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Diagnostic accuracy of paroxysmal spells: Clinical history versus observation☆,☆☆

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ABSTRACT

Our goal was to evaluate how accurate neurologists are at differentiating between different paroxysmal events based on clinical history versus observation of the spell in question. Forty-seven neurologists reviewed 12 clinical histories and videos of recorded events of patients admitted in the Epilepsy Monitoring Unit (EMU). They were asked to diagnose events as epileptic seizures, non-epileptic behavioral spells (NEBS), or other physiologic events as well as rate their confidence in their diagnosis. The median diagnostic accuracy for all paroxysmal events was 67% for clinical history and 75% for observation ($p = .001$). This was largely due to the difference in accuracy within the subgroup of patients with NEBS (67% history vs. 83% observation, $p < .001$). There were trends for higher diagnostic accuracy and increased inter-rater agreement with higher levels of training. Physicians with higher levels of training were more confident with diagnosis based on observation. In summary, reviewing videos of paroxysmal spells may improve diagnostic accuracy and enhance the evaluation of patients. Neurologists at all levels of training should encourage the recording and review of videos of recurrent spells to aid in medical decision-making especially when there is high concern that the spells in question are NEBS.

1. Introduction

Patients with paroxysmal events often do not experience their events with simple suggestion techniques during routine Electroencephalogram (EEG) [1,2]. While the gold standard of differentiating epileptic seizures from other paroxysmal spells is monitoring in the Epilepsy Monitoring Unit (EMU) where video-EEG monitoring, clinical history, and witnessed semiology converge [3,4], all three elements are not always essential to reach a diagnosis [5,6]. Epileptologists have high diagnostic accuracy in diagnosing epilepsy based solely on clinical history [7]. There have also been studies exploring the ability to diagnose epileptic seizures based on observation of the spell, but they have been limited in scope [3,8–11]. To date, no studies have attempted to compare diagnostic accuracy based on clinical history alone versus observation of the spell in question. In addition, no studies on this subject matter have compared diagnostic skills of residents and other nonepilepsy-trained neurologists against epileptologists.

With advances in cell phone camera technology, physicians are increasingly being shown videos of events taken by patients or family hoping this will help with clinical decision making. There is active research to assess the feasibility and value of patient-captured smartphone videos for diagnostic purposes [12].

The aim of this study was to investigate how accurately neurology-trained residents, fellows, and subspecialists differentiate paroxysmal spells based on clinical history versus observation alone. In addition, we sought to see how diagnostic confidence varied between the various levels of training.

2. Methods

The videos of patients admitted to the EMU at the University of Pittsburgh Medical Center (UPMC) Presbyterian Hospital (Pittsburgh, PA) from 2011 to 2015 for "spell classification" who had their typical events captured during their evaluations were analyzed retrospectively.

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Table 1
Paroxysmal spell types with age and gender.

Case number	Spell type	Age, gender
1	Focal temporal lobe seizure	20, F
2	Focal temporal lobe seizure with secondary generalization	50, M
3	Focal extratemporal lobe seizure	68, M
4	Focal extratemporal lobe seizure with secondary generalization	42, M
5	Generalized seizure	20, F
6	NEBS	42, F
7	NEBS	49, M
8	NEBS	32, M
9	NEBS	32, F
10	Vasovagal syncope	18, M
11	Convulsive syncope	65, M
12	Cough-induced syncope	49, M

A “typical event” was defined as an event which corresponded to the clinical description provided by the patient on admission. The reported EMU-confirmed diagnosis was considered final.

A total of 12 patients with established diagnoses and good quality videos were selected to provide a wide variation in paroxysmal spell types (Table 1). Five patients were diagnosed with epilepsy, four with nonepileptic behavioral spells (NEBS), and three had other physiologic events. Each patient met with a neuropsychologist during their EMU stay who completed a personality evaluation, neurocognitive testing, and documented the patient's description of their “typical” event. In order to maintain consistency, this depiction was reviewed and summarized into a clinical vignette. Neurologists from a single center were provided the summarized clinical vignettes arranged in a random order. They were asked to diagnose each event as epileptic, NEBS, or other physiologic event. Participants also expressed how confident they were in making that diagnosis using a Likert-type scale (scale of 1–5, 5 being most confident). Afterwards, participants were asked to watch the 12 videos of the same events captured while in the EMU without an EEG. These videos were presented in a different randomized order so that participants would not be able to correspond the order of the videos to the previously reviewed clinical histories. Participants were asked again to make a diagnosis and comment on their level of confidence. If the participant recognized the patient from video observation, they were asked to omit their diagnosis.

