The diagnostic value
of short-term video-EEG monitoring in childhood

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Abstract

Objective: the objective of this study was to investigate the value of short-term video-EEG monitoring in a pediatric population with distinct clinical complaints in order to verify the benefits and limitations of this procedure.

Patients and methods: a prospective protocol, developed in the University of São Paulo, analyzed 38 consecutive patients (age ranging from 4 months to 17 years; mean 6.9 years). All patients were referred in order to establish the diagnosis. The patients were divided in the following groups according to the main clinical complaint: doubts about seizure/syndromic classification (Group I, n = 22); differential diagnosis with non-epileptic events (Group II, n = 8) and differential diagnosis between cognitive decline and status epilepticus (Group III, n = 8).

Results: clinical episodes were observed in 36 patients (94.7%). In group I, seizures were reclassified in 11/22 (50%) patients and confirmed in eight (36.4%). One patient presented a sleep disorder and two did not present clinical events during monitoring. Syndromic classification was modified in nine (40.9%). In group II, four patients (50%) presented epileptic seizures; two had movement disorders and two, non-epileptic events. The cognitive deterioration was correlated with non-convulsive status epilepticus in five children (62.5%) of group III. Alterations of therapeutic and/or diagnostic approaches, as a consequence of monitoring, were performed in 21/38 (55.3%) patients.

Conclusion: in our series, short-term video-EEG monitoring established a reliable diagnosis in most patients due to correlation between clinical and EEG data. This procedure was well tolerated by children, including infants and those with psychiatric disorders.


Introduction

Video electroencephalograph (video-EEG) is a non-invasive diagnostic method characterized by EEG recording concurrent with a clinical event, providing an unequivocal correlation between these two data sources. In this manner, an ictal event which has been witnessed and reported by family members or by the patient themselves may be documented and its nature, epileptic or not, may be determined. An important reason for indicating this type of procedure is the differential diagnosis between epileptic...
and non-epileptic events (syncope, cardiac arrhythmia, disturbed sleep and psychiatric disturbances, among others). Other circumstances under which video-EEG is recommended are: the classification of epileptic crises and syndromes, the determination of the epileptogenic zone in pre-operative investigations for surgery for epilepsy, the determination of the frequency of crises and the response to therapeutic intervention.1-11

Video-EEG can be performed with the patient hospitalized and under permanent monitoring within a unit appropriate to it. Events will be registered 24 hours a day for a period which, on average, varies from three to seven days. This is the classic form of monitoring, and defined as prolonged monitoring. Monitoring with video-EEG without the patient being hospitalized and with a shorter duration (4 to 12 hours) is defined as outpatient video-EEG and takes as one of its prime motives the reduction to a minimum of the discomfort involved in prolonged monitoring.

Prolonged video-EEG, despite making an undeniable contribution to the diagnostic clarification of ictal events, entails certain inconveniences such as prolonged hospitalization, the discomfort of remaining for long periods with electrodes stuck to the scalp (with collodion), in addition to the high cost of the procedure.4

It is the pediatric population which benefits most from the video-electroencephalograph record, taking into account the peculiarity of epileptic crises during childhood, the inability of these patients to describe subjective phenomena and the difficulty of defining the nature of an event even when it is witnessed by a professional. Nevertheless, children represent a significant challenge when performing prolonged video-EEG, taking into account hospitalization as an important stress factor and the difficult that the child has in understanding the procedure being imposed. There is little published material on the diagnostic value of short duration video-EEG with pediatric patients at clinics and outpatient units (outpatient video-EEG) (<24h).8-10 As a result of the scarcity of studies, there are many estimates of the sensitivity of the method which differ greatly between different studies (55 to 83%).8,9 As a result of the variations in the populations studied and the type of indication.

The objective of this prospective study is to investigate the value of outpatient video-EEG within a pediatric population with a variety of clinical complaints, verifying the benefits and limitations of this method.

Patients and Methods

Population studied

A prospective protocol was developed at the Clinical Neurophysiology Laboratory of the Hospital das Clinicas of FMUSP during the period from May/00 to March/02. Thirty-eight consecutive patients were analyzed (aged between four months and 17 years - mean average of 6.9 years; median of 6 years). All of the patients had been referred by tertiary neurology and pediatrics centers, for clinical clarification. They were divided into groups depending on the primary complaint. Group I consisted of 22 patients with a strong suspicion of epilepsy, referred for improved classification of the crises and/or epileptic syndromes they presented.

Group II was made up of eight patients with clinical suspicion of non-epileptic events. One common denominator among these patients was that their interaction with their environment was compromised by the underlying pathology (the presence of psychiatric disturbances in six patients and serious mental deficiency in the remainder), which represented the main difficulty to clinical diagnosis by means of interviews with family members and the direct observation of the event presented by the patient.

