

Optimising the use of EEG in Non Epileptic Attack Disorder: results of a UK national service evaluation

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Abstract

Purpose: To produce an evidence base to formulate guidelines for optimal performance of EEG in patients referred with a possible diagnosis of non-epileptic attack disorder (NEAD).

Methods: 51 UK EEG departments participated in the prospective study. A pro-forma was completed for all consecutive patients aged 5 years and over referred for EEG over a six month period. Information obtained included referral diagnosis, occurrence/type of attack during EEG, the use of suggestion, length of recording and who was present during the EEG.

Results: 11,298 patients were entered into the study. 376 psychogenic non-epileptic seizures (PNES) occurred of which 337 were considered to be of the habitual type. In those patients suspected of having NEAD prior to referral, the use of verbal suggestion increased the yield of habitual attacks by a factor of three in both adults and children. Using suggestive techniques twice, improved the yield further. Non-habitual attacks occurred equally whether or not suggestion was used. At least 90% of habitual PNES occurred within the first 30 minutes of recording even in those patients having prolonged EEGs. In EEGs where additional professional personnel were present, PNES occurred more frequently.

Conclusion: This large multicentre study provides evidence to inform recommendations for EEG to investigate NEAD. We recommend the use of verbal suggestion at least twice and where practical the presence of additional professional staff. A thirty minute recording is sufficient to record a habitual PNES in most instances.

Key Words: Non epileptic attack disorder; Psychogenic non-epileptic seizures; Epilepsy; Suggestive techniques; Provocation techniques; EEG

Introduction

Non-Epileptic Attack Disorder (NEAD) is a condition often misdiagnosed as epilepsy [1]. It affects 30 patients in every 100,000 of the population [2]. The results of misdiagnosis are serious with patients receiving inappropriate anticonvulsant therapy and not receiving appropriate psychological treatments. The annual cost of misdiagnosis of epilepsy in England and Wales is estimated to be up to £138,000,000 [3]. There is often a delay in diagnosis of several years [4] although prognosis for recovery is directly related to early diagnosis [5].

The recording of simultaneous EEG and video during a typical clinical attack is the gold standard for diagnosis [6]. Video recording would be expected to show semiology characteristic of psychogenic non-epileptic seizures (PNES) without accompanying epileptiform activity on the EEG and preservation of normal rhythms before, during, and after the attack. An ictal EEG is therefore required and this is often obtained by long term monitoring of the patient with video telemetry (VT). However VT is an expensive investigation requiring an inpatient stay and facilities for this are limited often with long waiting times. Recording seizures during a short routine EEG as an outpatient is therefore preferable both in terms of resources and speed of diagnosis. There is good evidence that using suggestive techniques may provoke seizures in this setting thus helping diagnosis. Suggestive techniques may involve simple verbal suggestion [7, 8, 9] or may be extended to include a physical intervention such as placebo injection [10,11,12,]. National Guidelines vary as to the advice given on performing suggestion. NICE [13] discourages the use of suggestion but SIGN [14] acknowledges the improved sensitivity it may offer whilst stating that this has not been definitely established.

Other factors that may improve the yield of non-epileptic seizures further are prolonging the recording [15] and having extra people, especially doctors, attending the recording [9].

However, practitioners may be reluctant to use suggestive techniques for a number of reasons. Firstly, there is often concern that they involve being untruthful to the patient and thus breach

ethical standards. Secondly, there is some evidence that suggestive techniques may provoke non-habitual attacks thus worsening the diagnostic dilemma [8,16,17,18] and this is the reason NICE guidelines caution against their use [13]. Finally, there is a risk of injury to the patient in a psychogenic seizure. Although it is well recognised that PNES may result in injury both in the home setting [19] and on the video telemetry unit [20], it remains unknown how often adverse events result from PNES occurring during routine EEG.

Practice in the UK for recording the EEG in suspected NEAD varies. The purpose of this prospective study is to provide evidence from a large UK data set on which to base guidelines for performing EEGs in suspected NEAD particularly with regard to the use of verbal suggestion, length of recording and appropriate staffing during the procedure. The study was organised by the UK National Audit Group for Clinical Neurophysiology on behalf of the British Society for Clinical Neurophysiology (BSCN) and Association of Neurophysiological Scientists (ANS) who represent professionals providing EEG services in every major department in the UK.

Methods

86 Clinical Neurophysiology centres registered with the UK National Audit Group were invited to participate in the project out of which 51 (59 %) responded. Participating centres (Appendix A) were provided with a questionnaire to be completed by the recording clinical physiologists for all EEGs performed between 1/9/15 and 28/2/16. All patients over the age of 5 years having conventional (up to 30 minutes), prolonged (longer than 30 minutes) or sleep deprived recordings were included. Patients having long term EEG with ambulatory EEG or video telemetry were excluded. The full questionnaire can be seen in Appendix B but data collected included:

- Referral diagnoses falling into 4 groups: Epilepsy, NEAD, Epilepsy or NEAD and Other
- Whether suggestion was used and if so when in the recording it was employed
- Details of clinical attacks occurring during the EEG including type of attack, timing of attack during EEG and whether the attack was habitual.
- What type of staff were present during the recording and whether further staff were available to assist during attacks
- The occurrence of adverse events

Definitions of what was meant by 'suggestion' and 'psychogenic non-epileptic attacks' were provided and can be seen in Appendix B.

Data was collated centrally and entered into a Microsoft Access database. Statistical analysis used Microsoft Excel for descriptive statistics and GraphPad Prism v6 for contingency table analysis.

Ethical approval is not a requirement for the service evaluation of routine clinical practice (UK NHS National Research Ethics Service guidelines), nevertheless the project was registered as a service evaluation with Sheffield Teaching Hospitals NHS Trust Clinical Effectiveness Unit.

