Original article

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A comparison between the 1981 and 2017 International League Against Epilepsy classification of seizure types based on an outpatient setting

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ABSTRACT – *Aim*. To compare between the 1981 and 2017 International League Against Epilepsy (ILAE) classification of seizure types based on an outpatient setting.

Methods. We retrospectively reviewed 200 patients from our outpatient epilepsy registry. Based on clinical information, their seizure types were classified according to ILAE official reports, and differences between the 1981 and 2017 classifications were compared. All unclassifiable cases based on either one or both classification systems were discussed.

Results. The 200 patients had a total of 243 manifestations. Some terms in the 2017 classification clearly correspond to those of the 1981 classification, while others lack clarity and are more controversial. The three most frequently encountered seizure types based on the 2017 classification were focal to bilateral tonic-clonic (83; 34.1%), unknown-onset tonic-clonic (56; 23.0%), and focal impaired awareness (52; 21.4%). Based on the 1981 classification, the three most frequently encountered seizure types were unclassified (89; 36.6%), secondary generalized tonic-clonic (sGTCS) (83; 34.1%), and complex partial (CPS) (36; 14.8%). Seventy-five of 89 (84.3%) unclassified cases based on the 1981 classification were classified using the 2017 classification mainly due to the addition of the "unknown origin" category and a combination of different levels of terms (level of awareness and motor/non-motor features). In 14 cases, seizures were unclassifiable using both classification systems; eight were rare manifestations with unclear awareness or unusual bilateral movements and six were due to a lack of detailed description.

Conclusion. The 2017 seizure classification greatly reduces the number of unclassifiable cases. The combination of awareness level and motor/non-motor features introduces greater flexibility and allows for detailed seizure description. Several cases, however, remain unclassified, but these are mostly due to a lack of understanding of epilepsy. The 2017 seizure classification demonstrates a steady transition from the 1981 classification with acceptable consistency and improvements.

Key words: seizure, classification, 1981, 2017, ILAE, comparison, experience

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The concept of seizure classification dates back to the early 20th century, and the first seizure classification of the ILAE was published in 1970 (Gastaut, 1970). The 1981 seizure classification (Proposal, 1981) and 1989 epilepsy classification (Proposal, 1989) have been widely used in clinical care, epilepsy research, and worldwide communication over the past 30 years. The influence of classification, which enhances awareness and understanding of the disease, is highly valued. Classification should always be a dynamic process, even when faced with obstacles. Based on updates of knowledge, some new terms should be introduced with increased transparency of terms for educational needs. With the proposals of reorganization (Engel, 1998; Berg and Scheffer, 2011) and feedback from worldwide communities, the ILAE classification of seizure types (Fisher *et al*., 2017), followed by the classification of epilepsy types (Scheffer *et al*., 2017), was newly updated in 2017 (Proposal, 2017).

Seizure classification serves as the basis for epilepsy classification and further epilepsy syndrome classification. Classification requires clear knowledge of the clinical manifestations of a seizure along with available supportive information, such as EEG and neuroimaging studies in order to explore the underlying aetiology. A recent neurophysiology study of epilepsy showed that it is a network disease (Fisher *et al*., 2014), and from a network perspective, seizures may arise from neocortical, thalamo-cortical, limbic, or brainstem networks (Cavanna and Monaco, 2009; Blumenfeld, 2014). Our understanding, however, is still insufficient to classify seizures according to different networks or other mechanisms. Scientificity as well as utility should be considered in any classification. At present, the mechanisms underlying seizures are largely unknown, therefore the emphasis is placed on utility. The 2017 seizure classification still contains the overall framework of the 1981 seizure classification, and is reported to be more practical for clinical use, making it easier to assign seizures to categories, with more detailed descriptions and transparency for the non-medical community (Fisher *et al*., 2017).

In order to evaluate the 2017 classification in clinical settings, we designed our study based on outpatient scenarios, in comparison with the 1981 seizure classification.

