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Special Article

Report of the ILAE Classification Core Group

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Summary: A Core Group of the Task Force on Classification and Terminology has evaluated the lists of epileptic seizure types and epilepsy syndromes approved by the General Assembly in Buenos Aires in 2001, and considered possible alternative systems of classification. No new classification has as yet been proposed. Because the 1981 classification of epileptic seizure types, and the 1989 classification of epilepsy syndromes and epilepsies are generally accepted and workable, they will not be discarded unless, and until, clearly better classifications have been devised, although periodic modifications to the current classifications may be suggested. At this time, however, the Core Group has focused on establishing scientifically rigorous criteria for identification of specific epileptic seizure types and specific epilepsy syndromes as unique diagnostic entities, and is considering an evidence-based approach. The short-term goal is to present a list of seizure types and syndromes to the ILAE Executive Committee for approval as testable working hypotheses, subject to verification, falsification, and revision. This report represents completion of this work. If sufficient evidence subsequently becomes available to disprove any hypothesis, the seizure type or syndrome will be reevaluated and revised or discarded, with Executive Committee approval. The recognition of specific seizure types and syndromes, as well as any change in classification of seizure types and syndromes, therefore, will continue to be an ongoing dynamic process. A major purpose of this approach is to identify research necessary to clarify remaining issues of uncertainty, and to pave the way for new classifications. **Key Words:** Epileptic seizures—Epilepsy syndromes—Classification—Terminology

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*Although Dr. Lüders continues to be a participating member of this working group, he does not fully agree with this report and does not wish to be considered a coauthor.

The members of the Classification Core Group were chosen from the Task Force on Classification and Terminology by the ILAE Executive Committee as leaders in the field of epileptology whose work has most importantly influenced the concepts of classification in recent years. The group is not only representative of the major positions in the ongoing debate on classification, but also of the multiple professional disciplines and geographic regions that make up the ILAE constituency. In addition, Dr. Anne Berg was asked to join this group because of her background as an epidemiologist and her knowledge of the scientific process of constructing biological classification systems. The group has met three times, first in Santa Monica, California, on August 25–27, 2003, and was joined at that time by Dr. Nelson Freimer, a UCLA psychiatrist and geneticist, who has initiated the human phenome project. A second meeting was held during the American Epilepsy Society meeting in Boston on December 7, 2003. The third meeting was again in Santa Monica, California, on May 27 and 28, 2005. Between meetings, deliberations have

been carried out by e-mail. The work of the Task Force can be reviewed at www.epilepsy.org/ctf.

The purpose of these meetings was to discuss the feasibility of creating a paradigm shift in our concept of classifications in the field of epilepsy, based on the establishment of measurable objective criteria for recognizing epileptic seizure types and epilepsy syndromes as unique diagnostic entities or natural classes that can be reproducibly distinguished from all other diagnostic entities or natural classes (1). This process differs significantly from that used for previous classifications of epilepsy which, although based on the extensive experience of experts, did not include the establishment of explicit specific criteria and did not until recently have the capacity to move beyond signs, symptoms, and EEGs, and incorporate more fundamental concepts of pathophysiology.

This report represents an initial attempt to use a variety of specified criteria to identify discrete epileptic seizure types and epilepsy syndromes as diagnostic entities. An approach is developed to treat these diagnostic entities as testable working hypotheses, subject to verification, falsification, and revision. The report consists of a brief summary of the work of the Task Force to date, followed by a discussion of the basic concepts for identification of discrete diagnostic entities, which are then listed and described, for both epileptic seizures and epilepsy syndromes. One important purpose of this report is to stimulate future study and research, not only to construct a more scientifically valid classification of epileptic seizure types and epilepsy syndromes, but to better understand their fundamental mechanisms and design more effective means of diagnosis, treatment, and prevention.

BACKGROUND

Since its inception in 1997, the ILAE Task Force on Classification and Terminology set forth its goals for reevaluating the current classifications for epileptic seizures and epilepsy (2) and proposed a diagnostic scheme for describing individual patients, which includes lists of generally agreed-upon epileptic seizure types and epilepsy syndromes (3). It also published a glossary of terms to be used when describing ictal phenomena (4), and a series of essays on concepts of classification to be considered in the process of creating a new classification system (5–10). Although the ILAE General Assembly approved the new diagnostic scheme and the progress of the Task Force in Buenos Aires in 2001, none of the work so far has negated the current 1981 classification of epileptic seizures (11) and the 1989 classification of epilepsies, epilepsy syndromes, and related disorders (12). *It was a unanimous early agreement of the group that these two current classifications are generally accepted and workable, and that they should not be discarded unless, and until, a clearly better classification has been devised, although some modifications to the current classifications are anticipated.*

BASIC CONCEPTS AND PRELIMINARY CONCLUSIONS

EPILEPTIC SEIZURES

The ILAE has recently accepted the definition of an epileptic seizure as "a transient occurrence of signs and/or symptoms due to abnormal excessive or synchronous neuronal activity in the brain" (18). Epileptic seizures result from specific abnormal patterns of excitability and synchrony among neurons in select brain areas, usually, but not necessarily, involving cortex. There are many types of epileptic seizures. An epileptic seizure type that represents a unique diagnostic entity or natural class ought to be defined on the basis of a distinct pathophysiology and anatomical substrate. The anatomical substrate refers to specific local neuronal networks and long-tract connections, but not necessarily to areas of neocortex that subserve different normal functions. For instance, focal clonic movements caused by an epileptogenic abnormality in precentral cortex are not, in any essential way, different from unformed visual hallucinations caused by the same type of epileptogenic abnormality in the calcarine cortex if the pathophysiologic mechanisms are the same, just as electrical stimulation-induced afterdischarge of neocortex represents the same epileptogenic mechanism, regardless of the area of neocortex stimulated and the behavioral signs and symptoms elicited.

