Compare The Incidence Of Epileptiform Activity During Intermittent Photic Stimulation Test On The Electroencephalogram Of Normal And Epileptic Patients.

S Naidu.S, S K.T, S Veeraiah, S R, R Sharma

Citation

S Naidu.S, S K.T, S Veeraiah, S R, R Sharma. *Compare The Incidence Of Epileptiform Activity During Intermittent Photic Stimulation Test On The Electroencephalogram Of Normal And Epileptic Patients.*. The Internet Journal of Physiology and Pathophysiology. 2010 Volume 1 Number 2.

Abstract

Purpose of the study:Intermittent photic stimulation (IPS.test has been widely used in clinical Electroencephalogram (EEG.laboratories as “activation method” to enhance preexisting abnormalities and / or induce abnormal findings in an otherwise normal EEG. There has been considerable variability in the literature reported regarding EEG abnormalities in normal adult and epileptics using IPS test. Therefore the present work was done by using “IPS test” to,a. compare the incidence of epileptiform activity during IPS test on the EEGs of normal and epileptics.b. Quantification of Changes in different seizure categories like (a.Absent, (b.Focal and (c.Generalized.Methods: EEGs were recorded using IPS as activation procedure in 50 patients, who were proven cases of epilepsy with different seizure categories and compared with 50 age and sex matched normal subjects. Effects of IPS on EEG were recorded and changes were analyzed statistically.Results: IPS test had a significance result in activation of Interictal Epileptiform discharges.(IEDs.or photo paroxysmal response(PPR). (p=0.056). Effect of activation was seen maximally in patients of generalized seizures especially in patients with GTCS (30%).Interpretation and Conclusion: This work suggests that IPS provoke epileptiform changes in EEGs Of epileptic patients and hence increase the yield of EEG recordings.

INTRODUCTION

The EEG is a common neurophysiologic technique which is relatively inexpensive, noninvasive and safe as compared to newer brain imaging techniques, primarily used in the evaluation of patients with suspected seizures and for seizure management.

Several activation techniques like hyperventilation, intermittent photic stimulation, sleep, and sleep deprivation have been used in clinical EEG laboratories to enhance preexisting abnormalities and / or induce abnormal findings in an otherwise normal EEGs. (1)

IPS, is a form of specific visual stimuli, such as flashing lights or patterns used in conjunction with EEG to provocate epileptiform activity or Photo Paroxysmal Response(PPR) in Photosensitive patients.

Photosensitivity is an abnormal response of the EEG to light or pattern stimulation, consisting of a PPR or epileptiform activity which is expressed as spike & waves discharges. (1)

In our modern technologic environment, a wide variety of visual stimuli like television, video games computer monitors, cathode-ray tubes, video display tubes, , decorative lighting, car headlights, automobile riding or driving, flickering arc light etc, can provoke epileptiform discharges/photic-induced seizures of which television commercials & programs(2,3) , video games,(4),(5)(6), have proved to be responsible for some incidents of outbreaks of visually induced seizures which is a matter of concern to general public health.(7)

The prevalence of “photosensitivity” has been said to range from less than one in 10,000 to “5-9%” (8),(9).Photosensitivity is observed in 5% of all the patients with epilepsy and in 60% of patients with visually induced seizures.(10,11).

However, despite IPS being utilized in routine clinical EEGs for decades as a activation test for photosensitivity, a number of differing views on the usefulness and indications for these test exist in normal adult and epileptics.(1,8,12).

In epilepsy population the opinion prevails that photosensitivity is related to generalized rather than localized epilepsies during IPS test. (1,13)

Recent studies done on proven cases of epilepsies showed higher rates of activation, especially in generalized seizure category with IPS, inducing ictal epileptiform discharges or PPR responses in 75% of patients,(14) 50% of patients(15) & in 25% of patients.(13)

In contrast, Wolf & gooses (12) emphasized that the typical absent seizures were rarely induced by IPS & usefulness of IPS test done routinely in EEG laboratory has to be reevaluated. A study done by Baykan B et al, reported that Typical absence seizures triggered by photosensitivity is a rare condition.(10).

