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

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Continuous EEG Monitoring is becoming a commonly used tool in assessing brain function in critically ill patients. However, there is no uniformly accepted nomenclature for EEG patterns frequently encountered in these patients such as periodic discharges, fluctuating rhythmic patterns, and combinations thereof. Similarly, there is no consensus on which patterns are associated with ongoing neuronal injury, which patterns need to be treated, or how aggressively to treat them. The first step in addressing these issues is to standardize terminology to allow multicenter research projects and to facilitate communication. To this end, we gathered a group of electroencephalographers with particular expertise or interest in this area in order to develop standardized terminology to be used primarily in the research setting. One of the main goals was to eliminate terms with clinical connotations, intended or not, such as "triphasic waves," a term that implies a metabolic encephalopathy with no relationship to seizures for many clinicians. We also avoid the use of "ictal," "interictal" and "epileptiform" for the equivocal patterns that are the primary focus of this report.

A standardized method of quantifying interictal discharges is also included for the same reasons, with no attempt to alter the existing definition of epileptiform discharges (sharp waves and spikes [Noachtar et al 1999]). Finally, we suggest here a scheme for categorizing background EEG activity.

The revisions proposed here were based on solicited feedback on the initial version of the Report [Hirsch LJ et al 2005], from within and outside this committee and society, including public presentations and discussion at many venues. Inter- and intra-observer agreement between expert EEG readers using the initial version of the terminology was found to be moderate for major terms but only slight to fair for modifiers. [Gerber PA et al 2008] A second assessment was performed on an interim version after extensive changes were introduced. This assessment showed significant improvement with an inter-rater agreement almost perfect for main terms ($\kappa = 0.87, 0.92$) and substantial agreement for the modifiers of amplitude (93%) and frequency (80%) (Mani R, et al, 2012). Last, after official posting on the ACNS Website and solicitation of comment from ACNS members and others, additional minor additions and revisions were enacted.

To standardize terminology of periodic and rhythmic EEG patterns in the critically ill in order to aid communication and future research involving such patterns. Our goal is to avoid terms with clinical connotations and to define terms thoroughly enough to maximize inter-rater reliability.

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Not included in this nomenclature:

Unequivocal electrographic seizures including the following: Generalized spike-wave discharges at 3/s or faster; and clearly evolving discharges of any type that reach a frequency >4/s, whether focal or generalized. These would still be referred to as electrographic seizures. However, their prevalence, duration, frequency and relation to stimulation should be stated as described below when being used for research purposes.

Corollary: The following patterns *are* included in this nomenclature and would not be termed electrographic seizures for research purposes **(whether or not these patterns are determined to represent seizures clinically in a given patient):** Generalized spike and wave patterns slower than 3/s; and evolving discharges that remain slower than or equal to 4/s. **This does not imply that these patterns are not ictal, but simply that they may or may not be.** Clinical correlation, including response to treatment, may be necessary to make this determination.

N.B.: This terminology can be applied to all ages, but is not intended for use in neonates.

PROPOSED NOMENCLATURE

A. RHYTHMIC OR PERIODIC PATTERNS

All terms consist of main term #1 followed by #2, with modifiers added as appropriate.

Main Term 1: G, L, BI, or Mf

- **Generalized (G;** for this purpose, the term "generalized" refers to any bilateral, bisynchronous and symmetric pattern, even if it has a restricted field [e.g. bifrontal])
- **Lateralized (L;** includes unilateral and bilateral synchronous but asymmetric; includes focal, regional and hemispheric patterns)
- **Bilateral Independent (BI;** refers to the presence of 2 independent [asynchronous] lateralized patterns, one in each hemisphere)
- **Multifocal (Mf;** refers to the presence of at least three independent lateralized patterns with at least one in each hemisphere)

Additional localizing information

i. For Generalized patterns

1. Frontally predominant (defined as having an amplitude in anterior derivations that is at least 50% greater than that in posterior derivations on an ipsilateral ear, average, or non-cephalic referential recording)
2. Occipitally predominant (defined as having an amplitude in posterior derivations that is at least 50% greater than that in anterior derivations on an ipsilateral ear, average, or non-cephalic referential recording)
3. Midline predominant (defined as having an amplitude in midline derivations that is at least 50% greater than in

parasagittal derivations on an average or non-cephalic referential recording)
4. Generalized, not otherwise specified.

ii. For Lateralized patterns
1. Specify unilateral vs. bilateral asymmetric
a. Patterns that are purely unilateral are termed "Lateralized, unilateral".
b. Patterns seen bilaterally and synchronous but clearly more prominent on one side would be called "Lateralized, bilateral asymmetric".
2. Specify lobe(s) most involved (F, P, T, O, or hemispheric if more specific localization is not possible)

iii. For Bilateral Independent and Multifocal patterns:
1. Specify symmetric vs. asymmetric
a. Patterns that are bilateral and asynchronous but clearly more prominent on one side would be called "Bilateral Independent, asymmetric," or "Multifocal, asymmetric".
b. Patterns that are bilateral, asynchronous and symmetric would be called "Bilateral Independent, symmetric," or "Multifocal, symmetric".
2. Specify lobes most involved in both hemispheres (F, P, T, O, or hemispheric if more specific localization is not possible).

Main Term 2: PDs, RDA or SW

- **Periodic Discharges (PDs): Periodic** = repetition of a waveform with relatively uniform morphology and duration with a quantifiable inter-discharge interval between consecutive waveforms and recurrence of the waveform at nearly regular intervals.
  Discharges: These are defined as waveforms with no more than 3 phases (i.e. crosses the baseline no more than twice) *or* any waveform lasting 0.5 seconds or less, regardless of number of phases. This is as opposed to **bursts**, defined as waveforms lasting more than 0.5 seconds *and* having at least 4 phases (i.e. crosses the baseline at least 3 times).
  - "Nearly regular intervals" is defined as having a cycle length (i.e., period) varying by <50% from one cycle to the next in the majority (>50%) of cycle pairs.
- **Rhythmic Delta Activity (RDA): Rhythmic** = repetition of a waveform with relatively uniform morphology and duration, and without an interval between consecutive waveforms. RDA = rhythmic activity ≤ 4 Hz. The duration of one cycle (i.e., the period) of the rhythmic pattern should vary by <50% from the duration of the subsequent cycle for the majority (>50%) of cycle pairs to qualify as rhythmic.
- **Spike-and-wave or Sharp-and-wave (SW)** = polyspike, spike or sharp wave consistently followed by a slow wave in a regularly repeating and alternating pattern (spike-wave-spike-wave-spike-wave), with a consistent relationship between the spike (or polyspike or sharp wave) component and the slow wave; and with no interval between one spike-wave complex and the next (if there is an interval, this would qualify as PDs, where each discharge is a spike-and- wave).
  NOTE: A pattern can qualify as rhythmic or periodic as long as it continues for **at least 6 cycles** (e.g. 1/s for 6 seconds, or 3/s for 2 seconds).
  NOTE: If a pattern qualifies as both GPDs and RDA simultaneously, it should be coded as GPDs+ rather than RDA+ (see modifier 8 below for description of "+").

Most of the following sections can be applied to research on any EEG phenomenon. Although many of the categorizations are arbitrary, our hope is that standardization will allow systematic, scientific and collaborative investigation of these EEG features.

MODIFIERS

1. **Prevalence:** Specify percent of record or epoch that includes the pattern (see section B below). This should be based on the percent of seconds that include or are within the pattern. The time between widely spaced periodic discharges counts as part of the pattern duration. For example, 2Hz LPDs present for 1 minute every 10 minutes is 10% prevalence, and a 0.25 Hz. pattern present for 1 minute every 10 minutes is also 10% prevalence. When categorizing or using qualitative terms, follow the cutoffs listed below for each term. Suggested equivalent qualitative terms are given as well. If 2 or more patterns are equally or almost equally prevalent (e.g. ~30% GRDA, 30% GPDs, and 40% BIPDs), record the presence and prevalence of each one.
   a. ≥90% of record/epoch ("Continuous")
   b. 50-89% of record/epoch ("Abundant")
   c. 10-49% of record/epoch ("Frequent")
   d. 1-9% of record/epoch ("Occasional")
   e. <1 % of record/epoch ("Rare")
2. **Duration:** Specify typical duration of pattern if not continuous. When categorizing or using qualitative terms, follow the cutoffs listed below for each term. Also record the longest continuous duration.
   a. ≥1 hour ("Very long")
   b. 5-59 minutes ("Long")
   c. 1-4.9 minutes ("Intermediate duration")
   d. 10-59 seconds ("Brief")
   e. <10 seconds ("Very brief")
3. **Frequency** = rate per second: Specify typical rate and range for all patterns, e.g., 1/s and 0.5-2/s; When categorizing, use the following (record typical, minimum and maximum frequency).<0.5/s, 0.5/s, 1/s, 1.5/s, 2/s, 2.5/s, 3/s, 3.5/s and ≥4/s
4. **Number of Phases** = number of baseline crossings of the typical discharge (in longitudinal bipolar and in the channel in which it is most readily appreciated). Applies to PDs and the entire spike-and-wave or sharp-and-wave complex of SW (include the slow wave). This does not apply to RDA. Categorize as follows:
   a. 1, 2, 3 or >3.
5. **Sharpness:** Specify for both the predominant phase (phase with greatest amplitude) and the sharpest phase if different. For both phases, describe the *typical* discharge. Applies only to PDs and the spike/sharp component of SW, not RDA. Categorize as one of the following:
   a. Spiky (duration of that component, measured at the EEG baseline, is <70 ms)
   b. Sharp (duration of that component is 70-200 ms)
   c. Sharply contoured: used for theta or delta waves that have a sharp wave morphology (steep slope to one side of the wave and/or pointy at inflection point[s]), but are too long in duration to qualify as a sharp wave.
   d. Blunt: having smooth or sinusoidal morphology.
6. **Amplitude** [of PDs, SW, or RDA; Not Background EEG, Which is in Section D Below]:
   a. Absolute: Typical amplitude measured in standard longitudinal bipolar 10-20 recording in the channel in which the pattern is most readily appreciated. For PDs, this refers to the highest amplitude component. For SW, this refers to the spike/sharp wave. Amplitude should be measured from peak to trough (not peak to baseline). Specify for RDA as well.
   Categorize amplitude as:
   i. <20μV ("very low")
   ii. 20-49 μV ("low")
   ii. 50-199 μV ("medium")
   iii. ≥200 μV ("high")

b. Relative: For PDs *only* (PDs require 2 amplitudes, absolute and relative). Typical ratio of amplitude of the highest amplitude component to the amplitude of the typical background between discharges, measured in the same channel and montage as absolute amplitude. Categorize as ≤2 or >2.

7. **Polarity:** Specify for the predominant phase (phase with the greatest amplitude) only. Should be determined in a referential montage. Describe the *typical* discharge. Applies only to PDs and the spike/sharp component of SW, not RDA. Categorize as one of the following:
   a. Positive
   b. Negative
   c. Dipole, horizontal/tangential
   d. Unclear
8. **Stimulus-Induced (SI)** = reproducibly brought about by an alerting stimulus, with or without clinical alerting; may also be seen spontaneously. If *never* clearly induced by stimulation, report as ***spontaneous.*** If unknown, unclear or untested, report as "unknown". Specify type of stimulus (*auditory, light tactile,* patient care and other *non-noxious* stimulations, suction, sternal rub, nostril tickle or other *noxious* stimulations).
9. **Evolving OR Fluctuating:** both terms refer to changes in either frequency, location or morphology. If neither term applies, report as ***static.***

Evolving is defined as follows: at least 2 unequivocal, sequential changes in frequency, morphology or location defined as follows: Evolution in *frequency* is defined as at least 2 consecutive changes in the same direction by at least 0.5/s, e.g. from 2 to 2.5 to 3/s, or from 3 to 2 to 1.5/s; Evolution in *morphology* is defined as at least 2 consecutive changes to a novel morphology; Evolution in *location* is defined as sequentially spreading into or sequentially out of at least two different standard 10-20 electrode locations.