Results

12739 questionnaires were received. 1357 referrals were for a diagnosis other than epilepsy and/or NEAD and 84 gave no referral diagnosis and these patients were excluded. 11,298 patients were entered into the analysis. Patient and referrals details for the group including paediatric and adult sub-groups can be seen in Table 1.

Table 1: Patient and referral details

	Total n = 11,298		Adults (≥17y) n = 8487		Children (5-16y) n = 2811	
Referral Diagnosis	n	%	n	%	n	%
Epilepsy	10,021	89	7368	87	2653	95
NEAD	332	3	298	3	34	1
Epilepsy or NEAD	945	8	821	10	124	4
M:F	1:1		1:1		1:0.9	
Age Mean; Range (years)	36; 5- 94		43; 17 - 94		10; 5 - 16	

Attacks occurred in 864 (7.6%) of the EEG recordings, details of which can be seen in Table 2.

Although both epileptic and psychogenic non-epileptic seizures occurred in both age groups, the majority of attacks recorded in adults were psychogenic non-epileptic seizures whereas the majority of attacks recorded in children were epileptic.

Table 2: Types of clinical attacks occurring during EEG

	Total n = 864		Adults n = 585		Children n=279	
	n	%	n	%	n	%
Psychogenic	376	43	332	57	44	16
Epileptic	282	33	95	16	187	67
Other non-epileptic	71	8	54	9	17	6
Uncertain	135	16	104	18	31	11

Psychogenic non-epileptic seizures occurred in 28% of 332 patients referred with NEAD, 13% of 945 patients referred with epilepsy or NEAD and 2% of 10,021 patients referred with epilepsy. Thus the yield of PNES in the 1277 patients where NEAD formed part of the differential diagnosis was 17%. Epileptic seizures occurred in no patients referred with NEAD, 2% referred with epilepsy or NEAD and 3% referred with epilepsy. Other organic non-epileptic attacks (such as breath holding or vasovagal attacks) or attacks of uncertain origin occurred in 3% patients referred with NEAD, 3% referred with epilepsy or NEAD and 2% referred with epilepsy.

Of the 103 patients having attacks who were referred with NEAD, 92 (89%) attacks were PNES and none were epileptic. In the 591 patients having attacks referred with epilepsy 157 (26%) attacks were PNES, and 266 (45%) epileptic. In the 170 patients having attacks where the proposed diagnosis was either epilepsy or NEAD, 127 (75%) attacks were PNES and 16 (9%) epileptic. The remainder of attacks were either other organic non-epileptic attacks or of uncertain origin.

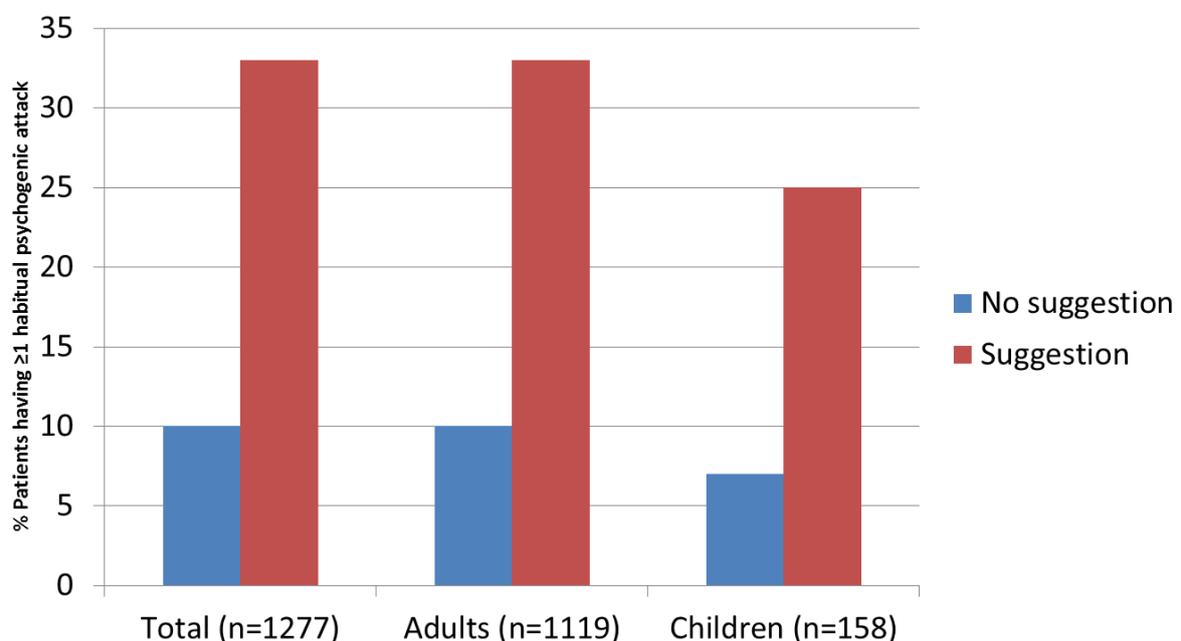
Of the 376 psychogenic attacks which occurred, 337 (90%) were considered habitual. 234 (62%), were reported as entirely habitual, 93 (25%) as habitual but less severe than usual and 10 (3%), as habitual but more severe than usual. 18 (5%), psychogenic seizures were reported as definitely non-

habitual and there was uncertainty as to whether the attack was habitual in 19 (5%). In 2 patients data was missing as to the whether the attack was habitual or not.

Suggestive techniques were used in 47% of 332 patients referred with NEAD, 27% of 945 patients referred with epilepsy or NEAD and 6% of 10,021 patients referred with epilepsy.

Suggestion was used in 416 (33%) patients where NEAD formed part of the referral differential diagnosis: 365/1119 (33%) of the adult and 51/158 (32 %) of the paediatric referrals. For the group as a whole, there was a significant increase in seizure yield from the use of suggestion 10% to 33% (χ^2 $p < 0.0001$). Similar improvements in PNES yield by use of suggestion were seen for the adult (χ^2 ; $p < 0.0001$) and paediatric subgroups (χ^2 $p < 0.002$) shown in Figure 1.