Group III, made up of eight patients with seriously retarded neuropsychomotor development (four with Angelman syndrome, one with Rett syndrome, one with Leber’s optical atrophy, one with Alpers syndrome and one with suspected metabolic disease under investigation). These patients presented a sudden cognitive decline characterized, in three children by the loss of previous acquisitions and in the others by prolonged unresponsive periods.

In 11 patients (28.9%) two or more complaints were associated and these patients were classified according to the most important reason for performing the procedure.

Study protocol

The protocol for this study included a revision of previous EEGs anamnesis and directed physical examinations to verify the necessity of additional electrodes, polygraphic recordings, circadian cycle modification and/or other activation methods.

Video-EEG assessment

During monitoring scalp electrodes were positioned according to the 10-20 system12 and with the additional of additional electrodes [10-10 system], when necessary. During the crisis and soon after the end of it all of the patients were tested, in an attempt to verify the level of consciousness and transitory neurological alterations (for example: language, motor and memory functions). Patients did not require hospitalization and were assessed by video-EEG studies which varied in length from 4 to 12 hours (average 8 hours). Recordings were made when awake, drowsy and asleep.

Video-EEG Review

After monitoring, the patients and/or their family members reviewed the events that had been recorded. In the event that these recordings were not recognized by the family members as being those that were observed at home the examination was considered inconclusive and the patient summoned for a second recording. If this second recording
was not sufficient, the patient was then referred for prolonged video-EEG monitoring. The videos and the electroencephalographic traces were later reviewed by three of the authors independently.

**Event classification**

Epileptic crises and syndromes were classified in accordance with the International League Against Epilepsy (ILAE). Before monitoring was begun, classification was made on the basis of clinical history and previous EEGs. Neuroimaging studies which had been performed also added data to further define the etiology of epileptic crises as symptomatic, cryptogenic or idiopathic.

**Results**

Clinical episodes were recorded in 36 of the 8 patients (94.7%), of which 27 (71%) were during the first 12 hours. The other eleven patients required a second twelve-hour procedure, which was then conclusive in nine cases. Ten of the monitored patients were referred for prolonged video monitoring for pre-operative assessment.

The twenty-seven patients whose events were recorded within the first 12 hours had all presented previous history of daily crises while the remainder (11 patients) presented weekly events.

**Group I**

This group was composed of 22 children (six infants) with a previous diagnosis of epilepsy with a clinical and electroencephalographic basis, with the exception of one patient who presented with normal routine EEGs.

Only 2/22 (9.1%) of the patients mentioned above did not present clinical events during monitoring and were referred for prolonged video-EEG. Of the twenty patients who presented a clinical record, one had only non-epileptic events. Epileptic crises had been erroneously classified in 11 of the others (50%) (Figure 1). The primary diagnostic error occurred in relation to the classification of partial crises followed by rapid secondary generalization which had been previously diagnosed as generalized crises (six patients). Video-EEG confirmed a previous epileptic syndrome diagnosis made by means of EEG history in eleven cases (50%) and resulted in a revision of the etiologic diagnoses of nine patients (40.9%) (Figure 2).

Eight epilepsy patients had been involved in the clinical suspicion of the appearance of a new type of epileptic crisis or a semiological difference from previously existing crises. It was possible to demonstrate by means of outpatient video-EEG that these events were not epileptic in seven cases. In contrast, subtle epileptic crises, imperceptible to the patient’s parents, were documented in one case.

After the first video-EEG and the consequent changes to therapy that were instituted, a second monitoring session was required for five of the patients in order to evaluate their clinical response to the new treatment.

**Group II**

Clinical events were recorded for all eight of the patients in this, who presented repetitive periods of altered behavior for which no etiology had been defined. Four (50%) of them presented epileptic events and in these cases the change in diagnosis led to alteration of therapy. Two patients (25%) presented movement disorders and two (25%), non-epileptic events (infantile masturbation and syncope), reinforcing earlier diagnostic suspicions.


**Group III**

Eight children had been referred for outpatient video-EEG for differential diagnosis between cognitive decline and subclinical events and/or non convulsive EME. These events had not been defined by routine EEG.

In five patients (62.5%), the decline was the result of EME (childhood absence epilepsy in four patients and childhood myoclonic epilepsy in one). Three patients presented non-epileptic events characterized by loss of autonomy, non-cortical myoclonus and cognitive deterioration resulting from their primary encephalopathy.

**The consequences of outpatient video-EEG on therapy and clinical investigation**

The nature of the ictal events was reclassified from non-epileptic to epileptic in the cases of six of the patients (Figure 3) from the group of 36 patients who had had their events monitored.

![Figure 3 - Reclassification of epileptic events in the group of 36 patients that presented clinical events during monitoring](image)

Major therapeutic modifications were made for 21/38 (55.3%) patients. Ten patients were referred for pre-operative evaluation; two had their AEDs discontinued; in nine cases medication was introduced (AEDs in five and psychotropic drugs in two). In nine patients, only an adjustment to the dosage of medication was necessary. Outpatient video-EEG was useful in indicating a region to be studied with neuroimaging with MR in 10 patients, previously classified as having cryptogenic or idiopathic epilepsy, and for a further two with other diagnostic hypotheses (one with suspected metabolic disorder and another with crises suspected of being non-epileptic).

**Prolonged monitoring**

Ten patients were referred for prolonged video-EEG, eight because they were considered as candidates for surgery and two because their outpatient video-EEG had been inconclusive. In these patients who underwent prolonged video-EEG, hospitalization was reduced with the help of information obtained previously with outpatient video-EEG.

**Discussion**

The pediatric population, especially young children and infants, represents the greatest challenge to the diagnosis of ictal events. As has been pointed out in other studies, histories of clinical manifestations of ictal events as provided by parents of patients in this age group are confusing and of little help towards clarification. In this context video-EEG comes to play an important role in diagnostic clarification and therapeutic approach to childhood ictal events. However, prolonged video-EEG is not well tolerated by the majority of children, and represents an additional stressing factor to family members who are already shocked by the appearance of the ictal events. Therefore, it is important to establish whether this group of patients could benefit from a shorter monitoring period during the clarification of diagnostic events, or if the time limitations of the study time of outpatient video-EEG signify an inadequacy factor. In our study, outpatient video-EEG was definitive with the first video-EEG in 71% of our cases, which is similar to figures found by other authors, and reached 94.7% taking into account a second monitoring period, irrespective of age or clinical complaint. We believe that these high rates are the result of a number of factors, such as: the performance of the study at a tertiary center, the use of individualized activation methods (e.g., altering the circadian cycle) and the greater duration of monitoring compared with other studies. The population studied should also be taken into account as consisting of children who benefit from this type of monitoring due to the higher frequency of epileptic crises, when compared with adults with refractory epilepsy. Certain strategies, in our opinion, could be adopted to increase the sensitivity of this method even further, such as the referral by the clinic or the instruction of the patients parents to encourage the performance of the examination at moments when there is an increase in the frequency of the crises and, as mentioned above, the use of a second, twelve hour video-EEG, when necessary, which second measure may avoid internment for prolonged video-EEG.

One of the main reasons for indicating video-EEG is to adequately classify epilepsy in order to improve therapeutic approaches. Generalized crises with focal starting points which are frequent during childhood, represent one of the greatest challenges in the diagnosis of children with epilepsy,
and, in our study, were one of the main reasons for epileptic crisis reclassification. Consequently, this method enabled, indirectly, a finer adjustment of AEDs and orientated neuroimaging examinations for patients who had been previously diagnosed as cryptogenic. The importance of this factor is demonstrated by the altered conduct resulting from this reclassification, which lead to a proportion of these patients undergoing early surgical intervention, thus avoiding the deleterious effect of epileptic crises on the developing cerebrum.

The diagnosis of non-epileptic events, in patients who had previously been treated for epilepsy, averted the possibility of these patients receiving AEDs or allowed their discontinuation. Nevertheless, while the advantages of outpatient video-EEG to these patients are, as has already been pointed out by others, undeniable, in our experience care should be taken with precipitate diagnosis and the sudden discontinuation of medication since the co-morbidity of epilepsy and non-epileptic events is elevated. Thus, therapeutic management based on a brief assessment could lead to an increase in morbidity.

One group of children who particularly benefited from monitoring was that made up of children with serious encephalopathies or psychiatric disturbances who presented difficulties in describing subjective symptoms, making clinical diagnosis more difficult. In our study, outpatient video-EEG was vital to the diagnosis of epilepsy in these children who present a high risk of non-convulsive EME which is difficult to detect due to the poor contact with the medium. At this point the identification of the event is necessary to appropriate therapy.

Other authors have used outpatient video-EEG for pre-operative assessment however it is our firm conviction that to achieve this objective, prolonged video-EEG is absolutely necessary due to the importance of detailing the epileptic crises and of the involvement of a multidisciplinary team in the planning of the surgical procedure. In this aspect outpatient video-EEG may shorten pre-operative monitoring, but it should not be used as a substitute for prolonged monitoring.

We conclude that, in our series, outpatient video-EEG established a diagnosis for the majority of patients, correlating clinical with electroencephalographic data. The recordings were well tolerated by the children, including those with psychiatric problems. The primary advantages of the method were the classification of epileptic crises and syndromes, the differential diagnosis of non-epileptic events and the detection of epileptic crises which were imperceptible to the observer. The primary limitation, further to the shorter recording period, lies in the high level of co-morbidity between epilepsy and non-epileptic events, and, therefore the recording of a non-epileptic event does not completely rule out a diagnosis of epilepsy and conduct should be by criteria. This study demonstrates the utility and importance of outpatient video-EEG in pediatric patients suffering ictal events for whom routine EEG was not capable of clarifying diagnosis. However, despite outpatient video-EEG being extremely useful for the identification of epileptic crises and their classification, we believe that prolonged monitoring is the method of choice for the pre-operative assessment of children who are candidates or epilepsy surgery.

References


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