



## Clinical Research

# Improving first responders' psychogenic nonepileptic seizures diagnosis accuracy: Development and validation of a 6-item bedside diagnostic tool



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## ARTICLE INFO

## Article history:

Received 27 September 2015

Revised 24 October 2015

Accepted 26 October 2015

Available online 29 November 2015

## Keywords:

Seizures

Nonepileptic seizures

Nonepileptic attacks

Seizure semiology

Video-electroencephalography

## ABSTRACT

**Objective:** Epileptic seizures (ES) are often seen as a medical emergency, and their immediate and accurate recognition are pivotal in providing acute care. However, a number of clinical situations may mimic ES, potentially leading to misdiagnosis at the emergency room and to inappropriate prescription of antiepileptic drugs (AED) in the acute and chronic settings. Psychogenic nonepileptic seizures (PNES) play a major role in this scenario and often delay the correct diagnosis and increase treatment morbidity and cost. First responders often conduct the initial assessment of these patients, and their impression may be decisive in the prehospital approach to seizures. We sought to investigate and improve the accuracy of PNES diagnosis among professionals involved in the initial assistance to patients with seizures.

**Methods:** Fifty-three registered nurses, 34 emergency physicians, 33 senior year medical students, and 12 neurology residents took a short training program consisting of an initial video-based seizure assessment test (pretest), immediately followed by a 30-minute presentation of a 6-item bedside diagnostic tool and then a video-based reassessment (posttest). Baseline status and learning curves were determined.

**Results:** The distinct professional categories showed no significant differences in their ability to diagnose PNES on both pretests and posttests. All groups improved diagnostic skills after the instructional program.

**Significance:** The findings helped determine the best identifiable PNES clinical signs and to provide initial validation to a novel diagnostic instrument. In addition, our results showed that educational measures might help in the identification of PNES by first responders, which may decrease the treatment gap.

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## 1. Introduction

Epilepsy is currently defined as a disease of the brain diagnosed on the bases of a single unprovoked seizure plus a probability of further seizures similar to the general recurrence risk (~60%) after two unprovoked seizures [1]. This updated conceptualization has increased the relevance of a correct diagnosis of the nature of a first seizure, particularly the differentiation of epileptic seizures (ES) from

psychogenic nonepileptic seizures (PNES). We have evolved from Hippocrates' description of convulsions "similar to those of epilepsy" [2] to recently reported minimum requirements for the diagnosis of PNES [3]. Still, unrecognized PNES not only delay correct diagnosis by a mean of 7 years, but also increase treatment cost and morbidity [4,5].

As convulsions are often considered an emergency, ambulance personnel and emergency room (ER) staff are frequently involved in the primary assessment [6,7]. Diagnostic errors in this setting may bias the next steps in the evaluation and treatment, including unnecessarily aggressive treatment of prolonged PNES mistaken as status epilepticus [8,9]. Thus, it is important to train 'first responders' in the clinical hallmarks of PNES and to develop tools to aid these professionals in the suspicion of a diagnosis of PNES. Here, we report first responders'

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diagnostic performance on a suspicion of PNES and present a novel instrument designed to improve accuracy in the initial approach. We hypothesized that this instrument would considerably enhance first responders' awareness of PNES, as well as their ability to identify clinical clues that may lead to this diagnosis. This study was designed with two components to be carried out together: one, to identify a useful diagnostic instrument and two, to assess the value of an educational measure. In this paper, we describe the findings as they inform both parts.

## 2. Methods

### 2.1. Developing a bedside seizure semiology identification tool

We reviewed video-EEG recordings of documented PNES from the archives of epilepsy monitoring units (EMU) of two tertiary epilepsy centers (Hospital de Clínicas, Federal University of Paraná and EPICENTRO, Hospital Nossa Senhora das Graças, Curitiba, Paraná, Brazil), between 2004 and 2014. Cases in which the PNES had motor features resembling generalized tonic-clonic epileptic seizures (ES) were selected, and PNES with pure immobility, subtle random movements, or hypotonia and unresponsiveness were excluded. Fifty patients were selected, 30 with “lone” PNES and 20 “mixed”, with documented coexistence of PNES and ES. A mean of 3 (ranging from 1 to 12) PNES were recorded per patient. All seizures were analyzed, and one representative sample per patient was selected and edited, based upon the quality of both the video and the interaction with the patient during the episode. Semiology in patients with lone and mixed PNES was analyzed, compared, and proven similar. The 50 patients with PNES were compared with 20 patients with video-EEG documented ES, randomly assigned from the same databases. A mean of 2.8 (ranging from 1 to 10) ES were recorded per patient, and one representative episode was selected and edited. All 70 videos were then reviewed for the presence or absence of 27 semiological signs considered as potential discriminators between PNES and ES according to the pertinent literature [3,10–12]. Comparison between PNES and ES allowed us to select

six practical semiological features with potential to distinguish PNES from ES and to build a rapid assessment instrument. We aimed to include signs that were easily and promptly identifiable at the emergency site, assuming that, if present, they would not be missed, even in the distressful environment of seizure-like events. Recognition of these signs and consequent consideration of PNES into the differential diagnosis may prevent the “error on the safe side” effect that leads to starting antiepileptic drugs for any event resembling an epileptic seizure. To optimize recognition, these signs were plotted on cartoon figures displaying the positions or features of each chosen sign, favoring either PNES or ES. This layout was loosely inspired by Gates' [2] classical paper on “ictal characteristics of pseudoseizures” (Fig. 1).

### 2.2. Testing and validation of PNES diagnostic tool among first-responders

We tested and validated the usefulness of this rapid seizure assessment instrument by analyzing performance on a group of first responders. In our setting, “first responders” encompass distinct categories of professionals, as opposed to the exclusive emergency medical technicians (EMTs) seen on other countries. Subjects were 53 nurse clinicians (RN), 34 emergency physicians (MD), 33 senior medical students (MS), and 12 neurology residents (NR), all related to emergency care. The RN and MD were recruited from a pool of professionals working at the city public emergency medical ambulance system. The MS were at their senior year of medical school, attending subinternship activities and routinely taking calls at emergency rooms under staff supervision. The NR group encompasses both neurology and child neurology residents. All participants signed an informed consent form and were presented with a random selection of 6 videos, 3 of PNES and 3 of ES. Before any specific training, participants were pretested by watching each video and selecting either “PNES” or “ES” as a primary diagnosis. Accuracy of responses was established for all responders and for each professional category. Following the pretest, subjects immediately attended a 30-minute live slide- and video-based group educational activity covering concepts of PNES, the importance of their recognition,

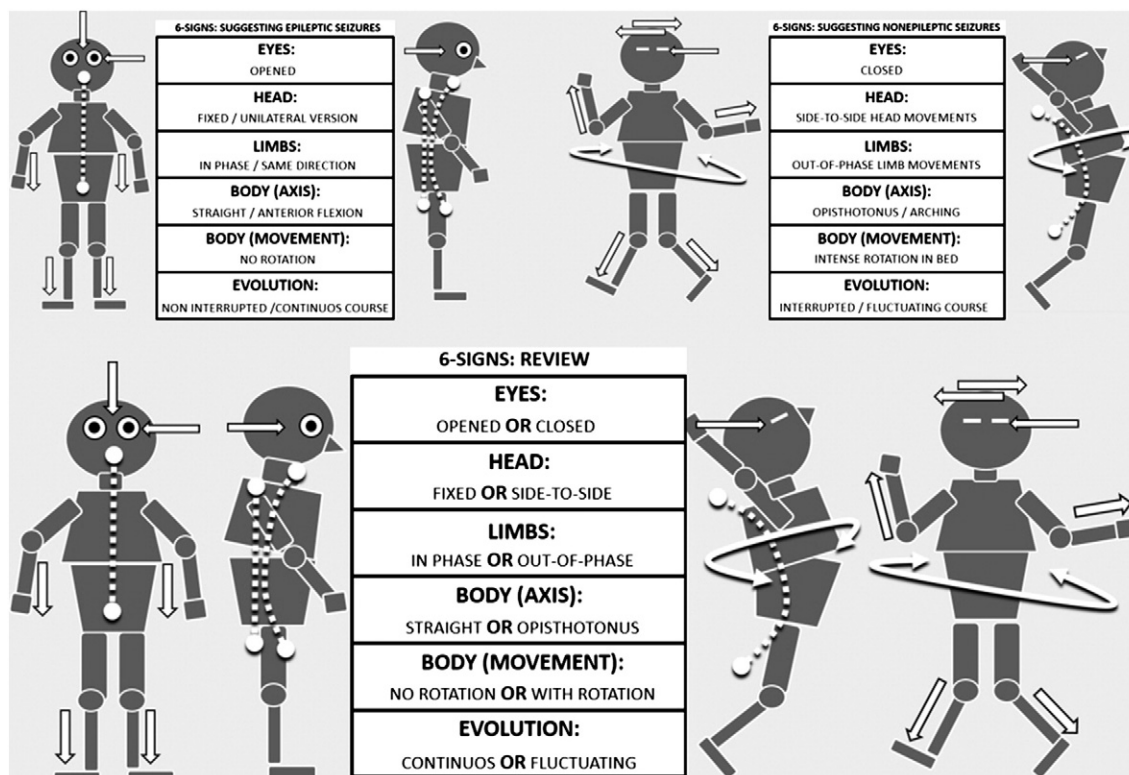


Fig. 1. Cartoon figures shown during the teaching sessions displaying the 6 signs used as ES/CNEP discriminators.

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