It was noted that causes of ictal phenomena are not unitary and static, but often evolve over time. For instance, as shown in the Fig. 1, several separate etiologies (e. g., four sodium-channel gene mutations, A, B, C, and D) could ultimately give rise to the same ictal generation, either directly (solid straight line), or by altering developmental patterns (dotted lines), or by some circuitous unknown mechanism (wavy line). In this example, examining the etiology too early (dashed line 1) could falsely increase the

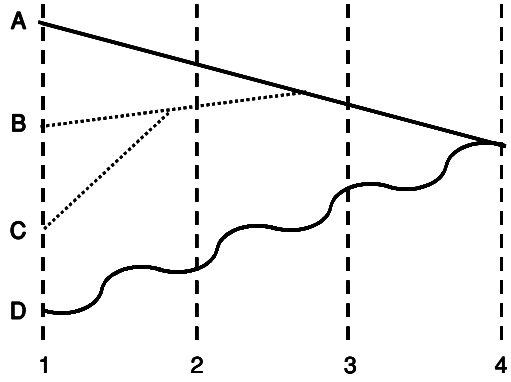

FIG. 1. Potential developmental influence of four different etiologies producing the same phenotype. See text for explanation.

number of pathophysiologic mechanisms and anatomic substrates, while observing the end point (dashed line 4) would give the mistaken impression that there was only one mechanism. Where along the causal pathway (dashed line 2 or 3) the correct determination of the mechanisms should be made, however, remains unclear.

The following criteria were used to select specific seizure types as possibly unique diagnostic entities, for further hypothesis testing.

- Pathophysiologic mechanisms: Including electrophysiological features, neural networks, neurotransmitter evidence if known (e. g., increased excitation and decreased inhibition for generalized tonic–clonic and some neocortical seizures vs. increased excitation and increased inhibition, leading to hypersynchronization for absences and some hippocampal seizures).
- Neuronal substrates: For these purposes, the neocortex is considered a single substrate regardless of exact location, unless specific pathophysiologic mechanisms differ. Other brain structures and networks should be included (e. g., thalamic reticular nucleus for absence seizures vs. brain stem for generalized tonic–clonic seizures [GTCS]).
- Response to AEDs: Selective responsiveness to or exacerbation associated with specific drugs can suggest a specific mechanism of seizure generation.
- Ictal EEG patterns: Specific ictal EEG patterns can be necessary diagnostic features of specific seizure types (e. g., 3/sec s/w for absences). These should reflect specific pathophysiologic mechanisms and anatomical substrates.
- Propagation patterns and postictal features: Patterns of propagation, or lack of propagation, and postictal features, or lack of them, help to define pathophysiologic mechanisms and anatomic substrates (e. g., typical absences have no postictal dysfunction; contralateral propagation is slow for hippocampal seizures vs. fast for neocortical seizures; some seizures are strictly local, others are more widespread).
- Epilepsy syndrome(s): Syndromes that are associated with this seizure type.

Although the dichotomy of focal (partial) versus generalized has been criticized, and we have recommended in an earlier report that these terms should eventually be discarded because no seizures or syndromes are truly generalized, nor is it likely that many, if any, seizures or syndromes are due to a discretely focal epileptogenic process, the Core Group has recognized the value of distinguishing epileptic seizures that begin in a part of one hemisphere, from those that appear to begin in both hemispheres at the same time. The Core Group, however, has been unable to come up with simple terms to describe these two situations. Given the prevalent usage, and the therapeutic implications, of the terms "focal" and "generalized," we have decided to retain them, with the understanding that the former does not necessarily imply that the epileptogenic region is limited to a small circumscribed area, nor does the latter imply that the entire brain is involved in initiation of the epileptogenic process. Epileptic seizure types are shown in Table 1.

Self-Limited Epileptic Seizure Types

I. GENERALIZED ONSET

A. Seizures with Tonic and/or Clonic Manifestations

1. *Tonic–clonic seizures*: involve brain stem, possibly prefrontal, and basal ganglia mechanisms. Ictal initiation of primarily bilateral events are predominantly disinhibitory, but other mechanisms are responsible for ictal evolution to the clonic phase, involving gradual periodic introduction of seizure-suppressing mechanisms. Several discrete types might be identified: Future investigation is needed to determine which of these types represent unique phenomena.

- Reactive GTCS (acutely provoked seizures).
- GTCS of idiopathic generalized epilepsies.
- GTCS of symptomatic generalized epilepsies.
- GTCS evolving from myoclonic seizures (e. g., clonic–tonic–clonic seizures in Juvenile myoclonic epilepsy (JME) and epilepsy with myoclonic astatic seizures).
- GTCS evolving from absence seizures.

And several questions can be raised:

- Do patients with idiopathic focal epilepsies have primarily generalized as well as secondarily generalized seizures? Some data suggest that GTCS in Benign childhood epilepsy with centrotemporal spikes (BCECTS) are secondarily generalized, although some patients with this condition may have primarily generalized GTCS as well.
- What are clonic–tonic–clonic seizures? Are GTCS that evolve from myoclonic seizures the only form, or are there also true clonic–tonic–clonic seizures (as may be seen in forms of progressive myoclonus epilepsy [PME])?
- How should we regard hemi-generalized seizures that manifest unilaterally in the immature brain owing to poor myelinization of the corpus callosum? In this case, the disorder is bilateral, but the onset is clearly unilateral. Do these only occur in infants, or do they also occur in children and adults? In some infants, hemi-generalized seizures have focal onset.