- In order to qualify as present, a single frequency or location must persist at least 3 cycles (e.g. 1/s for 3 seconds, or 3/s for 1 second). Thus, the following pattern would qualify as evolving: 3/s for ≥1 second, then 2/s for ≥ 1.5 seconds (the first change), then 1.5/s for ≥ 2 seconds (the 2nd change). To qualify as evolution in morphology, each different morphology or each morphology plus its transitional forms must last at least 3 cycles. Thus the following examples would both qualify as evolving in morphology:
  - spiky 4-phase PDs for 3 cycles then sharp 2-3 phase PDs for 3 cycles then blunt diphasic PDs for 3 cycles
  -1 blunt triphasic PD then 2 blunt biphasic PDs then 2 sharply contoured biphasic PDs then 2 sharp biphasic PDs then 3 sharp monophasic PDs.
- The criteria for evolution must be reached without the pattern remaining unchanged in frequency, morphology or location for 5 or more minutes. Thus, the following pattern would *not* qualify as evolving: 3/s for 1 minute, then 2/s for 7 minutes, then 1.5/s for 2 minutes.

Fluctuating is defined as follows: ≥3 changes, not more than one minute apart, in frequency (by at least 0.5/s), ≥3 changes in morphology, or ≥3 changes in location (by at least 1 standard inter-electrode distance), but *not qualifying as evolving.* This includes patterns fluctuating from 1 to 1.5 to 1 to 1.5/s; spreading in and out of a single electrode repeatedly; or alternating between 2 morphologies repeatedly.

- The following would *not* qualify as fluctuating: 2/s for 30 seconds, then 1.5/s for 30 seconds, then 2/s for 3 minutes, then 1.5/s for 30 seconds, then 2/s for 5 minutes. The changes are too far apart (>1 minute).
- The following *would* qualify as fluctuating: 2/s for 10 seconds, then 2.5/s for 30 seconds, then 2/s for 5 seconds, then 2.5/s for 5 seconds.

Change in amplitude alone would not qualify as evolving or fluctuating.

a. For data entry, if evolving or fluctuating, a minimum and maximum frequency should be specified under the "frequency" modifier above. For non-generalized patterns, specify degree of spread (none, unilateral, or bilateral).

10. **Plus** (+) = additional feature which renders the pattern more ictal-appearing than the usual term without the plus. (Does not apply to SW)

Periodic discharges (PDs): includes superimposed fast activity (theta or faster, rhythmic or not) with each discharge (+F), or superimposed rhythmic or quasi-rhythmic delta activity (+R).

Rhythmic delta activity (RDA): includes superimposed fast activity (+F) or frequent intermixed sharp waves or spikes (+S; "frequent" is defined as more than one sharp wave or spike every 10 seconds, but not periodic and not SW) or RDA that is sharply contoured (also+S). If absent, indicate as "no+".

a. **Subtyping of "+":** all cases with "+" should be subtyped as follows into +F, +R, +FS, or +FR:
   i. "+F": superimposed *fast* activity. Can be used with PDs or RDA.
   ii. "+R": superimposed *rhythmic* or quasi-rhythmic delta activity; applies to PDs only.
   iii. "+S": superimposed *sharp* waves or *spikes, or sharply contoured;* applies to RDA only.
   iv. It is possible to have "+FR" for PDs, or "+FS" for RDA

NOTE: Re: Bilateral "+" vs. unilateral: If a pattern is bilateral and qualifies as plus on one side, but not on the other, the overall main term should include the plus (even though one side does not warrant a plus). For example, bilateral independent periodic discharges with fast activity superimposed in one hemisphere only (PD on one side, and PD+F on the other) would qualify for BIPDs+F. Similarly, generalized rhythmic delta activity with superimposed spikes in one hemisphere only (RDA on one side and RDA+S on the other) would qualify for GRDA+S.

NOTE: Re: +F: If a pattern qualifying as RDA or PDs has superimposed continuous fast frequencies (theta or faster), this can and should be coded as +F if the fast activity is not present in the background activity when the RDA or PDs is not present. In other words, code as +F if the superimposed fast activity is part of the RDA or PD pattern and not simply part of the background activity.

MINOR MODIFIERS:

1. *Quasi-:* Used to modify rhythmic or periodic, as in *quasi-periodic* or *quasi-rhythmic.* (Quasi preferred over pseudo- or semi-). This distinction between quasi- and not quasi is *to be applied only if determined by quantitative computer analysis* (not by visual impression). Quasi is defined as having a cycle length (i.e., period) varying by 25-50% from one cycle to the next in the majority (>50%) of cycle pairs. If >50% variation in the majority of cycles, the pattern would not qualify as rhythmic or periodic and would not be included in this nomenclature. If the variation is <25%, the modifier quasi- would not be appropriate. When not using computer analysis, quasiperiodic is coded as periodic, and quasirhythmic as rhythmic.
2. *Sudden onset OR gradual onset* (sudden onset preferred over paroxysmal). Sudden onset is defined as progressing from absent to well developed within 3 seconds.
3. "*Triphasic* " *morphology:* Applies to PDs and SW. Either two

or three phases, with each phase longer than the previous, and the positive phase of highest amplitude. If three phases, this must be negative-positive-negative in polarity; if two phases, positive-negative. Note that a biphasic waveform may be categorized as "triphasic" by this definition.

4. *Anterior-posterior lag or posterior-anterior lag:* Applies if a consistent measurable delay of > 100 ms exists from the most anterior to the most posterior derivation in which is seen; specify typical delay in ms from anterior to posterior (negative = posterior to anterior) in both a longitudinal bipolar and a referential montage, preferably with an ipsilateral ear reference.

B. Minimal Time Epochs to be Reported Documented Separately:

1. First ~30 minutes (equivalent to a "routine" EEG).
2. Each 24 hour period.

If significant changes occur in the record during this time period, report additional epochs separately as needed.

C. Quantification and Categorization of Sporadic (Non-rhythmic and Non-periodic) Epileptiform Discharges (includes sharp waves and spikes as previously defined [Noachtar et al 1999]).

- ≥1/10 s, but not periodic ("Abundant")
- ≥1/min but less than 1/10s ("Frequent")
- ≥1/h but less than 1/min ("Occasional")
- <1/h ("Rare")

D. Background EEG:

Symmetry: 1. Symmetric; 2. Mild asymmetry (consistent asymmetry in amplitude on referential recording of <50%, or consistent asymmetry in frequency of 0.5 -1 Hz, present for the majority [>50%] of the epoch/record); 3. Marked asymmetry (≥50% amplitude or >1 Hz frequency asymmetry, present for the majority [>50%] of the epoch/record).

- Breach effect (note presence, absence, or unclear)
- When any of the following features are asymmetric, they should be described separately for each hemisphere.

Posterior dominant "alpha" rhythm: Must be demonstrated to attenuate with eye opening. Specify frequency (to the nearest 0.5 Hz) or absence.

Predominant background EEG frequency: Delta, Theta, and/or ≥Alpha (including beta). If 2 or 3 frequency bands are equally prominent, record each one.

Anterior-posterior (AP) gradient: Present, absent or reverse. An AP gradient is present if at any point in the epoch, there is a clear and persistent (at least 1 continuous minute) anterior to posterior gradient of voltages and frequencies such that lower amplitude, faster frequencies are seen in anterior derivations, and higher amplitude, slower frequencies are seen in posterior derivations A reverse AP gradient is defined identically but with a posterior to anterior gradient of voltages and frequencies.

Variability: Yes, No, or Unknown/unclear/not applicable. The last choice might apply, for example, in a 30 minute wake record.

Reactivity: Change in cerebral EEG activity to stimulation: Yes, No, or Unclear/unknown/not applicable. This may include change in amplitude or frequency, including attenuation of activity. Strength and/or nature of stimulus should be noted. Appearance of muscle activity or eye blink artifacts does not qualify as reactive.

If the only form of reactivity is SI-RDA, SI-PDs or SI-seizures, categorize as Reactive, SIRPIDs *only*.

Voltage [of background EEG; this is different than voltage of Main Term #2 above, defined under modifier 6]: 1. Normal; 2. Low (most or all activity <20 μV in longitudinal bipolar with standard 10-20 electrodes, [measured from peak to trough]); or 3. Suppressed (all activity <10 μV). If the background is discontinuous, this refers to the higher amplitude portion.

Stage II sleep transients (K-complexes and spindles): 1. Normal (K-complexes and spindles both present and normal); 2. Present (at least one) but abnormal; or 3. Absent (both absent).

Continuity:

1. Continuous.
2. Nearly Continuous: continuous, but with occasional (≤10% of the record) periods of attenuation or suppression. Describe typical duration of attenuation/suppression as above.
   a. Nearly continuous with **attenuation**: periods of lower voltage are ≥10μV but <50% of the background voltage.
   b. Nearly continuous with **suppression**: periods of lower voltage are <10 μV;
   c. If suppressions/attenuations are stimulus-induced, code as "nearly continuous with SI-attenuation" or "…with SI-suppression";
3. Discontinuous: 10-49% of the record consisting of attenuation or suppression, as defined above.
4. Burst-attenuation/Burst-suppression: more than 50% of the record consisting of attenuation or suppression, as defined above, with bursts alternating with attenuation or suppression; specify the following:
   a. Typical duration of bursts and interburst intervals;
   b. Sharpest component of a typical burst using the sharpness categories defined above under modifiers;
   c. Presence or absence of Highly Epileptiform Bursts: Present if multiple epileptiform discharges (traditional definition) are seen within the majority (>50%) of bursts and occur at an average of 1/s or faster; record typical frequency (using categories above) and location (G, L, BI or Mf). Also present if a rhythmic, potentially ictal-appearing pattern occurs at 1/s or faster within the majority (>50%) of bursts; record frequency and location as well.
5. Suppression: entirety of the record consisting of suppression (<10 μV, as defined above).

NOTE: Bursts must average more than 0.5 seconds and have at least 4 phases (at least 3 baseline crossings); if shorter or fewer phases, they should be considered single discharges; if shorter, they should be considered single discharges (as defined above under main term 2). Bursts within burst-suppression or burst-attenuation can last up to 30 seconds.

E. Other Terms for Research Use:

"**Daily Pattern Duration**" is defined as total duration of a pattern per 24 hours. e.g. if GPDs were present for 33% of the record for 12 hours, then 10% of the record for 12 hours, the Daily GPD Duration would be 4 hours + 1.2 hours = 5.2 hours.

"**Daily Seizure Duration**" can be calculated similarly: e.g. six 30-second seizures in one day would have a Daily Seizure Duration of 3minutes.

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.

"**Daily Pattern Index**" is defined as Daily Duration X Mean Frequency (Hz). In the above example, if GPDs were at 1.5 Hz, the Daily GPD Index would be 5.2 h x 1.5 Hz = 7.8 Hz-hours.

Examples of Appropriate Terms:

Continuous 1-2/s fluctuating GPDs
Occasional 30-60 second periods of 1.5/s SI-LRDA
Abundant 1-3 minute periods of 0.5-1.5/s LPDs+F
Occasional 10-second periods of 1/s BIPDs

Other examples of corresponding new terms for older terms are shown in Table 1 (some could have alternative new terms depending on exact pattern).

