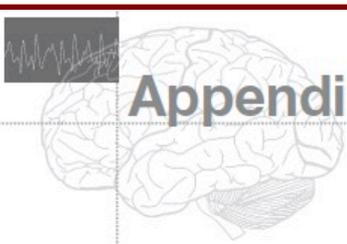
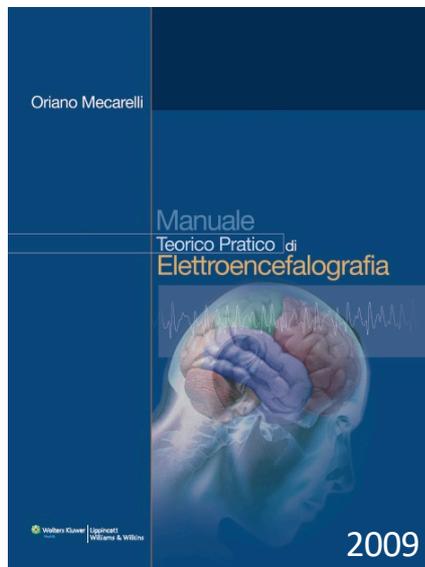
REFERTO:

h. 22,00

Al controllo rituale pz. autonomo. Espanso 386 -
Pulsato doppio VPA (61 µg/ml - v.k. = 50-100)
Il pz. riferisce di aver perduto sonno la notte scorsa e di
aver sentito delle bruciate "insistenti" (Reo curi)
Ultimo episodio simile precedente, risalito al marzo v.g.

Lo consiglio di proseguire le terapie in atto

Si raccomanda inoltre ipiere di vite (adeguato sonno
notturno, evitare situazioni quali disidratazione o comunque esacerbazione
de eccessive reazioni, all'aria secca, etc.)
Controllo mensile periodico



Appendice A

Glossario e refertazione

O. Mecarelli

Glossario

Il primo tentativo di descrivere in maniera organica un syllabus per gli elettroencefalografisti si deve a O'Leary e Knott, che già nel 1955 pubblicarono sull'*EEG Journal* "Some Minimal Essentials for Clinical Electroencephalographers" (*Electroencephalogr Clin Neurophysiol* 1955;7:293-8). Nei decenni successivi, essendo divenuto l'elettroencefalogramma di sempre maggiore utilizzo in ambito sperimentale e clinico, l'esigenza di adottare un linguaggio il più possibile comune tra i vari Laboratori di ogni parte del mondo si fece ancora più impellente. La molteplicità terminologica, infatti, contribuiva (e talvolta contribuisce tuttora!) a generare confusione e interpretazioni errate, rendendo difficile il confronto dei dati tra Laboratori diversi e favorendo la misdiagnosi.

Per ovviare a tutto ciò, nel 1974 fu pubblicato sull'*EEG Journal* "A Glossary of Terms most commonly used by Clinical Electroencephalographers", derivante dal lavoro di un Gruppo di Esperti dell'International Federation of Clinical Neurophysiology (IFCN) guidato da Chatrian, cui partecipò tra l'altro per l'Italia il prof. Bergamini. Il Glossario fu poi anche tradotto in italiano a cura della Società Italiana di Elettroencefalografia e

Clinical Neurophysiology Society [ACNS]) si preoccupò di redigere un proprio Glossario, con una prima edizione nel 1979, rivista poi nel 1984 e quindi nel 1994.

Il Glossario internazionale dell'IFCN fu anch'esso rivisto e ripubblicato nel 1999 a cura di Noachtar e coll. basandosi interamente sulla proposta di Chatrian e coll. (1974), ma apportandovi gli opportuni aggiornamenti, resi necessari peraltro anche dall'evoluzione tecnologica.

Di seguito si riporta un Glossario liberamente adattato e sintetizzato a partire dalle varie fonti suddescritte.