Figure 1: Yield of habitual psychogenic non-epileptic seizures in patients referred where NEAD was part of differential diagnosis in relation to whether suggestive techniques were used.

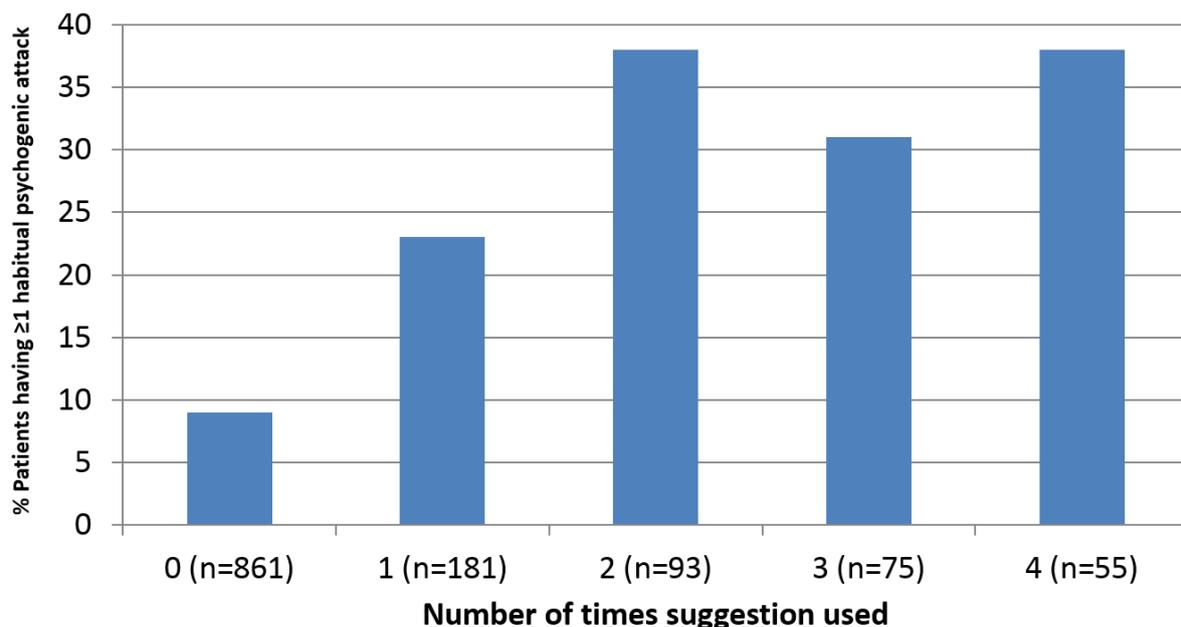


Where suggestion was used in patients referred with epilepsy (n=568), 7% had an habitual psychogenic seizure compared to 1.1% in the 9346 patients where suggestion was not used

($\chi^2 p < 0.0001$). It should be noted that data was missing on whether suggestion had been delivered in 107 patients referred with epilepsy. The yield of epileptic seizures in those patients referred with epilepsy was similar whether or not suggestion was used 2.6% vs 2.2% (χ^2 ns).

Of the 416 patients receiving suggestion where NEAD formed part of the referral differential diagnosis, it was employed before the EEG in 75%, during the resting record in 33%, with hyperventilation in 37% and with photic stimulation in 48%. The number of times suggestive techniques were used varied: once in 181, twice in 93, three times in 75 and four times in 55 patients. In 12 patients information on number of times suggestion was used was not provided. The yield of habitual psychogenic attacks in relation to the number of times suggestion was delivered can be seen in Figure 2. There was a significant increase in yield between using once and twice from 23% to 38% ($\chi^2 p = 0.01$) but using suggestion more than twice did not improve yield further.

Figure 2: Yield of habitual psychogenic non-epileptic seizures in relation to number of times suggestion delivered



37/376 (9.8%) of psychogenic non-epileptic seizures were non habitual, either confirmed as definitely non-habitual or where there was some uncertainty expressed. Non-habitual attacks were provoked in 17/177 (9.6%) where suggestion was used and 20/199 (10%) where suggestion was not used (χ^2 ns).

18/376 (5%) of psychogenic attacks occurred only before electrode placement or after electrode removal. This was similar to the frequency of epileptic attacks occurring at these times 8/282 (3%) (Fishers exact test ns).

Length of recording

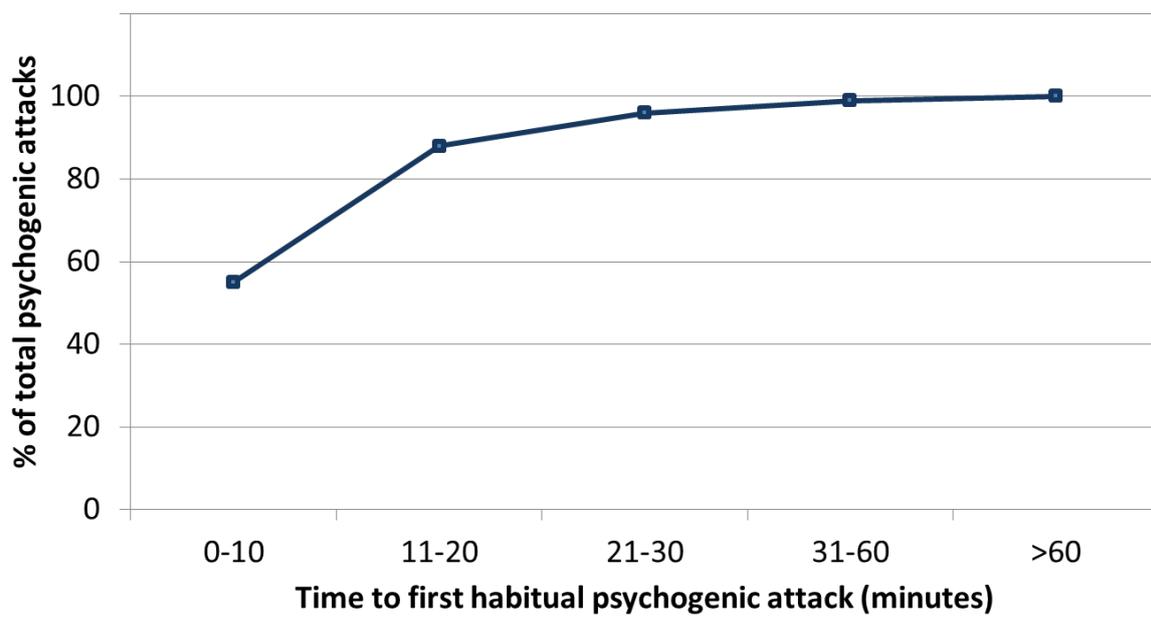
The yield of habitual psychogenic attacks occurring at different times of the recording can be seen in Figure 3 (a). 96% of PNES occurred within 30 minutes of recording. The yield of habitual PNES in a sub-group of 103 patients having prolonged EEGs longer than 30 minutes can be seen in Figure 3 (b). 90% of the PNES occurred within the first 30 minutes of the prolonged recordings.

