Seizure 53 (2017) 26–30

Contents lists available at ScienceDirect

Seizure

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

Epileptic seizure or not? Proportion of correct judgement based only on a video recording of a paroxysmal event

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ARTICLE INFO

Article history:
Received 29 May 2017
Received in revised form 25 August 2017
Accepted 27 August 2017
Available online xxx

Keywords:
Seizure
Video-EEG
Neonate
Infant
Paroxysmal movement
Evaluation

ABSTRACT

Purpose: Our study was intended to measure the proportion of correct seizure recognition among different medical and non-medical groups based on only a video recording.
Methods: Video recordings about paroxysmal movements of 15 very young infants (2 days – 5 months of age) were displayed for six groups: 159 1st-year medical students, 65 4–5th-year medical students, 52 paediatric residents, 18 paediatric neurologists from different European countries, 43 adult neurologists and 37 parents whose children were treated at our Department. All participants were asked to decide which recording they considered as of epileptic origin or a non-epileptic event. Correct answer rate (CAR) was calculated in each group for every video.
Results: The average CAR was the lowest in the group of 1st-year medical students (36.6%), the best results were reached by paediatric neurologists (67.4%). The CAR was significantly different between the groups of 1st-year medical students and paediatric neurologists ($p = 0.02$), and between the groups of 1st-year medical students and residents ($p = 0.045$). The CAR of the most deceptive epileptic seizure was only 18.2%. The judgement of parents proved to be better than that of the 1st-year medical students.
Conclusions: Recognising epileptic seizures in very young infants without EEG is extremely inaccurate. Even trained paediatric neurologists were able to judge correctly the different movement types in only 67.4% of the cases. The role of education and experience is clearly indicated by the increase in CAR from 1st-year medical students through well–trained paediatric neurologists.

1. Introduction

Neonatal seizures (occurring from birth to 28 days of age) and infantile seizures (occurring in the first year after neonatal period) are fairly common conditions in paediatric neurology. The overall incidence of seizures is about 1–3 per 1000 live births in term infants, while in preterm or low birth weight (LBW) infants the incidence is about 10 times more common than in term infants [1]. The incidence of seizures is the highest during the first year of life [2,3], because the immature brain has enhanced excitability compared to the mature brain due to the different expression time of inhibitory and excitatory receptors during the development [4].

Identification and differentiation of seizures belong to the most difficult tasks of paediatric neurologists. Not only do several types of epileptic seizures and syndromes have to be separated but they also have to be distinguished from non-epileptic events. Especially in the neonatal period and in early infancy the differentiation of the pathological and physiological movements can be very difficult. Though early recognition of neonatal and infantile seizures is essential for the proper treatment. It is also well-known that the shorter the period between the seizure onset and the initiation of the treatment the more favourable is the prognosis [5,6]. The unusual extra movements of a baby can be frightening or frustrating for the parents and they usually seek urgent consultation with their paediatric general practitioner. But distinguishing among epileptic or non-epileptic seizures and harmless movements in this age group can be very challenging without an EEG examination for paediatric neurologists, too [7]. Epileptic spasms can be especially deceptive. Auvin et al. [8] studied the consequences of diagnostic delay in West syndrome. They found that the majority of physicians did not find any specific diagnosis,

Abbreviations: CAR, correct answer rate; paed. neur., paediatric neurologist; PPV, positive predictive value; NPV, negative predictive value; CI, confidence interval.

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http://dx.doi.org/10.1016/j.seizure.2017.08.017
1059-1311/

they assessed spasms as behavioural changes, while others suggested gastroesophageal reflux, constipation or colitis.

Our study was intended to measure the proportion of correct seizure recognition in a range of medical and non-medical groups based on only a video recording. We set up six groups such as (1) first-year medical students, (2) 4–5th-year medical students, (3) paediatric residents, (4) paediatric neurologists, (5) adult neurologists and (6) parents. Our hypothesis was, that the more professionally qualified population will recognise seizures more adequately.

2. Methods

We conducted an observational study. From the video-EEG database of the Department of Paediatrics, University of Pécs 15 videos were randomly chosen. Inclusion criteria were (1) all video recordings were chosen about babies whose age was 1 day-6 months (2) the history of children included unusual movements reported by their parents (3) the correct diagnosis of epileptic or non-epileptic event was obvious based on video-EEG (4) parents gave written permission to present video recordings of their children.

