

REVIEW

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# The first-line management of psychogenic non-epileptic seizures (PNES) in adults in the emergency: a practical approach



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## Abstract

Distinguishing non-epileptic events, especially psychogenic non-epileptic seizures (PNES), from epileptic seizures (ES) constitutes a diagnostic challenge. Misdiagnoses are frequent, especially when video-EEG recording, the gold-standard for PNES confirmation, cannot be completed. The issue is further complicated in cases of combined PNES with ES. In emergency units, a misdiagnosis can lead to extreme antiepileptic drug escalation, unnecessary resuscitation measures (intubation, catheterization, etc.), as well as needless biologic and imaging investigations. Outside of the acute window, an incorrect diagnosis can lead to prolonged hospitalization or increase of unhelpful antiepileptic drug therapy. Early recognition is thus desirable to initiate adequate treatment and improve prognosis. Considering experience-based strategies and a thorough review of the literature, we aimed to present the main clinical clues for physicians facing PNES in non-specialized units, before management is transferred to epileptologists and neuropsychiatrists. In such conditions, patient recall or witness-report provide the first orientation for the diagnosis, recognizing that collected information may be inaccurate. Thorough analysis of an event (live or based on home-video) may lead to a clinical diagnosis of PNES with a high confidence level. Indeed, a fluctuating course, crying with gestures of frustration, pelvic thrusting, eye closure during the episode, and the absence of postictal confusion and/or amnesia are highly suggestive of PNES. Moreover, induction and/or inhibition tests of PNES have a good diagnostic value when positive. Prolactinemia may also be a useful biomarker to distinguish PNES from epileptic seizures, especially following bilateral tonic-clonic seizures. Finally, regardless the level of certainty in the diagnosis of the PNES, it is important to subsequently refer the patient for epileptological and neuropsychiatric follow-up.

**Keywords:** Psychogenic non-epileptic seizures (PNES), Epilepsy, Emergency, Pseudostatus, Prolactin dosage, Homemade video

## Background

“On call in the emergency room, you receive a 19-year-old patient diagnosed with epilepsy at age 5 years. A friend found him in his bedroom 30 minutes earlier and called emergency services. The patient reports having had seven convulsions, each lasting more than 15

minutes, over the last 3 hours. These events occurred while he was studying for his final exams. What is your approach?” The diagnostic approach can be well oriented by the details mentioned above. Indeed, the fact that the patient was able to give precise details about his recent history after seven close seizures is questionable. Other cues are disseminated in the clinical summary above. From a practical point of view, even though several non-epileptic seizures cases are relatively simple to manage, many others show substantial challenges. In the acute phase, an incorrect diagnosis can lead to an extreme therapeutic escalation in anticonvulsant therapy,

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unnecessary resuscitation measures (intubation, catheterization, etc.) as well as biologic and radiologic investigations, whose results can sometimes be confusing simply by coincidence. For example, Walker et al. reported 23.1% of "pseudostatus epilepticus" among 26 consecutive patients admitted to a UK neurological intensive care unit with a diagnosis of status epilepticus [1]. The economic consequences for the patient and/or for the health care system may be huge, considering that in the US for example, the costs of exploration of "medically unexplained" neurologic symptoms is estimated at more than 256 billion dollars US per year [2]. Outside of the acute window, misdiagnosis can lead to the initiation of long-term antiepileptic drug therapy. Pana et al. found that 26% of patients referred to their Canadian tertiary care epilepsy clinic were non-epileptic cases [3]. In an earlier study, Smith et al. found that 26% of patients referred for "refractory epilepsy" had incorrectly been diagnosed as epileptic [4]. They identified an incomplete history-taking and EEG misinterpretation as equally responsible for the misdiagnosis. Overall, the main reasons of epilepsy/psychogenic non-epileptic seizures (PNES) misdiagnosis are: overlapping clinical features, inadequate witnessed history, insufficient expertise on the clinical features of epileptic and non-epileptic disorders and investigation limitations [5]. A recent Iranian study found that recognition of psychogenic seizures is delayed for more than 10 years in 20% of patients [6]. The problem may be more confusing when the episodes occur in a patient with a confirmed history of epileptic seizures. Indeed, in a 2016 study which included 1 567 consecutive patients investigated in an epilepsy monitoring unit (EMU), Chen-Block et al. found that 12.3% also had non-epileptic seizures [7]. Moreover, they reported that 14.8% of patients with non-epileptic seizures also had epilepsy [7]. In another study, while comparing PNES patients with concomitant learning disability (LD) with those without LD, Duncan and Oto found that a higher proportion of the LD group had epilepsy as well as PNES (36.0% vs 8.7%,  $p < 0.001$ ) [8]. As opposed to the epileptologist who has enough time and adapted tools in the EMU, the emergency physician does not. He is sometimes confronted with alarming clinical situations that require immediate reaction. This article aims to present practical checklists for optimal PNES care in the emergency and other non-specialized units. The first diagnostic and therapeutic line is crucial for the prognosis and sometimes constitutes the sole step of patient care in geographic areas with limited medical resources.

In 2013, a task force commissioned by the International League Against Epilepsy (ILAE) published recommendations for scaled PNES diagnosis according to available tools [9]. Subsequently, third party investigations of high scientific quality brought an additional

value to the diagnostic assets. Therefore, on PubMed, we collected original studies and reviews, using combinations of the keywords "PNES", "psychogenic", "non-epileptic" "epilepsy diagnosis" "emergency". Articles presenting clinical details relevant for clinical diagnosis of PNES were selected and screened. In light of these publications and our local experience, we suggest PNES/epileptic seizures (ES) diagnosis strategies to help physicians who are not familiar with epileptiform events as well as epileptologists practicing in units without v-EEG. However, it is important to note that the final care of PNES should be conducted by a multidisciplinary team involving both an epileptologist, a neuropsychiatrist, and a psychologist.

### **Understanding the question of non-epileptic seizures**

Non-epileptic seizures are abnormal paroxysmal psychic, sensory and/or motor manifestations which resemble (at least in part) to epileptic seizures but are not related to abnormal epileptiform discharges [9]. In general, seizure-like events can first be divided in two main categories: epileptic seizures and non-epileptic seizures. The latter can further be subdivided into physiological non-epileptic seizures versus psychogenic non-epileptic seizures [9]. ES are clinical or subclinical manifestations of excessive and hypersynchronous, spontaneous or reflex cortical discharges. Conversely, PNES are not the result of epileptic neuronal discharges. However, these PNES would involve at least a partial alteration of level of consciousness with a partial preservation of awareness. The patient can interrupt the clinical course of the event and preserve its physical integrity. Psychogenic episodes can consist in a fall (usually safe), a gesticulation (or, on the contrary, a frozen posture), pseudo-clonus of the limbs, ocular revulsion with or without eye blinking, or simply an eye closure with subsequent non-responsive attitude [9–11]. The PNES are opposed to factitious seizures, which are totally voluntary. In these, it is a search for secondary gain that motivates the pseudo-ictal event, either it be attention (desire to captivate the entourage's interest, to show frustration, etc.) or monetary considerations (ex. disability). Finally, physiologic non-epileptic events are epileptic-like episodes that are in fact symptoms of a paroxysmal systemic disorder (convulsive syncope, hypoglycemia, movement disorders, migraine aura, non-ictal dysautonomia, intoxications, transient ischemic attacks, balance disorder, sleep disorders, panic attacks) [12].

### **Classification of non-epileptic seizures**

There is no official classification of PNES nor one used in clinical practice. A classification would however be useful to establish the differential diagnosis with

epileptic seizures and for research purposes. Hubsch et al. suggested an interesting classification, distinguishing: (a) dystonic attacks with primitive gestural activity (31.6%); (b) pauci-kinetic attacks with preserved responsiveness (23.4%); (c) pseudo-syncope (16.9%); (d) hyperkinetic prolonged attacks with hyperventilation and auras (11.7%); (e) prolonged axial dystonic attacks (16.4%) [13].

### **The diagnostic approach: interview data**

Patient history and objective data from physical exam can help for the diagnosis. However, no strategies can guarantee an accurate diagnosis. On the same hand, an active search for a PNES diagnosis is not justifiable if prior to that, the physician has not made sure of the normality and stability of the vital signs. The medical history represents an essential step during the diagnosis course. Therefore, the physician's ability to guide the history will be key.

### **The history of the patient's seizures**

The physician needs to focus on the age and circumstances of the disease onset, the frequency of seizures, the promoting and inhibitory factors, the personal and familial history, as well as the social history of the patient. At least, the questions should enlighten:

#### ***The age and circumstances of PNES onset***

PNES are more prevalent in the 20s or 30s, but all ages are possible [9]. There is a certain female predominance in most of the studies with a proportion of 2/3 to 3/4 of cases [9]. The patient interview could retrieve a preceding remote traumatizing event or a prolonged conflictual or abusive history. The temporal relation between such detail and the onset of the suspicious events could be evident (during the traumatizing period or with a delay of days or weeks) or could be harder to establish (delay of months to years). The physician must actively look for certain elements when it comes to the patient's social history: sexual abuse, unemployment or handicap, psychiatric disorder, psychological trauma concomitant to the first episodes (social or familial conflict, lost or dramatic situation of a loved one, accidental traumatizing event).

#### ***The frequency of seizures, as well as the influencing factors***

The frequency of episodes and their usual timeframe occurrence can help in the diagnosis. Regarding frequency, relatively rare episodes (3–4 /year) are rarely PNES. The context in which they take place (moments of the sleep-wake cycle, influence of daily stress factors) will also guide the diagnosis. However, the data collected during interview do not have the same reliability as objective observations by a physician witnessing an event or analyzing a recording in a hospital environment. For

example, seizures reported as occurring at night are not necessarily occurring during sleep. In this regard, approximately 50% of patients presenting with PNES also report night time seizures upon questioning [8]. This detail may be confusing. Indeed, seizures occurring during sleep are typically epileptic in nature. Usually, PNES mistaken as sleep-related seizures are episodes occurring soon after awakening or simply during the night but without being linked to sleep.

#### ***A confirmed personal epilepsy history***

Here, it is important to verify the value of the previous diagnosis (EEG confirmation of interictal epileptiform activity or, at best, of ictal events). Likewise, it is important to attempt to obtain a description of the seizures that is as accurate as possible. Usually, patients will provide a different description of their PNES comparatively to their other type of seizures [7]. However, the semiology can be similar [14].

#### ***A family history of epilepsy***

The value of a family history of epilepsy is a two-edged sword; indeed, it can suggest familial epilepsy in some cases; on the contrary, in other cases, familial epilepsy may explain the determinism of PNES semiology.

#### ***Search for a psychological trauma***

The identification of a psychic trauma possibly correlated to the circumstances of the onset of episodes is of great value. Even if such a correlation is not evident (long latency for example), the social details need to be expanded (professional situation, social niche, familial context). Usually, the family of the patient will be generous in the information they give, as opposed to the patient himself who can be reluctant. However, family members are not always aware of crucial details that are often kept secret by the patient. It will therefore be necessary to gain his trust ("human" more than strict professional approach from the physician, discussions without the relatives/friends, strict engagement of professional confidentiality). Practically, previous psychic traumas are picked up upon interrogation in the majority of PNES cases (up to 88%) [9, 15]. The proportion of past sexual abuse can go up to 40% of cases according to studies [16, 17]. However, lower rates have been reported. For example, Asadi-Pooya et al. reported a rate of 8.3% of cases with a notion of sexual abuse over a study population of 314 patients having had a formal diagnosis of PNES in Iran [15]. Such history of sexual abuse is more often noted in women than men [18].

#### ***Description of recent versus past events***

A thorough analysis of the semiology reported by the patient can provide a probability of isolated PNES or a

PNES/ES coexistence. The physician will need to stay attentive to details and guide the discussion while letting the patient choose his own words. In particular, he will need to elucidate if there is one or various types of episodes. The key-points needed for each type are: (a) the presence of auras or prodromes (“do you have a particular feeling before your convulsions?”, if yes “is it the same thing every time?”, “how long do these sensations last?”); (b) the level of consciousness during the episodes (“are you able to hear people around you during your convulsions?”); (c) the evolution of seizures (“does the intensity of your feelings fluctuate during a single episode?”). Likewise, the consequences of seizures are important. However, even though an ictal major traumatic injury is almost always associated to ES, in practice, it may be challenging to state about the potential gravity of a trauma based on history report. Indeed, it appears that for approximately 73% of PNES cases resulting in a trauma, the definition criteria of mild traumatic brain injury can be met [19]. Therefore, this information should be considered with caution. Regarding the length of PNES, it is patient-related and may also vary in a same patient. This duration can range from a minute to several minutes, up to a dozens of minutes. This last scenario would evoke PNES status, with a threshold of 20–30 min according to the authors [20]. The distinction of PNES versus ES can be difficult for seizures lasting less than a minute. On the other hand, episodes lasting more than 5 min will be relatively typical of PNES [20, 21]. Note however that some ES can last more than 5 min; in such case, post-ictal confusion is usual.

#### **The linguistic style and the prominent points of the patient’s narration**

The lexical style used by the patient, as well as the details he insists on during his descriptions are important [22–25]. Patients with epileptic seizures will tend to accentuate subjective details with some evident wording difficulties including some pauses, rephrasing and neologisms [9, 22]. On the contrary, patients with PNES will tend to emphasize on the occurrence conditions of the events as well as their consequences, while only enumerating the paroxysmal symptoms without describing them [9, 22, 25]. Also, patients with PNES will have more tendency to be vague when questioned on the most striking episode [9, 22]. Conversely, patients with ES will deeply care about mentioning semiological features describing his “worst” episode. Finally, patients with PNES will have tendency to use third party references to catastrophize their ictal experience [22, 24, 25]. Conversely, patients with ES will usually try to use these references to provide a normalized description of their life with seizures [22, 24, 25].

#### **The homemade video**

The availability of a homemade video recorded by the family or paramedics can be of great interest. This type of support finds its major usefulness when no other episode occurs after hospital admission. Moreover, practically, an accompanying person at the bedside of a patient under observation in the emergency room will be encouraged to record any new episode if the observation unit is not equipped with a video archive. Such a recording could become useful when the opinion of a neurologist is solicited (see Video 1). Ramanujam et al. observed that homemade videos in 269 patients helped making the diagnosis of PNES with a sensibility of 95.4% (95%CI 87.2–99.1%), specificity of 97.5% (95%CI 94.3–99.2%), positive and negative predictive values of 92.65% (95%CI 84.1–96.8%) and 98.5% (95%CI 95.6–99.5%) respectively [26]. Therefore, for the semiology, a fluctuating course, asynchronous movements, pelvic thrusting, an agitation involving bilateral alternate rotations of head or whole body, crying with gesture indicative of frustration, maintenance of palpebral occlusion during the seizure and the absence of post-ictal confusion or amnesia are semiological details strongly suggestive of PNES [9, 11, 26, 27]. Note that features such as gradual onset, non-stereotyped events, flailing or thrashing movements, opisthotonus “arc en cercle”, tongue biting and urinary incontinence are by themselves of insufficient value for PNES conclusion [9].

#### **The diagnosis approach: physical exam and para-clinical data**

##### **Live analysis of a spontaneous episode**

The possibility of analyzing a spontaneous PNES after hospital admission will increase the accuracy of the diagnosis (Video 2 presents examples of PNES). The major PNES semiological features are commented in Table 1. However, PNES and ES of relatively similar clinical semiology can occur in the same patient [14]. This highlights the relevance of a v-EEG for a diagnosis of certainty, even for a physician experienced in the analysis of epileptic events.

##### **Non- epileptic seizures induction test**

Several strategies of PNES induction have been described. Their efficacy relies on the physician’s ability to suggest in an efficient way. The idea is to provide a logical and convincing explanation showing that the stimulus applied can induce a seizure. The induction will have even more impact if the physician is able to rapidly establish a solid trustful relationship with his patient. One of the simplest induction strategies is the “tuning fork test” (See Table 2 for an example of a script for the tuning fork test). As for other induction procedures, the strength of this test lies in the clear and “scientific”

**Table 1** Main semiological details distinguishing PNES from ES

Characteristic details	PNES	ES	Comments
<b>General characteristics of the conversation analysis</b>			
Main theme of the seizure description	Patient emphasizes on the context of occurrence and the consequences of the episodes [22, 24]	Patient emphasizes on the description of the signs [22, 24]	Value is dependent of the patient's level of cooperation
Answer when questioned about the most memorable event	Patient skipping the question or providing evasive answers [22]	Usually 2–3 memorable episodes are reported [22]	Value is dependent of patient's level of cooperation
Emotional component of the conversation	Catastrophizing [24]	Tendency to dedramatize [24]	More valuable when the patient has a good social situation
<b>Ictal features</b>			
Duration of the episodes	Usually, suspicious events longer than 5 min are PNES [40]	ES are usually shorter than 1–2 min	Consider the usual length of seizures thoroughly
Sleep occurrence (ES Sp = 100% [9])	No [9]	Episodes occurring during sleep are usually ES (or sleep disorders)	Low reliability of details based on history. V-EEG proof is important
Fluctuating intensity of the manifestations during a seizure (PNES Sp = 96% [9])	Usual for prolonged episodes (i.e. lasting more than 2 min) [9, 27]	Not usual, except in some cases of status epilepticus	In prolonged PNES, the patient is often able to respond to a gesture or word
Pelvic or whole-body thrusting (PNES Sp = 96–100% [9])	Yes, for episodes mimicking FBTCs [9, 10]	No for FBTCs. Could be seen in hyperkinetic ES (often frontal or anterior insular).	Here, the occurrence during sleep could help to eliminate PNES if this detail is reliable
Eye closure (PNES Sp = 74–100% [9])	If yes, most likely PNES [9, 10]	Eyes usually opened	Very good indicator, easily identifiable
Ability to respond to a gesture or a word during a seemingly convulsive episode	Could be able to answer	Unable to respond during focal with impaired awareness seizure or FBTCs	Relevant for bilateral convulsive events. Non-response state does not exclude PNES
Side to side head or body movement (PNES Sp = 96–100% [9])	Highly suggestive of PNES [9, 26, 40]	Usually, ictal turning in ES occur once or twice	Relevant for convulsion-like episodes
Ictal crying (PNES Sp = 100% [9])	Yes, sometimes (then combined with frustration gestures)	Usually no. If they occur, they are noted prior to the convulsions	Could very rarely occur during ES but not during the convulsive phase
<b>Post-ictal characteristics</b>			
Memory recall after a FBTCs-like episode (PNES Sp = 96% [9])	Typically preserved [21]	Usually, total amnesia of the episode or transient confusion [43]	Relevant for FBTCs and focal seizures with impaired awareness
Post-ictal confusion (ES Sp = 84–88% [9])	No (post-PNES fatigue may be confuse with confusion)	If yes, likely ES. May be surprisingly absent in frontal seizures with hypermotor semiology	Details often difficult to evaluate based on history
Breathing (ES Sp = 100% [9])	Tachypnea or apnea [44]	Bradypnea [44] Stertorous breathing [44]	Relevant semiological value for bilateral convulsive episodes
<b>Physical examination details</b>			
Induction test by nocebo effect	High value if positive. However, may be negative	Usually negative. May be positive by induction of PNES. However, true reflex ES may be triggered! [28]	A good suggestion is required. Rarely, the induction test may trigger PNES or ES in patients previously presenting only spontaneous ES [28]
Inhibition test by placebo effect	Possible intense response if experienced physician	Usually negative	The quality of the suggestion is crucial. Relevant in prolonged episodes
<b>Paraclinical investigations</b>			
EEG	Interictal: normal Ictal: normal	Inter-ictal: normal or epileptiform activity Ictal: abnormal	Physiologic spikes can be wrongly interpreted and thus lead to a wrong diagnosis. Epileptiform spikes do not exclude PNES (mixed PNES/ES patients)
Prolactin level	Usually normal [32, 33]	High sensitivity for FBTCs (up to 100%) [33]	Relevant for bilateral convulsive episodes

ES epileptic seizure, PNES psychogenic non-epileptic seizure, SE status epilepticus, FBTCs focal to bilateral tonic-clonic seizure, Sp specificity (%) for PNES or ES

**Table 2** Example of transcription of the suggestion before a tuning fork PNES induction test

« This is a tuning fork. It is a tool that creates vibrations. It is used in neurologic tests for various purposes. In your case, the tuning fork will be applied on your head. It will generate vibrations to the skull bone that will be transmitted to the auditory nerves and then the brain, more precisely to the regions that can induce seizures. I will therefore start by stimulating the skull regions that are a little bit less sensitive, before getting to the most sensitive region. Allow me first to help you take on a safe position\*... Are you ready? » (\*...rearrange the pillows and remove dangerous or fragile objects...)

explanation that the application of a tuning fork on a precise point on the head can induce a seizure. The physician can also stimulate multiple areas, explaining that there is a gradation of the ictogenic power of the tuning fork, depending on the stimulation point (Video 3 illustrates the tuning fork test with an example of answer depending on the stimulation site). This approach shows the advantage of putting the patient in optimal psychological conditions before applying the stimulation to the vertex. Apart from the induction with tuning fork, intermittent photic stimulation can also induce PNES. However, without concomitant EEG recording, a positive response may be misinterpreted as photic stimulation may induce real ES in photosensitive epilepsies. Other stimulation techniques, like the application of an alcohol tampon on the neck or the alternating hot/cold stimuli on a distal point of the body are used by certain groups. Finally, if a usual stimulating stimulus is reported by the patient, the physician can try to reproduce as well as possible the identified conditions: it can be a music, an object or a visual sequence or even a specific recall. Use of isotonic saline infusion after suggestion of a nocebo effect has been reported in the literature. In their cohort, Walczack et al. were able to trigger PNES in 90% of patients presenting only this type of episodes and in 50% of those who presented with ES and PNES [28].

#### The placebo inhibition test

Here, the principle is the opposite of the induction test. The idea is to use a placebo while optimizing psychological suggestion. A normal saline isotonic perfusion will have an exceptional value if it is accompanied by comments presenting it as a strong anticonvulsant. This strategy is particularly interesting in cases of episodes occurring in close series, mimicking a status epilepticus. However, before using such an option, the physician must be sure that there is a strong probability of PNES with certainty that the vital signs are stable. If an intravenous access is not available, an oral placebo can be administered if the conditions are adequate.

#### Diagnostic scores

Several tools with diagnostic scores have been suggested, but none is officially recommended by the ILAE.

Moreover, there is a poor background because of the relative rarity of studies evaluating their efficiency in different cultural regions. Some of the scores imply an analysis by an epileptologist and will have more relevance in an epileptology unit. In the emergency room or in a general physician consultation, in absence of v-EEG, the relevant tests should mainly refer to clinical details with a good objectivity coefficient. Recently, Kerr et al. proposed a diagnostic scale based on psychosocial details collected during history taking [29]. Their study included 1 375 patients with a definitive PNES diagnosis and showed a detection sensitivity of 74% (95%CI 70–79%) and a specificity of 71% (95%CI 64–82%) [29]. However, these tests should not have a diagnostic value over “probable PNES”.

#### Short lasting EEG, if possible

Some emergency units benefit from a rapid access to EEG access at the bedside. This can turn out to be particularly helpful if the manifestations remain present after the patient's admission to the emergency room. Such an EEG allows to distinguish a true status from prolonged or repetitive PNES very rapidly. Moreover, it may show interictal epileptiform discharges, which are suggestive of ES in patients previously not diagnosed with epilepsy. However, interictal epileptiform findings do not exclude the possibility of coexisting PNES and ES.

#### Prolactin level

The first studies on the significance of prolactin dosage in post-ictal period for ES trace back to 1978 [30]. Despite several subsequent studies, prolactin levels remain a controversial issue on several points. Indeed, some controversies touch on the increase threshold having a clinical value and the maximal post-ictal delays upon prolactin dosage. In general, prolactin dosage is a good biomarker if completed within the post-ictal first 10–20 min after bilateral seizures [31]. Concerning the relevant threshold, the increase is generally considered significant if there is a doubling from baseline (if this baseline is available, with a minimum of 15–16.5 ng/ml in post-ictal period) or if there is an increase over 45 ng/ml [32]. Sensitivity can go up to 100% for bilateral tonic-clonic seizures and more than 80% for focal seizures with impaired awareness [9, 31–33]. Abubakr and Wambacq have reported a false positive rate of 28% [33]. These false positives can be linked to the use of dopaminergic antagonists or some tricyclic derivatives, breast stimulation or syncope [9, 31]. False negatives for hyperprolactinemia are less frequent (15.6% in Abubakr and Wambacq's study for focal seizures with impaired awareness [33]), and are linked to a use dopaminergic

antagonists or to a status epilepticus (because of the short half-life of prolactin) [9, 31–33].

**Other possible dosages**

Other substances have been studied by many authors to help in the differential diagnosis of ES/PNES such as serum cortisol and creatine kinase [9]. However, strong evidence is lacking, and findings have been controversial. The work of Sundararajan et al. detailed the different biomarkers studied for PNES diagnosis [34].

**Establishing a diagnosis**

Based on clinical practice, we identified five main scenarios that are summarized in Table 3. Aside from a precise description of the episodes (with homemade video analysis if possible), the diagnosis approach should tackle specific details depending on the scenario:

**First suspicious episode(s) in a patient never having presented epileptiform episodes in the past**

Unless someone witnesses an episode and has sufficient experience to clinically analyze the seizures, it is difficult in the emergency room to establish a diagnosis with high level of certitude in the current scenario; Fig. 1 summarizes the diagnostic tree.

- History: a detailed description of the semiology should be obtained; psychic bases have to be actively looked for; a diagnostic score based on the historical data of the PNES can be useful to better guide the diagnostic discussion;
- Physical examination: when available, analysis of a homemade video can be useful to hypothesize probable PNES; PNES induction test is then crucial;

- Paraclinical investigations: if possible, a bedside EEG during hospitalization is relevant; another routine EEG will be requested as outpatient if the one done in the emergency is negative or inconclusive; a referral to neurology or epileptology must be scheduled.

**Previous similar episodes (in a patient never diagnosed)**

- History: first, it is important to ensure that none of the previous episodes presents characteristics evoking ES: sleep occurrence, usual duration inferior to a minute, a lateral tongue bite, post-ictal confusion, or trauma with aftermath consequences. The search for a psychic base is also important here;
- Physical examination: a PNES induction test is crucial;
- Paraclinical investigations: here also, if available, a bedside EEG during hospitalization should be systematically completed with another routine EEG as outpatient; a neurology or epileptology referral will be prescribed as inpatient (ideally) or outpatient.

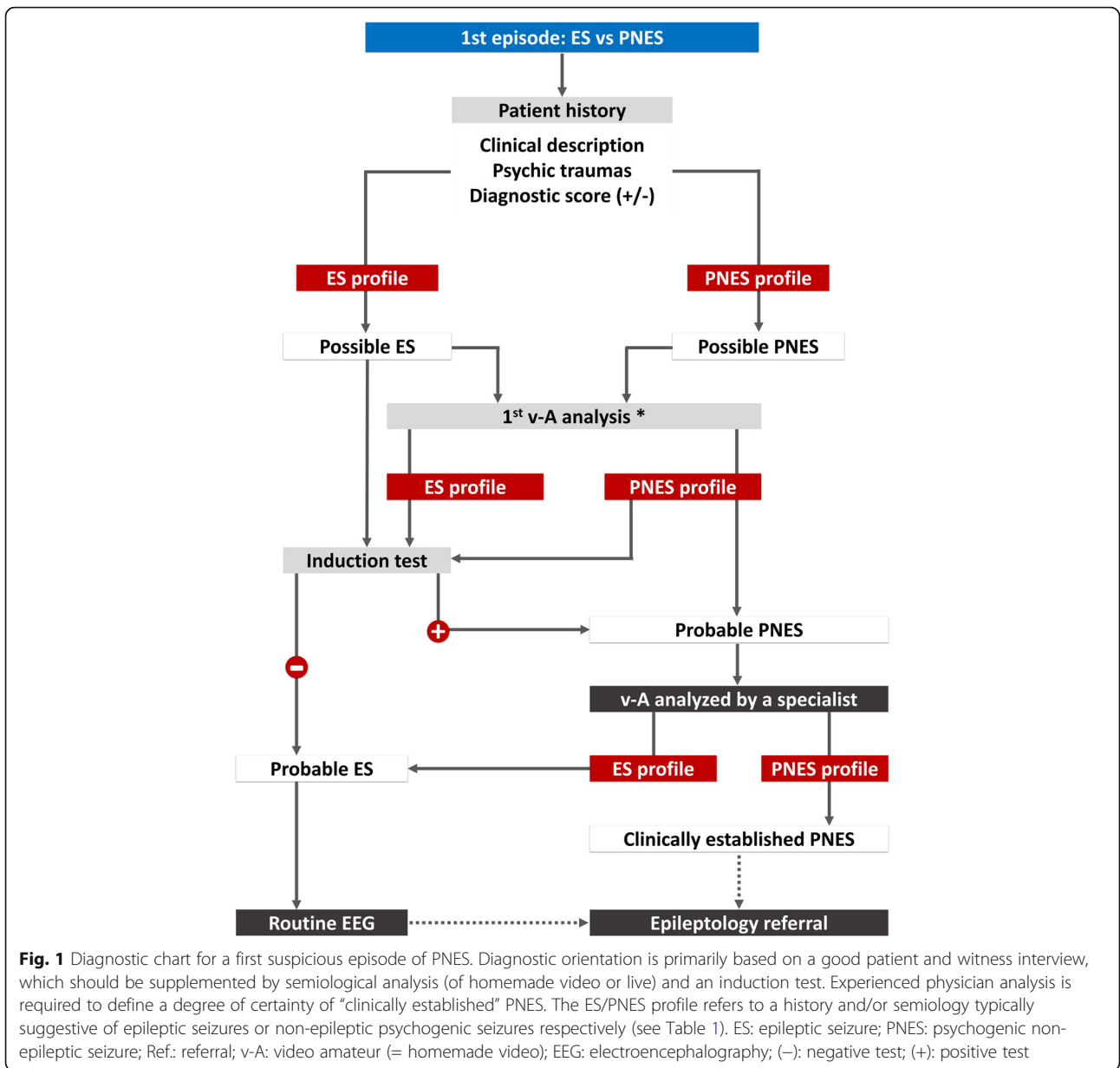
**Diagnosed epilepsy (PNES unknown)**

First, it is crucial to ensure of the value of the epilepsy diagnosis (based on interictal EEG epileptiform activity? Based on EEG recorded seizure? Diagnosis only based on clinical history?). An epilepsy diagnosis without ictal recording and based solely on isolated EEG spikes may be questioned when faced with new clues suggesting possible PNES as some benign physiological variants may sometimes be mistaken for spikes by EEG readers. Clinical details reported in patient history may be of high value but these features cannot lead to a definitive diagnosis. The “rule of 2s” will have a particular

**Table 3** Key-points of practical management (positive and severity diagnoses) according to the scenario

	First suspicious episode (s)	Previous similar episodes	Diagnosed epilepsy (unknown PNES)	Known PNES diagnosis	PNES status
<b>History key-points</b>	- Details suggestive of PNES? - Psychic bases? - Diagnostic score	- Prior semiology (also possible ES?) - Psychic bases? - Diagnostic score	- Define the bases of the previous ES diagnosis (clinical? iEEG? iEEG?) - Unusual semiology? - Frequency? AED?	- Recurrence circumstances - Major psychiatric disorders (especially suicidal risk)?	- Recent social situation of the patient - Known epilepsy?
<b>Physical examination</b>	- Amateur video - Induction test	- Amateur video - Induction test	- Amateur video - Induction test	- Depression diagnostic score if possible	- Inhibition test
<b>Early paraclinical investigations</b>	- Bedside EEG if possible - Prolactin level within 10–20 min if possible FBTCs	- Bedside EEG if chances of in-hospital recurrences - Prolactin level within 10–20 min if possible FBTCs	- Bedside EEG if chances of in-hospital recurrences - Prolactin dosage within 10–20 min if possible FBTCs	- Not a must - Prolactin dosage within 10–20 min (maximum of 30 min) if possible FBTCs	- Prolactin dosage (interpretation with caution after the first hour) - Bedside EEG
<b>Referrals and deferred tests</b>	- Routine EEG as outpatient - Neurology referral	- Systematic routine EEG as outpatient - Neurology referral	- Neurology referral	- Neurology referral	- Neurology referral

*FBTCs* bilateral tonic-clonic seizure, *ES* epileptic seizure, *PNES* psychogenic non-epileptic seizure, *iEEG* ictal electroencephalography, *iiEEG* interictal electroencephalography, *AED* antiepileptic drugs



relevance here [35, 36]. Showing a positive predictive value of 85%, it involves a table associating: (a) at least 2 EEGs without epileptiform abnormalities, (b) at least 2 seizures per week, (c) resistance to at least 2 antiepileptic drugs [35].

- History: here, it is important to verify if the recent semiology is unusual;
- Physical examination: the PNES induction is crucial here as well;
- Paraclinical investigations: a bedside EEG and a routine outpatient EEG appear less pertinent here. The bedside EEG would be done if there is a chance

that the patient presents a new episode during the day; in this case, the PNES induction test will be performed under EEG surveillance. A prolactin level is indicated within 10–20 (maximum 30) minutes following the offset of a tonic-clonic-like convulsion [31, 32, 36]. In all cases, a referral to the attending neurologist can be done for a follow-up that would ideally include a video-EEG monitoring.

**Known PNES diagnosis**

- History: first, it is important to clarify the circumstances of the event and look for a recent



alarming context that could require medical, psychological, social or legal assistance;

- Physical examination: here, the goal is mainly to detect clues suggesting possible postictal implying ES) in a patient previously diagnosed with only PNES;
- Paraclinical investigations: a routine outpatient EEG as outpatient will be requested if there is doubt about the semiological similarities between the seizures or if a sign evoking ES is reported by the patient or his family.

**Particular case of PNES status**

PNES status will usually be easy to diagnose when occurring in a hospital environment. However, when the semiology mostly implies a non-responsive state with ocular movements, a non-convulsive status should be hypothesized first and therefore be explored by EEG;

- Witness’ history: it must focus on the recent social condition of the patient and a possible preexisting diagnosis of ES and/or PNES;
- Physical examination: here, an inhibition test is especially indicated when the semiology is fluctuating and enable a suggestion prior to the induction;
- Paraclinical investigation: a prolactin dosage could be requested; however, even for an ES status, prolactinemia can normalize within a few dozens of minutes. Likewise, a bedside EEG will usually lead to a conclusive diagnosis.

**Practical management**

In brief, the first step must consist in identifying all the parameters suggestive of PNES. Even though the "gold standard" test is v-EEG of at least one seizure,

live visualization of an episode or analysis of a home-made video recording can help if the physician is familiar with epileptiform episodes. In the presence of a doubt on the psychogenic nature or a ES/PNES coexistence, it is important to refer the patient to a specialized unit and to avoid sharing a diagnosis with the patient before that. When the diagnosis has at least a certitude of "clinically established" (Table 4), the patient can be told that the seizures objectively analyzed are "not epileptic in nature". The conversation may be challenging. Therefore, such a communication should be, if possible, completed by an epileptologist and then a psychiatrist. Multiple recommendations of communication strategies have been suggested by different teams, but no style can guarantee an optimal effect with all patients [37]. The text in Table 5 presents the outline suggested by Hall-Patch et al. that is one of the most stratified and simplest [38].