Figure 3

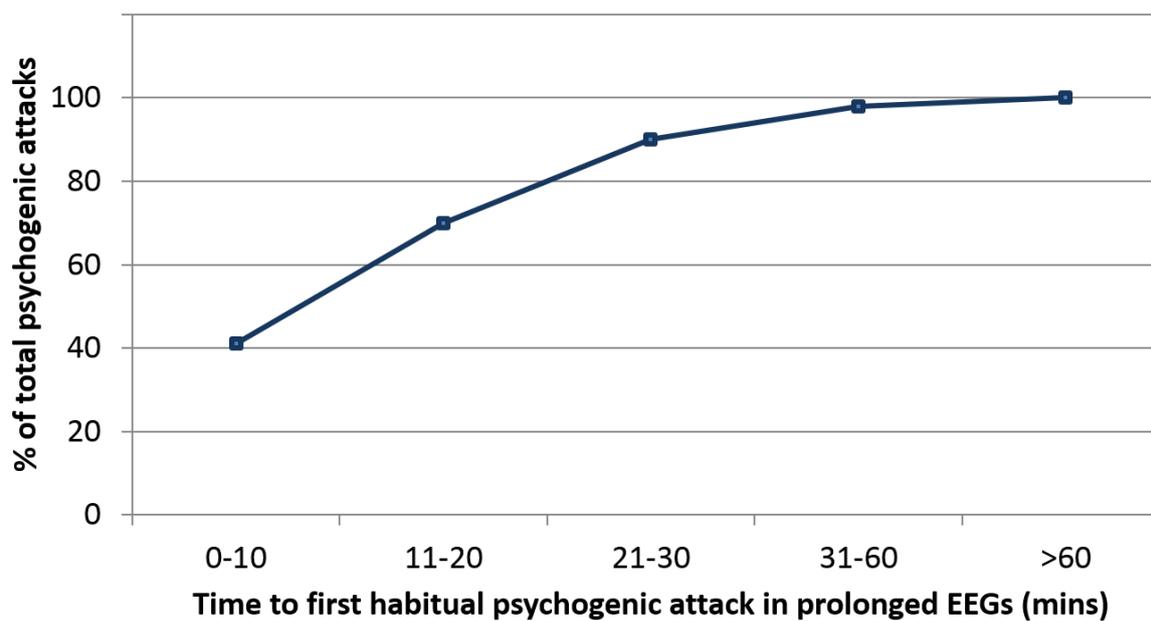
(a) Percentage of total habitual psychogenic non-epileptic seizures occurring at time from start of EEG (n= 376)

(b) Percentage of total habitual psychogenic non-epileptic seizures occurring at time from start of prolonged EEGs (n=103)

(a)



(b)

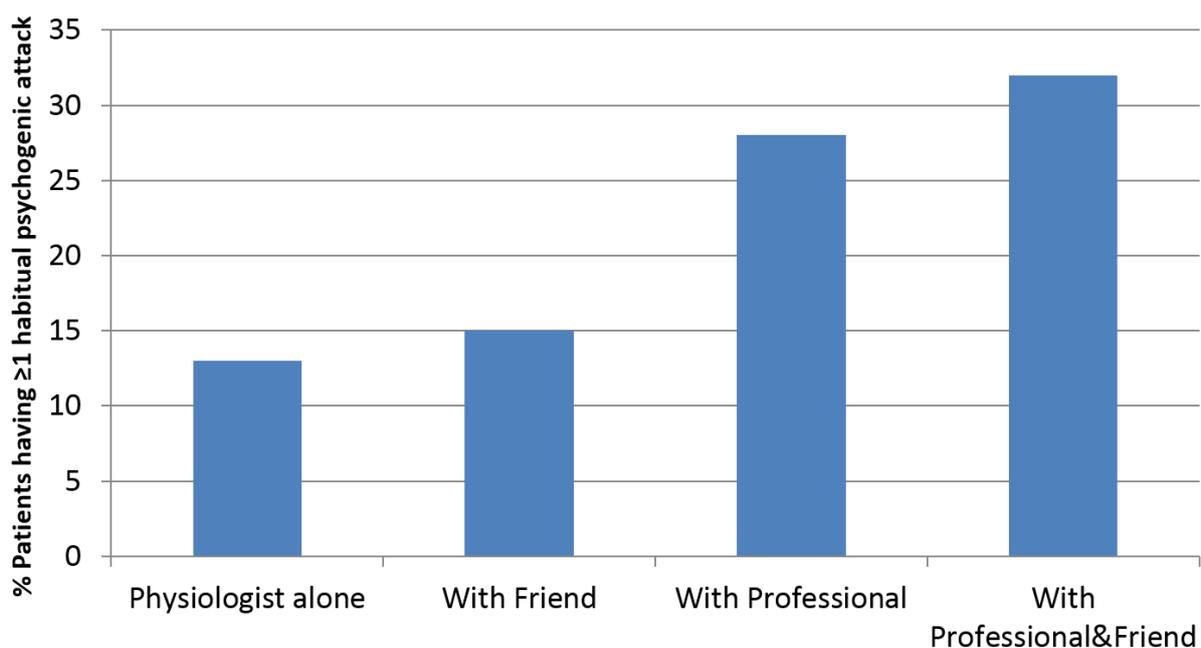


Extra people

Of the 1277 patients referred where NEAD formed part of the differential diagnosis, 617 EEGs were performed without additional people being present other than the recording physiologist. In 528 a friend or relative was present, in 101 an additional professional was present and in 31 a friend/relative and a professional were present.