Similarly another recent study reported, the prevalence of "photosensitivity" has been said to range from less than one in 10,000 in the general population,& as low as 2%, of the epilepsy population.(8)The survey from an epilepsy center in Japan reported that the PPR responses to intermittent photic stimulation (IPS) was relatively low (1.7%) in epileptic patients.(16)

Therefore, the present work was undertaken by using IPS test to,

a. compare the incidence of epileptiform activity during IPS test on the EEGs of normal and epilepitics.

b. Quantification of Changes in different seizure categories like

(a) Absent, (b) Focal and (c) Generalized.

METHODS

The sample used in this study consisted of 50 epileptic patients and 50 age matched normal subjects. Our study was a comparative study in which 50 Rt handed proven epileptic patients between the age group of 10-30 yrs, attending outpatient departments at M. S. Ramaiah Medical and Teaching Hospital were studied and further compared with age matched normal healthy subjects from the general population.

Ethical clearance was obtained from the M. S. Ramaiah Medical College ethical committee for human research to conduct the study. Patients with a history of Neurological diseases, Head injury ,Migraine ,Drug abuse, Severe cardiopulmonary disease, Left handed Men, Uncontrolled hypertension, Sickle cell anemia were excluded from the study..

Data was collected from 50 males with known history of seizures and proven cases were taken as epileptic subjects who satisfied the inclusion and exclusion criteria were recruited from M.S. Ramaiah Medical and Teaching Hospital.

In epileptics, 25 patients had partial seizures and 25 patients had generalized seizures.

Age and sex matched normal volunteers without a history of seizures was taken from the general population. The study extended over a period of two years.

PROCEDURES AND EQUIPMENT

EEGs were recorded digitally on a 21-channel EEG Nihon Kohden Neurofax Electroencephalograph EEG-1100.

EEGs were recorded from 21scalp sites based on the international 10-20 system (1), using silver/silver chloride electrodes with a ground electrode at the forehead, and use of referential, longitudinal bipolar and transverse bipolar montages.

It was explained that IPS might bring on attacks. The consent form was signed at this stage.

Our standard IPS protocol1 in performing screening EEGs started with eyes open for 5 s and then eyes closed for 5 s; the stimulus trains of 5-10-15-20-25-30-35 Hz were given in screening phase at a distance of 30 cm in a normally illuminated room. A photic stimulator with a granular diffuser and lamp housing reflector capable of delivering a flash from 1 to 50 Hz at a constant intensity was used for all cases.

EEG findings during IPS and baseline condition were tabulated as showing

a) No changes.

b) Clinical seizures that included ictal EEG patterns.

c) An increase inter ictal epileptiform discharges (IED) or PPR.

All EEGs were interpreted by qualified neurologist in neurophysiology laboratory.

Difference in the 2 groups will be statistically analyzed

using

1) Analysis of variance2) Chi-Square chart.

Investigations and interventions conducted on patients:

Study involved non-invasive EEG recordings for both cases and controls in the department of neurology as described earlier with no financial liability on them.

RESULTS AND ANALYSIS

A Case control study consisting of 50 normal and 50 epileptic patients is undertaken to study and Compare physiological changes seen in EEG of normal, and epileptic patients, Quantification of Changes in different seizure categories like (a) Absent, (b) Focal and (c) Generalized and to look critically the utility and limitations of the IPS test procedure.

IPS test had a significance result in activation of IEDs p=0.056. (Table-1, Figure-1).

In our selected series of 50 epileptic patients with different categories and 50 normal persons, clinical seizure was not seen in any patient during IPS.

IEDs (PPR), in turn, were increased in 16% and 1% of the patients with generalized and partial epilepsies, respectively. (Table-2, Figure-1, Figure-2).

Effect of activation was seen maximally in patients of generalized seizures especially in patients with GTCS (30%).(Table-2, Figure-1).

IPS could not produce any epileptiform changes or clinical seizures in the EEGs of normal controls. (Table-2).

Statistical Methods: Chi-square and Fisher exact test have been used to test the significance of changes in IEDs in different tests comparing between Epileptic and Normal. 95% confidence Interval has been used to find the clinical significance generalized seizures.