Some experimental evidence suggests that the mechanisms of ictal initiation could be different for some or even

TABLE 1. *Seizure types*

- Self-limited epileptic seizures
  - I. Generalized onset
    - A. Seizures with tonic and/or clonic manifestations
      - 1. Tonic-clonic seizures
      - 2. Clonic seizures
      - 3. Tonic seizures
    - B. Absences
      - 1.Typical absences
      - 2. Atypical absences
      - 3. Myoclonic absences
    - C. Myoclonic seizure types
      - 1. Myoclonic seizures
      - 2. Myoclonic astatic seizures
      - 3. Eyelid myoclonia
    - D. Epileptic spasms
    - E. Atonic seizures
  - II. Focal onset (partial)
    - A. Local
      - 1. Neocortical
        - a. Without local spread
          - i Focal clonic seizures
          - ii Focal myoclonic seizures
          - iii Inhibitory motor seizures
          - iv Focal sensory seizures with elementary symptoms
          - v Aphasic seizures
        - b. With local spread
          - i Jacksonian march seizures
          - ii Focal (asymmetrical) tonic seizures
          - iii Focal sensory seizures with experiential symptoms
      - 2. Hippocampal and parahippocampal
    - B. With ipsilateral propagation to:
      - 1. Neocortical areas (includes hemiclonic seizures)
      - 2. Limbic areas (includes gelastic seizures)
    - C. With contralateral spread to:
      - 1. Neocortical areas (hyperkinetic seizures)
      - 2. Limbic areas (dyscognitive seizures with or without automatisms [psychomotor])
    - D. Secondarily generalized
      - 1. Tonic-clonic seizures
      - 2. Absence seizures
      - 3. Epileptic spasms (unverified)
  - III. Neonatal seizures
- Status epilepticus
  - I. Epilepsia partialis continua (EPC)
    - A. As occurs with Rasmussen syndrome
    - B. As occurs with focal lesions
    - C. As a component of inborn errors of metabolism
  - II. Supplementary motor area (SMA) status epilepticus
  - III. Aura continua
  - IV. Dyscognitive focal (psychomotor, complex partial) status epilepticus
    - A. Mesial temporal
    - B. Neocortical
  - V. Tonic-clonic status epilepticus
  - VI. Absence status epilepticus
    - A. Typical and atypical absence status epilepticus
    - B. Myoclonic absence status epilepticus
  - VII. Myoclonic status epilepticus
  - VIII. Tonic status epilepticus
  - IX. Subtle status epilepticus

all of these subtypes of GTCS, and that there may even be more than one mechanism of initiation within each of the subtypes.

2. *Clonic seizures*: Clonic seizures are fast rhythmic events (1–2 Hz), associated, or not, with impaired consciousness. Mechanisms are different from those of the clonic phase of GTCS. In the latter, the clonic phase represents the phasing in of seizure-suppressing mechanisms, whereas in clonic seizures, the repetitive discharges appear to be due primarily to rhythmic excitatory discharges. There may be several types of generalized clonic seizures.

3. *Tonic seizures*: The mechanism of tonic seizures is probably not the same as that of the tonic phase of GTCS. Generalized tonic seizures typically occur in Lennox–Gastaut syndrome and occasionally in epilepsy with myoclonic astatic seizures.

B. Absences

1. *Typical absences*: Although the pyknoleptic manifestations of typical absences in Childhood absence epilepsy (CAE) have been suggested to differ by shorter duration from the longer-duration, less-frequent absences of Juvenile absence epilepsy (JAE), based on what we currently know, it seems likely that they do not represent two mechanisms, but merely the evolution of a single mechanism as the brain matures. Phantom absences also are likely to be a result of brain maturation. A working group will be convened to study whether absences of CAE and JAE represent two seizure types or a spectrum of the same seizure type, and to better define associated motor components.

2. *Atypical absences*: There are variable manifestations of this ictal event, some involving hypotonia and atonia. Better criteria for characterizing atypical absences will also be discussed by the working group on atonic seizures.

3. *Myoclonic absences*: The myoclonic components of these seizures are rhythmic ($2\frac{1}{2}$–$4\frac{1}{2}$ Hz) clonic rather than myoclonic and have a tonic component. The seizure type should be called something else, but there is no agreement on another name at this time.

C. Myoclonic Seizures Types

1. *Myoclonic seizures*: The distinction between myoclonic seizures and clonic seizures is not clear. Classically, clonic seizures are rapid rhythmically recurrent events, whereas myoclonic seizures are single, or irregularly recurrent events. The prototype of generalized myoclonic seizures are those occurring with JME. These are typically bilateral and symmetrical, but localized reflex myoclonus can also occur. The slowly rhythmic events of Subacute sclerosing panencephalitis (SSPE) used to be considered epileptic myoclonus but are more accurately epileptic spasms; those with biPEDs (bilaterally synchronous PLEDs) in comatose patients also are not necessarily epileptic, and their cause is usually not clearly defined. Differential diagnosis between myoclonic and clonic seizures can be difficult because a single jerk can be a fragment of a clonic seizure.

Working groups will be convened to specifically evaluate myoclonic epileptic phenomena, including negative myoclonus and atonic seizures, compare them with nonepileptic myoclonic phenomena, and develop uniform criteria and terminology for these diagnoses.

2. *Myoclonic astatic seizures*: These seizures occur typically in epilepsy with myoclonic astatic seizures. There is a question as to whether the astatic component is an atonic seizure.