The yield of habitual psychogenic seizures recorded can be seen in Figure 4. There was a significant increase in the yield of psychogenic seizures from 13% to 28% if additional professional personnel were present ($\chi^2 p < 0.0001$) during the recording. The presence of a friend (or relative) either with or without a professional in attendance did not further increase the likelihood of an attack occurring (χ^2 ns).

Figure 4: Yield of habitual psychogenic non-epileptic seizures according to type of persons present during EEG



The professional personnel constituted a doctor in 13 EEGs, an additional clinical physiologist in 79 EEGs and a nurse in 46 EEGs. The highest yield of attacks was when a doctor was present at 62% which was significantly higher than when an extra physiologist was present when the yield was 24% (Fishers exact test $p < 0.02$). However the yield of 33% when a nurse was present was not significantly different (Fishers exact test) to the yield from either a doctor or extra clinical physiologist being in attendance.

94 of the 376 psychogenic seizures involved marked motor activity described as thrashing around. In these more severe attacks, additional professional help for the patients was provided in 39% and the recording clinical physiologist remained alone in 61%. Injuries were reported in 2 (0.5%) patients having PNES : in one the patient bit her lip and in the other the clinical physiologist's hand was squeezed very hard. The remaining psychogenic seizures were less severe and included slumping in 29 (8%), unresponsiveness in 88 (23%) and other minor motor or sensory phenomena in 220 (58%).

Discussion

Suggestive techniques to induce psychogenic non epileptic seizures have been used for many years. Early methods routinely included some sort of placebo such as saline injections along with verbal suggestion. Induction rates from these techniques was high and reported between 54 to 84% in individuals suspected to have NEAD [10, 11, 12]. Subsequent work showed that verbal suggestion used with standard EEG activation techniques of hyperventilation and photic stimulation without the need for more invasive placebos could be equally effective with induction rates of 66- 84% [7,8]. In a staged protocol for inducing PNES, Popkirov [16] showed that adding placebo administration to the use of verbal suggestion with hyperventilation and photic stimulation did not result in a significant improvement in seizure yield. Verbal suggestion has the advantage of being less uncomfortable for the patient and also solving many of the ethical concerns involved with deceiving the patients with placebos. There is very little work published quantifying the effect of verbal suggestion on the yield of PNES. McGonigal [9] performed a small randomised control trial of verbal suggestion with hyperventilation and photic stimulation in 15 patients and 15 controls. The study was underpowered and failed to show a significant effect of the use of suggestive techniques in other than a subgroup of patients who were prone to having seizures in medical settings. Our large multicentre study now confirms a significant improvement in seizure induction rates by the use of verbal suggestion increasing the yield by a factor of three. This holds true for adults and children.

The yield of PNES from EEGs using verbal suggestion in patients where NEAD formed part of the differential diagnosis is lower at 33% than reported in other studies. This is likely to be due to the fact that previous studies have generally used a highly selected cohort of patients where the diagnosis of NEAD was very strongly suspected. Ours was a more unselected group where the diagnosis was less certain hence the investigation with EEG.

It would be beneficial to be able to recommend the most effective times to deliver verbal suggestion in the recordings. Benbadis [7] showed that induced attacks are likely to occur within 4 minutes of

the suggestive technique. Published protocols [7,9,17] include details on when to give suggestion usually before hyperventilation and photic stimulation. However, there is very little data to support a particular protocol. Our study shows that three quarters of patients received suggestion before the EEG recording commenced and approximately a half before photic stimulation. Suggestion was less often delivered during the resting record or before hyperventilation. We do not have the data to determine a temporal relationship between delivery of verbal suggestion and the induced attacks. Analysis of such data would be difficult as allowance for a cumulative effect of the provocations would have to be made. We therefore cannot recommend a precise timing for the delivery of suggestion. Nevertheless it is clear that applying suggestive techniques more than once improves the yield by a further 50% and we would therefore recommend this. There is a perception amongst health care workers (at least in the UK) that patients have some control over their psychogenic attacks [21]. Historically, attacks occurring when electrodes are not recording are more likely considered to be psychogenic. This belief is not upheld by our results. 5% of psychogenic seizures occurred only before or after the recording which is similar to the rate of epileptic seizures occurring outside recording periods. Thus the occurrence of attacks when EEG is not being recorded cannot be used to differentiate between psychogenic and epileptic seizures.

The yield of PNES also depended on the certainty of the referral diagnosis. All the attacks recorded in those referred with NEAD were psychogenic as were the vast majority of attacks in patients where epilepsy was also part of the differential diagnosis of NEAD; less than 2% of this group exhibited epileptic attacks. This is similar to the results from Benbadis [8] where just over 2% of patients referred with PNES had an epileptic seizure during the recording.

About a quarter of the attacks seen in patients referred with a diagnosis of epilepsy where NEAD was not being considered as a diagnosis by the referring clinician were psychogenic. Suggestive techniques were used in some of these patients. Presumably in these instances the recording physiologist having taken a history decided on the basis of the description that NEAD was a

possibility. Whatever the reason, the results showed that the use of verbal suggestion even in patients referred with epilepsy improved the yield of habitual PNES significantly. Thus it may be reasonable to use suggestive techniques in all patients referred for EEG to help diagnose attacks even if the referring clinician favours an epileptic diagnosis.