Nine children were diagnosed with epileptic seizure, six children showed other benign movements. All of them were diagnosed after a detailed history taking and video EEG examination. EEG recordings were taken at the EEG lab of Department of Paediatrics University of Pécs. BrainQuick System Plus Evolution EEG (Neuro Trend, Budapest, Hungary) was used with 9 scalp electrodes (F3, F4, C3, C4, O1, O2, T3, T4, Cz). Video-EEG findings were evaluated by two paediatric neurologists. All video-EEG recordings were performed in supine position except for video 9.

Only video recordings (without EEG recording and any additional history data) were displayed for the six groups: 18 paediatric neurologists from different European countries (who participated in the EPNS Training Course, Budapest 2016), 52 paediatric residents, 159 first-year medical students, 65 fourth or fifth-year medical students, 43 neurologists (25 of them were also specialised in clinical neurophysiology) attended the Education and Training Course of Neurophysiology in Debrecen 2017 and 37 parents (31 mothers and 6 fathers). The children of these parents have been followed up regularly at the Outpatient Service of Child Neurology at Department of Paediatrics, University of Pécs. 30 of them had children with epilepsy, 7 had children with tension type headache. 28/37 parents completed at least secondary education.

The videos were presented to the participants in 2016–2017 (Microsoft Office PowerPoint 2013). Each video was presented only once. The average duration of the videos was 30 s (Table 1).

The participants were given a paper-based questionnaire, and they were requested to answer immediately after watching each video. They had to decide whether or not the movement of the child was an epileptic or non-epileptic event. In advance, they were informed about the purpose of the study and ensured about the anonymity of their answers.

The data were collected by Microsoft Office Excel 2013. Correct answer rate (CAR) was calculated in each group and for every video. The statistical analyses were performed by IBM SPSS Statistics 24. The level of significance was set at 0.05. The CAR for videos between the groups was compared by One-Way ANOVA. To reveal which results of the six groups were significantly different from each other further Post-Hoc Analyses (Bonferroni) were performed. Agreement with correct responses and the interrater agreement were analysed by Kappa correlations (Cohen and Fleiss) statistics. The value of kappa ranges from +1 (perfect agreement) to −1 (perfect disagreement). Difference between sensitivity, specificity, positive and negative predictive values was compared by Independent-Samples T test. Difference between sensitivity, specificity, positive and negative predictive values in each group of responders was evaluated by comparison of confidence intervals.

3. Results

374 persons participated in our survey. 5610 answers were evaluated, 2766 of them (49.3%) were correct. The average experience of paediatric neurologists was 5.3 year (range between 0 and 16 years) after their license exam. The lowest average CAR was given by the first-year medical students (36.6%). The highest average CAR was reached by the paediatric neurologists (67.4%) (Fig. 1).

Video 7 proved to be the most difficult to differentiate for the participants. The very discrete finger rubbing movements of a 4-month-old baby with septo-optic dysplasia were deceptive. The average CAR was only 18.2%. The first year medical students were

Table 1
Characteristics of patients and videos.

Number of the video	Age and gender of the child	Visible movements on the video recording	Aetiology-Diagnosis	Epilepsy or not?
1.	2 days, male	continuous tremor of four limbs	hypoxic-ischaemic encephalopathy	yes
2.	2 months, male	rhythmic, tremor like movements involving four limbs	jitteriness	no
3.	4 months, female	clonus of the right arm	left temporooccipital cortical dysplasia	yes
4.	7 days, female	horizontal nystagmus to the right side	congenital hydrocephalus	yes
5.	14 days, male	the examiner knocks the nose of the baby, he becomes stiff for a moment and produces a myoclonus-like movement	hyperekplexia	no
6.	5 months, male	continuous horizontal shaking of the head with munching	Alexander leukodystrophy	yes
7.	5 months, female	very discrete finger rubbing movements on the left hand	Septo-optic dysplasia	yes
8.	7 days, male	asymmetric myoclonic jerks involving four limbs	nonketotic hyperglycinemia	yes
9.	2 months, male	subtle myoclonic jerks of four limbs during sleep	benign neonatal sleep myoclonus	no
10.	5 days, male	tremor of the lower limbs	jitteriness	no
11.	2 months, female	rhythmic, tremor like movements involving four limbs which can be stopped by touching of the limbs	jitteriness	no
12.	10 days, male	high amplitude, rough tremor of four limbs	drug addict mother (heroin)	no
13.	2 months, male	rough myoclonia dominantly of arms	nonketotic hyperglycinemia	yes
14.	2 days, male	sudden, synchronised extension of the arms	polymicrogyria	yes
15.	5 months, male	in supine position repeating elevation of the arms and lower extremities with the flexion of neck	epileptic spasms, West syndrome	yes