3. *Eyelid myoclonia*: The degree to which these recurrent events (5–6 Hz) are associated with impairment of consciousness has not been adequately documented, and should be. In some patients, they can be provoked by eye closure. The seizure type, however, does exist as a unique entity.

D. Epileptic Spasms: The mechanism of epileptic spasms is unknown. The semiology and pathophysiology of epileptic spasms in the more mature brain need to be better defined.

E. Atonic Seizures: A number of seizure types involve an atonic component, some of which may be variants of atypical absences, others of which can have an initial brief tonic or myoclonic component. When these events are very short, they have been referred to as negative myoclonus. A working group will be convened to review videotapes of various types of atonic seizures, and to develop criteria to distinguish between negative myoclonus, atonic seizures, and perhaps some atypical absences.

II. FOCAL ONSET

The anatomical substrates of a substantial number of focal seizure manifestations have now been sufficiently established to include this information in their description. Because focal seizures represent dynamic events that usually involve propagation, and clinical manifestations can reflect discharges at the site of ictal onset, and/or sites of propagation, the organization of focal seizures here takes into account the various patterns of ictal propagation. In addition, a number of factors will need to be investigated in order to develop more definitive criteria for distinguishing between different types of focal seizures. These include:

- Factors that might distinguish between focal seizures due to discretely localized lesions, as occur with focal symptomatic epilepsy, and focal seizures due to more distributed network disturbances, as might occur with some focal idiopathic epilepsies (e. g., those responsible for the transverse dipole of BCECTS), or even in idiopathic generalized epilepsies.
- Maturational factors.
- Modes of precipitation, as in reflex seizures.
- Pathology, that is, focal seizures due to various malformations of cortical development may be different from each other and from those due to other lesions.
- Pathophysiologic mechanisms, for example, hypersynchronous ictal onsets, which most commonly occur in hippocampus, versus low voltage fast ictal onsets, which most commonly occur in neocortex. These electrophysiological features clearly reflect different pathophysiologic mechanisms of seizure initiation, which may not be absolutely correlated with location, and there may be other ictal onset patterns indicative of other initiating mechanisms that have not yet been well described.
- Location, not with respect to differences in ictal semiology that reflect differences in the normal function of cortex, but to differences in neurophysiologic properties and anatomical connections unique to specific areas of cortex, for example, those that cause brief and clustered seizures with little or no postictal disturbances and nocturnal predilection typical of some frontal areas, as compared to longer, less-frequent events with profound postictal disturbances in other areas, and those that cause fast distant propagation from some areas and localized, slower propagation in others.

Factors influencing seizure-induced progressive disturbances in neuronal function and structure at the site of, and downstream from, ictal onset.

A. Local

1. *Neocortical*

a. Without local spread

i *Focal clonic seizures* are brief focal motor events that are distinguished from focal myoclonic seizures by their rhythmic repetition. Localization to the primary motor cortex is implied.

ii *Focal myoclonic seizures* most likely consist of many types. These events, including *multifocal myoclonus*, will be discussed by the working group on myoclonus. There is no unanimity of opinion as to whether the myoclonic events in PME which have no EEG correlate are epileptic. At least in Lafora, there is evidence to suggest a cortical site of initiation.

iii *Inhibitory motor seizures* are not a unique seizure type. The clinical manifestation merely represents the function of the involved cortex, just as focal motor seizures and unformed visual hallucinations reflect seizures in precentral gyrus and calcarine cortex.

iv *Focal sensory seizures with elementary* (visual, somatosensory, vestibular, olfactory, gustatory, or auditory) symptoms manifest themselves as a variety of sensory phenomena that can be produced by activation of primary sensory cortices.

v *Aphasic seizures* can consist of inability to speak when Broca's area is principally involved, or more complex disturbances of speech production or reception when other language cortical areas are principally involved.

b. With local spread

i *Jacksonian march seizures* refers to the clinical manifestations of the slow ephaptic propagation of epileptic discharge along the motor cortex, although similar progression can sometimes be seen in other primary cortical areas as well.

ii *Focal (asymmetric) tonic seizures* can be associated with seizure origin from practically anywhere in the neocortex. In their purest form, focal tonic seizures are seen in the explosive motor seizures of supplementary motor area origin.

iii *Focal sensory seizures with experiential symptoms* are those with complex, usually formed, distorted and/or multimodal, sensory symptoms implying seizure initiation in association cortices, such as the temporo-parieto-occipital junction, with connections to multiple sensory areas.

2. *Hippocampal and parahippocampal* seizures almost always require local spread for clinical manifestation, which may involve insula, amygdala, hypothalamus, and other limbic structures. Autonomic features such as a sensation of epigastric rising is common, as well as emotional experiences such as fear, dysmnesias, focal sensory seizures with olfactory or gustatory symptoms, and vague bilateral sensory phenomena such as tingling.

B. With Ipsilateral Propagation to:

1. *Neocortical areas*

a. Same manifestations as II. A.1. a. and b.

b. *Hemiclonic seizures* occur early in the development before myelinization of the corpus callosum and do not necessarily have localizing value. They can alternately affect both hemispheres, as in Dravet syndrome and ischemic encephalopathy, or only one hemisphere in the case of focal disturbances.

2. *Limbic areas*

a. Same manifestations as II. A.2.

b. *Gelastic seizures* are clearly unique ictal events when they are initiated in relation to structural abnormalities of the hypothalamus, which are usually hamartomas. The mechanism is unknown, but initiation, at least, is distinct from gelastic seizures arising from other areas, such as mesial temporal lobe and cingulate.