The Statistical software namely SPSS 11.0 and Systat 8.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

Figure 1

Table 1 : Effect of Photic stimulation on IED in Epileptic and Normal

	Results	Epileptic patients (N=50)	Normal subjects (n=50)	P value
Intermittent photic stimulation test.	Fresh IED	2 (4.0%)	-	0.495
	Increased IED	3 (6.0%)	-	0.242
	Fresh/Increased IED	5(10%)		0.056+
	No changes	45(90.0%)	50	0.056+

Figure 2

Table 2: Effects of Intermittent Photic stimulation test in different seizure category

+ Suggestive of significance * Moderately significance ** Strongly significant

Type of epilepsy	Number	Activation during IPS
A. Generalized seizures	Total-(25)	Total- 4(16.05%)
1)GTCS	10	3 (30.0%)
2)Absence	5	1(20.0%)
3)JME	3	-
4)Tonic	2	-
B.Partial seizures	Total(25)	Total- 1(4.0%)
1)SPS	13	-
2)CPS	10	1(10.0%)
3)PS with SG	2	-

Figure 3

Figure 1 Accentuated sharp waves,polyspikes and slow waves seen during photic stimulation in a case of GTCS

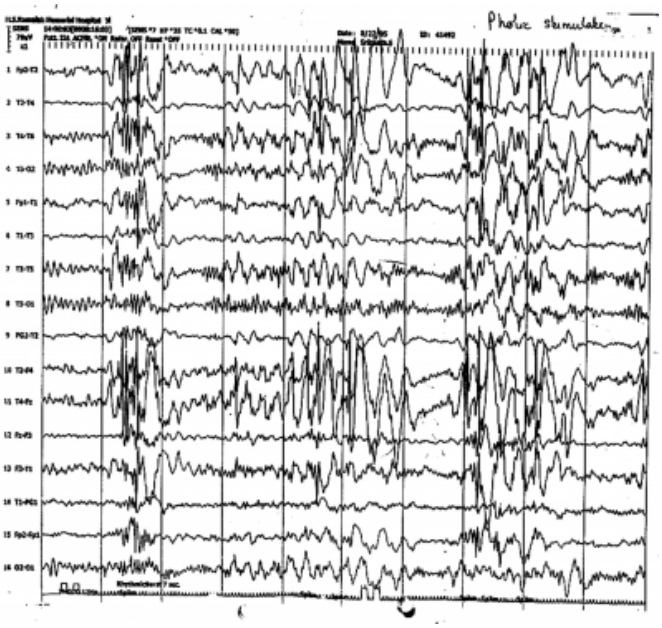
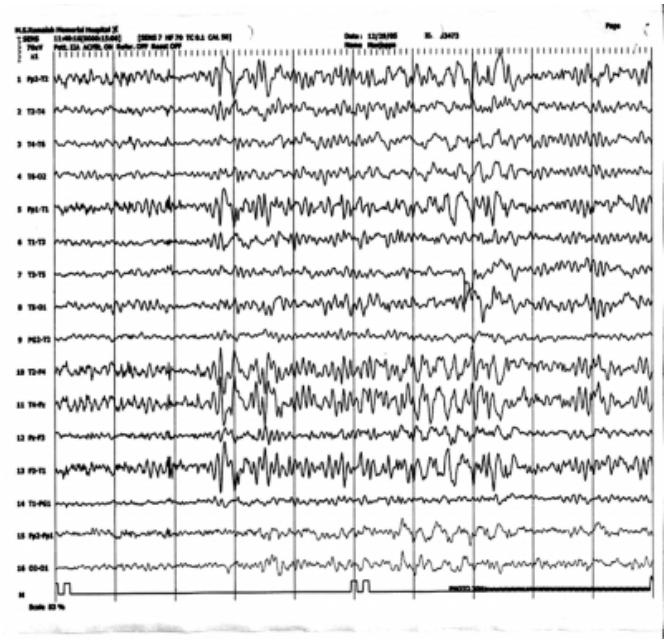


Figure 4

Figure 2 - Sharp waves arising from bilateral fronto temporal leads during photic stimulation in case of CPS



DISCUSSION

This study was done to test the hypothesis that the activation test such as IPS enhance preexisting abnormalities and / or induce epileptiform activity in an otherwise normal EEGs. However, activation test IPS despite being utilized in routine clinical EEGs for decades, a number of differing views on the usefulness and indications for these procedures exist.(1,8,12)

In this study, we gathered evidence suggesting that IPS, is a useful activation method, which increase the yield of EEGs in EEG units.