Although NICE guidelines [13] state that suggestion may be used in the evaluation of non-epileptic attack disorder, they comment that its role is limited as it may lead to false-positive results in some people. Bazil's study [18] of 52 patients referred with a tentative diagnosis of epilepsy showed 23% of provocations using one or two injections of saline elicited atypical symptoms. On the other hand in a study of 93 patients who already had confirmed PNES, no false positive results were found from provocation using saline patches [22]. In the clinical scenario where suggestion is used for patients referred where the diagnosis of psychogenic seizures is being considered but is not yet confirmed, the false positive results from EEGs which included suggestion are reported as 3 – 14% [9, 16, 17, 23]. However McGonigal's study [9] showed no difference in the rate of induced non-habitual seizures (7%) between patients who did and did not receive suggestion. Our larger study confirms this finding in the group of patients referred for consideration of NEAD where 9.6 % of non-habitual attacks were recorded in patients receiving suggestion which is an almost identical rate to 10% in the population who didn't receive suggestion. Whilst we would recommend that it is always checked with the patient or relative/carer that the recorded seizure type was habitual, we would question the NICE guideline based on this evidence and hope for revision.

Good evidence on the optimal length of recording is lacking. Modur [15] showed that in a mixed referral group for both epilepsy and NEAD diagnoses, a routine 20 minute recording captured PNES in 7% and extending the recording to 4 hours improved the yield by another 10%. Chen [24] showed that no additional PNES were recorded by a prolonged period of video telemetry (mean 3.5 days) if no attack occurred following placebo and verbal provocation. Mosely et al [25] also suggested that prolonging VT recordings did little to improve PNES capture if none had been captured earlier in the

recording. Our results showed that 96% of all PNES captured occurred within the first 30 minutes of recording. Of course we do not know if more recordings had been prolonged in patients who failed to have attacks early in the recording whether yield would have been improved. However in the subgroup of patients having a prolonged recordings of more than 30 minutes, 90% of seizures occurred within the first 30 minutes. Best use of resources would suggest that patients referred for investigation of NEAD receive a routine 30 minute recording initially and only if no attack is recorded should more long term monitoring be considered. This approach appears to have successfully reduced the requirement for investigation of PNES by video telemetry in some centres [26].

Despite commonly held beliefs that PNES occur more frequently in the presence of witnesses there is very little published on this subject. Leis et al [27] noted that the presence of other persons in attendance during EEG was a provoking factor for psychogenic non-epileptic seizures. They found 79% of psychogenic seizures occurred in the presence of another person during EEG of 47 patients. In McGonigal's study [9] the verbal suggestion techniques were delivered by a doctor and this may have had some influence on the success of the technique. Our results suggest that if additional professional staff were present there was an increase in attack yield whether the professional was a doctor, nurse or clinical physiologist. It would seem reasonable therefore to recommend that where practicable, extra personnel are present during the recording although the numbers in the various professional groups are too small to definitely recommend a particular staff group. The presence of family or friends did not make a difference to seizure yield. **Nevertheless, the presence of patients' friends or relatives should be encouraged as they have an important role in confirming whether or not recorded events were habitual .**

As with all provocation techniques it is important to consider the patient's safety during induced seizures. There have been case reports of psychogenic status epilepticus induced by suggestion with saline placebo [28]. Ictal injury from PNES is common affecting 31 – 40% of patients [19, 29] and the rate of falls in VT units in PNES is documented to be 2.6% [20]. In our study of 376 PNES only 2

adverse events (0.5%) occurred during the seizures. However there was a potential for adverse events in many more patients who exhibited marked motor manifestations. It is of some concern that in only a third of these patients additional professional help was given. Because of the frequency of PNES occurring during routine EEG we recommend that additional personnel should be available to assist in the case of non-epileptic as well as epileptic seizures.

Although this was a large prospective and multicentre study it had some limitations. It was not a randomised control trial. For the study to be feasible the questionnaire had to be simple and easy to complete and therefore the information collected was limited in some instances such as the timing of the attacks in relation to the suggestive techniques. Neither was data collected on other variables which may have influenced seizure occurrence such as frequency of events, timing of last event and whether the EEGs were performed in an inpatient or outpatient setting. Techniques for verbal suggestion will have varied not only between centres but between individual recording physiologists. However the data does represent a good cross section of UK units ranging from small departments in district general hospitals to large units in tertiary and quaternary referral centres and therefore should be representative of current practice.

Conclusion

The aim of this study was to provide a UK evidence base on which to produce national guidelines for EEG investigation when NEAD forms part of the differential diagnosis. The guidelines must strike a balance between encouraging the patient to have a typical event without being untruthful or precipitating non-habitual attacks. Although intended for use where the EEG referral includes the possibility of NEAD they may also be applicable to epilepsy.

It is recommended that verbal suggestion is used in adults and children aged 5 years and over and that it is used more than once. The recording physiologist should emphasise the importance of capturing a typical attack. The possibility of activation techniques (photic stimulation and hyperventilation) inducing typical attacks should be stated both before recording and again prior to each activation technique. The use of verbal suggestion should be documented in the report. **It is recommended that video recording commences immediately after appropriate consent has been obtained at the start of the EEG appointment and continues until the patient departs.** It is recommended that additional staff are available to assist with patient/staff safety in case of attacks with severe motor manifestations. The presence of additional professional staff for the duration of the EEG may improve the likelihood of a clinical attack occurring. **Patients should be requested to bring family members or friends with them to confirm whether attacks recorded were of the habitual type. An EEG recording of 30 minutes should be sufficient to record a habitual PNES in most instances.**