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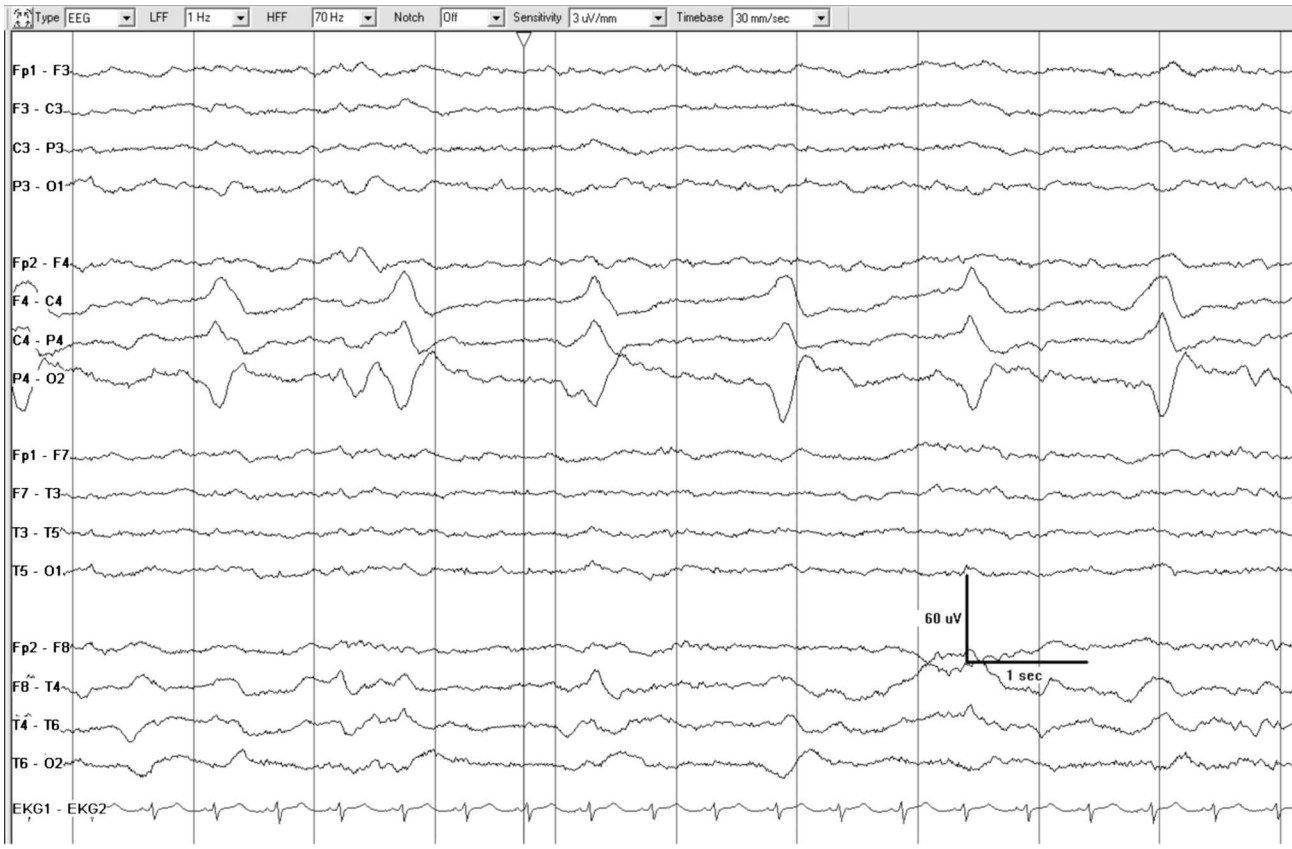

FIG. 1. LPDs: Sharply contoured lateralized periodic discharges. In this case, LPDs are unilateral.

FIG. 2. LPDs: Sharply contoured lateralized periodic discharges. In this case, PDs are bilateral asymmetric.

FIG. 3. LPDs: Sharply contoured lateralized periodic discharges. In this case, PDs are bilateral asymmetric. Although some discharges are on the border of sharp, most are sharply contoured.

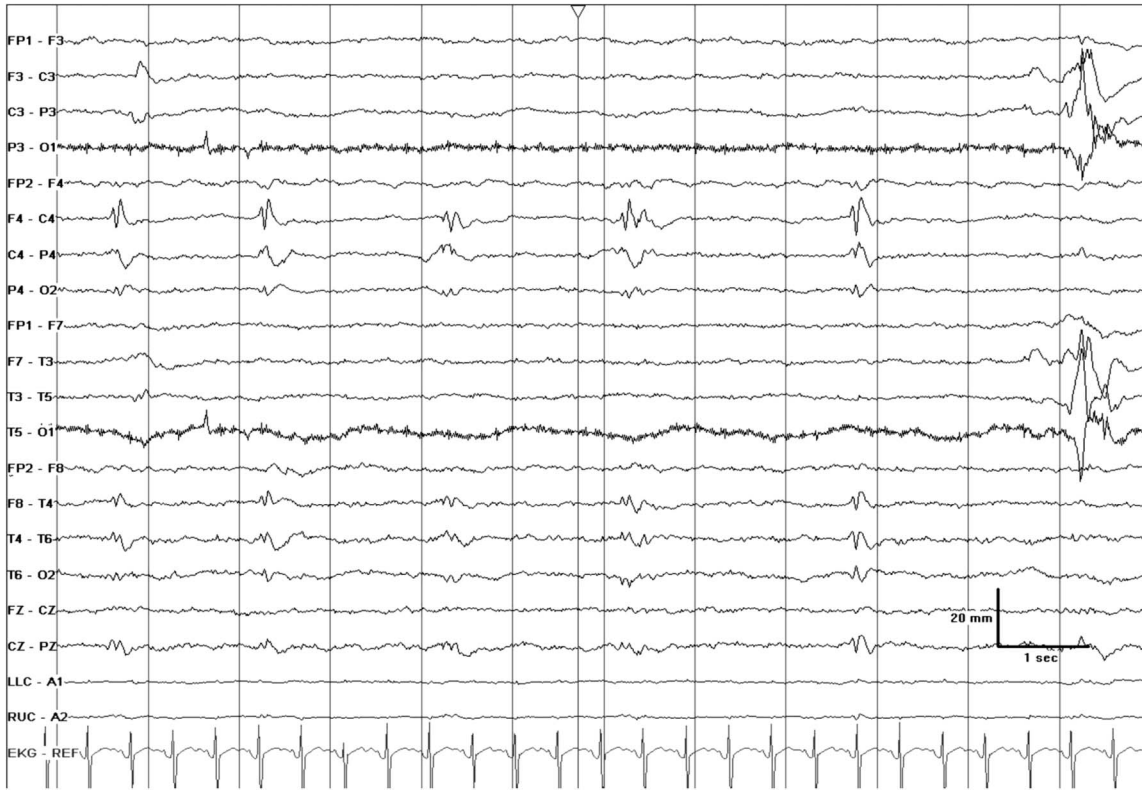

FIG. 4. LPDs: 0.5 per second spiky lateralized periodic discharges.

FIG. 5. LPDs: 0.5-1 per second spiky lateralized periodic discharges. Despite their spike-and-wave morphology, the discharges are periodic (as there is a quantifiable inter-discharge interval between consecutive waveforms and recurrence of the waveform at nearly regular intervals).

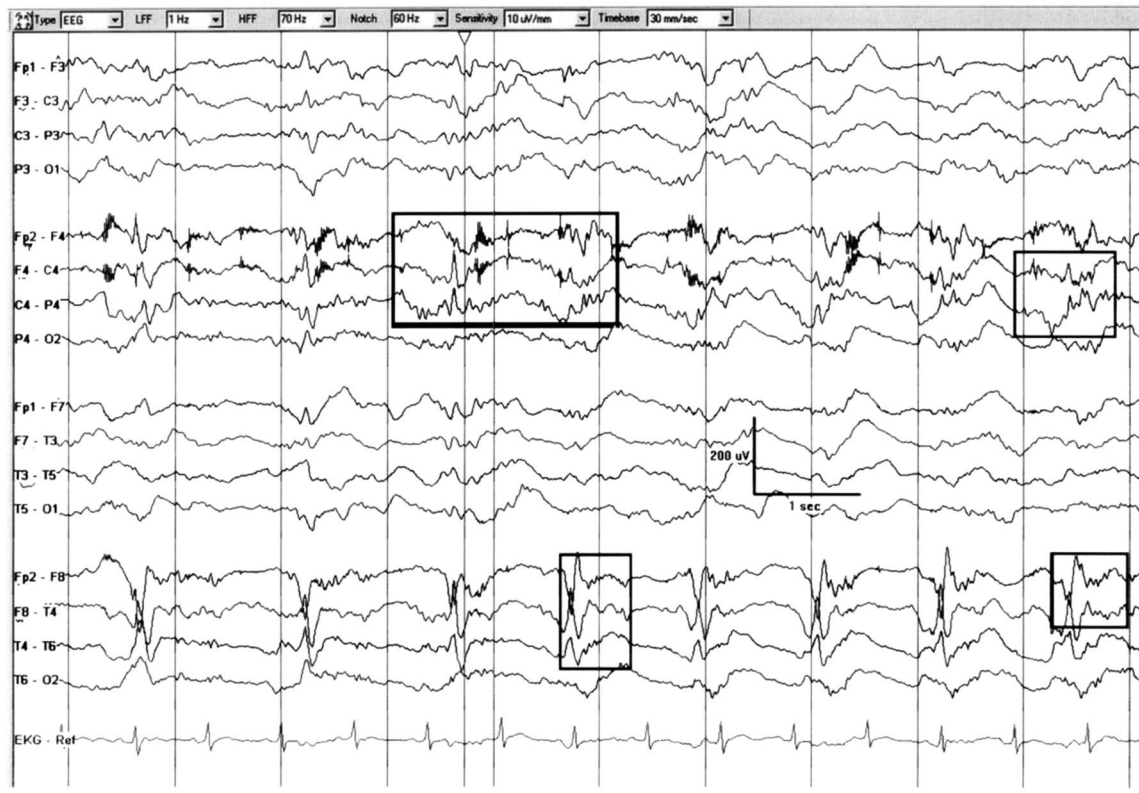

FIG. 6. LPDs+F: 0.5 to 1 per second spiky LPDs with superimposed burst of low amplitude fast activity (highlighted in boxes).