IPS test had a significance result in activation of IEDs p=0.056.(Table1).

In concurrence with previous studies IEDs during IPS, were increased in 16% of the patients with generalized epilepsies.(Table2). (figure-1) (14,16,17)

Effect of activation was seen maximally in patients of generalized seizures especially in patients with GTCS (30%).Normal subjects did not show any response to IPS.

Our findings in epileptic patients correlate with the previous studies which have shown, among patients with certain types of generalized epilepsies like example, juvenile myoclonic epilepsy & jeavons syndrome, the prevalence of photosensitivity can be 15-20%(13,16), and 75% of patients (14) or even higher 90%(17).

Possibly our study might have got more percentage of provocation if we had withdrawn antiepileptic drug treatment.

In concurrence with previous studies where incidence of epileptiform activity, photoparoxysmal response was less than 1% in the EEGs of normal subjects of young and middle age adult controls, IPS could not produce any epileptiform changes or clinical seizures in normal controls. (8,15,17,18)

IEDs, in turn, were increased in only 1% of the patients with partial epilepsies, which is in concurrence with previous studies. .(Table2) (figure-2). (1, 13, 16)

Apart from IPS being used in epileptic patients to detect photosensitivity, IPs has also been routinely advised for migraine patients (19). IPS can be used to signify the persistence of photosensitive epilepsy & abnormalities to diffuse IPS are more likely to indicate the patient is poorly controlled and at risk of further seizures. (20)

Photosensitive epilepsy is the most common type of reflex epilepsy and has attracted considerable attention because of numerous reports of seizure occurrence precipitated by television and video games.(2,3,4,5,6,21).

The general mechanisms of the activation effect of IPS are also still poorly understood. Cellular mechanisms are difficult to study in patients because of ethical and practical constraints.

Study done on patient's with generalized PPR by simultaneous recording EEG and functional MRI.(22), transcranial magnetic stimulation (TMS)(23) have, revealed IPS led to a significant activation of the visual , parietal and frontal cortices. & suggest that PPR is a cortical phenomenon

Positron emission tomography (PET) studies with oxygen (24) showed that statistically significant increases in regional cerebral blood flow occurred in occipital cortex, Brodmann's areas 18, 19, 20, hypothalamus, caudate, hippocampus, and scattered other regions.

Genetics plays a role in tendency to develop PISs. Waltz in Germany performed family studies of 41 patients with PISs. In this study, 50% of siblings with one photosensitive parent were themselves photosensitive, suggesting a dominant

mode of inheritance of the tendency (25).Recent study reported evidence for linkage on chromosomes 7q32 and 16p13

For PPR response to IPS in generalized epilepsies. (26)

Photosensitive subjects found in clinical EEG practice have epilepsy and have seizures induced by environmental visual stimuli such as television and flickering sunlight.(27)

In about 50% it seems that no spontaneous seizures occur, all attacks being visually induced.(9),(2) Avoidance of precipitating stimuli rather than medication is an important therapeutic option.

A study done in in photosensitive persons using IPS, for seeking nonpharmacologic methods for reducing the levels of photic stimulation of televised images revealed that the compound optical filters may be useful to prevent seizures induced by television.(28)

The limitations in our current study was that effects of IPS test can be assessed more accurately using sub dural depth electrode EEG recordings taken in conjunction with Brain imaging techniques,study done after discontinuing antiepileptic drugs. We could not withdraw the antiepileptic drugs because of fear of recurrence of seizures among the epileptic patients and the also because of ethical constraints.

CONCLUSION

With this study it can be concluded that the IPS test exacerbate or precipitate the epileptiform changes in EEGs and thus avoid missing abnormalities in EEG recordings and increase the yield of EEGs in epilepsy patients. Hence routine use of IPS Test for seizures patients is recommended. When a diagnosis of non-epileptic and epileptic seizures is missed, it may lead to morbidity, mortality & and also unnecessary use of anti-epileptic drugs etc., carry significant risks.

EEG screening with IPS to determine the incidence of photosensitivity in general population, and especially in those at risk like, pilots, air crew, and train drivers etc, is recommended.

National guidelines for protection against photosensitivity in high risk subjects should be made. Diagnosing and avoidance of precipitating stimuli rather than medication is an important therapeutic option for photosensitivity.