Materials and methods

Study population

The study took place in West China Hospital, SCU. We retrospectively collected data from 200 newly registered epilepsy cases (visiting our clinic for the first time, but not necessarily previously diagnosed with epilepsy) from our outpatient epilepsy registry from January to June 2017.

Data acquisition

Data for all the patients were recorded in our database; this included demographic information, clinical manifestations extracted from their descriptions, results of supplementary information (all required for routine EEG and at least 1.5T MRI at registry), and contact information. All individuals consented to be registered in our database, agreed that their data could be used in scientific studies, and were willing to be followed.

Seizure classification

For each individual, all of their distinct manifestations were listed. When there was insufficient information for classification, we contacted the individual to ask for their clinical manifestations. We defined the level of consciousness (awareness) of patients according to "AAA" (alertness, attention, awareness) (Ali *et al*., 2012; Blumenfeld, 2012). Alertness was defined based on whether the individual could have behaviourally meaningful responses to simple questions, commands, or aversive stimuli; attention was defined based on whether the individual could carry out a sequence of tasks and detect stimuli from distractors; and awareness was defined based on whether the individual was aware of the surrounding environment and could report verbally or non-verbally.

Three authors (H Gao, YF Xiao, and YY Zhang) were experienced with the use of the standard 1981 and 2017 classification systems. They independently classified each individual's seizure types. In the event of disagreement, the final results of classification were based on discussion. We used "new term", "term change", "same term", and 'both unclassified" to demonstrate differences between the 1981 and 2017 classification systems. "New term" indicates that the term could not be found in the 1981 system or that it has no, or no clear relationship with the respective 1981 term. "Term change" indicates that the term in the 1981 and 2017 classification systems refers to the same manifestation, but is expressed differently. We also added descriptive phrases, such as "showing origin" (in which the origin of the seizure is part of the term), "showing details" (in which manifestations during the seizure are described with detail and accuracy), and "can be classified" (could not be classified in the 1981 classification but was classifiable in the 2017 classification), as identifiers to show the major traits of the new classification for situations in which the differences could be described with a "new term" or "term change". All authors checked their

Table 1. Demographic data of the 200 patients described in the study.

Gender		Place of residence		Age		Years of confirmed epilepsy diagnosis	
Male	96	Rural	73	Median	23.5	Median	3.0
Female	104	Urban	127	Range	1-86	Range	0-40

classification results three times, and subsequently discussed the results based on the different classifications. For controversial cases, final classifications were based on discussions between authors. We especially focused on unclassified situations, regardless of whether they were unclassified according to just one classification system or both, and the reasons for non-classification were analysed.

Data analysis

All patient data were recorded and analysed using SAS version 9.4 (SAS Institute, Cary, NC, USA). We analysed the kappa value between classifiers and determined the number of each seizure type based on both classifications as well as differences and traits, and then compared results between classifications.

Results

Demographic data

The cohort comprised more patients from urban areas than from rural areas (*table 1*). The male to female ratios in both areas were close to 1 (data not shown). Age and years of confirmed epilepsy diagnosis were both skewed distributions, therefore the median and not the mean was used to describe the data. Most people (177 patients; 78.5%) were younger than 35 years old with the majority between 16 and 35 years old. The median number of years of confirmed epilepsy was three. Forty-nine of 200 patients (24.5%) had video-EEG (vEEG) at admission. Despite being at a referral and tertiary hospital, 29 (14.5%) of our patients were newly-diagnosed with epilepsy.

Seizure types based on both classifications

Seizure distribution

The 200 patients had 243 manifestations in total. The Kappa value of results between three classifiers for the 2017 classification was 0.938 and for the 1981 classification was 0.947. The number of each different kind of seizure under the 1981 and 2017 classifications are presented in *figure 1*. The three most frequently encountered seizure types in clinical settings in our experience based on the 2017 classification were focal to bilateral tonic-clonic (83; 34.1%), unknown-onset tonic-clonic (56; 23.0%), and focal impaired awareness (22; 9%). The latter included focal impaired awareness with automatism, focal impaired awareness with behavioural arrest, focal impaired awareness motor, focal impaired awareness cognitive, focal impaired awareness emotional, and focal aware to focal impaired awareness seizures (*figure 1, supplementary data*). The three most frequently encountered seizure types in clinical settings based on the 1981 classification were unclassified (89; 36.6%), sGTCS (83; 34.1%), and CPS (36; 14.8%).