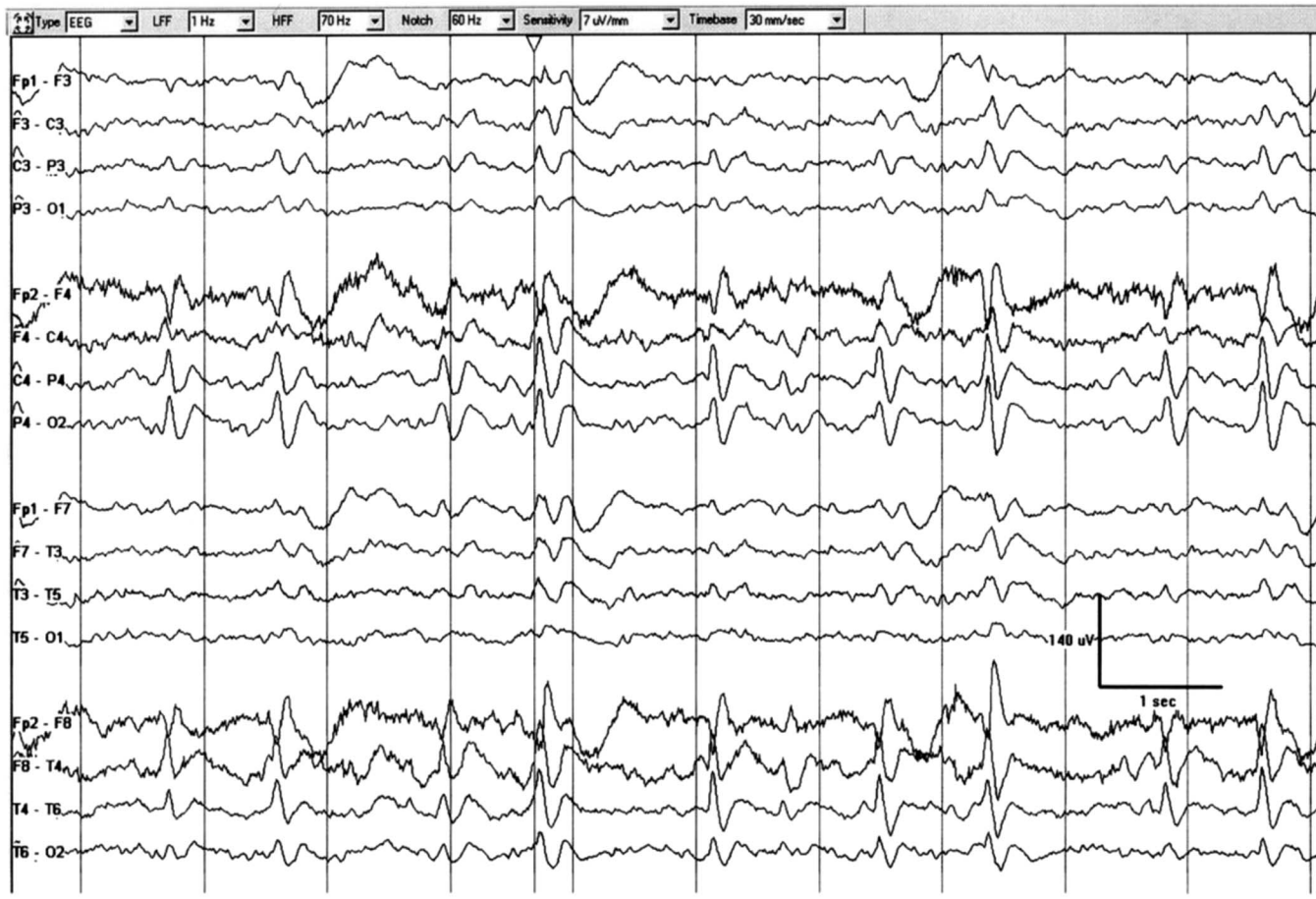

FIG. 7. LPDs+R: Irregular (in morphology and repetition rate) 0.5-1 per second quasi-periodic discharges with superimposed quasi-rhythmic delta activity in the right hemisphere with occasional spread to the left. Less "stable" pattern and more ictal-appearing than LPDs alone; compare with Figure 1.

FIG. 8. Fluctuating LPDs: Lateralized periodic discharges that fluctuate in frequency between 0.5 and 1 per second.

FIG. 9. GPDs: One per second sharp generalized periodic discharges.

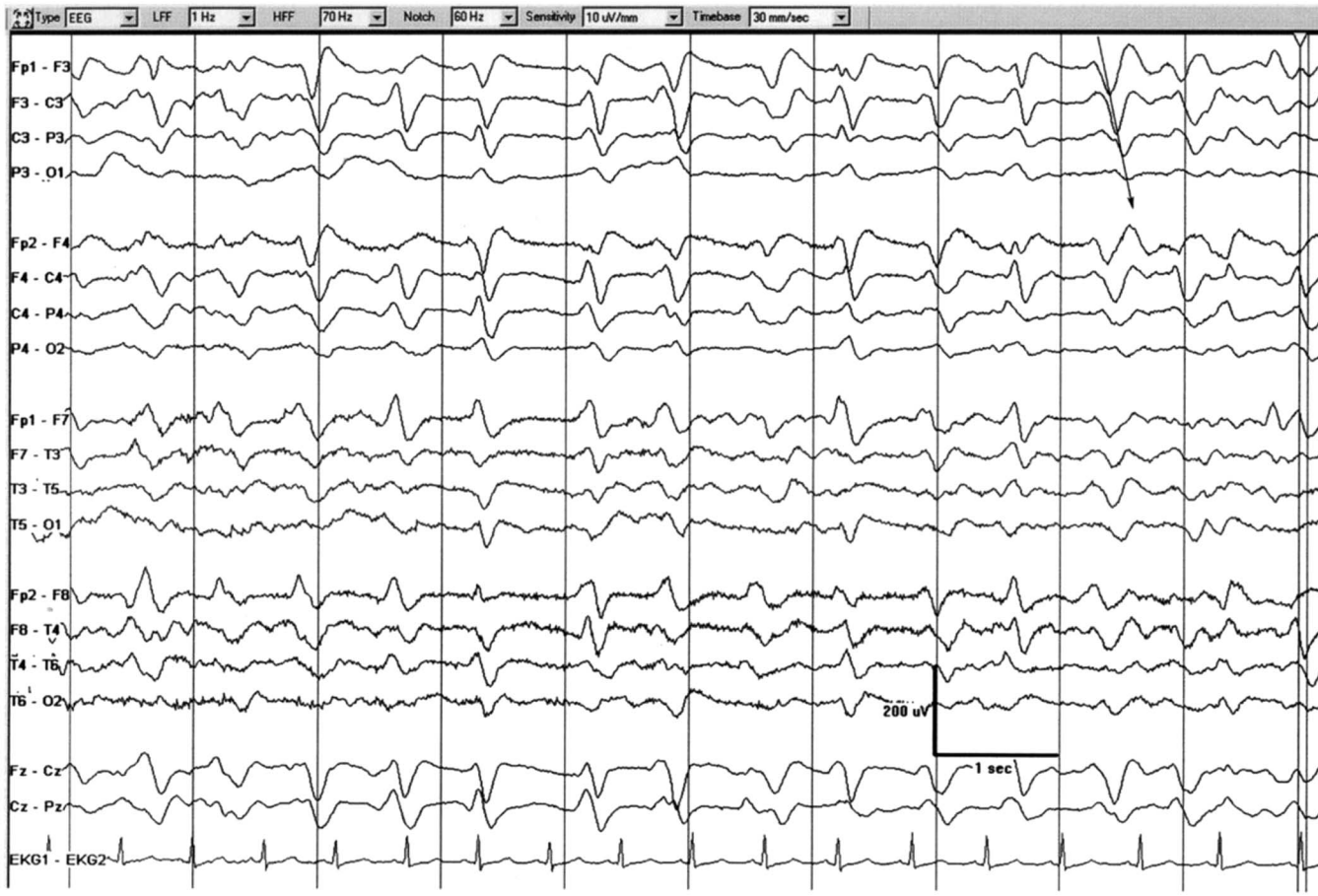

FIG. 10. GPDs with triphasic morphology and A-P lag: Generalized periodic discharges at just under 1.5 per second. In this case there is also a triphasic morphology and an anterior-posterior lag, highlighted with the diagonal line in the upper right of the figure.

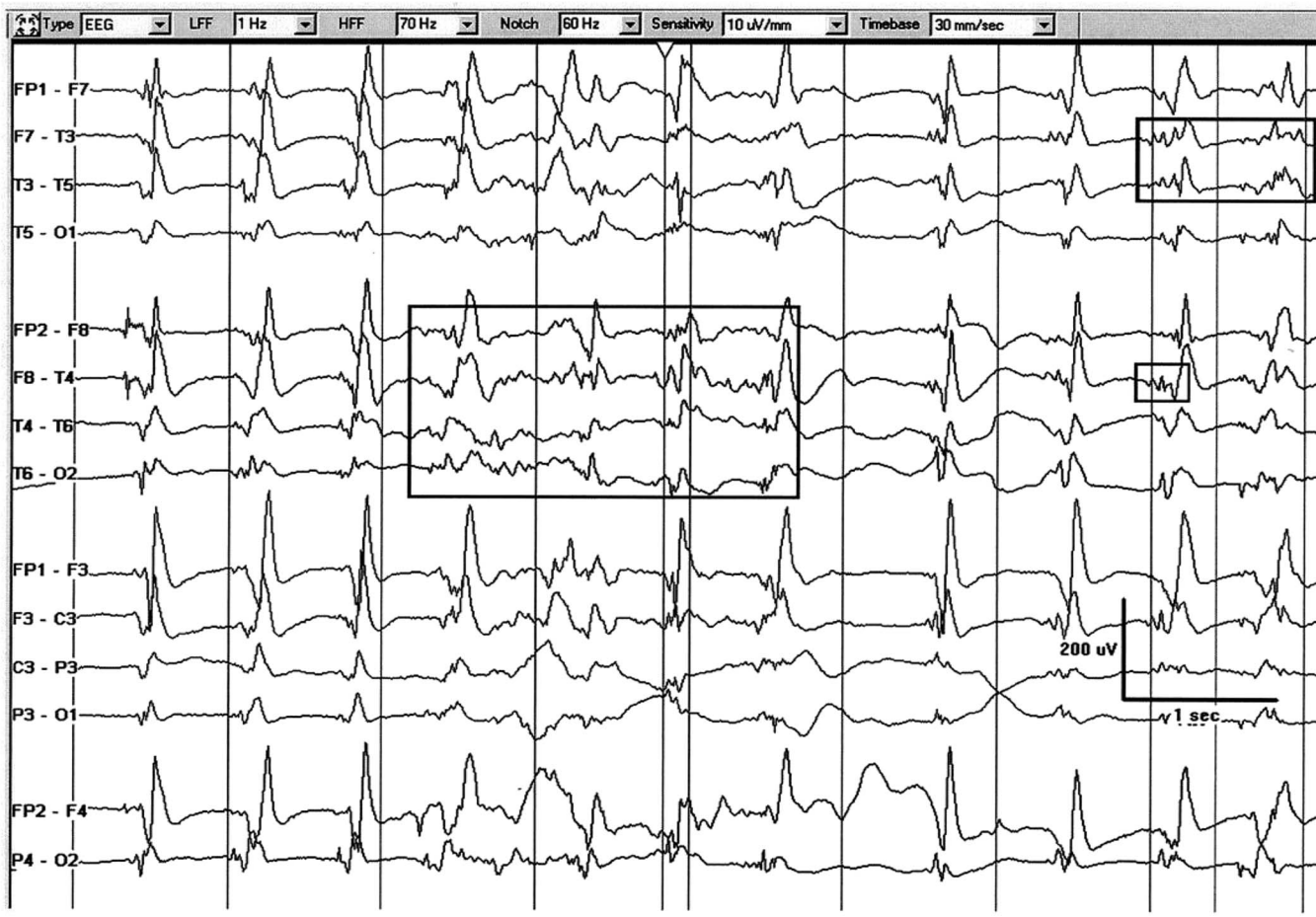

FIG. 11. GPDs+F: 1-1.25 per second sharp GPDs with superimposed low amplitude quasi-rhythmic sharp activity (highlighted in boxes).