C. With Contralateral Spread to:

1. *Neocortical areas*. *Hyperkinetic seizures,* also referred to by some as *hypermotor seizures*, involve bilateral forceful limb movements, sometimes with vocalizations. Frontal lobes are implicated in these behaviors.

2. *Limbic areas*. *Dyscognitive seizures with or without automatisms (psychomotor)* are not exactly synonymous with the current term "complex partial seizures," which were defined on the basis of impaired consciousness only and do not necessarily involve limbic areas. This new term, as well as the term "psychomotor," conforms more to the original intent of the term "complex partial seizures" in the 1970 ILAE Classification of Epileptic Seizures (13). It is implied that mesial temporal limbic areas and their immediate connections are involved in the clinical manifestations, although seizures may have been initiated elsewhere.

D. Secondarily Generalized

1. *Tonic–clonic seizures* that are secondarily generalized probably consist of multiple types and may involve different pathophysiologic mechanisms and anatomical substrates, at least initially, than generalized tonic–clonic seizures with generalized onset.

2. *Absence seizures* can rarely represent propagation from localized cortical areas, usually in the frontal lobe. There may be a continuum between these events and generalized atypical absences.

3. Although *epileptic spasms* can occur in infants with focal lesions, the mechanism by which these generalized events are generated is unknown.

III. NEONATAL SEIZURES

Neonatal seizures: Although the components of neonatal seizures can be described in terms of the seizure types itemized above, they often display unique organizational features. Therefore, a study group will be created to more completely define and characterize the various types of neonatal seizures.

Status Epilepticus

Mechanistically, status epilepticus represents the failure of the natural homeostatic seizure-suppressing mechanisms responsible for seizure termination (14). Although an operational definition of status epilepticus has been proposed (15,16) and is in common use in the clinical and epidemiological literature, it does not adequately reflect the underlying mechanisms involved in status epilepticus, nor is it always useful for clinical purposes (17). Regardless of the specific operationalized definition, however, the mechanisms involved in initiation and spread of the various types of status epilepticus are, in general, similar to those of self-limited ictal events, but additional factors that need to be considered in determining criteria for classification include:

- Different mechanisms that can prevent seizure termination, for example, mechanisms that prevent active inhibition, desynchronization of hypersynchronous discharges, and depolarization block.
- Progressive features that contribute to subsequent functional and structural brain disturbances.
- Maturational factors.

I. EPILEPSIA PARTIALIS CONTINUA (EPC) OF KOJEVNIKOV

This is a combination of focal seizures with continuous twitching in the same area. The clinical and EEG features permit distinction of three conditions that correlate with etiology.

A. As Occurs with Rasmussen Syndrome. EPC in this subacute lateralized encephalitis of unknown cause (half the cases show the clinical expression of this encephalitis) combines focal myoclonus and focal seizures affecting various areas of the same hemisphere, with or

without clear EEG correlation of the myoclonic jerks, and at times persistence of the jerks in sleep. There is progressive slowing of the background EEG activity on the affected side.

B. As Occurs with Focal Lesions. Various dysplastic, vascular, or tumor lesions produce EPC lasting a few days, weeks, or months before the patient returns to baseline. EPC is also seen with nonketotic hyperglycemia. The jerks affect the same area as the focal seizures, and have an EEG correlate; they do not persist in sleep.

C. As a Component of Inborn Errors of Metabolism. Various conditions affecting energy metabolism, namely, Alpers disease or Myoclonus epilepsy with ragged-red fibers (MERRF), produce uni- and then bilateral rhythmic jerks that persist in sleep, with EEG correlates.

II. SUPPLEMENTARY MOTOR AREA (SMA) STATUS EPILEPTICUS:

Frequently repeated seizures from the SMA usually present as a type of focal status epilepticus with preserved consciousness and individual tonic motor seizures occurring every few minutes all night long. Another type of SMA status epilepticus consists of secondarily generalized seizures that evolve into repetitive asymmetrical tonic motor seizures with profound impairment of consciousness.

III. AURA CONTINUA

Aura continua is a rare but well-described manifestation of focal epilepsy. The symptoms depend on the localization. The attacks are usually without impairment of consciousness. The symptoms wax and wane, often for hours, and may be associated with a motor component, depending on the spread. Dysesthesia, painful sensations, and visual changes are examples. Limbic aura continua is the most common clinical pattern. Fear, an epigastric rising sensation, or other features may recur every few minutes for many hours, or more than a day without going on to seizures with impairment of awareness. Electrographic correlation is variable. Diagnosis must be entertained, particularly in patients with well-established epilepsy.

IV. DYSCOGNITIVE FOCAL (PSYCHOMOTOR, COMPLEX PARTIAL) STATUS EPILEPTICUS

A. Mesial Temporal: Focal status epilepticus predominantly involving mesial limbic structures consists of serial dyscognitive focal ictal events without return of clear consciousness in-between. Onset can be limited to one side, or can alternate between hemispheres.

B. Neocortical: Focal status epilepticus originating in various neocortical regions can present with a wide variety of unpredictable clinical patterns. Status epilepticus from some frontal foci can resemble absence status or generalized tonic–clonic status. It can present as repetitive discrete behavioral seizures. To some extent, this type of status epilepticus can reflect the neocortical region of origin. For example, occipital status epilepticus might present with unexplained blindness while dysphasia or aphasia could represent focal status in language cortex.

V. TONIC–CLONIC STATUS EPILEPTICUS:

Generalized tonic–clonic status epilepticus can be an acute symptomatic event; it can be primarily generalized in idiopathic and symptomatic generalized epilepsies; and it is commonly secondarily generalized from focal epilepsies. Occasionally, the manifestations can be unilateral.

