Does the primary literature provide support for clinical signs used to distinguish psychogenic nonepileptic seizures from epileptic seizures?

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ABSTRACT

Psychogenic non-epileptic seizures (PNES) represent a diagnostic challenge. When trying to distinguish between PNES and epileptic seizures (ES), clinicians rely on the presence or absence of several clinical signs. The purpose of this review is to establish the extent to which these signs are supported by primary data from the literature. A Medline search was used to identify primary studies that used video-EEG to define the presence or absence of different clinical signs in PNES and ES. The methodological quality of the studies was assessed using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool. 34 studies matched the inclusion criteria. A specific sign was considered well supported by the data from the primary literature if we were able to identify at least two controlled studies demonstrating its usefulness and if the data from other studies were supportive. There is good evidence from the literature that long duration, occurrence from apparent sleep with EEG-verified wakefulness, fluctuating course, asynchronous movements, pelvic thrusting, side-to-side head or body movement, closed eyes during the episode, ictal crying, memory recall and absence of postictal confusion are signs that distinguish PNES from ES. Postictal stertorous breathing proved to distinguish convulsive PNES from generalised tonic clonic seizures (GTCS) and should be added to the list of useful clinical signs. The final clinical diagnosis should encompass all available data and should not rely on any single sign alone.

INTRODUCTION

Psychogenic non-epileptic seizures (PNES) are paroxysmal motor events, disturbances of sensation or of responsiveness that do not result from abnormal electrical activity of the brain, but are caused by a psychological process. In contrast to epileptic seizures (ES), these events lack characteristic electrographic features.[1 2] A number of PNES types have been described.[3–5] The most frequently encountered characteristics are excessive movements of the limbs, trunk and head. Seizures with stiffening and tremor, as well as seizures with atonia or purely sensory events, are less common. Most PNES are accompanied by an apparent impairment of consciousness.[6] When trying to distinguish between PNES and ES, clinicians rely on the presence or absence of several classic signs. In 1881, Gowers described the clinical characteristics of PNES.[7] Subsequently, PNES semiology has been the subject of many studies, ranging from case reports to uncontrolled and controlled studies using variable methods from questionnaires to video-EEG. The evidence for all the clinical signs said to distinguish between PNES and ES may thus not be equally strong.

Our purpose is to establish the extent to which the signs said to distinguish between PNES and ES are supported by primary data from the literature.

METHODS

Recent review papers on the semiology of PNES were searched to identify a list of signs commonly used signs to distinguish PNES from ES.[6 8–11] These were:

1. duration of episodes;
2. occurrence from sleep;
3. gradual onset;
4. fluctuating course;
5. stereotyped attacks;
6. motor features:
   flailing, thrashing movements;
   asynchronous or asymmetrical movements;
   pelvic thrusting;
   opisthotonus, 'arc en cercle';
   side-to-side head or body movement;
7. closed eyes;
8. tongue biting;
9. urinary incontinence;
10. ictal crying;
11. recall for the period when the patient appears unconscious;
12. rapid postictal recovery of responsiveness.

A Medline search was performed to find primary studies between 1980 and June 2009 using the following keywords: psychogenic seizures, pseudoseizures, non-epileptic seizures, psychogenic nonepileptic seizures, clinical signs, ictal signs, video-EEG, telemetry. Abstracts were reviewed to determine which full-text articles should be retrieved. In addition, reference lists from each of the articles that were included in the review were manually searched for papers meeting the inclusion criteria and not identified through Medline. Papers were eligible for inclusion if they assessed one or more of the above-mentioned signs, if they used video-EEG as a reference standard to diagnose events, if the frequencies of occurrence of ictal signs were reported for all patient groups or if it was possible to calculate them from the given data, and if the article was in English. Case reports were not included. Studies were excluded if they were conducted on a paediatric population.