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References

1. Chadwick D, Smith D. The misdiagnosis of epilepsy BMJ 2002; 324:495
2. Asadi-Pooya, AA, Sperling MR. Epidemiology of Psychogenic Non-epileptic Seizures. *Epilepsy & Behaviour* 2015; 46 : 60–65
3. Juarez-Garcia A , Stokes T, Shaw B , Camosso-Stefinovic J , Baker R. The costs of epilepsy misdiagnosis in England and Wales *Seizure* 2006; 15: 598—605.
4. Reuber M, Fernández G, Bauer J, Helmstaedter C, Elger CE. Diagnostic delay in Psychogenic nonepileptic seizures. *Neurology* 2002; 58:493–495.
5. Walczak TS, Papacostas S, Williams DT, Scheuer ML, Lebowitz N, Notarfrancesco A. Outcome After Diagnosis of Psychogenic Non-epileptic Seizures. *Epilepsia* 1995 36,(11) 1131–1137
6. LaFrance WC, Baker GA, Duncan R, Goldstein LH, Reuber M. Minimum Requirements for the Diagnosis of Psychogenic Non-epileptic Seizures: A Staged Approach. *Epilepsia* 2013 54 (11): 2005–18. doi:10.1111/epi.12356.
7. Benbadis SR, Johnson K, Anthony K, Caines G, Hess G, Jackson C et al. Induction of psychogenic nonepileptic seizures without placebo. *Neurology* 2000;55:1904–5.

8. Benbadis SR, Siegrist K, Tatum WO, Heriaud L, Anthony K. Short term outpatient EEG video with induction in the diagnosis of psychogenic seizures. *Neurology* 2004; 63: 1728 - 1730
9. McGonigal A, Oto M, Russell AJC, Greene J, Duncan R. Outpatient Video EEG Recording in the Diagnosis of Non-Epileptic Seizures: A Randomised Controlled Trial of Simple Suggestion Techniques. *Journal of Neurology, Neurosurgery & Psychiatry* 2002; 72 (4): 549–51.
doi:10.1136/jnnp.72.4.549.
10. Cohen R J, Suter C. Hysterical Seizures: Suggestion as a Provocative EEG Test. *Annals of Neurology* 1982; 11 (4): 391–95. doi:10.1002/ana.410110413.
11. Walczak T, Williams D, Berten W. Utility and reliability of placebo infusion in the evaluation of patients with seizures. *Neurology* 1994; 44(3): 394-399
12. Dericioğlu, N, Saygi S, Ciğer A. The Value of Provocation Methods in Patients Suspected of Having Non-Epileptic Seizures. *Seizure* 1999; 8 (3): 152–56. doi:10.1053/seiz.1999.0277.
13. NICE Epilepsies: diagnosis and management. Clinical guideline (CG137) Feb 2016
14. SIGN 143: Diagnosis and management of epilepsy in adults May 2015
15. Modur, Pradeep N, Rigdon B. Diagnostic Yield of Sequential Routine EEG and Extended Outpatient Video-EEG Monitoring. *Clinical Neurophysiology* 2008; 119 (1): 190–96.
doi:10.1016/j.clinph.2007.09.128.

16. Popkirov S, Grönheit W, Wellmer J. Hyperventilation and photic stimulation are useful additions to a placebo-based suggestive seizure induction protocol in patients with psychogenic non-epileptic seizures. *Epilepsy & Behaviour* 2015; 46: 88–90.
17. Popkirov S, Gronheit W, Wellmer J. A Systematic Review of Suggestive Seizure Induction for the Diagnosis of Psychogenic Non-epileptic Seizures. *Seizure* 2015; 31: 124–32.
doi:10.1016/j.seizure.2015.07.016
18. Bazil CW, Kothari M, Luciano D, Moroney J, Song B, Vasquez B et al. Provocation of non-epileptic seizures by suggestion in a general population. *Epilepsia* 1994; 35:768-770
19. Asadi-Pooya AA, Emami M, Emami Y. Ictal injury in psychogenic non-epileptic seizures
Seizure 2014; 23: 363–366
20. Atkinson A, Shah A, Hari K, Schaefer K, Bhattacharya P, Shah A. Safety considerations in the epilepsy monitoring unit for psychogenic non-epileptic seizures. *Epilepsy and Behaviour* 2012; 25:176–80.
21. Worsley C, Whitehead K, Kandler R, Reuber M. Illness perceptions of health care workers in relation to epileptic and psychogenic non-epileptic seizures. *Epilepsy and Behaviour* 2011
20(4):668-73

22. Lancman ME, Asconape JJ, Craven WJ, Howard G, Penry JK. Predictive value of induction of psychogenic seizures by suggestion. *Ann Neurol* 1994; 35: 359-36 1
23. Varela HL, Taylor DS, Benbadis SR. Short-Term Outpatient EEG-Video Monitoring With Induction in a Veterans Administration Population. *Journal of Clinical Neurophysiology* 2007; 24(5): 390-391
24. Chen D, Izadyer S, Collins R, Bengé J, LeMaire A, Hrachovy R. Induction of psychogenic non-epileptic events: success rate influenced by prior induction exposure, ictal semiology, and psychological profiles *Epilepsia* 2011; 52(6): 1063-1070
25. Moseley BD, Dewar S, Haneef Z, Stern JM. The utility of prolonged inpatient video EEG monitoring. *Epilepsy Res.* 2015; 109:9-12
26. Alving J, Beniczky S. Diagnostic usefulness and duration of the inpatient long-term video-EEG monitoring: Findings in patients extensively investigated before monitoring *Seizure* 2009; 18: 470-473
27. Leis AA, Ross MA, Summers AK. Psychogenic Seizures Ictal Characteristics and Diagnostic Pitfalls. *Neurology* 1992 42 (1): 95–95. doi:10.1212/WNL.42.1.95.
28. Ney G, Zimmerman C, Schaul N. Psychogenic status epilepticus induced by a provocative technique *Neurology* 1996; 46(2): 546