In practice, many patients will feel that the physician "does not understand their illness" or that the exclusion of epilepsy is equivalent to the absence of diagnosis and so that their "state is non treatable" [39]. More than 80% of patients will present a reduction or cessation of PNES episodes immediately after an accurate diagnosis announcement [36]. However, only 1/3 will undergo a complete arrest of the episodes after 3–6 months and less than 20% after the first year following their diagnosis [37]. In all cases, the majority of patients with PNES arrest will have shown a favorable evolution as early as immediately after the diagnosis [40]. Although the prognosis is difficult to establish with a high degree of certainty, negative prognostic factors are: depression, personality disorders, history of abuse (physical or psychic), a long evolution [41]. Conversely, a recent onset, an absence of psychiatric disorders associated with worse

**Table 4** Table of PNES diagnosis certainties, adapted from the work by LaFrance et al. (2013) for the ILAE Nonepileptic Seizures Task Force (with permission) [9]

		Suspicious history	Analysis	Electroencephalography
Degree of diagnostic certainty	<b>Possible</b>	+	Based on witness or self-report/description	Routine or sleep-deprived EEG without epileptiform abnormalities
	<b>Probable</b>	+	Clinical features typical of PNES, objectively witnessed by the physician or reviewed on a homemade video	Routine or sleep-deprived EEG without epileptiform abnormalities
	<b>Clinically established</b>	+	Clinical features typical of PNES, objectively witnessed by an epileptologist (or epilepsy experienced neurologist) or reviewed on a homemade video, without EEG recording	Routine EEG (or ambulatory EEG) without epileptiform discharges during a typical episode that, for ES, should be associated with evident EEG ictal epileptiform activity
	<b>Documented</b>	+	Clinical features typical of PNES events, objectively identified on video-EEG by a clinician experienced in diagnosis of seizure disorders	No epileptiform activity immediately before, during or after ictus captured on ictal video-EEG with typical PNES semiology

ES epileptic seizure, PNES psychogenic non-epileptic seizure, EEG electroencephalography. Additional tests may affect the certainty of the diagnosis—for instance, self-protective maneuvers or forced eye closure during unresponsiveness or normal postictal prolactin levels with convulsive seizures

**Table 5** Crib sheet with 14 core points for the strategy of PNES diagnosis communication to a patient (Adapted from the work of Hall-Patch et al. (2009), with permission) [38]

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- **Confirm that the symptoms are authentic**  
Real attacks: can be frightening or disabling

- **Define a label**  
Give a name for the condition  
Give alternative names (not offensive) that the patient can easily understand  
Reassure that it is a common and recognized condition

- **Explain the causes and the maintaining factors**  
No epilepsy  
Predisposing factors: it is difficult to find causes  
Precipitating factors: can be linked to stress / emotions  
Perpetuating factors: vicious circle consisting in - worry → stress → attacks → worry  
Provide a model for the attacks – e.g., the brain becomes overwhelmed and shuts down

- **Explain the treatment**  
Antiepileptic drugs will not be effective  
Present the proofs that psychological treatment is effective  
Talk to the patient about referral to a specialist

- **Guide the expectations**  
PNES episodes can resolve  
Improvement can be expected

---

prognosis, or even a stable socio-economic situation are factors which increases the chance of a good outcome [41].

In all cases, a neurological and psychiatric follow-up is needed to: (a) ensure that the patient only experiences PNES versus a mixture of PNES and ES; (b) provide an access to psychotherapy and psychiatric follow-up. Even when episodes remit after diagnosis delivery, management may still require a rigorous neuropsychiatric follow-up in many cases. Indeed, PNES patients have a high suicidal ideation and suicide rate [42]. When PNES are suspected and ES doubtful, there is no need to urgently initiate an antiepileptic treatment. In the presence of frequent unexplained episodes, empirical treatment with an antiepileptic drug can be initiated prior to an appointment with a specialist.

## Conclusion

Non-epileptic seizures diagnosis, especially psychogenic ones in the emergency, requires a good knowledge of specific and often easily identifiable relevant features. Practically, homemade video and/or live analysis of a seizure will constitute the best diagnostic tools in the emergency room. Diagnostic scales solely based on history taking can be very useful in some cases. However, these tools are usually limited by the narration bias that can alter the analysis of the clinical picture. Even if an almost certain diagnosis can be made without EEG support, it is important to verify the absence of associated ES. Besides, the guidance towards an epileptologic and a neuropsychiatric follow-up is crucial after a 'probable' PNES diagnosis.

## Supplementary information

Supplementary information accompanies this paper at <https://doi.org/10.1186/s42494-020-00016-y>.

**Additional file 1: Video 1.** Homemade video in emergency room. Sudden movements mimicking epileptic spasms but exaggerated for epileptic seizures. This amateur video is an excellent diagnostic medium that can enable a diagnosis of clinically established PNES if presented to an epilepsy specialist.

**Additional file 2: Video 2.** Tuning fork test. The PNES event is induced by the application of vibrations to the vertex. The preceding lateral applications potentiate the impact of this vertex stimulation.

**Additional file 3: Video 3.** Examples of PNES events. Psychogenic seizures can manifest by stereotypical movements (pelvic thrusting in sequence 1), psychomotor agitation with a strong emotional component (tears in sequence 2), focal signs (pseudo-clonic movements of the right hand that is sensitive to interaction in sequence 3), a polymorphic semiology over the course of episodes and through the PNES series (sequences 4–6 with: first, tremors followed by frozen attitude, then barking, then an hypermotor behaviour ; (\*): "1<sup>st</sup> analysis" refers to the analysis of the homemade video by a physician who is not familiar with seizure disorders).

## Abbreviations

EMU: Epilepsy monitoring unit; ES: Epileptic seizures; ILAE: International League Against Epilepsy; LD: Learning disability; PNEE: Physiologic non-epileptic events; PNES: Psychogenic non-epileptic seizures; v-EEG: Video-electroencephalography

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DHT: conception and design, drafting and review, approval; LP: drafting and review, approval; DKN: review, approval.

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Not applicable.

## Consent for publication

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## Competing interests

None.

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