The quality of the studies that were included in the review was evaluated using the Quality Assessment of Diagnostic Accuracy Studies (QUADAS) tool (table 1).[12] QUADAS consists of 14 items that

are scored as 'yes,' 'no' or 'unclear.' Although there are no recommendations on scoring, previous studies have used a minimum of 8 or 10 'yes' answers to indicate a study of high quality.[13–15]

RESULTS

A summary of our search procedure is presented in figure 1.

We identified 34 studies that matched the inclusion criteria and also fulfilled eight or more QUADAS criteria. They are summarised in table 2.

The quality of the studies was heterogeneous: only 22 of them featured a control group of patients with ES; there were also slight differences in selection criteria. Most authors excluded events with subjective phenomena. Three studies (9%) lacked basic demographic information about the patients. None of the studies fulfilled the QUADAS item 7, since assessing the ictal signs was always an integral part of the video-EEG study. The investigators who assessed the ictal signs by viewing video-recordings were blinded to EEG tracings and the results of clinical investigations in four (12%) studies. The authors reported the frequencies for ictal signs in two ways: per patient or per event. As this may give slightly different results, we have tried to maintain this distinction throughout the review.

In the following section, we summarise the evidence from primary studies for each of the chosen clinical signs that are used to distinguish PNES from ES. Since the number of the studies meeting the criteria for the review was low, we considered a specific sign well supported by the data from the primary literature if we were able to identify at least two controlled studies proving its usefulness and if the data from other studies were supportive.

Table 1 Quality Assessment of Diagnostic Accuracy Studies tool

Item		Yes	No	Unclear
1	Was the spectrum of patients representative of the patients who will receive the test in practice?			
2	Were selection criteria clearly described?			
3	Is the reference standard likely to correctly classify the target condition?			
4	Is the time period between reference standard and index test short enough to be reasonably sure that the target condition did not change between two tests?			
5	Did the whole sample or a random selection of the sample, receive verification using a reference standard of diagnosis?			
6	Did patients receive the same reference standard regardless of the index test result?			
7	Was the reference standard independent of the index test (ie, the index test did not form part of the reference standard)?			
8	Was the execution of the index test described in sufficient detail to permit replication of the test?			
9	Was the execution of the reference standard described in sufficient detail to permit its replication?			
10	Were the index test results interpreted without knowledge of the results of the reference standard?			
11	Were the reference standard results interpreted without knowledge of the results of the index test?			
12	Were the same clinical data available when test results were interpreted as would be available when the test is used in clinical practice?			
13	Were uninterpretable/intermediate test results reported?			
14	Were withdrawals from the study explained?			

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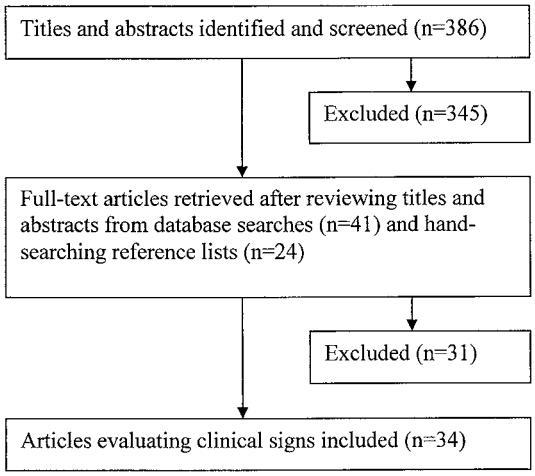

Figure 1 Flow diagram of the literature screening process.

Long duration

Seven studies compared duration of PNES and ES.[17 21 27 30 32 37 39] According to six of them, the mean duration of PNES was significantly longer than ES duration, irrespective of the type of ES and PNES studied. One study failed to show significant differences in duration—which can probably be attributed to considerable variation in the length of PNES.[27] The ranges of duration of the events were reported by four authors. According to three of them, ES did not exceed 2 min in duration, while there was wide variation in the duration of PNES (from less than 1 min to 150 min).[17 27 30] One study which included patients with partial ES found the maximum duration of an ES to be 275 s.[37] Four studies only measured the duration of PNES. Although the length of PNES within the studies was variable, a mean duration of several minutes was a consistent finding. PNES lasting less than 1 min were either not found or occurred very rarely—in 4.5% of the patients in the study by Meierkord *et al*.[26 34 38 41]

There is considerable evidence to suggest that a duration of more than 2 min is highly suggestive of PNES, although this is an arbitrary limit. Partial ES may last longer than 2 min, and PNES occasionally do not exceed one minute in duration.

Occurrence from sleep

In three controlled studies, all PNES occurred from EEG-verified wakefulness, but the occurrence of ES from sleep was common (31–59% of events).[18 37 39] Benbadis *et al* also studied preictal pseudosleep (PIPS), when the patient appears to be asleep, but EEG shows normal activity of wakefulness. Although 23% of PNES events in 54% of patients occurred from PIPS, this was never observed in ES ($p<0.01$).[20]

Four uncontrolled studies included this parameter. None of the patients was observed to have PNES during sleep.[38 44] Occurrence from PIPS was found in 12% to 39% of PNES patients.[31 44] Of note, Orbach *et al* analysed PNES events that apparently occurred during sleep. Most of them occurred from PIPS, but 7% of events occurred either during EEG-verified sleep or within 7 s after the onset of alpha-rhythm.[36]

In conclusion, there is good evidence to suggest that the occurrence of seizures from sleep can distinguish ES from PNES. The diagnosis of sleep itself in these circumstances will require EEG.

Table 2 Video-EEG studies of ictal features of PNES

Study	No of patients (events) PNES	ES
Abubakr *et al*[16]	23 patients	–
Azar *et al*[17]	16 patients (24 events)	15 patients with GTCS (23 seizures) 9 patients with FLPS (21 seizures)
Bazil and Walczak[18]	280 events	622 CPS, 149 FLPS
Bell *et al*[19]	13 patients (24 events)	31 patients with CPS (102 seizures) 5 patients with SPS (13 seizures)
Benbadis *et al*[20]	18 patients (68 events)	39 patients (220 seizures)
Brown *et al*[21]	23 patients	25 patients
Chen *et al*[22]	16 patients (16 events)	27 patients with simple and secondarily generalised partial seizures PS (27 events)
Chung *et al*[23]	52 patients	156 patients
DeToledo and Ramsay[24]	197 events	457 seizures
Devinsky *et al*[25]	20 patients with PNES only, 20 patients with PNES and ES	20 patients
Flugel *et al*[26]	100 patients (100 events)	–
Gates *et al*[27]	25 patients with convulsive PNES	25 patients with GTCS
Geyer *et al*[28]	100 patients	100 patients with TLS 50 patients with FLPS 11 patients with generalised seizures
Groppel *et al*[4]	27 patients	–
Gulick *et al*[29]	27 (71 events)	–
Henry and Drury[30]	44 patients	133 patients with complex partial or secondarily generalised seizures
Hovorka *et al*[31]	56 patients	/
Jedrzejczak *et al*[32]	30 patients with PNES, 25 patients with both PNES and ES (221 PNES events, 9 ES events)	15 patients (74 seizures)
Leis *et al*[1]	47 patients	–
Luther *et al*[33]	30 patients (37 events)	–
Meierkord *et al*[34]	110 patients	–
Oliva *et al*[35]	18 patients (50 events)	66 patients with primary and secondarily generalised seizures (129 seizures)
Orbach *et al*[36]	27 patients (128 events)	–
Oto *et al*[3]	160 patients	–
Pierelli *et al*[37]	15 patients (87 events)	10 patients with complex partial ES (144 seizures) 2 patients with SPS (25 seizures)
Raymond *et al*[38]	14 patients with both PNES and ES (>40 PNES events)	–
Saygi *et al*[39]	12 patients (29 events with motor involvement)	11 patients with FLPS (63 seizures)
Sen *et al*[40]	17 with PNES, 8 with both PNES and GTCS (31 PNES events in all)	19 patients with GTCS (44 seizures)
Silva *et al*[41]	17 patients (41 events)	–
Slater *et al*[42]	31 events	41 seizures
Syed *et al*[43]	43 patients	84 patients
Thacker *et al*[44]	103 patients	–
Vinton *et al*[45]	15 patients with convulsive PNES (32 events)	15 patients with GTCS
Walczak and Bogolioubov[46]	31 patients with PNES (93 events) 5 patients with both PNES and ES (nine PNES events, 20 ES)	48 patients (261 seizures)

CPS, complex partial seizures; FLPS, frontal-lobe partial seizures; GTCS, generalised tonic clonic seizures; SMS, supplementary motor partial seizures; TLS, temporal-lobe partial seizures.

Gradual onset

One study compared the onset of PNES and ES. A gradual buildup of visible signs was seen significantly more often in partial ES (81%) than in PNES (6.3%, $p<0.01$).[22] One uncontrolled study found that in 40% of patients with PNES with bilateral motor activity, motor activity began gradually.[29] There is insufficient evidence to support this clinical sign.

Fluctuating course

This parameter was assessed in two controlled clinical studies. Vinton *et al* performed a time-frequency analysis of movement artefacts in convulsive PNES and generalised tonic clonic seizures (GTCS). Brief pauses in rhythmic movement were documented in 47% of PNES patients and none of the ES patients.[45] Chen *et al* compared partial ES with PNES. A waxing–waning event tempo was seen in 69% of PNES and only 3.7% of ES ($p<0.01$).[22] In one uncontrolled study, eight patients with several recorded PNES were identified. In seven of them, the episodes occurred in clusters with brief intervening periods during which the patient usually remained unresponsive.[29]

There is thus sufficient evidence from the literature to suggest that a fluctuating course distinguishes PNES from partial and generalised ES.

Non-stereotyped attacks

Only uncontrolled studies were identified in this category. One hundred and sixty patients with PNES were included in the most extensive study: 88% of them had stereotyped attacks.[3] In the remaining four studies, stereotyped attacks were found in 77% to 96% of PNES patients.[4 29 38 41] There is insufficient evidence to suggest that non-stereotyped attacks are a feature of PNES. Furthermore, there is some evidence from uncontrolled studies that PNES events show consistent semiology with little variation in different episodes.

Flailing or thrashing movements

Thrashing and writhing movements were observed in 17% of partial ES and 31% of PNES in one controlled study. The difference was not statistically significant.[22] In two uncontrolled studies, flailing or thrashing movements were observed in 18% and 19% of the patients with PNES.[28 29] We therefore did not find sufficient evidence to suggest that the presence of flailing or thrashing movements can distinguish PNES from ES.

Asynchronous movements

This ictal sign was assessed in three controlled studies. Gates *et al* compared patients with GTCS and convulsive PNES. Asynchronous jerks of upper and lower extremities were seen in 56% of patients with PNES and in none of the patients with ES ($p<0.01$).[27] Similarly, Azar *et al* observed asynchronous movements in 96% PNES and only 5% GTCS ($p<0.01$), but there were no differences between PNES and frontal-lobe partial seizures (FLPS).[17] Chen *et al* described asynchronous movements in 44% of PNES events and 7.4% of partial ES. The difference was statistically significant ($p<0.05$).[22] As the authors of two uncontrolled studies included several types of PNES, they found asynchronous limb movements in a smaller proportion of their patients (34% and 9–10%).[1 31]

There is sufficient evidence to suggest that the presence of asynchronous limb movements can distinguish convulsive PNES from GTCS and partial ES, with the exception of FLPS.

Pelvic thrusting

Pelvic thrusting is a specific behavioural characteristic that has traditionally been associated with PNES.[8] Three out of six controlled studies compared GTCS with PNES. While pelvic thrusting was never observed in GTCS, it occurred in 8.3% of PNES events in the study by Azar *et al*, in 44% of patients with PNES resembling GTCS in the study by Gates *et al*, and in 17% of PNES in the study by Geyer *et al*[17 27 28] When PNES and partial ES were compared, pelvic thrusting was seen significantly more frequently in PNES (31%) than in ES (3.7%) ($p<0.05$).[22] Devinsky *et al* only observed pelvic thrusting during PNES in three patients with both PNES and ES.[25] Importantly, when PNES were compared with FLPS, there was no statistically significant difference in the frequency of pelvic thrusting.[17 28 39] In six uncontrolled studies, pelvic thrusting was present in 7–27% of PNES patients.[4 16 26 29 31 33]

We therefore conclude that there is sufficient evidence from the primary studies to suggest that the presence of pelvic thrusting can distinguish between convulsive PNES and GTCS, but not between PNES and FLPS.

Opisthotonus, 'arc en cercle'

Only two uncontrolled studies reported on this parameter. Opisthotonus was present in 19% and 29% of PNES patients, respectively.[29 31] Due to the lack of controlled studies, there is not enough evidence to support this clinical sign.

Side-to-side head or body movement

Five controlled studies reported on this variable. In both of the studies that compared convulsive PNES with GTCS, the proportion of patients (or events) with side-to-side head or body turning was significantly higher in the PNES groups ($p<0.01$). Gates *et al* found it in 36% of patients with PNES, and Azar *et al* observed it in 63% of PNES.[17 27] Chen *et al* compared PNES with partial ES. Side-to-side head movements were present in 25% of PNES and none of the ES events ($p<0.05$).[22] However, when PNES were compared with complex partial ES, side-to-side head turning occurred in 20% of patients in both groups.[37] Similarly, there was no statistically significant difference between PNES and FLPS.[17 39] In three uncontrolled studies, side-to-side head or body turning was observed in 15% to 23% of patients.[1 31 33]

There is sufficient evidence from the primary studies to suggest that the presence of side-to-side head or body movement can distinguish between convulsive PNES and GTCS, but not between PNES and some other types of ES.

Closed eyes

This sign was assessed in five controlled studies. When events were considered, ictal eye closure was significantly more frequent in PNES (34–87%) than ES (0–26%).[17 22 24 43] Ninety-six per cent of PNES patients and only 2.6% of ES patients kept their eyes closed during the ictal phase in the study by Chung *et al*.[23] Ictal eye closure was also found in a high proportion of PNES patients (52–90%) in three uncontrolled studies.[26 29 31]

There is good evidence from the primary literature to suggest that closed eyes during an attack can distinguish PNES from ES.

Tongue biting

Oliva *et al* compared convulsive PNES with generalised ES. No tongue injuries were seen in PNES. Lacerations of the side of the tongue occurred in 11% of ES, and the tip of the tongue was injured in one event (0.8%).[35] Three uncontrolled studies examined this parameter. Devinsky *et al* failed to find tongue biting in PNES patients. Oto *et al* observed tongue biting in 19% of male and 21% of female PNES patients. Eighteen per cent of PNES patients had tip-of-the-tongue, lip or buccal bites in the study by Hovorka *et al*.[3 25 31]

In conclusion, there is insufficient evidence from controlled studies to support this clinical parameter.

Urinary incontinence

Two controlled studies reported on this clinical sign. In the first, incontinence was observed in 23% of epilepsy patients and 6% of PNES patients. The difference was not statistically significant ($p=0.09$).[35] In the study by Slater *et al*, none of the PNES patients was incontinent during the attack, while this was observed in 26% of ES patients ($p<0.01$).[42] Three of the five uncontrolled studies failed to document incontinence in PNES patients.[25 31 33] It was seen in 6% of patients with PNES in the study by Silva *et al*, and in 21% of males and 33% of females in the study by Oto *et al*.[3 41]

There is insufficient evidence to support the usefulness of this clinical sign in distinguishing PNES from ES. Furthermore, urine incontinence can occur in syncope.