Amplezza

Definisce il voltaggio delle onde EEG espresso in microvolt (μV) e misurato picco a picco. I valori dell'ampiezza risentono innanzitutto della tecnica di registrazione (bassi per ridotte distanze interelettrodeiche, alti per elevate distanze interelettrodeiche), ma dipendono anche da fattori extracerebrali (impedenza delle meningi, del liquor, del cranio, dello scalpo, degli elettrodi). Nella descrizione dell'ampiezza di un'attività EEG, soprattutto in riferimento all'attività di fondo, abitualmente si utilizzano aggettivi come bassa, media o elevata, che comunque sono inficiati da variabili soggettive.

Oriano Mecarelli
Editor

Clinical Electroencephalography

 Springer

EXTRAS ONLINE

EEG Glossary

The first attempt to systematically propose a syllabus for electroencephalographers was made by O'Leary and Knott who in 1955 published in the EEG Journal "Some Minimal Essentials for Clinical Electroencephalographers" [1]. In the following decades, with the EEG being increasingly used in the experimental and clinical field, need to adopt a language as common as possible between various laboratories worldwide became even more pressing. In fact, the multiplicity of terms generated (and sometimes still generates) confusion and misinterpretations, promoting misdiagnosis and making it difficult to compare data between different laboratories.

To overcome this risk, in 1974 "A Glossary of Terms," most commonly used by "Clinical Electroencephalographers," was published in the EEG Journal; this glossary was the result of the work of a group of experts from the International Federation of Clinical Neurophysiology (IFCN) led by Chatrian [2]. Thanks to this document, it was for the first time officially established which term had to be used to correctly describe a specific EEG element, avoiding the proliferation of different terms to indicate the same pattern. Furthermore, the use of terms deemed inappropriate was strongly discouraged.

Similarly, the American Electroencephalographic Society (later to become the American Clinical Neurophysiology Society) wrote its own glossary, published as first edition in 1979, subsequently revised in 1984, 1994 [3], 2006 [4], and 2016 [5].

The IFCN International Glossary was also revised and republished in 1999 by Noachtar et al. [6], basing entirely on the proposal made by Chatrian et al. [2], but updating the terminology according to changes due to technological evolution. The last, updated and revised version of the IFCN glossary has been published in 2017, including a proposal for the report format of the EEG findings [7]. The most relevant entries of the "revised glossary of terms most commonly used by clinical electroencephalographers" by the IFCN, so far the single most authoritative, comprehensive, and updated EEG glossary available in the literature, are reported in the next pages (portions of the text reproduced with permission from [7]).

Activation procedure Any procedure designed to modulate EEG activity, for instance to enhance physiological waveforms or elicit abnormal paroxysmal activity. Examples include eye closing, hyperventilation, photic stimulation, natural or drug-induced sleep, sensory stimulation (acoustic, somatosensory, or pain).

Activity, EEG An EEG wave or sequence of waves of cerebral origin.

Alpha band Frequency band of 8–13 Hz inclusive. Greek letter: α .

Alpha rhythm Rhythm at 8–13 Hz inclusive occurring during wakefulness over the posterior regions of the head, generally with maximum amplitudes over the occipital areas. Amplitude varies but is mostly below 50 μV in the adult, but often much higher in children. Best seen with the eyes closed, during physical relaxation and relative mental inactivity. Blocked or attenuated by attention, especially visual, and mental effort.

Alpha variant rhythms An EEG rhythm recorded most prominently over the posterior regions of the head that differs in frequency, but resembles in reactivity, the alpha rhythm.

Alpha wave Wave with duration of 1/8–1/13 s (77–125 ms).

Amplitude, EEG Is a measure of the change of EEG signals with respect to the mean value, usually measured in microvolts (μV), and often expressed as the difference between the maximum and minimum deviation (i.e., peak-to-peak), or in rectified EEG from baseline to peak. For a variable EEG activity or modulating sinusoidal rhythm a range can be provided.

Amplitude-integrated EEG (aEEG) Involves customized display of EEG activity following signal processing which includes an asymmetric band-pass filter (2–15 Hz), logarithmic amplitude display, rectification, smoothing, and time compression (such that several hours can be viewed on a screen). Widely used in neonatal intensive care unit monitoring, for example, of infants suffering a hypoxic ischemic encephalopathy.