ACKNOWLEDGEMENT

The authors would like to thank and acknowledge the immense support of Dr.S. Kumar, Principal and Dean M.S. Ramaiah Medical College and Research Hospital.

The authors also acknowledge Dr. K. P. Suresh, Statistician, Animal Nutrition and Physiology for his contribution to work.

LIST OF ABBREVIATIONS USED

References

1. Takahashi T. Activation methods. In: Neidermeyer E, Lopes da Silva F, eds. Electroencephalography: basic principles, clinical applications, and related field. 5th ed. Baltimore: Williams & Wilkins, 2005: 282–303.
2. Harding GFA. Jeavons PM. Photosensitive epilepsy. London:MacKeith Press,1994.
3. Enoki H, Akiyama T, Hattori J, Oka E. Photosensitive fits elicited by TV animation: an electroencephalographic study. Acta Paediatr Jpn. 1998 Dec;40(6):626-30.
4. Bureau M, Hirsch E, and Vigevano F. Epilepsy and videogames. Epilepsia 2004;45 (Suppl. 1):1–3.
5. Quirk JA, Fish DR, Smith SJ, Sander JW, Shorvon SD, Allen PJ. First seizures associated with playing electronic screen games: a community-based study in Great Britain. Ann Neurol. 1995 Jun;37(6):733-7.
6. Graf WD, Chatrian GE, Glass ST, Knauss TA.Video game-related seizures: a report on 10 patients and a review of the literature. Pediatrics. 1994 Apr;93(4):551-6.
7. Newmark ME, Penry JK. Photosensitivity and epilepsy: a review. New York: Raven Press, 1979
8. De Bittencourt PR. Photosensitivity: the magnitude of the problem.
Epilepsia. 2004;45 Suppl 1:30-4.
9. Erba G. Preventing seizures from "Pocket Monsters": a way to control reflex epilepsy. Neurology. 2001 Nov 27; 57(10):1747-8
10. Baykan B, Matur Z, Gürses C, Aykutlu E, Gökyiğit A. Typical absence seizures triggered by photosensitivity. Epilepsia. 2005 Jan; 46(1):159-63.
11. Kasteleijn-Nolst Trenite DG. Photosensitivity in epilepsy. Electrophysiological and clinical correlates. Acta Neurol Scand Suppl. 1989 ; 125:3-149.
12. P Wolf and R Goosses. Relation of photosensitivity to epileptic syndromes.J Neurol Neurosurg Psychiatry. 1986 December; 49(12): 1386–1391.
13. Hamid Reza Riasi, Fariba Nakhaei, Kavian Ghandehari, Frood Salehi, Zahra Toraby, and Mojtaba Teimoori.Clinical evaluation of 32 patients with. juvenile myoclonic epilepsy in southern. khorasan. Pak J Neurol Sci 2009; 4(1):4-7
14. Viravan S, Go C, Ochi A, Akiyama T, Carter Snead O 3rd, Otsubo H.2. Jeavons syndrome existing as occipital cortex initiating generalized epilepsy.Epilepsia. 2011 Jul;52(7):1273-9.
15. Jayakar P, Chiappa KH. Clinical correlations of photoparoxysmal responses. Electroencephalogr Clin Neurophysiol. 1990 Mar;75(3):251-4.
16. Shiraishi H, Fujiwara T, Inoue Y, Yagi K.Photosensitivity in relation to epileptic syndromes: a survey from an epilepsy center in Japan.Epilepsia. 2001 Mar;42(3):393-7.
17. Appleton R, Beirne M, Acomb B. Photosensitivity in juvenile myoclonic epilepsy. Seizure 2000; 9: 108–11.

18. Jabbari B, Russo MB, Russo ML. Electroencephalogram of asymptomatic adult subjects. Clin Neurophysiol. 2000 Jan;111(1):102-5.
19. Parisi P.Why is migraine rarely, and not usually, the sole ictal epileptic manifestation?
Seizure. 2009 Jun;18(5):309-12.
20. Fylan, F.; Edson, A. S.; Harding, G. F. A. Clinical Significance of EEG Abnormalities During Photic Stimulation in Patients with Photosensitive Epilepsy.Epilepsia. 40(3):370-372, March 1999.
21. