Acta Scientific Neurology (ISSN: 2582-1121)

Volume 5 Issue 5 May 2022

Research Article

Psychogenic Nonepileptic Seizures - The Empirical Evidence Weighs in

Catherine A Carlson*

Psychological Services Division, Minnesota Judicial Branch, USA

***Corresponding Author:** Catherine A Carlson, Psychological Services Division, Minnesota Judicial Branch, USA.

DOI: 10.31080/ASNE.2022.05.0502

Received: March 20, 2022

Published: April 29, 2022

Abstract

An estimated 15% to 30% of patients referred to epilepsy-monitoring units for drug resistant epilepsy walk away with a diagnosis of psychogenic nonepileptic seizures (PNES). Seizures that do not produce an epileptiform discharge on the ictal video-electroencephalogram (vEEG) will likely garner the 'rule in' diagnosis of PNES, or Conversion Disorder in modern nomenclature. The absence of an epileptiform discharge is considered proof that the seizure is not epileptic and thus, it presumably has a psychological origin. For decades, the scalp EEG has been hailed as the 'gold standard' for distinguishing PNES from epilepsy and a great deal of empirical data has been amassed on the PNES patient population. Though the PNES diagnostic entity is treated as a proven fact, in truth, it rests on but one hypothesis that might explain a negative scalp EEG. Since not all epileptic seizures produce a scalp EEG correlate, an epileptic seizure is a recognized competing hypothesis for a negative scalp finding. In fact, studies that gather data from both scalp and intracranial EEG recordings show that scalp-negative epileptic seizures are not uncommon, but in modern epilepsy-monitoring units, they are at high risk of being mislabeled PNES. To assess for such diagnostic error we must turn to the empirical evidence which shows that the clinical profiles of PNES and epilepsy patient populations are identical. The similarities are striking and the only data the PNES hypothesis can explain is a negative scalp EEG. Conversely, the competing epileptic hypothesis seamlessly accounts for the bulk of the findings on patients with seizures labeled PNES. The diagnostic terrain is further muddied by the ongoing conflation of conscious feigning with conversion disorder which represents a long-standing conceptual error. The data establishes that the PNES patient population consists primarily of patients with epilepsy, along with a smattering of factitious and likely psychotic disorders, thereby exposing the PNES diagnostic entity as a hypothetical construct that does not exist. Diagnostic theory and practice in epilepsy-monitoring units must be revisited

Keywords: Epilepsy; Psychogenic; Electroencephalogram; Conversion; Functional; Dissociative

Abbreviations

PNES: Psychogenic Non-Epileptic Seizures; AED: Anti-Epileptic Drug; EMU: Epilepsy-Monitoring Unit; MRI: Magnetic Resonance Imaging; VEEG: Video Electroencephalogram; EEG: Electroencephalogram; ILAE: International League Against Epilepsy; FLE: Frontal Lobe Epilepsy; PES: Pseudo-Epileptic Seizure; SMC: Standardized Medical Care; CBT: Cognitive Behavioral Therapy; IED: Interictal Epileptiform Discharge

Introduction

Psychogenic non-epileptic seizures (PNES) are defined as paroxysmal episodes which clinically resemble epileptic seizures but unlike the latter, do not show an epileptiform discharge on ictal

vEEG electrodes [1]. The absence of an epileptiform discharge is considered proof that the seizure is not caused by epileptogenic activity, and thus, it presumably has a psychological origin [2,3]. In modern nomenclature, PNES warrants a diagnosis of Conversion Disorder or Functional Neurological Symptom Disorder [4]. Seizures labeled PNES are thought to be non-volitional responses to internal or external triggers perceived as threatening or challenging [5,6]. PNES is promoted as a 'rule in' diagnosis [7] and there is a high incidence of this disorder coming out of epilepsy-monitoring units (EMUs) [3,8].

The proposed origins of 'psychogenic' (aka 'functional') symptoms are ubiquitous in the human condition. Factors that purportedly trigger and perpetuate seizures labeled PNES include, among others, insecure attachment, adverse life events, family dysfunction, psychiatric symptoms [9] and even just frustrating situations [3]. Remarkably, epileptic seizures have been suggested as a potential trigger after studies showed PNES developing right behind epileptic seizures [10].

The cornerstone of treatment for PNES is psychotherapy. According to experts, once the diagnosis is made, "in therapy we then begin doing the hard work of getting to what lies underneath… the conversion seizure or the psychogenic tremor is just the tip of the iceberg" [11] and improvement may require extensive psychotherapy [12]. The 'psychogenic' theory posits that seizures labeled PNES spring from deep-seated and unconscious psychological distress, and that seizure remission rests on psychological intervention.

The 'gold standard' for distinguishing PNES from epileptic seizures is the video electroencephalogram (vEEG) [13,14]. While members of the International League Against Epilepsy (ILAE) PNES Task Force have suggested that PNES can be differentiated from epileptic seizures on clinical grounds [14], in their guidance to the field, they maintain there is no symptom or sign that has diagnostic value [15]. The semiology of PNES vis-a-vis epileptic seizures receives a lot of attention [16-18] but it plays a nonessential diagnostic role, and the literature is unequivocal; the scalp vEEG test result dictates the diagnosis.

There is an extensive body of literature on patients with seizures labeled PNES but the theorizing and clinical investigations proceed from the definitive diagnosis [16,18] which has already been established by the vEEG. Though the PNES diagnostic entity is treated as a proven 'fact,' in truth it rests on but one hypothesis that might explain a negative scalp EEG. The purpose of this paper is to review the literature and assess whether the hypothesis that underlies the PNES diagnosis is supported, or refuted, by the empirical data. The analysis has profound diagnostic ramifications for patients with epilepsy.

Materials and Methods

To generate and support the analysis, a wide sampling of articles that address psychogenic nonepileptic seizures, epilepsy, and conversion disorder were reviewed.

Results and Discussion

The 'gold standard' for distinguishing PNES from epilepsy is admittedly fallible. Not all epileptic seizures show a scalp EEG discharge when deep or buried cortex is involved or when EEG systems with few surface electrodes are used [14]. Though far less likely than their scalp counterpart, even intracranial electrodes may fail to capture epileptic seizures [19-21].

Epileptic seizures that fail to register on scalp EEG electrodes are not uncommon. Simple partial seizures for example have a scalp EEG correlate in only 20% to 30% of the cases [8]. In one study that looked at the EEG features of 7 subjects with simple partial seizures [19], 6 of 55 seizures were detected with scalp electrodes compared to 61 of 68 with subdural electrodes. Ten to 15% of complex partial seizures do not register on scalp electrodes [8] and frontal lobe seizures are known for their failure to produce scalp EEG correlates [8,13,22]. In epilepsy-monitoring units (EMUs), that rely on surface electrodes during the diagnostic phase, scalp-negative epileptic seizures such as these will likely garner the 'rule in' diagnosis of PNES.

Members of the International League Against Epilepsy (ILAE) PNES Task Force have addressed the challenge of differentiating PNES from frontal lobe epilepsy (FLE), a condition often caused by head trauma [23]. "In hypermotor seizures, in which semiology is suspected of being psychogenic, given that both FLE and PNES are scalp EEG-negative, it can be impossible to prove based on EEG that such episodes are psychogenic." [13] Further, "the closet test to a biopsy for distinguishing epilepsy from PNES would be intracranial monitoring," however, "the risk and morbidity associated with

craniotomy and grid or depth electrode placement outweighs the use in patients with a suspicion of PNES. In the absence of the definitive confirmation of the diagnosis, there is no way to prove that the PNES diagnosis is correct even when there is a high degree of certainty." [13] In point of fact, the scalp EEG does not definitively diagnose PNES, and patients with frontal lobe seizures erroneously labeled 'psychogenic,' will not be offered further investigation which is the only way to prove they have epilepsy.

Studies show that the morbidity of subdural strip electrodes is low [20,24,25] and their employment has exposed critical diagnostic errors. After a 15-year-old was re-evaluated and diagnosed with PNES, her anti-epileptic drugs (AEDs) were discontinued [20]. Three months later, she died of cardiac arrest during a witnessed seizure. This dramatic event prompted the neurologists who diagnosed her with PNES to conduct a study using subdural strip electrodes in 12 patients previously diagnosed with PNES [20]. The intracranial monitoring revealed that 6 of the 12 patients actually suffered from drug resistant epilepsy with complex partial seizures. Both patient groups had histories of central nervous system injuries and all 6 of the PNES patients demonstrated epileptiform spikes on the intracranial electrodes which cast some doubt on their diagnosis; "An incorrect diagnosis of PES (pseudoepileptic seizure) is possible because spiking may occur in hippocampus without transmission to other regions of cortex [25,26] and subdural strip electrodes cannot record from hippocampus." [20] Of the 6 patients whose seizures were re-classified as epileptic, 5 underwent epilepsy surgery with excellent results; at the 2 year follow-up, 4 patients were still seizure-free and one maintained a significant reduction in seizure frequency. But for this impromptu intracranial investigation proving epilepsy, these patients would have been referred for psychotherapy (for PNES) not epilepsy surgery.

Studies show elevated comorbidity rates (10- 53%) of PNES and epilepsy [27,28] but without the use of invasive monitoring it is difficult to determine the validity of these results. In one study, investigators explored the incidence of PNES and epilepsy in a sample of 300 patients who underwent long-term EEG monitoring with subdural strip electrodes after having had previous long-term scalp vEEG monitoring [20]. At least 15% had ictal events without electroencephalographic correlates from scalp recordings. Investigators pointed out that it would be easy to conclude that such events represent PNES. When the same patients were monitored with intracranial electrodes, however, similar events were found to be associated with focal and restricted ictal changes. "Put another way, we have found only two clear cases of the coexistence of PES (pseudoepileptic seizure) and true epilepsy in over 300 patients." [20] Other studies using combined recordings of intracranial and scalp EEG electrodes have demonstrated that 25% of patients with drug resistant temporal lobe epilepsy have entire seizures recorded on intracranial electrodes that show no clear ictal correlate on scalp EEG [29,30]. In modern EMUs, without intracranial recordings to demonstrate the epileptic origin of their scalp-negative seizures, such epilepsy patients would likely receive a comorbid diagnosis of PNES, yielding 15% and 25% comorbidity rates, respectively. This data indicates that the elevated comorbidity rates of PNES and epilepsy are not valid, but an artifact of relying on the scalp EEG which fails to capture a significant percentage of epileptic seizures.

Despite the fallibility of the 'gold standard,' PNES investigators promote the vEEG as a litmus test. If the scalp EEG is negative, even patients with "well-defined" and "epileptogenic lesions" on magnetic resonance imaging (MRI) [31] should be diagnosed with PNES [31,32]. This diagnostic instruction was presented as "a timely reminder of the pitfalls of diagnosing epilepsy based on neuroimaging findings alone." [31] What about the pitfalls of employing a fallible 'gold standard' as a litmus test? No single test result should supplant clinical judgment. The EEG cannot 'know' the results of the MRI, only the clinician can reconcile the totality of the data in the diagnostic formulation. Structural alterations anywhere in the cerebral cortex can result in epileptogensis [33] and scalp-negative EEGs should not preclude further investigation in patients with well-defined and epileptogenic lesions.

The spontaneous remission of seizures labeled PNES is well documented [34,35] and mirrors the spontaneous remission of seizures in patients with untreated epilepsy [36-38]. In some patients, PNES stop right after the diagnosis is given [39], while in others, they simply remit with the passage of time [34]. Investigators have suggested that just the provision of the diagnosis is the causal factor producing PNES remission but provide no further elucidation [39]. The 'psychogenic' theory cannot explain this uncanny similarity with epilepsy patients.

Patients with seizures labeled PNES and patients with drug resistant epilepsy have the same high mortality rate, dying at a rate

2.5 times above the general population [40]. PNES investigators do not and cannot account for this remarkable parallel with epilepsy patients.

Seizures subsequently labeled PNES have remitted on AEDs. In one retrospective study, 22 of 47 patients with sole PNES reported complete or partial remission of ongoing seizures with AEDs [41]. The PNES investigators conclusion: "Placebo response to AEDs appears to be common in patients with PNES. A response to AEDs should not be taken as a confirmation of a diagnosis of epilepsy, particularly when other features raise suspicion of PNES." [41]. Alternately, these patients had epileptic seizures that remitted with first-line epilepsy treatment.

Patients with seizures labeled PNES and patients with epilepsy show many other telltale similarities. The seizure semiology of PNES is "all too easily mistaken for epilepsy" and diagnostic error is "the rule rather than the exception." [42] Both epilepsy and PNES patient populations show pervasive brain disease including structural alterations and both are considered network disorders [43,44]. Both seizure types have remitted or failed to remit on AEDs [8,41,45]. Both conditions demonstrate instances of prolonged seizure activity, designated status epilepticus and pseudo-status epilepticus in patients with epilepsy and PNES, respectively [46,47]. Both have been eliminated by epilepsy surgery [48]. Traumatic brain injury is a risk factor for both seizure types [49,50]. Seizure-alert trained dogs- who recently demonstrated the existence of an epileptic odor in humans [51] - have reliably alerted to epileptic seizures [51,52] and seizures labeled PNES [53-55].

The best study to date shows that ongoing seizures labeled PNES (aka 'dissociative') do not remit with psychotherapy. The CODEs trial (cognitive behavioral therapy for adults with dissociative seizures) was a parallel-arm, multicenter randomized controlled trial that randomized 368 people with 'dissociative' seizures (i.e. PNES) to receive either standard medical care (SMC) alone or PNES-specific cognitive behavioral therapy (CBT) plus SMC [56]. At the 12 month endpoint, investigators found no statistically significant advantage of CBT over SMC for the reduction of monthly seizures labeled 'dissociative.' In their conclusions, members of the ILAE PNES Task Force focused on the positive impact of CBT over SMC on secondary outcomes (i.e. functional improvements) and suggested that perhaps, the reduction of seizures labeled PNES should not be a primary outcome of investigations [56].

In defense of their position that the term 'psychogenic' should be replaced with 'functional,' experts exposed their fallacious reasoning. Belatedly, they acknowledged that the presumption of a 'psychogenic' etiology entails a "circular logic that is scientifically unfalsifiable." [57] They further admitted that the proposed 'psychogenic' etiology is "poorly defined" and "not supported by the current evidence." [58] This change in terminology however, has not disabused investigators of their conviction that 'functional' symptoms are primarily psychological in origin, [2,59,60] which is why psychotherapy remains the recommended treatment for PNES. So in other words, the poorly defined 'psychogenic' hypothesis that still underlies the now 'functional' diagnosis is not valid or supported by the empirical data.

When presented with this epileptic argument for seizures labeled PNES, [61] members of the ILAE PNES Task Force gave a perfunctory nod to "diagnostic difficulties" followed by an unqualified rejection of an epileptic origin for PNES [14,62].

The conflation of feigning with unconsciously generated 'psychogenic' symptoms has been a longstanding conceptual problem [63]. A survey of neurologists showed that while they endorsed psychological models for conversion disorder, they did not view it as clearly different from feigning [64,65]. They diagnosed conversion according to features of the clinical presentation, most importantly inconsistency and abnormal illness behavior, [65] and felt that the psychiatric discernment of conversion vis-a-vis feigning was outside their skill set [64]. A recent survey of psychiatrists showed they too endorsed the 'psychogenic' model but also "saw feigning as usually present to a degree." [66] This data indicates that when clinicians detect feigning they are labeling it conversion disorder which exemplifies the confusion. The 'psychogenic' hypothesis maintains that these symptoms are unconsciously generated, [5,6,67] and thus by definition, are not under the patients' conscious control. Putting aside the possibility of an epileptic event, a seizure that produces a negative EEG cannot be simultaneously feigned and unconsciously generated. The two etiologies are mutually exclusive which makes the feigning of symptoms a differential diagnosis, not a comorbidity of conversion disorder. Patients who appear overtly unstable, irrational, demanding, bizarre in presentation, and/or show evidence of consciously feigned symptoms do suffer from major psychiatric illness, but it's not conversion disorder. The 'psychogenic' model is indeed poorly defined

[58] and clinicians appear to be misapprehending factitious and likely, psychotic conditions, as manifestations of conversion disorder.

Given the increased risk and cost of intracranial recordings, improved scalp EEG-based diagnostic methods are an area of considerable interest [68]. In a recent study, investigators explored a novel computational approach that allowed for the non-invasive detection of deep seizure activity [69]. They identified 25 scalp-negative mesial temporal seizures in 10 patients and obtained control records from an additional 13 patients, all of whom underwent simultaneous recordings with foramen ovale electrodes and scalp EEG. Scalp data from these records were used to train a scalp-negative seizure detector, which consisted of a pair of logistic regression classifiers that used scalp EEG coherence properties as input features. On cross-validation performance, this detector correctly identified scalp-negative seizures in 40% of the patients, and correctly identified the side of seizure onset for each seizure detected. In comparison, routine clinical interpretation of these scalp EEGs failed to identify any of the scalp-negative seizures. Another study employed a simple signal analysis procedure based on scalp EEG zero-crossing patterns which extracted the spatiotemporal structure of scalp voltage fluctuations [70]. Investigators analyzed simultaneous scalp and intracranial EEG recordings from patients with drug resistant temporal lobe epilepsy and observed that a large proportion of intracranial interictal epileptiform discharges (IEDs) manifested only as subtle, low-amplitude waveforms below scalp EEG background and thus, were not detected visually. They found that scalp zero-crossing patterns allowed detection of these IEDs in their subjects and an independent dataset, and proposed their use to identify scalp signatures of intracranial IEDs.

Conclusion

The empirical data substantiates an epileptic etiology for PNES, thereby exposing the diagnostic entity as a hypothetical construct that never existed beyond speculation. Intracranial monitoring, seizure-alert trained dogs, high density scalp EEG, scalp-negative seizure detectors and scalp EEG zero-crossing patterns could all provide further proof that the PNES population consists primarily of patients with epilepsy. The high incidence of PNES diagnoses belies, roughly, how often epileptic seizures fail to register on scalp EEG electrodes. Diagnostic theory and practice in EMUs must be revisited.

Conflict of Interest

Dr. Carlson has no conflicts of interest.

Bibliography

1. LaFrance WC Jr and Devinsky O. "The Treatment of Nonepileptic Seizures: Historical Perspectives and Future Direction". *Epilepsia* 45.2 (2004): 15-21.

2. Baslet G., *et al*. "Psychogenic Non-epileptic Seizures: An Updated Primer". *Psychosomatics* 57.1 (2016): 1-17.

3. Bompaire F., *et al*. "PNES Epidemiology: What is known, what is new?" *European Journal of Trauma and Dissociation* 5.1 (2021): 100136.

4. American Psychiatric Association. Diagnostic and statistical manual of mental disorders (5th edition) (2013).

5. Asadi-Pooya AA and Sperling MR. "Epidemiology of psychogenic non-epileptic seizures". *Epilepsy and Behavior* 46 (2015): 60-65.

6. Brown RJ and Reuber M. "Towards an integrative theory of psychogenic non-epileptic seizures (PNES)". *Clinical Psychology Review* 47 (2016): 55-70.

7. Adams C., *et al*. "You've made the diagnosis of functional neurological disorder: now what?" *Practical Neurology* 18.4 (2018): 323-330.

8. Hani AJ and Husain AM. "Scalp Video EEG Monitoring. Chapter 17". In *Practical Epilepsy,* Edit. Husain AM. Demos Medical Publishing, LLC, NY, NY (2015).

9. Nielsen G., *et al*. "Physiotherapy for functional motor disorders: a consensus recommendation". *Journal of Neurology, Neurosurgery, and Psychiatry* 86 (2015): 1113-1119.

10. Devinsky O and Gordon E. "Epileptic seizures progressing into nonepileptic conversion seizures". *Neurology* 51 (1998): 1293-1296.

11. Remaly J. "How can Neurologists Treat Psychogenic Nonepileptic Seizures? Treatments including CBT plus medication,

have reduced seizures in randomized trials". *Neurology Reviews* 25.12 (2017): 5.

12. International League Against Epilepsy. "Inside the world of psychogenic seizures: Diagnosis, treatment and stigma". *International League Against Epilepsy Epigraph* 21.2 (2019).

13. LaFrance WC Jr and Benbadis SR. "Differentiating Frontal Lobe Epilepsy from Psychogenic Nonepileptic Seizures". *Neurologic Clinics* 29 (2011): 149-162.

14. McGonigal A., *et al*. "Correct Diagnosis of Psychogenic Nonepileptic Seizures". *International Journal of Epilepsy* 5 (2018): 112-113.

15. Gasparini S., *et al*. "Management of psychogenic non-epileptic seizures: a multidisciplinary approach". *European Journal of Neurology* 26.2 (2019): 205-e215.

16. LaFrance WC Jr., *et al*. "Minimum requirements for the diagnosis of psychogenic nonepileptic seizures: A staged approach A report from the International League Against Epilepsy Nonepileptic Seizures Task Force". *Epilepsia* 54.11 (2013): 2005-2018.

17. Xiang X., *et al*. "Differential diagnosis between epileptic seizures and psychogenic nonepileptic seizures based on semiology". *Acta Epileptologica* 1 (2019): 6.

18. Goldstein LH and Mellers JDC. "Recent developments in our understanding of the semiology and treatment of psychogenic nonepileptic seizures". *Current Neurology and Neuroscience Reports* 12.4 (2012): 436-44.

19. Devinsky O., *et al*. "Electroencephalographic studies of simple partial seizures with subdural electrode recordings". *Neurology* 39.4 (1989): 527-533.

20. Wyler AR., *et al*. "Pseudo-Pseudoepileptic Seizures". In: Rowan AJ, Gates J, editors. *Non-epileptic seizures*. Massachusetts: Cambridge University Press (1993): 73-84.

21. Sinha SR. "Intracranial EEG Monitoring. Chapter 18. *Practical Epilepsy.* Edit. Husain AM. Demos Medical Publishing, LLC, NY, NY (2015).

22. Williamson PD., *et al*. "Complex partial seizures of frontal lobe origin". *Annals of Neurology* 18 (1985): 497-504.

23. Gupta PK., *et al*. "Subtypes of Post-Traumatic Epilepsy: Clinical, Electrophysiological, and Imaging Features". *Journal of Neurotrauma* 31 (2014): 1439-1443.

24. Wyler AR., *et al*. "Chronic subdural strip electrode recordings in difficult epileptic patients". *Journal of Epilepsy Research* 1 (1988): 71-78.

25. Lieb JP., *et al*. "A comparison of EEG seizures patterns recorded with surface and depth electrodes in patients with temporal lobe epilepsy". *Epilepsia* 17.2 (1976): 137-160.

26. Spencer SS., *et al*. "Human hippocampal seizure spread studied by depth and subdural recording: the hippocampal commissure". *Epilepsia* 28 (1987): 479-489.

27. Liampas A., *et al*. "Psychogenic non-epileptic seizures (PNES) in the context of concurrent epilepsy- making the right diagnosis". *Acta Epileptologica* 3 (2021): 23.

28. Yon MI., *et al*. "The coexistence of psychogenic nonepileptic and epileptic seizures in the same patient is more frequent than expected: Is there any clinical feature for defining these patients?" *Epilepsy and Behavior* 105 (2020): 106940.

29. Ebersole JS and Pacia SV. "Localization of temporal lobe foci by ictal EEG patterns". *Epilepsia* 37 (1996): 386-399.

30. Pacia SV and Ebersole JS. "Intracranial EEG substrates of scalp ictal patterns from temporal lobe foci". *Epilepsia* 38.6 (1997): 642-654.

31. Lowe MR., *et al*. "MRI evidence of mesial temporal sclerosis in patients with psychogenic nonepileptic seizures". *Neurology* 56.6 (2001): 823.

32. Benbadis SR., *et al*. "MRI evidence of mesial temporal lobe sclerosis in patients with psychogenic nonepileptic seizures". *Neurology* 55 (2000): 1061-1062.

33. Williamson PD. "Frontal lobe seizures. Problems of diagnosis and classification". *Advances in Neurology* 57 (1992): 289-309.

34. Asadi-Pooya AA., *et al*. "Natural history of patients with psychogenic nonepileptic seizures". *Seizure* 66 (2019): 22-25.

35. McKenzie P., *et al*. "Early outcomes and predictors in 260 patients with psychogenic nonepileptic attacks". *Neurology* 74.1 (2010): 64-69.

36. Watts AE. "The Natural History of Untreated Epilepsy in a Rural Community in Africa". *Epilepsia* 330.3 (1992): 464-468.

37. Nicoletti A., *et al*. "Natural history and mortality of chronic epilepsy in an untreated population of rural Bolivia: a follow-up after 10 years". *Epilepsia* 50.10 (2009): 2199-2206.

38. Sillanpää M and Schmidt D. "Long-term outcome of medically treated epilepsy". *Seizure* 44 (2017): 211-216.

39. Duncan R., *et al*. "Psychogenic nonepileptic seizures that remit when the diagnosis is given: Just good luck?" *Epilepsy and Behavior* 102 (2020): 106667.

40. Nightscales R., *et al*. "Mortality in patients with psychogenic nonepileptic seizures". *Neurology* 95.6 (2020): e643-2652.

41. Alessi R and Valente KD. "Psychogenic nonepileptic seizures: Should we use response to AEDs as a red flag for the diagnosis?" *Seizure* 23.10 (2014): 906-908.

42. Mellers JDC. "The Approach to Patients with Non-Epileptic Seizures". *Postgraduate Medical Journal* 81 (2005): 498-504.

43. Whelan CD., *et al*. "Structural brain abnormalities in the common epilepsies assessed in a worldwide ENIGMA study". *Brain* 141.2 (2018): 398-408.

44. Szaflarski JP and LaFrance WC Jr. "Psychogenic Nonepileptic Seizures (PNES) as a Network Disorder- Evidence from Neuroimaging of Functional (Psychogenic) Neurological Disorders". *Epilepsy Currents* 18.4 (2018): 211-216.

45. Laxer KD., *et al*. "The consequences of refractory epilepsy and it treatment". *Epilepsy and Behavior* 37 (2014): 59-70.

46. Walker MC., *et al*. "Diagnosis and treatment of status epilepticus on a neurological intensive care unit". *Quarterly Journal of Medicine* 89 (1996): 913-920.

47. Asadi-Pooya AA., *et al*. "Prolonged psychogenic nonepileptic seizures or pseudostatus". *Epilepsy and Behavior* 31 (2014): 304-306.

48. Reuber M., *et al*. "Epilepsy surgery in patients with additional psychogenic seizures". *Archives of Neurology* 59 (2002): 82-86.

49. Lucke-Wold BP., *et al*. "Traumatic brain injury and epilepsy: Underlying mechanisms leading to seizure". *Seizure* 33 (2015): 13-23.

50. Popkirov S., *et al*. "Scared or scarred: Could 'dissociogenic' lesions predispose to nononepileptic seizures after head trauma?" *Seizure* 58 (2018): 127-132.

51. Catala A., *et al*. "Dogs demonstrate the existence of an epileptic seizure odour in humans". *Scientific Reports* 9 (2019): 4103.

52. Kirton A., *et al*. "Seizure response dogs: Evaluation of a formal training program". *Epilepsy and Behavior* 13 (2008): 499-504.

53. Ortiz R and Liporace J. "Seizure alert dogs": Observations from an inpatient video/EEG unit". *Epilepsy and Behavior* 6 (2005): 620-622.

54. Krauss GL., *et al*. "Pseudoseizure dogs". *Neurology* 68 (2007): 308-309.

55. Doherty MJ, and Haltiner AM. "Wag the dog: skepticism on seizure alert canines". *Neurology* 68 (2007): 309.

56. Goldstein LH., *et al*. "Cognitive behavioural therapy for adults with dissociative seizures (CODES): a pragmatic, multicentre, randomised controlled trial". *The Lancet Psychiatry* 7.6 (2020): 491-505.

57. Edwards MJ., *et al*. "Functional/Psychogenic Movement Disorders: Do We Know What They Are?" *Movement Disorders* 29.13 (2014b): 1696-1697.

58. Edwards MJ., *et al*. "From Psychogenic Movement Disorder to Functional Movement Disorder: It's Time to Change the Name". *Movement Disorders* 29.7 (2014a): 849-852.

59. Reuber M and Brown RJ. "Understanding psychogenic nonepileptic seizures- Phenomenology, semiology and the Integrative Cognitive Model". *Seizure* 44 (2017): 199-205.

60. Nicholson TR., *et al*. "Life events and escape into conversion disorder". *Psychological Medicine* 46.12 (2016): 2617-2626.

61. Carlson CA. "A Proposed Etiology of Psychogenic Nonepileptic Seizures". *Journal of Neurology and Psychiatric Disorders* 1.2 (2019): 201.

62. McGonigal A., *et al*. "A Clear Diagnostic Framework Exists for Psychogenic Non-epileptic Seizures (PNES)". *Journal of Neurology and Psychiatric Disorders* 1.1 (2019): 108.

63. Galli S., *et al*. "Conversion, Factitious Disorder and Malingering: A Distinct Pattern or a continuum?" *Frontiers of Neurology and Neuroscience* 42 (2018): 72-80.

64. Kanaan R., *et al*. "In the psychiatrist's chair: how neurologists understand conversion disorder". *Brain* 132 (2009): 2889-2896.

65. Kanaan RA., *et al*. "Neurologists' understanding and management of conversion disorder". *Journal of Neurology, Neurosurgery, and Psychiatry* 82.9 (2011): 961-966.

66. Dent B., *et al*. "Psychiatrists' Understanding and Management of Conversion Disorder: A Bi-National Survey and Comparison with Neurologists". *Neuropsychiatric Disease and Treatment* 16 (2020): 1965-1974.

67. Voon V., *et al*. "The involuntary nature of conversion disorder". *Neurology* 74 (2010): 223-228.

68. Wilson SB and Emerson R. "Spike detection: A review and comparison of algorithms". *Clinical Neurophysiology* 113.12 (2002): 1873-1881.

69. Lam AD., *et al*. "Widespread changes in network activity allow non-invasive detection of mesial temporal lobe seizures". *Brain* 139 (2016): 2679-2693.