Ictal crying

Four controlled studies assessed this parameter. In the study by Walczak and Bogolioubov, weeping occurred in 14% of PNES and in none of the 281 ES ($p<0.01$).[46] Slater *et al* observed ictal crying or yelling in 13% of PNES patients and none of the ES patients ($p<0.05$).[42] Similarly, Devinsky *et al* found ictal crying

in 5% of PNES patients, in 5% of the patients with both types of events and in none of the ES patients. No statistical analyses were performed.[25] Chen *et al* found ictal crying in 13% of the patients with PNES and none of the patients with CPS, but the difference was not statistically significant.[22] Three uncontrolled studies also included this clinical sign. Ictal crying was present in 3.7% of PNES patients in the study by Gulick *et al* and 8.9% in the study by Hovorka *et al*, while Oto *et al* found it in 21% of males and 43% of females.[3 29 31]

In conclusion, there is sufficient evidence to suggest that ictal crying is rather specific for PNES, although its sensitivity seems low.

Recall for the period when the patient appears unconscious

Two authors tested memory recall for the ictal period. Bell *et al* performed ictal cognitive assessment in 13 patients with PNES and 31 patients with complex partial seizures (CPS). The recall of memory items never reached 50% in CPS, but was more than 50% in 54% of PNES ($p<0.01$). If any memory recall was considered as a parameter, the sensitivity was 63% with 96% specificity for PNES.[19] In the study by Devinsky *et al*, memory recall was tested in 16 patients in a group of patients with both PNES and ES. Eighty-eight per cent were able to recall items presented to them during the ictus after their PNES, compared with only 6.3% of patients after their ES. Similarly, 85% of patients with only PNES recalled the items, as opposed to 10% of patients with only ES.[25]

There is sufficient evidence to suggest that memory recall of items presented during the event can distinguish PNES from ES.

Postictal recovery of responsiveness

Several studies that assessed postictal states used different definitions, and consequently we were not able to integrate all the data in this section.[25 29 30 33 39] However, two authors assessed postevent confusion. In the study by Slater *et al*, postevent confusion was seen in 16% of PNES patients and 67% of ES patients ($p<0.01$).[42] Azar *et al* observed postictal confusion in 13% of convulsive PNES events, as opposed to 100% of GTCS and 61% of FLPS ($p<0.01$).[17]

We can therefore conclude that there is sufficient evidence from the primary literature to suggest that the presence of postictal confusion distinguishes ES from PNES.

Postictal stertorous breathing

We identified three controlled studies that evaluated this clinical sign and met the QUADAS criteria. Sen *et al* and Azar *et al* found stertorous breathing after 91% and 61% of GTCS, respectively, while none of the patients was judged to have stertorous breathing after PNES. The difference was statistically significant in both cases.[17 40] The second study also compared postictal breathing in patients with PNES and FLPS with prominent motor activity, but there was no statistically significant difference. A similar result was obtained by Chen *et al*, who compared PNES and CPS.[22]

The absence of postictal stertorous breathing is a useful clinical sign to distinguish convulsive PNES from GTCS, but not from partial seizures.

DISCUSSION

There is good evidence from the literature to suggest that long duration, fluctuating course, asynchronous movements, pelvic thrusting, side-to-side head or body movement, closed eyes during the episode, ictal crying and memory recall are signs that distinguish PNES from ES. Occurrence of the spells from

Table 3 Summary of evidence that supports the signs used to distinguish between psychogenic non-epileptic seizures (PNES) and epileptic seizures (ES)

Sign that favour PNES	Evidence from primary studies	Sensitivity (%) for PNES	Specificity (%) for PNES
Long duration	Good	–	–
Fluctuating course	Good	69 (events) 47–88 (patients)	96 96–100
Asynchronous movements	Good (frontal-lobe partial seizures excluded)	44–96 (events) 9–56 (patients)	93–96 93–100
Pelvic thrusting	Good (frontal-lobe partial seizures excluded)	1–31 (events) 7.4–44 (patients)	96–100 92–100
Side-to-side head or body movement	Good (convulsive events only)	25–63 (events) 15–36 (patients)	96–100 92–100
Closed eyes	Good	34–88 (events) 52–96 (patients)	74–100 97
Ictal crying	Good	13–14 (events) 3.7–37 (patients)	100 100
Memory recall	Good	63 (events) 77–88 (patients)	96 90

Signs that favour ES	Evidence from primary studies	Sensitivity for ES	Specificity for ES
Occurrence from sleep	Good	31–59 (events) –	100 –
Postictal confusion	Good	61–100 (events) 67 (patients)	88 84
Stertorous breathing	Good (convulsive events only)	61–91 (events) –	100 –

Other signs	Evidence from primary studies
Gradual onset	Insufficient
Non-stereotyped events	Insufficient
Flailing or thrashing movements	Insufficient
Opisthotonus, 'arc en cercle'	Insufficient
Tongue biting	Insufficient
Urinary incontinence	Insufficient

The sensitivity and specificity values were calculated from the frequencies of clinical signs in PNES and ES. We were not able to obtain the CIs in most cases.

EEG-verified sleep and postictal confusion favour ES and are also well supported by the evidence from the primary studies. Postictal stertorous breathing proved to distinguish GTCS from convulsive PNES and should be added to the list of useful clinical signs. These findings are summarised in table 3.

We have concentrated mostly on motor signs in this review, so some of the conclusions only apply to spells with predominantly motor manifestations. Patients with PNES with pure sensory phenomena or unresponsiveness were often excluded from the primary studies, and consequently information on these two types of PNES is scarce. Other potentially useful clinical signs such as ictal stuttering and the 'teddy bear sign' can be found in the literature; some of them have only been described by single authors and have not been included in our review.[47 48] One of the criteria for inclusion was observation of events in the video-EEG monitoring unit. Consequently, our conclusions do not apply to reports by the subjects or witnesses. This is illustrated in the study by Syed *et al*, who compared observer and self-report of eye closure with video-EEG findings. They showed that observers did not reliably assess eye closure, while the value of self-report remains uncertain.[43]

Assessing the primary studies with the QUADAS tool revealed several methodological shortcomings. Only 21 of the studies included in the review featured a control group of patients with ES. Classification of ES was provided in only 12 of them, and only a few authors tried to compare patients with PNES that resembled a certain type of ES with that particular type of ES. The investigators who assessed the ictal signs by viewing video-recordings were only rarely blinded to EEG tracings and the results of clinical investigations. Often, the clinical signs (for instance postictal states, ictal crying) were not defined well enough for adequate comparison with other studies. Several methodological issues were also stressed in a recent review on clinical signs in PNES.[43] The authors suggested improvements for future research: prospective design, well-defined clinical signs, inclusion of all types of events, independent assessors blinded to the video-EEG recording.[43] Our conclusions, examining a broader range of signs, are similar, emphasising the need for more studies.

Another limitation to our review is that all the included studies were carried out in specialised epilepsy centres on adult patients with refractory seizures or spells that presented a diagnostic problem. Generalisability to community-based populations or children can therefore not be assumed.

In conclusion, the level of evidence supporting specific ictal signs used to distinguish between PNES and ES is variable. The same applies to their frequency and specificity for either PNES or ES.

The diagnosis of PNES requires careful integration of history, ictal signs and other clinical and investigational information, and should not be driven by any one clinical sign alone. Video-EEG monitoring may be crucial for the analysis of ictal characteristics and postictal behaviour. Some of the useful clinical signs, for instance postictal stertorous breathing, can be reliably identified by trained staff even without telemetry.[40]

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Does the primary literature provide support for clinical signs used to distinguish psychogenic nonepileptic seizures from epileptic seizures?

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