Forty-seven physicians participated in the study. These neurologists were at various levels of training: 10 postgraduate year-1 (PGY-1) interns, 10 PGY 2–3 residents, 9 neurology PGY-4 residents and fellows, 14 nonepilepsy-trained attendings, and 4 board-certified epileptologists. Participants in the fellowship group were in various neurologic specialties (clinical neurophysiology, vascular neurology, and movement disorders). The nonepilepsy-trained attendings were from various specialties including general neurology, vascular neurology, movement, headache, and clinical neurophysiology. Data were collected by a single-blinded researcher from participants individually or in small groups over a span of 8 months. An Institutional Review Board (IRB) approved the use of human subjects for this study.

3. Statistical analysis

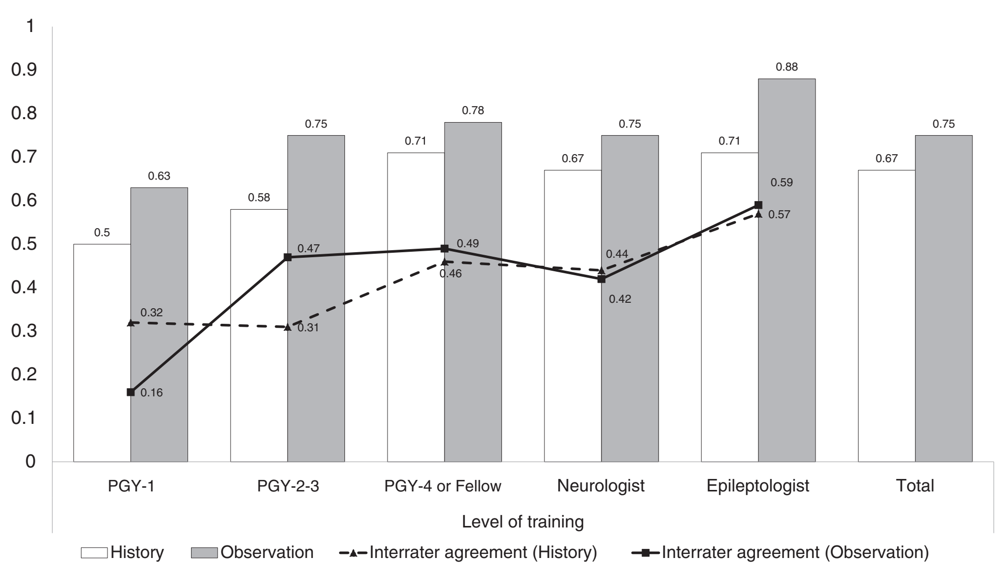
Raw data were summarized by calculating each physician's diagnostic accuracy (correct vs. incorrect), sensitivity, and specificity for each of the possible diagnoses. Overall diagnostic accuracy was also defined, with separate statistical analysis for clinical history and observation. These data were compared via a Wilcoxon signed-rank test. Diagnostic accuracy across groups of physicians based on training level was compared via a Kruskal–Wallis test.

Fleiss kappa statistics to measure agreement between physicians were calculated from the raw data, both overall ($n = 47$ physicians) and then separately for the various levels of training: interns, PGY-2 and 3, PGY-4/fellows, nonepilepsy-trained neurologists, and epileptologists. Confidence values for each diagnosis were summarized as means for each physician level of training. Statistical analysis was carried out in IBM SPSS version 24 (IBM Corp., Armonk, NY) and Stata version 14 (StataCorp, College Station, TX). Two-sided p-values < 0.05 were considered statistically significant.

4. Results

The median diagnostic accuracy for all paroxysmal events was 67% based on clinical history and 75% based on observation ($p = 0.001$) (Graph 1). A higher accuracy of diagnosis of NEBS based on observation was statistically significant (67% history vs. 83% video, $p = 0.001$). There was a higher accuracy for diagnosis of epileptic seizures with observation which was not statistically significant (75% history vs. 83% observation, $p = 0.447$). The median accuracy for other physiologic spells was equal for both history and observation at 83% ($p = 0.288$).

There were six cases in which there was over a 30% difference in diagnostic accuracy between observation and history. The four cases in which accuracy was over 30% higher with observation included a



Graph 1. Median accuracy for history (white), observation (gray), interrater agreement for history (straight line) and observation (dashed line) by level of training.