29. Peguero E, Abou-Khalil B, Fakhoury T, Mathews G. Self injury and incontinence in psychogenic seizures. *Epilepsia* 1995; 36(6) 586-591

Appendix A: Participating Centres

Queen Elizabeth Hospital Birmingham
City Hospital Birmingham
Birmingham Children's Hospital, Birmingham
Royal United Hospitals Bath
St Lukes Hospital Bradford
Poole Hospital, Poole
Southmead Hospital, Bristol
Royal Victoria Hospital, Belfast
Royal Belfast For Sick Children, Belfast
Altnagelvin Area Hospital, Londonderry
Craigavon Area Hospital, Belfast
Addenbrookes Hospital, Cambridge
University Hospital Of Wales, Cardiff
University Hospital Coventry And Warwickshire, Coventry
Dorchester Hospital, Dorchester
Royal Devon And Exeter Hospital, Exeter
Forth Valley Royal Hospital, Larbet
Southern General Hospital, Glasgow
Gloucester Royal Hospital, Gloucester
Royal Surrey County Hospital, Guildford
Hull Royal Infirmary, Hull
Calderdale Royal Hospital, Halifax
Ipswich Hospital, Ipswich
Raigmore Hospital, Inverness
Ashford St Peter's Hospital Chertsey
Walton Hospital For Neurology And Neurosurgery, Liverpool
Lincoln County Hospital, Lincoln
Salford Royal Infirmary, Manchester
North Manchester General Hospital, Crumpsall
Royal Manchester Childrens Hospital, Manchester
Manchester Royal Infirmary, Manchester
Whittington Hospital, London
Royal Victoria Infirmary, Newcastle

Northampton General Hospital, Northampton
Norwich And Norfolk University Hospital ,Norwich
Nottingham University Hospital; Nottingham
John Radcliffe Hospital, Oxford
Derriford Hospital, Plymouth
Queen Alexandra Hospital, Portsmouth
Royal Preston Hospital, Preston
Royal Hallamshire Hospital, Sheffield
Sheffield Childrens Hospital, Sheffield
Chalfont Epilepsy Centre, Chalfont St Peter
Southampton General Hospital, Southampton
Sunderland Royal Hospital, Sunderland
University Hospital North Midlands, Stoke
St Georges Hospital, London
National Hospital For Neurology And Neurosurgey, London
Worcester Royal Infirmary, Worcester
New Cross Hospital, Wolverhampton
York Hospital, York

Appendix B: Questionnaire



FORM B: Please complete for all routine/prolonged/sleep EEGs over the age of 5

Postcode of Centre (Please complete)		Local EEG number (Please complete):		Project code (Do not complete – for office use only)	
1. Patient Details:			Age:	
			Gender:	M/F	
			Type of Recording:	Routine / Prolonged / Sleep	
			Length of Recording: (minutes)	
2. What was the referral diagnosis?			Epilepsy Non-Epileptic Attack Disorder (NEAD) Epilepsy and/or NEAD Other		
3. Were 'suggestive' techniques used during the recording?			Yes/No		
4. If suggestive techniques were used, when were they applied (circle all that occurred)			Before start of recording During resting record Before Hyperventilation Before Photic Stimulation		
5. Who was present for the duration of the recording other than yourself? (circle all that apply)			Friend/Relative/Carer Doctor Nursing staff Additional Clinical Physiologist(s) No one		
6. Did a clinical attack occur during this hospital visit for EEG?			Yes : Proceed to question 7 & continue No: Do not complete any further questions		

7. At what point in the recording did the patient have the attack (circle all that apply)	<p>Before start of recording or during preparation</p> <p>Resting record</p> <p>Hyperventilation</p> <p>Photic stimulation</p> <p>After EEG electrodes disconnected</p>
8. How many minutes after the start of the recording did the attack occur?	
9. Was the attack:	<p>Epileptic</p> <p>Psychogenic Non-Epileptic</p> <p>Other Non-Epileptic eg breath holding, vaso-vagal (Please state)</p> <p>Diagnosis uncertain</p>
10. If the attack was Psychogenic Non-Epileptic, were the clinical features mostly (circle all that apply)	<p>Obvious thrashing around</p> <p>Slumping</p> <p>Unresponsive</p> <p>Other (please state)</p>
11. Who attended the patient during the attack? (circle all that apply)	<p>Yourself</p> <p>Additional Clinical Physiologist(s)</p> <p>Doctor</p> <p>Nursing staff</p>
12. Was the recorded attack of the habitual type?	<p>No</p> <p>Yes / Yes but less severe / Yes but more severe</p> <p>Uncertain</p>
13. Did any adverse events occur during/after the attack?	Yes / No
14. If yes, what type of adverse event occurred?	<p>Injury to patient</p> <p>Patient required hospital admission</p> <p>Injury to staff</p> <p>Equipment damage</p> <p>Complaint from patient/carer</p> <p>Other (please state)</p>
15. Was there unequivocal epileptiform activity in the inter-ictal EEG ie. sharp waves /spikes with or without slow waves	Yes/No

In order to help complete the Forms a couple of definitions might be helpful.

- i. **‘Suggestion’ or ‘Suggestive techniques’:** by this we mean that the Clinical Physiologist emphasises to the patient that during the EEG recording it is likely that one of the patient’s typical attacks will occur. This can be done to a greater or lesser extent and at any time during the procedure.

- ii. **Psychogenic Non-Epileptic Attack:** this refers to an attack which is emotionally driven without the typical clinical appearances of an epileptic seizure and no accompanying epileptiform EEG abnormality. Typical psychogenic non-epileptic attacks might manifest as apparent unresponsiveness, slumping or thrashing around of body and limbs. Psychogenic attacks may be prolonged with sudden onset and offset. We appreciate that it may be difficult in some instances to differentiate between a psychogenic non-epileptic attack and a simple partial seizure or a frontal lobe seizure. Where there is diagnostic doubt there is the option of documenting this on Form B.