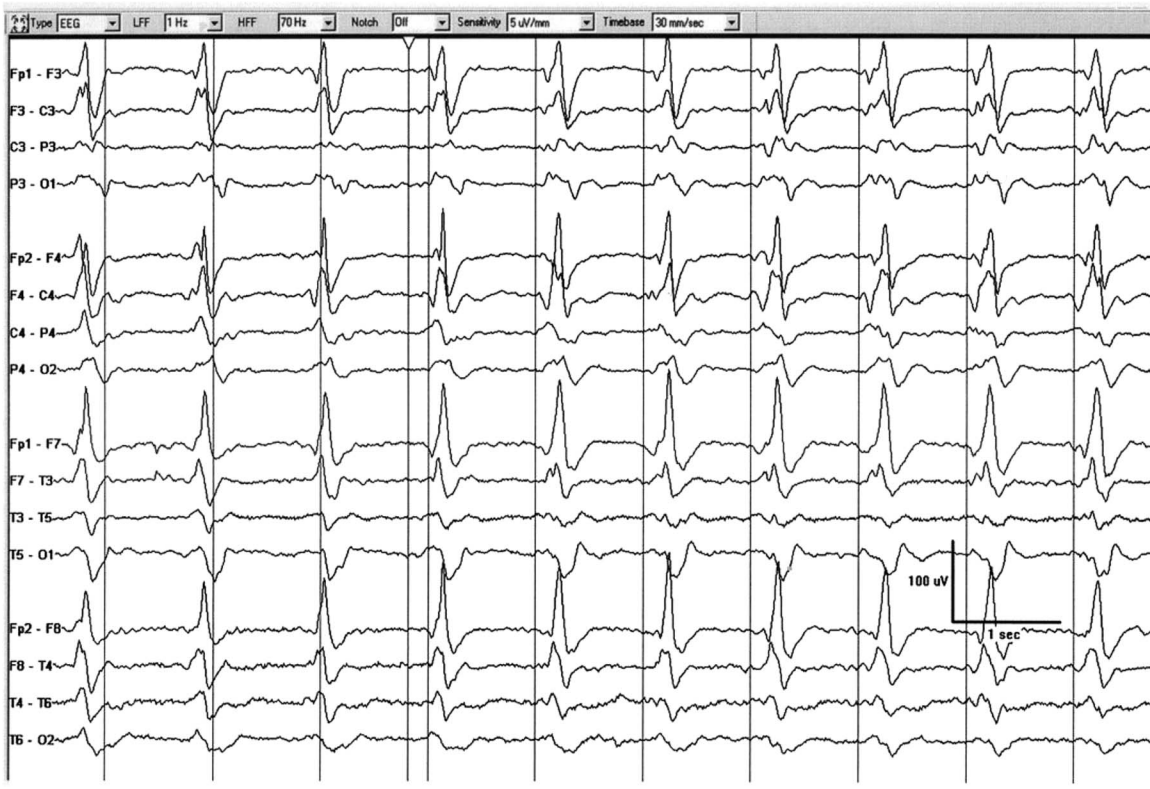

FIG. 12. GPDs: One per second generalized periodic discharges, characterized by a marked frontal predominance and a sharp morphology. Despite background attenuation, the discharges last less than 500ms and thus do not qualify as bursts.

FIG. 13. BIPDs+F: Bilateral independent periodic discharges at 0.5-1 per second, most prominent centroparietally on both sides. The periodic discharges have a sharp morphology and are associated with low amplitude sharply contoured quasi-rhythmic fast activity, especially posteriorly, and more prominent on the right where the fast activity is nearly continuous.

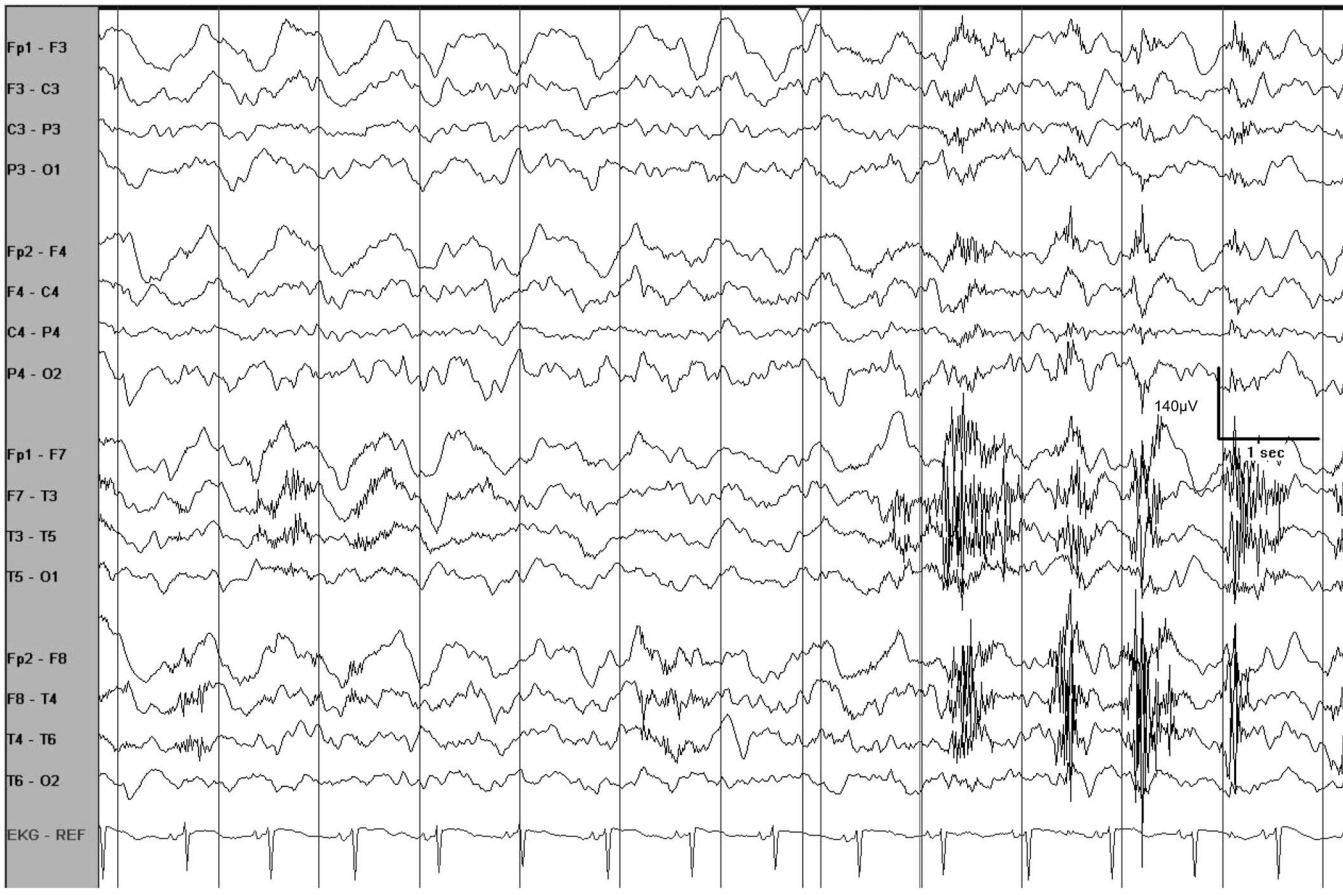

FIG. 14. GRDA: Generalized rhythmic delta activity, frontally predominant. If the lower amplitude faster (α range) frequencies are not present in the background when the GRDA is not present, then this would qualify as GRDA+F.

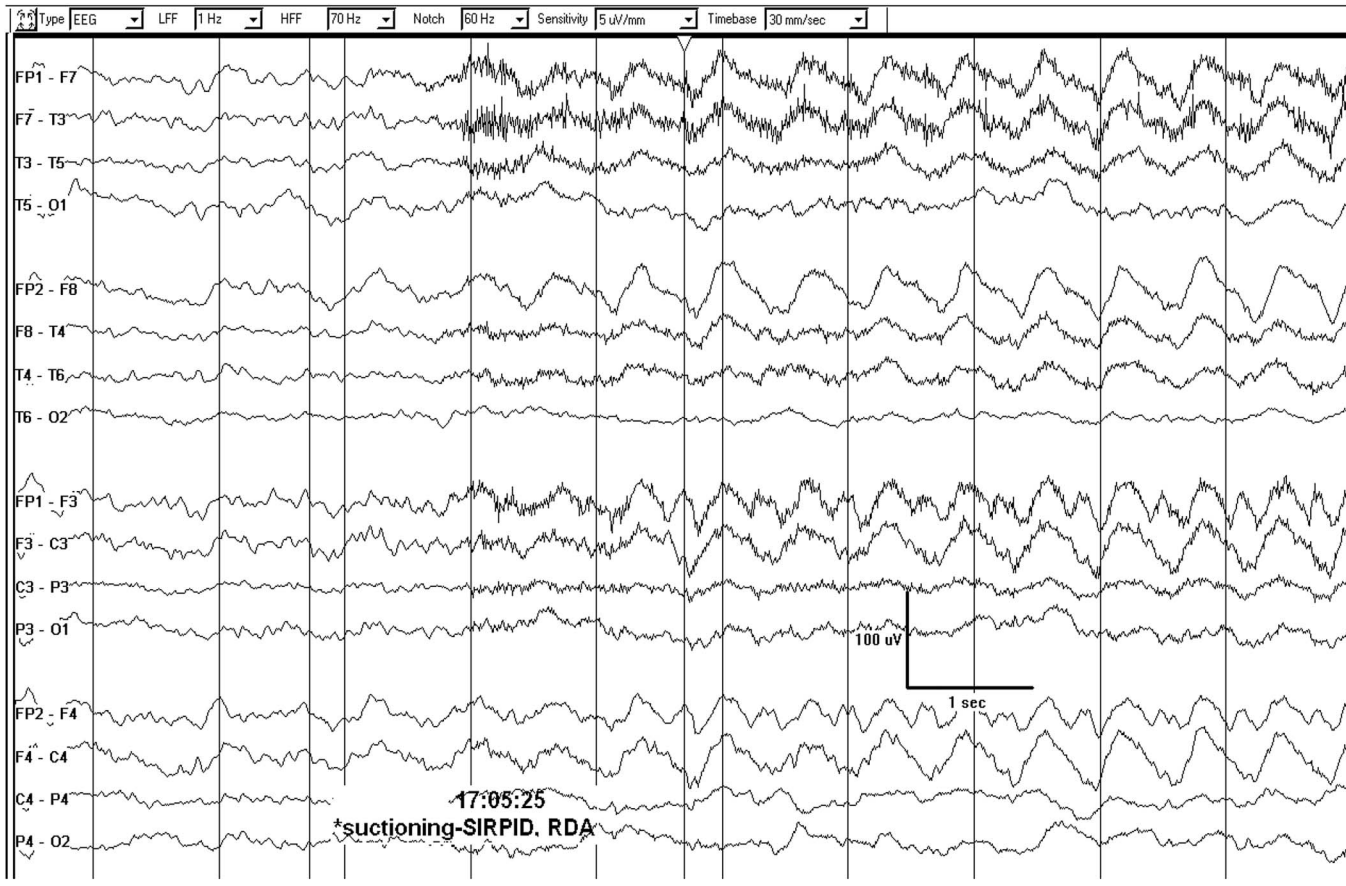

FIG. 15. SI-GRDA: Stimulus-induced generalized rhythmic delta activity, frontally predominant. In this case, the pattern was elicited by suctioning the patient.

FIG. 16. Evolving LRDA: Lateralized rhythmic delta activity that evolves in morphology and frequency. It begins as low voltage sharply contoured 1.5 Hz delta in the left parasagittal region, evolves to 3 Hz rhythmic delta, then again slows.

FIG. 17. Evolving LRDA: Lateralized rhythmic delta activity that evolves in frequency and morphology from a 4 per second blunt RDA to a 2.5 per second sharply contoured RDA.