VI. ABSENCE STATUS EPILEPTICUS

A. Typical and Atypical Absence Status Epilepticus: When absence status epilepticus occurs in the idiopathic epilepsies, it has features similar to atypical absence and can be terminated by antiepileptic drugs. In the generalized symptomatic epilepsies, there is overlap with focal status epilepticus due to lesions of certain frontal lobe areas. The absence status epilepticus occurring in elderly patients without a prior history of epilepsy, as well as drug-induced and drug-withdrawal absence status epilepticus, have been characterized and most likely represent similar mechanisms; however, there may be several different types of typical and/or atypical absence status epilepticus.

B. Myoclonic Absence Status Epilepticus: Myoclonic absence status epilepticus consists of proximal, predominantly upper extremity myoclonic jerks corresponding with 3 Hz spike-wave discharges in the EEG. It can last hours or even days and is usually very resistant to therapy.

VII. MYOCLONIC STATUS EPILEPTICUS

Myoclonic status epilepticus consists of irregular, usually bilateral or generalized myoclonic jerking without interference with consciousness. Duration may be up to hours. It is most often seen in patients with insufficiently controlled JME, Dravet syndrome, and in nonprogressive myoclonic epilepsy in infancy, particularly Angelman syndrome. In myoclonic-astatic epilepsy, it predominates in the extremities of the upper limbs and around the mouth, the areas most represented in the precentral gyrus.

VIII. TONIC STATUS EPILEPTICUS

Tonic status epilepticus most commonly occurs in patients with symptomatic generalized epilepsy, but may occur in patients with idiopathic generalized epilepsy. In some of these patients, there appears to be an overlap of symptoms of idiopathic and symptomatic generalized epilepsy. Characteristically, when the patient is lying down, the neck is flexed, and the arms are flexed at the elbow and slightly elevated. The tonic spasms are brief and can continue at brief intervals for hours. In symptomatic generalized epilepsy the duration of the status epilepticus can be much longer.

IX. SUBTLE STATUS EPILEPTICUS

This has become an accepted concept, although its accurate diagnosis is often controversial. It refers to an end stage of prolonged generalized tonic–clonic status epilepticus characterized by focal or multifocal myoclonic movements, coma, and pseudoperiodic lateralized epileptiform discharges (PLEDs) against a slow low-voltage background on EEG. The myoclonic movements reflect severe brain damage caused by prolonged status epilepticus and may not be epileptic in nature.

EPILEPSY

There are operational (16) and conceptual (18) definitions of epilepsy endorsed by the ILAE. In general, the diagnosis of epilepsy implies a persistent epileptogenic abnormality of the brain that is able to spontaneously generate paroxysmal activity. This is in contrast to a brain that has an acute seizure as a natural response to a transient insult or loss of homeostasis. The epilepsies and syndromes listed here presume the existence of an intrinsic epileptogenic abnormality that is a property of the brain itself and present between seizures, independent of any acute insult or condition. This property may be responsible for seizures during a relatively short period of time (as in many of the age-dependent idiopathic epilepsies) or for many years or even throughout an individual's lifetime.

An epilepsy syndrome was defined in an earlier report of this Task Force (3) as "a complex of signs and symptoms that define a unique epileptic condition. This must involve more than just a seizure type: thus frontal lobe seizures per se, for instance, do not constitute a syndrome." Epilepsy syndromes were distinguished from epileptic diseases, which were defined as "a pathologic condition with a single, specific, well-defined etiology." Thus, the term PME would designate a syndrome, but Unverricht-Lundborg is a disease. Epilepsy syndromes may be symptomatic when they result from one or more identifiable pathological disturbances in cerebral structure or metabolism, or idiopathic when no such underlying disturbance exists and the primary etiology is believed to be genetic.

Not all syndromes can be easily classified as either focal or generalized or as either symptomatic or idiopathic, and there is no need to do so. These terms are used here with respect to specific syndromes only when they have historical or clinical value. The term "cryptogenic" is avoided here because of ambiguities in its definition and use. The term was introduced in the 1989 classification (12) to define conditions where the cause of the disorder is "hidden or occult." It is specifically stated that "cryptogenic epilepsies are *presumed to be symptomatic*, but the etiology is not known." The 1993 report of the ILAE Commission on Epidemiology and Prognosis, however, stated that the group of cryptogenic epilepsies "includes patients who do not conform to the criteria *for the symptomatic or idiopathic categories*." It is beyond the scope of this report to debate whether the term "cryptogenic" should be limited to conditions that are probably symptomatic, as originally intended, to all conditions with unknown etiology, as it is currently used by epidemiologists, or remain unclarified. In any event, it was decided not to use the term "cryptogenic" in relation to any of the identified syndromes listed here.

Now that it is becoming increasingly possible to investigate the suppositions that form the basis of individual syndrome definitions, it is important that we use the best available scientific evidence to construct clinical entities that are as homogeneous and biologically relevant as possible. The epilepsy syndromes approved by the General Assembly in 2001, therefore, were evaluated according to the following criteria:

- Epileptic seizure type(s): This includes seizure type(s) that i) must occur in order to diagnose a syndrome, ii) occur but are not necessary for diagnosis, and/or iii) would preclude a diagnosis of this syndrome.
- Age of onset: Is there a distinctive range for age of onset for taxonomic purposes and, if so, how strictly should this range be applied for diagnostic purposes?
- Progressive nature (i.e., epileptic encephalopathy): Evidence that suggests or supports the notion that there is an *epilepsy-dependent* neurodevelopmental or neurodegenerative process involved in the evolution of the syndrome (as opposed to an underlying metabolic, degenerative, or encephalitic process).
- Interictal EEG: EEG findings that i) must be observed in order to diagnose the syndrome, ii) may be observed in some cases; and iii) if observed, preclude diagnosis of the syndrome.
- Associated interictal signs and symptoms (particularly neurological and neuropsychological status and deficits). It is important to distinguish between deficits that are due to the cause of the epilepsy, those that are due to pharmacotherapy, and those that are due to the epilepsy itself (epileptic encephalopathy). Unfortunately, this can be difficult and many epileptic encephalopathies remain theoretical.
- Pathophysiologic mechanisms, anatomical substrates, and etiological categories: Permanent disturbances that characterize the syndrome (i.e., generalized brain damage vs. localized brain damage vs. no brain damage). Genetic diseases that cause epilepsy and susceptibility genes can also be included.
- Genetic basis: This consists of specific genetic mechanisms that have been implicated and differentiate a syndrome from all other syndromes, but do not constitute diseases.

The epilepsy syndromes listed in Table 2 were individually discussed by the Core Group and rated on a score of

TABLE 2. *Epilepsy syndromes by age of onset and related conditions*

Neonatal period
Benign familial neonatal seizures (BFNS)
Early myoclonic encephalopathy (EME)
Ohtahara syndrome
Infancy
Migrating partial seizures of infancy
West syndrome
Myoclonic epilepsy in infancy (MEI)
Benign infantile seizures
Dravet syndrome
Myoclonic encephalopathy in nonprogressive disorders
Childhood
Early onset benign childhood occipital epilepsy (Panayiotopoulos type)
Epilepsy with myoclonic astatic seizures
Benign childhood epilepsy with centrotemporal spikes (BCECTS)
Late onset childhood occipital epilepsy (Gastaut type)
Epilepsy with myoclonic absences
Lennox-Gastaut syndrome (LGS)
Epileptic encephalopathy with continuous spike-and-wave during sleep (CSWS) including Landau-Kleffner syndrome (LKS)
Childhood absence epilepsy (CAE)
Adolescence
Juvenile absence epilepsy (JAE)
Juvenile myoclonic epilepsy (JME)
Progressive myoclonus epilepsies (PME)
Less Specific Age Relationship
Autosomal-dominant nocturnal frontal lobe epilepsy (ADNFLE)
Familial temporal lobe epilepsies
Mesial temporal lobe epilepsy with hippocampal sclerosis (MTLE with HS)
Rasmussen syndrome
Gelastic seizures with hypothalamic hamartoma
Special epilepsy conditions
Symptomatic focal epilepsies not otherwise specified
Epilepsy with generalized tonic-clonic seizures only
Reflex epilepsies
Febrile seizures plus (FS+)
Familial focal epilepsy with variable foci
Conditions with epileptic seizures that do not require a diagnosis of epilepsy
Benign neonatal seizures (BNS)
Febrile seizures (FS)

1–3 (3 being the most clearly and reproducibly defined) regarding the certainty with which the group believed each syndrome represented a unique diagnostic entity. These ratings are informal and should be considered very preliminary pending the development of firm criteria. Criteria for syndrome identification continue to be improved and the syndromes are being reanalyzed in more detail. This process could involve an evidence-based approach requiring formal review and systematic evaluation of the published literature.

Epilepsy Syndromes and Related Conditions

NEONATAL PERIOD

Benign Familial Neonatal Seizures (BFNS): (3) This may be a disease and not a syndrome.

Early Myoclonic Encephalopathy (EME): (3) Although this may be different from Ohtahara syndrome, the clinical distinction can be difficult.

Ohtahara Syndrome: (3) See above.

INFANCY

Migrating Partial Seizures of Infancy: (3) This has been sufficiently described by several independent investigators to merit recognition as a syndrome.

West Syndrome: (3) This is a clearly defined syndrome based on specific clinical features and age of onset.

Myoclonic Epilepsy in Infancy (MEI): (3) Because this is not benign in some infants, the word "benign" was removed from the name. It was initially introduced to distinguish it from Severe myoclonic epilepsy in infancy (SMEI), which is now called Dravet syndrome. Seizures may occasionally be reflex (i.e., touch).

Benign Infantile Seizures: (3). Whereas BFNS and Benign (nonfamilial) neonatal seizures clearly represent two distinct syndromes because of differences in seizure type and age of onset, the familial and nonfamilial forms of Benign infantile seizures are identical except for the family history. Consequently, the sporadic form cannot be considered a separate syndrome, and both should be combined into a single syndrome, unless subsequent information indicates otherwise.

Dravet Syndrome: (3) Because many of these children do not have myoclonic components to their characteristic seizures in infancy, it cannot be called SMEI, and we should retain the eponym.

Myoclonic Encephalopathy in Nonprogressive Disorders: (3) There is sufficient evidence to support this as a syndrome. It is important as a form of epileptic encephalopathy.

CHILDHOOD

Early Onset Benign Childhood Occipital Epilepsy (Panayiotopoulos Type): (3) The consistency of localization remains controversial in this syndrome.

Epilepsy with Myoclonic Astatic Seizures: (3) This syndrome is now well defined but the course is variable. Many are epileptic encephalopathies.

Benign Childhood Epilepsy with Centrotemporal Spikes (BCECTS) (3) This condition also is not always benign, although nonbenign forms occur in only a small percentage of patients, and may represent related conditions.

Late Onset Childhood Occipital Epilepsy (Gastaut Type): (1) There was concern because this condition is rare and there has been a paucity of recent confirmatory reports. More data are needed.

Epilepsy with Myoclonic Absences: (2) This syndrome needs further study in the context of the work to be done on myoclonic seizures.

Lennox–Gastaut Syndrome (LGS): (3) This syndrome is clearly defined by clinical and EEG features and by age of onset.

Epileptic Encephalopathy with Continuous Spike-and-Wave During Sleep (CSWS) Including Landau-Kleffner Syndrome (LKS): (3) It was decided that there is insufficient evidence for mechanistic differences between

LKS and CSWS to warrant considering them separate syndromes. It is unknown whether these conditions are idiopathic, symptomatic, or both.

Childhood Absence Epilepsy (CAE): (3) Further deliberation and research will be needed to clarify the distinction between this syndrome and JAE, and to define the relationship of this syndrome to the other idiopathic generalized epilepsies such as JME.

ADOLESCENCE

Juvenile Absence Epilepsy (JAE): (3) See above.

Juvenile Myoclonic Epilepsy (JME): (3) See above.

Progressive Myoclonus Epilepsies (PME): (3) This group is different from the others in that it consists entirely of specific diseases, and might be considered under diseases with epilepsy rather than epilepsy syndromes. However, because it is a very helpful concept for diagnostic purposes when it is not possible to reach a more specific diagnosis, it is still included in this list.

LESS SPECIFIC AGE RELATIONSHIP

Autosomal-Dominant Nocturnal Frontal Lobe Epilepsy (ADNFLE): (3) All affected family members have nocturnal frontal lobe seizures. In some families, mutations in neuronal nicotinic acetylcholine receptor genes are found, but in many families the genetic etiology is unknown.

Familial Temporal Lobe Epilepsies: (3) There are a number of forms that are being defined. Division into lateral and mesial temporal types based on the predominant seizure semiology is useful. The lateral temporal type (also known as Autosomal-dominant partial epilepsy with auditory features) is associated with mutations in the LGI1 gene in about half the families. The mesial group is heterogenous within and between families in terms of epilepsy severity, association with febrile seizures and presence of hippocampal sclerosis.

Mesial Temporal Lobe Epilepsy with Hippocampal Sclerosis (MTLE with HS): (2) This condition probably consists of more than one syndrome, and it is not certain whether features of patients with HS clearly differentiate them from those with other mesial temporal lesions.

Rasmussen Syndrome: (3) There continues to be a question as to whether this is best characterized as a syndrome or a disease; that is, whether there may be multiple etiologies for this inflammatory process.

Gelastic Seizures with Hypothalamic Hamartoma: (3) This may be a disease and not a syndrome.

SPECIAL EPILEPSY CONDITIONS

Symptomatic Focal Epilepsies not Otherwise Specified: Disorders due to epileptogenic lesions that are localized, diffuse but limited to one hemisphere, or multifocal do not constitute syndromes per se, but can be defined according to the seizure type, the underlying pathophysiologic disturbance, if known, and the location of the lesion(s), if they do not fit into a described syndrome.

Epilepsy with Generalized Tonic–Clonic Seizures only is not a syndrome, and the Core Group was unable to agree on any syndrome with this feature: The consistent diurnal pattern of seizures in some patients needs further investigation. Whether epilepsy with generalized tonic–clonic seizures on awakening exists as a distinct entity is unclear.

Reflex Epilepsies: Although Idiopathic photosensitive occipital lobe epilepsy (2), Primary reading epilepsy (3) and Hot water epilepsy in infants (2) are syndromes, it is unclear whether other reflex epilepsies constitute unique syndromes.

Febrile Seizures Plus (FS+): This is a condition that is part of the familial syndrome known as GEFS+. The latter is broader than a single generalized syndrome and may be a useful category for future classifications.

Familial Focal Epilepsy with Variable Foci: (3) This syndrome cannot be diagnosed in a single individual. Recognition depends on the occurrence within a family of individuals with different seizure patterns (commonly temporal or nocturnal frontal); each individual has a single seizure pattern.

CONDITIONS WITH EPILEPTIC SEIZURES THAT DO NOT REQUIRE A DIAGNOSIS OF EPILEPSY

The reasons for not considering some syndromes to be epilepsy seem to be more political than scientific. Two syndromes exist in this group.

Benign Neonatal Seizures (BNS): (2) These are self-limited events without sequelae.

Febrile Seizures (FS): (3) Classically, the seizures that constitute this condition consist of two forms: simple and complex; however, many different types undoubtedly exist. This condition may eventually be understood to encompass many different entities.

The Core Group is not prepared to recommend a new classification of epilepsies and epilepsy syndromes to replace the current classification (12); however, it was decided that a number of axes would be much more accurate and useful than the current dichotomies of idiopathic versus symptomatic, and localization-related versus generalized. When adequate data are obtained regarding the accepted epilepsy syndromes, multivariate approaches could be used to construct an organization of syndromes, with

TABLE 3. *Categories that might be considered in future classification systems*

Autosomal dominant epilepsies
Epileptic encephalopathies
GEFS+
Idiopathic generalized epilepsies
Idiopathic focal epilepsies
Reflex epilepsies

the recognition that some syndromes may be represented in more than one grouping, while other syndromes may fit in none of the groupings. The syndromes have been listed here by age only, in lieu of a more detailed approach to syndrome classification or categorization. Possible categorizations would involve the recognition that clusters of syndromes have certain commonalities. Considerations in this regard could include the items listed in Table 3. We caution, however, that these should *not* be interpreted as a new classification but, rather, suggestions for future work to develop a new classification or modify the current one.

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