Based on the 2017 classification, the onset of manifestations was focal in 60.1% (146), generalized in 11.1% (27), unknown in 23% (56), and unclassified in 5.8% (14).

Comparison of terminology between classifications

Most of the differences in the terms are minor changes, as listed in *table 2*, however, there are some terms without a clear relationship between the two classification systems. This is mainly because of the addition of new terms and flexible combinations of awareness levels with motor/non-motor features in the 2017 seizure classification system. This change requires a detailed analysis of awareness (consciousness), although some types such as *déjà vu* are categorized under simple partial seizures (SPS) without a change in consciousness in the 1981 classification.

For example, one individual had *déjà vu* with a distorted perception of her environment which always lasted for several seconds. She could hear her family members speaking at the time, but she said she did not want to reply to them. Afterwards, she was able to recall the event and describe how she felt during the seizure, but with only a limited description of her environment. Using the new classification, with a concise evaluation of awareness, her seizures are considered as focal impaired awareness (FIA)-cognitive, as she had impairment of attention and awareness. Based on a thorough consideration of the level of consciousness, we classified the patient's seizures as unclassified in the 1981 system. A similar situation also arose for emotional seizures) in our study (affective seizures are also categorized under SPS in the 1981 system.

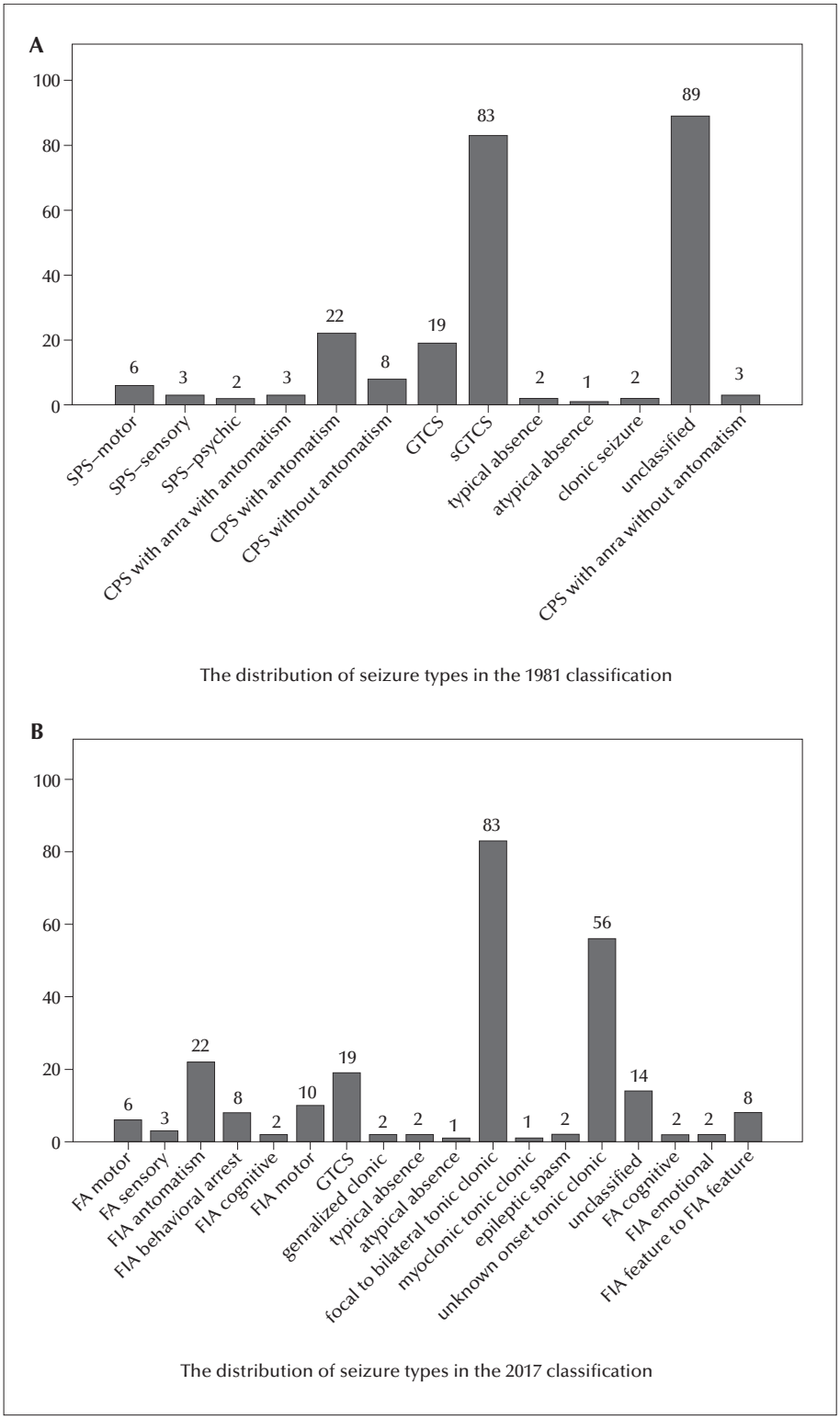

Figure 1. Distribution of seizure types based on 243 manifestations according to the 1981 (A) and 2017 (B) ILAE classifications of seizures. SPS: simple partial seizure; CPS: complexed partial seizure; FA: focal aware; FIA: focal impaired awareness; GTCS: generalized tonic-clonic seizure; sGTCS: secondary generalized tonic-clonic seizure; FA feature to FIA feature: focal aware with motor/non-motor features to focal impaired awareness with automatism/behavioural arrest/other motor features.