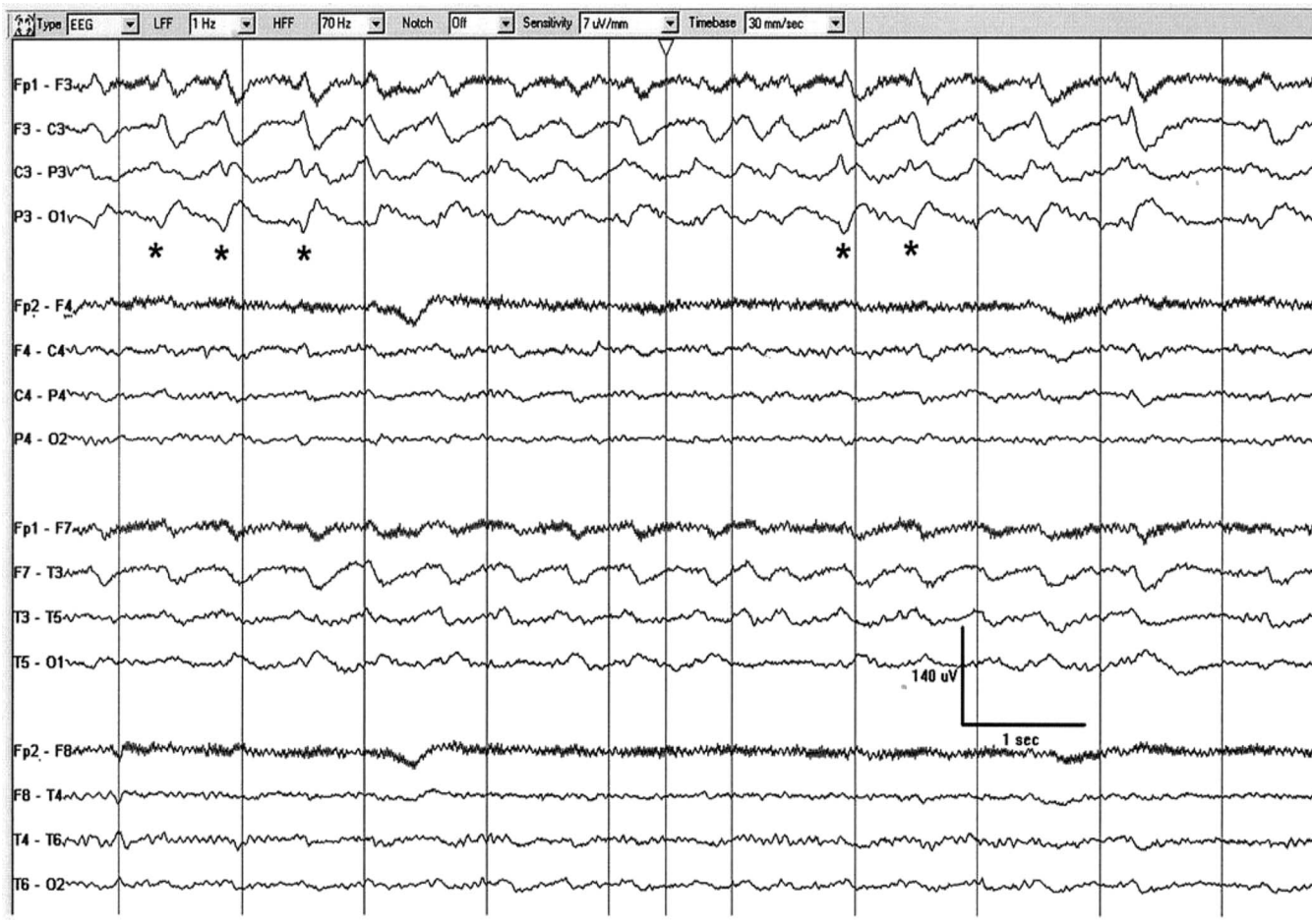

FIG. 18. LRDA+S: Two per second lateralized rhythmic delta activity with superimposed repetitive sharp waves (several marked with asterisks). The superimposed low amplitude fast activity is also present on the right hemisphere and should not be recorded as +F.

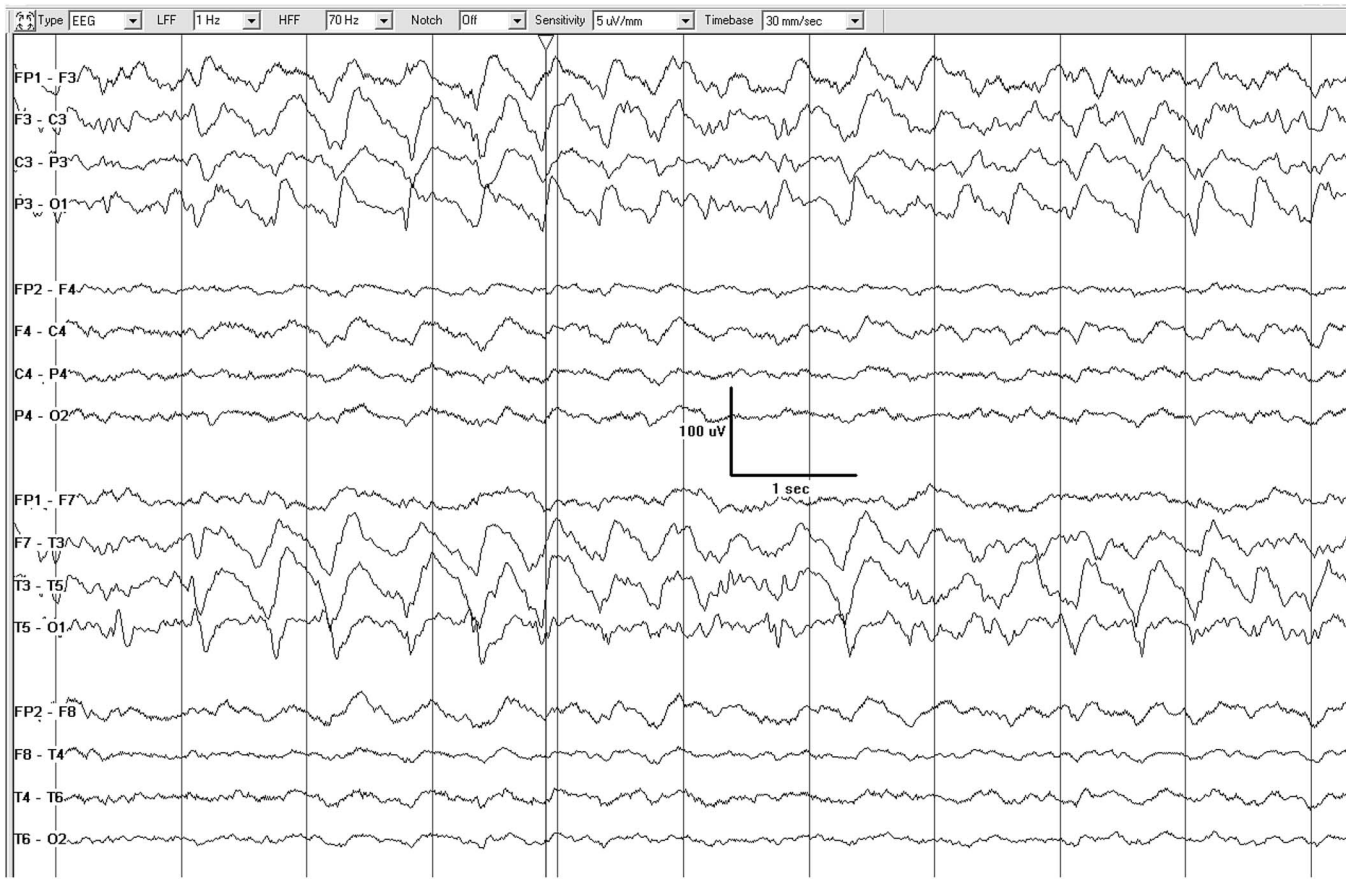

FIG. 19. LRDA+S: Two per second lateralized rhythmic delta activity with superimposed sharp waves most prominent in the left parasagittal region. The superimposed low amplitude fast activity is also present on the right hemisphere and could be recorded as +F if not present in the background (i.e., in the absence of the rhythmic delta activity).

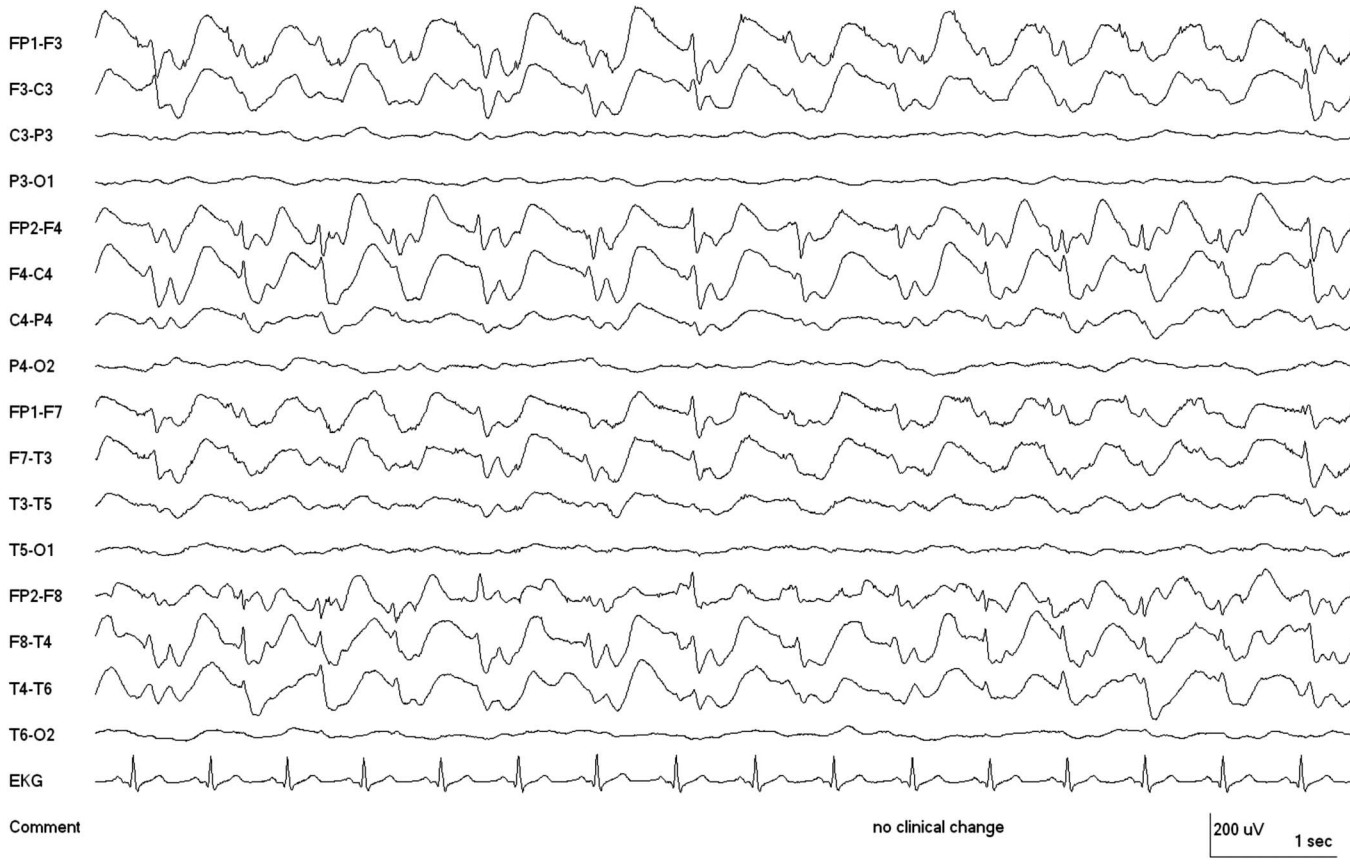

FIG. 20. GSW: 1.5 per second generalized polyspike-and-wave, frontally predominant. A polyspike precedes every slow wave and there is no inter-discharge interval; thus this pattern does not qualify for GRDA+S or GPDs+R.

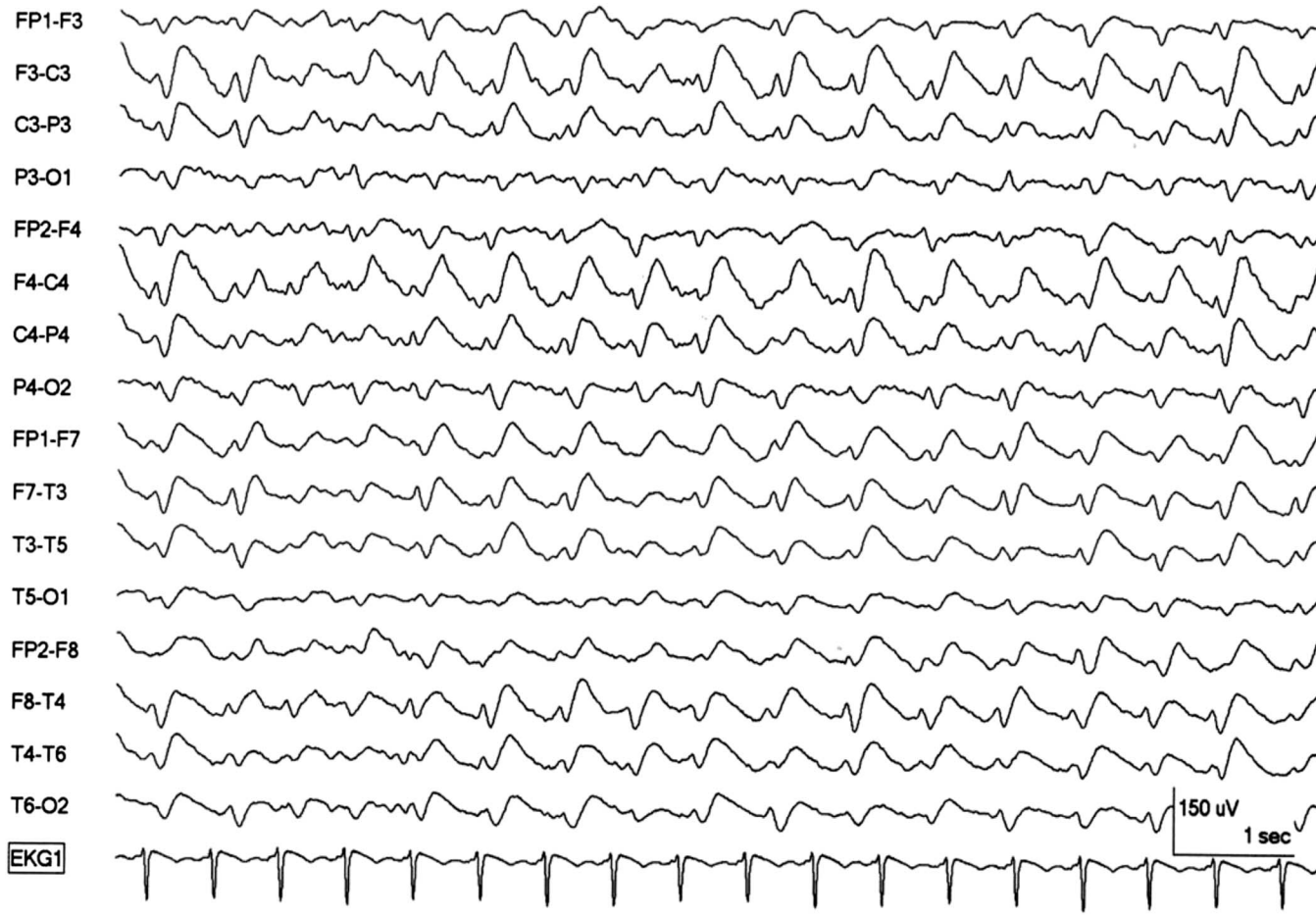

FIG. 21. GSW: 1.5 per second generalized spike-and-wave.

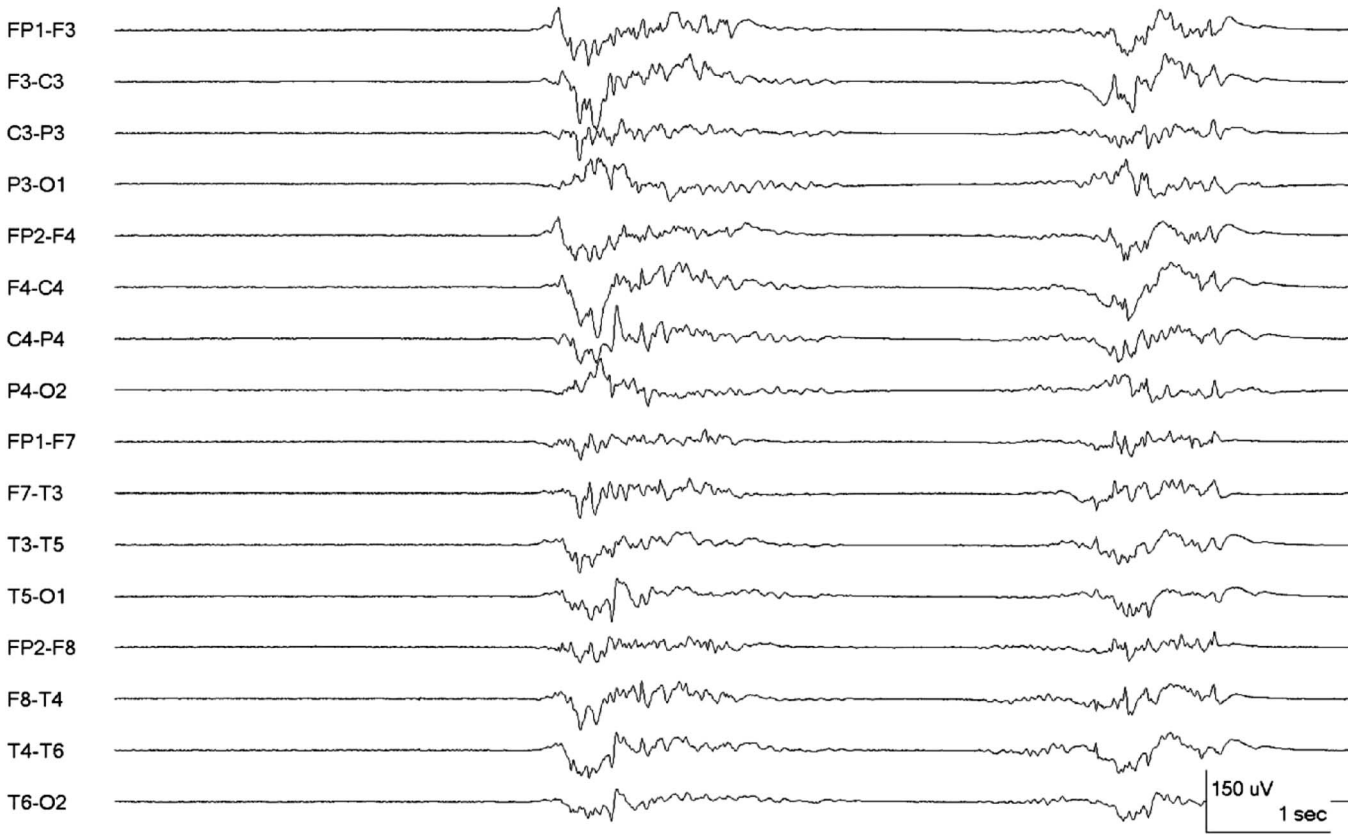

FIG. 22. Burst-suppression pattern: Bursts (>500ms AND >3phases) of generalized activity on a suppressed (<10 μV) background.

FIG. 23. Burst-attenuation pattern: In between bursts of generalized activity, there is low amplitude background activity (<50% of the background/bursts, but >10 μV).

ACNS STANDARDIZED ICU EEG NOMENCLATURE v. 2012: POCKET VERSION

RHYTHMIC OR PERIODIC PATTERNS

All patterns recorded must consist of main term # 1 followed by #2, with modifiers added as appropriate.

MAIN TERMS

1. **Generalized** (**G**) OR **Lateralized** (**L**) OR **Bilateral Independent** (**BI**) OR **Multifocal** (**Mf**)
   Additional localizing information:
   For **L**: Specify unilateral or bilateral asymmetric; and lobe(s) most involved or hemispheric
   For **BI** or **Mf**: Specify symmetric or asymmetric; and lobe(s) most involved or hemispheric in both hemisphere
   For **G**: Specify frontally predominant, occipitally predominant, midline predominant or "truly" generalized

2. **Periodic Discharges** (**PDs**) OR **Rhythmic Delta Activity** (**RDA**) OR **Spike-Wave** (**SW**; includes sharp-wave and polyspike-wave)
   NOTE 1: A pattern can qualify as rhythmic or periodic as long as it continues for at least 6 cycles (e.g. 1/s for 6 seconds, or 3/s for 2seconds).
   NOTE 2: If a pattern qualifies as both GPDs and RDA simultaneously, it should be coded as GPDs+ rather than RDA+ (see modifier 8 below)

MODIFIERS

1. **Prevalence:** Specify % of record or epoch that includes the pattern. This should be based on the percent of seconds that include or are within the pattern. If ≥ 2 patterns are equally or almost equally prominent, record presence and persistence of each.
   a. ≥90% of record/epoch ("Continuous")
   b. 50-89% of record/epoch ("Abundant")
   c. 10-49% of record/epoch ("Frequent")
   d. 1-9% of record/epoch ("Occasional")
   e. <1% of record/epoch ("Rare")
2. **Duration**: Specify typical duration of pattern if not continuous.
   a. ≥1 hour ("Very long")
   b. 5-59 minutes ("Long")
   c. 1-4.9 minutes ("Intermediate duration")
   d. 10-59 seconds ("Brief")
   e. <10 seconds ("Very brief")
3. **Frequency** = Rate (cycles per second): Specify typical rate and range (minimum-maximum) for all patterns.
   Categorize as <0.5/s, 0.5/s, 1/s, 1.5/s, 2/s, 2.5/s, 3/s, 3.5/s and ≥4/s.
4. **Phases** = Number of baseline crossings of the typical discharge (in longitudinal bipolar and in the channel in which it is the most readily appreciated). Applies to PDs and the entire spike-and-wave or sharp-and-wave complex of SW (includes the slow wave) but not to RDA. Categorize as 1, 2, 3 or >3.
5. **Sharpness**: Specify for both the predominant phase (phase with greatest amplitude) and the sharpest phase if different. Applies only to PDs and SW, not RDA. If SW, specify for the spike/sharp wave only. For both phases, describe the *typical* discharge.
   a. Spiky (duration of that component [measured at the EEG baseline] is <70 ms)
   b. Sharp (duration of that component is 70-200 ms)
   c. Sharply contoured (>200ms but with sharp morphology)
   d. Blunt (>200ms)
6. **Amplitude** [of PDs, SW or RDA; not background EEG]:
   a. ***Absolute*:** Typical amplitude measured in standard longitudinal bipolar 10-20 recording in the channel in which the pattern is most readily appreciated. For PDs, this refers to the highest amplitude component. For SW, this refers to the spike/sharp wave. Amplitude should be measured from peak to trough (not peak to baseline). Specify for RDA as well. Categorize amplitude as:
      i. <20 μV ("very low")
      ii. 20-49 μV ("low")
      iii. 50-199 μV ("medium")
      iv. ≥200 μV ("high")
   b. ***Relative:*** For PDs *only* (PDs require 2 amplitudes, absolute and relative). Typical ratio of amplitude of the highest amplitude component to the amplitude of the background between discharges measured in the same channel and montage as absolute amplitude. Categorize as ≤2 or >2.
7. **Polarity**: Specify for the predominant phase (phase with the greatest amplitude) only. Describe the typical discharge. Applies only to PDs and the spike/sharp component of SW, not RDA. Categorize as the following:
   a. Positive
   b. Negative
   c. Dipole, horizontal/tangential
   d. Unclear
8. **Stimulus-Induced** (**SI**) = repetitively and reproducibly brought about by an alerting stimulus, with or without clinical alerting; may also be seen spontaneously. If never clearly induced by stimulation, report as ***spontaneous***. If unknown, unclear or untested, report as "**unknown**". Specify type of stimulus (*auditory*; *light tactile*; patient care and other *non-noxious* stimulations; or *noxious*: suction, sternal rub, nostril tickle or other).
9. **Evolving** OR **Fluctuating**: both terms refer to changes in *either frequency, location or morphology.* If neither term applies, report as **static**.
   a. **Evolving**: an unequivocal sequential change in frequency or location lasting for at least 3 cycles each or an unequivocal sequential change in morphology with each morphology or each morphology plus its transitional forms lasting for at least 3 cycles; The criteria for evolution must be reached without the pattern remaining unchanged in frequency, morphology and location for 5 or more minutes.
      i. Evolution in *frequency:* a change in the same direction for 2 consecutive time periods by at least 0.5/s
      ii. Evolution in *morphology*: at least 2 consecutive changes to a novel morphology
      iii. Evolution in *location*: sequential spread into or sequentially out of at least two standard 10-20 electrode locations
   b. **Fluctuating:** ≥3 changes, not more than one minute apart, in frequency (by at least 0.5/s), ≥3 changes in morphology, or ≥3 changes in location (by at least 1 standard inter-electrode distance), but *not qualifying as evolving*. Change in amplitude or sharpness alone would not qualify as evolving or fluctuating.
10. **Plus (+)** = additional feature(s) rendering a pattern more ictal-appearing than the usual term without the plus. Applies to PDs and RDA only. Categorize as follows:
    a. "+F": superimposed *fast* activity. Can be used with PDs or RDA.

b. "+R": superimposed *rhythmic* or *quasi-rhythmic* activity. Applies to PDs only.
c. "+S": superimposed *sharp* waves or *spikes, or sharply contoured*. Applies to RDA only.
d. "+FR": superimposed *fast* activity and *rhythmic* or *quasi-rhythmic* activity. Applies to PDs only.
e. "+FS": superimposed *fast* activity and *sharp* waves or *spikes, or sharply contoured.* Applies to RDA only.
f. "No +"

NOTE 3: Re: Bilateral "+" vs. unilateral: If a pattern is bilateral and qualifies as plus on one side, but not on the other, the overall main term should include the plus (even though one side does not warrant a plus).
NOTE 4: Re: +F: If a pattern qualifying as RDA or PDs has superimposed continuous fast frequencies, this can and should be coded as +F if the fast activity is not present in the background activity when the RDA or PDs is not present. In other words, if the superimposed fast activity is part of the RDA or PD pattern and not simply part of the background activity.

MINOR MODIFIERS:

1. ***Quasi-*:** Used to modify rhythmic or periodic, as in *quasi-periodic* or *quasi-rhythmic.* (Quasi preferred over pseudo- or semi-). This distinction between quasi- and not quasi is *to be applied only if determined by quantitative computer analysis* (not by visual impression). Quasi is defined as having a cycle length (i.e., period) varying by 25-50% from one cycle to the next in the majority (>50%) of cycle pairs. If >50% variation in the majority of cycles, the pattern would not qualify as rhythmic or periodic and would not be included in this nomenclature. If the variation is <25%, the modifier quasi- would not be appropriate. When not using computer analysis, quasiperiodic is coded as periodic, and quasirhythmic as rhythmic.
2. ***Sudden onset** OR **gradual onset***. Sudden onset is defined as progressing from absent to well developed within 3 seconds.
3. ***Triphasic morphology*:** Either two or three phases, with each phase longer than the previous, and the positive phase of highest amplitude. If three phases, this must be negative-positive-negative in polarity; if two phases, positive-negative. Note that a biphasic waveform may be categorized as "triphasic" by this definition.
4. ***Anterior-posterior lag or reverse lag*:** Applies if a consistent measureable delay of ≥100 msec appears to be present from anterior derivations to posterior derivations; specify typical delay in msec from anterior to posterior (negative = posterior to anterior lag) in both longitudinal bipolar and in a referential montage, preferably with an ipsilateral ear reference.

Quantification of SPORADIC (non-rhythmic and non-periodic) EPILEPTIFORM DISCHARGES

Includes sharp waves and spikes.

- Abundant: >1/(10s), i.e. averaging at least one per typical EEG page, but not periodic
- Frequent: >1/min but less than 1/(10s)
- Occasional: > 1/h but less than 1/min
- Rare: <1/h

BACKGROUND EEG

1. **Symmetry:**
   a. Symmetric
   b. Mild asymmetry (consistent asymmetry in amplitude on referential recording of <50%, or consistent asymmetry in frequency of 0.5 - 1 Hz)
   c. Marked asymmetry (≥50% amplitude or >1 Hz frequency asymmetry).
2. **Breach effect** (note presence, absence, or unclear).
   When any of the following features are asymmetric, they should be described separately for each hemisphere.
3. **Posterior dominant "alpha" rhythm:** Specify frequency (to the nearest 0.5 Hz) or absence.
4. **Predominant background EEG frequency:** Delta, Theta, and/or ≥Alpha. If 2 or 3 frequency bands are equally prominent, record each one.
5. **Anterior-posterior (AP) gradient**: Present, absent or reverse. An AP gradient is present if at any point in the epoch, there is a clear and persistent (at least 1 continuous minute) anterior to posterior gradient of voltages and frequencies such that lower amplitude, faster frequencies are seen in anterior derivations, and higher amplitude, slower frequencies are seen in posterior derivations. A reverse AP gradient is defined identically but with a posterior to anterior gradient of voltages and frequencies.
6. **Variability:** Yes, No, or unknown/unclear/not applicable. The last choice might apply, for example, in a 30-minute awake record.
7. **Reactivity:** Change in cerebral EEG activity to stimulation: Yes, No, or Unclear/unknown/not applicable. This may include change in amplitude or frequency, including attenuation of activity. Strength and/or nature of stimulus should be noted. Appearance of muscle activity or eye blink artifacts does not qualify as reactive. *If the only form of reactivity is SI-RDA, SI-PDs, SI-SW or SI-seizures, categorize as "Reactive, SIRPIDs only").*
8. **Voltage:**
   a. Normal
   b. Low (most or all activity <20 μV in longitudinal bipolar with standard 10-20 electrodes, [measured from peak to trough])
   c. Suppressed (all activity <10 μV). If discontinuous, this refers to the higher amplitude portion
9. **Stage II sleep transients (K-complexes and spindles):**
   a. Normal (K-complexes and spindles both present and normal)
   b. Present (at least one) but abnormal
   c. Absent (both absent).
10. **Continuity:**
    a. Continuous.
    b. Nearly Continuous: continuous, but with occasional (≤10% of the record) periods of attenuation or suppression. Describe typical duration of attenuation/suppression as above.
       i. Nearly continuous with attenuation: periods of lower voltage are ≥10μV but <50% of the background voltage
       ii. Nearly continuous with suppression: periods of lower voltage are <10 μV
       iii. If suppressions/attenuations are stimulus-induced, code as "nearly continuous with SI-attenuation" or "…with SI-suppression"
    c. Discontinuous: 10-49% of the record consisting of attenuation or suppression, as defined above.
    d. Burst-attenuation/Burst-suppression: more than 50% of the record consisting of attenuation or suppression, as defined above, with bursts alternating with attenuation or suppression; specify the following:
       i. Typical duration of bursts and interburst intervals
       ii. Sharpest component of a typical burst using the sharpness categories defined above under modifiers
       iii. Presence or absence of Highly Epileptiform Bursts: Present if multiple epileptiform discharges (traditional definition) are present >1/sec, or a rhythmic, potentially ictal-appearing pattern >1 Hz is seen within the majority (>50%) of bursts; record typical frequency (using categories above) and location (G, L, BI or Mf).
    e. Suppression: entirety of the record consisting of suppression (<10 uV, as defined above).

NOTE 5: Bursts must average more than 0.5 seconds and have at least 4 phases (polyphasic); if shorter or fewer phases, they should be considered single discharges. Bursts within burst-suppression or burst-attenuation can last up to 30 seconds.

Other terms for Research Use:

1. "**Daily Pattern Duration**" is defined as total duration of a pattern per 24 hours.
2. "**Daily Pattern Index**" is defined as Daily Pattern Duration X Mean Frequency (Hz).

ACNS Standardized Critical Care EEG Terminology: 2012 version
Reference Chart

Main term 1
G *Generalized* *- Optional : Specify frontally, midline or occipitally predominant*
L *Lateralized* *- Optional: Specify unilateral or bilateral asymmetric* *- Optional: Specify lobe(s) most involved or hemispheric*
BI *Bilateral Independent* *- Optional: Specify symmetric or asymmetric* *- Optional: Specify lobe(s) most involved or hemispheric*
Mf *Multifocal* *- Optional: Specify symmetric or asymmetric* *- Optional: Specify lobe(s) most involved or hemispheric*

Main term 2
PD *Periodic Discharges*
RDA *Rhythmic Delta Activity*
SW *Rhythmic Spike and Wave* *OR* *Rhythmic Sharp and Slow Wave* *OR* *Rhythmic Polyspike and Wave*

Plus (+) Modifier
No +
+F *Superimposed fast activity – applies to PD or RDA only*
+R *Superimposed rhythmic activity – applies to PD only*
+S *Superimposed sharp waves or spikes, or sharply contoured - applies to RDA only*
+FR *If both subtypes apply – applies to PD only*
+FS *If both subtypes apply – applies to RDA only*

Major modifiers

Prevalence	Duration	Frequency	Phases[1]	Sharpness[2]	Absolute Amplitude	Relative Amplitude[3]	Polarity[2]	Stimulus Induced	Evolution[4]
Continuous ≥90%	**Very long** ≥1h	**≥4/s**	**>3**	**Spiky** <70ms	**High** ≥200μV	**>2**	**Negative**	**SI** *Stimulus Induced*	**Evolving**
Abundant 50-89%	**Long** 5-59min	**3.5/s**	**3**	**Sharp** 70-200ms	**Medium** 50-199μV	**≤2**	**Positive**	**Sp** *Spontaneous only*	**Fluctuating**
Frequent 10-49%	**Intermediate duration** 1-4.9min	**3/s**	**2**	**Sharply contoured** >200ms	**Low** 20-49μV		**Dipole**	**Unk** *Unknown*	**Static**
Occasional 1-9%	**Brief** 10-59s	**2.5/s**	**1**	**Blunt** >200ms	**Very low** <20μV		**Unclear**		
Rare <1%	**Very brief** <10s	**2/s**							
		1.5/s							
		1/s							
		0.5/s							
		<0.5/s							

Minor modifiers

Onset	Triphasic[5]	Lag
Sudden ≤3s	**Yes**	**A-P** *Anterior-Posterior*
Gradual >3s	**No**	**P-A** *Posterior-Anterior*
		No

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

Prevalence
Abundant ≥1/10s
Frequent 1/min-1/10s
Occasional 1/h-1/min
Rare <1/h

Background

Symmetry	Breach effect	PDR	Background EEG frequency	AP Gradient	Variability	Reactivity	Voltage	Stage II Sleep Transients	Continuity
Symmetric	**Present**	**Present** Specify frequency	**Delta**	**Present**	**Present**	**Present**	**Normal** ≥20μV	**Present and normal**	**Continuous**
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)
Marked asymmetry >50% Amp. >1/s Freq.	**Unclear**		**≥Alpha**	**Reverse**	**Unclear**	**Absent**	**Suppressed** <10μV	**Absent**	**Discontinuous:** 10-49% **periods of suppression** or **attenuation**
						Unclear			**Burst-suppression** or **Burst-attenuation:** 50-99% **periods of suppression** or **attenuation**
									Suppression