Table 2. Respective 2017 and 1981 classification terms based on 243 manifestations.

Clear correlation			Unclear or no correlation		
Term		**Relationship**	**Term**		**Relationship**
1981	**2017**		**1981**	**2017**	
SPS-motor	FA-motor	A	SPS-psychic	FA-cognitive	C
SPS-sensory	FA-sensory	A		FIA-cognitive	
CPS with automatism	FIA with automatism	A	SPS-affective	FA-emotional	C
CPS without automatism	FIA with behavioural arrest	A		FIA-emotional	
sGTCS	Focal to bilateral tonic clonic	A	-	FIA-motor	-
GTCS	GTCS	B	-	Myoclonic(clonic) tonic clonic	-
Generalized tonic/clonic	Generalized tonic/clonic	B	-	Epileptic spasm	-
Typical/Atypical absence	Typical/Atypical absence	B	-	Unknown onset tonic clonic	-

A: Changed term referring to the same manifestation; B: same term; C: new term, possibly referring to the listed old term but not exactly the same.

Table 3. Differences and traits of the 2017 relative to the 1981 classification.

Differences	Traits	Examples
New term (31.7%; 77)	Showing details (2)	Focal aware cognitive (clearly showing awareness level)
	Can be classified (75) (also showing details because classified)	Unknown-onset tonic-clonic Focal impaired awareness motor Focal impaired awareness cognitive Focal impaired awareness emotional Focal aware to focal impaired awareness motor Myoclonic-tonic-clonic Epileptic spasm
Change in term (53.5%; 130)	Similar (31)	Focal aware sensory/motor Focal impaired awareness automatism
	Showing details (16)	Focal impaired awareness with behavioural arrest Generalized clonic/tonic Focal aware to focal impaired awareness with automatism/behavioural arrest.
	Showing origin (83)	Focal to bilateral tonic-clonic
Same term (9.1%; 22)	-	GTCS, typical absence, atypical absence

Detailed traits associated with differences in terms between the two classification systems and further examples are presented in *table 3*.

Unclassified situations

All unclassified cases based on one or both of the classifications are shown in *table 4*. Clinical information (details of manifestations) was initially lacking for seizure classification in 11 individuals who mainly (10/11) had two manifestations (only one had a single manifestation). Most had a few words of description in the notes, such as "staring", without specific descriptive words regarding the level of awareness or motor/non-motor features. All these individuals were contacted and six provided more information. Thus, five cases remained unclassified based on both classifications due to a lack of information. The seizures of another individual could not be classified, as there was no witness of the onset and no vEEG ictal onset recording, thus an evaluation of awareness and movement features was not possible.

Of the manifestations that were unclassifiable in the 1981 classification, most (56; 62.9%) were ultimately classified as unknown-onset tonic-clonic in the 2017 classification. This is more specific as behaviour associated with a seizure can be visualized even though the origin is unknown. Other situations included manifestations that were classified as focal impaired awareness motor, focal impaired awareness cognitive/emotional, epileptic spasm, and myoclonic-tonic-clonic seizures. Focal impaired awareness motor seizures were not rare cases (10 cases in total; 4.1% of the 243 manifestations, affecting 10% of patients). A typical scenario would be an individual presenting with staring and no response to the environment, together with focal tonic/clonic/tonic-clonic movements affecting the left/right upper/lower limb.

In some cases, the information for classification was unclassifiable in both classifications. Some individuals had tonic/tonic-clonic movements of both upper limbs or lower limbs, which is a sign of bilateral involvement of brain regions, however, these were not classic "bilateral" manifestations for classification; *i.e.* a bilateral tonic-clonic movement. In our study, a 24-year-old male had right-sided upper and lower clonic limb movement that subsequently spread to all limbs. He was aware of his environment (he described the environment of the seizure afterwards) and recalled the whole event, however, he could not respond with words or actions and was not able to respond due to muscle involvement. This was clearly not a classic lack of response, and we considered the patient to be aware. His ictal video-EEG failed to show a dominant side of spikes and his neural imaging studies were also negative.

Discussion

Compared to the 1981 classification, the 2017 classification is more straightforward to apply and provides a high level of detail, leading to a significant reduction in unclassified cases.

The sequential framework of how to classify a seizure has greatly clarified the key elements needed for seizure classification and provided increased flexibility based on combinations of awareness level and motor/non-motor features. The more recent framework of classification has also reduced some misunderstandings. Based on the 1981 classification, some clinicians may classify focal clonic activity with intact awareness as a clonic seizure (a clonic seizure in the 1981 classification refers to whole-body clonic activity with loss of consciousness). Using the new classification framework, this would clearly be more appropriately classified as a focal aware clonic seizure. A similar misunderstanding can be avoided by changes in more descriptive terms. For instance, for CPS without automatism in the 1981 classification, "without automatism" actually refers to no movement noticed during a seizure (equal to behavioural arrest in the 2017 classification). Since the details of this term are not outlined, clinicians tend to consider "without automatism" as some other type of non-automatism movement, such as aimless looking around, which may lead to misclassification of cases that should be unclassified according to the 1981 system. However, in the 2017 classification system, the term "behavioural arrest" clearly refers to termination of all movements and remaining still during a seizure, which clarifies this issue.

In the 2017 classification, brain electrophysiology is also better considered, with a change in the term "secondary GTCS" to "focal to bilateral tonic-clonic seizure". This is a great starting point for moving towards further changes that include terms such as "network". "Focal" is defined as a network of seizures limited to one hemisphere of the brain, "generalized" defines the involvement of both hemispheres at seizure onset, and "bilateral" defines the spread of seizures involving both hemispheres (Fisher *et al.*, 2017). "Focal" is also used to describe the origin of a seizure. This reflects our progress over time to ultimately determine a seizure onset zone and consider surgery for patients when possible. "Generalized" means general involvement of body movement as well as generalized brain activity. "Bilateral" appears to be a more appropriate word than "generalized" in our opinion. This is especially true for some previously unclassified cases, such as those with focal aware features to impaired awareness with bilateral upper/lower limb motor activity; since whole-body movement is not involved, the term "generalized" is clearly not suitable

Table 4. Unclassifiable cases based on the 1981 classification or both classifications.

Situation	Number	Clinical detail (no. patients)
1981- Unclassifiable 2017- Classifiable	75	1. Unknown-onset tonic-clonic (56) 2. Focal impaired awareness motor (10) 3. Focal impaired awareness cognitive (2) 4. Focal impaired awareness emotional (2) 5. Epileptic spasm (2) 6. Focal aware followed by focal impaired awareness motor (not automatism) (2) 7. Myoclonic-tonic-clonic (1)
Both unclassifiable (good clinical information)	8	1. Focal awareness features at onset to impaired awareness with bilateral movement, but not involving the whole body, often only both upper limbs or lower limbs (7) (*see supplementary data: Patient 8, 13, 21, 31, 50, 134, 148*) 2. Intact consciousness with tonic movement of all limbs (1) (*supplementary table 1: Patient 93*)
Both unclassifiable (lack of information)	6	1. Loss of contact with patient, therefore important information lacking for classification (5) (*see supplementary data: Patient 104, 142, 144, 151*) 2. No witness of onset: no evaluation of impairment of awareness or other motor features (1) (*supplementary table 1: Patient 30*)

here. Based on the manifestation, this is a focal to bilateral type, yet the difference between other types is not clear and this would also not fit with the current classification system. For one of our cases, consciousness was intact and the patient had clonic movements of all limbs. This type of manifestation has also been shown in the literature (Botez *et al*., 1966; Weinberger and Lusins, 1973; Bell *et al*., 1997), and involvement of the bilateral frontal region sparing other brain regions has been observed during this type of seizure (Blumenfeld, 2012). Moreover, it has also been proven in some studies that, even in classic "generalized" seizures, some regions of the brain are spared (Schindler *et al*., 2007). This phenomenon is not only seen in humans but has also been proven in some animal studies (Desalvo *et al*., 2010).

The importance of determining certain features of a seizure is still unclear. Some researchers believe that cognitive features such as *déjà vu* and forced thinking actually represent an impairment of consciousness (Blumenfeld, 2012). Clinically, when patients have cognitive seizures, the awareness level is often hard to evaluate as the experience is often short-lived and patients are mostly alone at the time or no abnormality is noticed by other people; thus, there are no language provocation or other tests to determine their state of awareness. We wonder whether it is meaningful to discuss awareness for this certain type of manifestation. Should we consider certain manifestations for which evaluation of awareness is not necessary, or introduce another special category of consciousness? Further understanding of these seizures is needed. It is also important to consider the differences between potential seizure types for a given manifestation. Further studies will enrich our understanding of these distinctions, and thus lead to better classifications.

This study has several limitations. Firstly, it is a preliminary investigation into clinical practice based on the 2017 ILAE seizure classification. Secondly, our study was based on an outpatient setting, limiting the number of patients with vEEG, thus details of seizure manifestations based on history-taking may not have been accurate. Thirdly, we were unable to consider all seizure types. Lastly, this study focused on a comparison between different terminology, and such a comparison should be more multi-dimensional and include input from both the physician and patient. Further studies are needed to evaluate the 2017 classification more comprehensively.

Conclusion

The 2017 ILAE classification of seizures greatly reduces unclassifiable cases. Flexible combinations of awareness level and motor/non-motor features provide detailed seizure description. Several unclassified cases, however, are still likely to arise, and this is mostly

due to our lack of understanding of epilepsy. To date, the ILAE 2017 classification of seizures demonstrates a steady transition from the 1981 classification, with acceptable consistency and improvements. □

Supplementary data.
Summary didactic slides and supplementary data are available on the www.epilepticdisorders.com website.

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TEST YOURSELF

(1) What are the improvements in the 2017 classification?

(2) What are the reasons for less misclassification of cases in clinical settings based on the 2017 classification?

(3) What influence has the 2017 classification had on the public?

Note: Reading the manuscript provides an answer to all questions. Correct answers may be accessed on the website, www.epilepticdisorders.com, under the section "The EpiCentre".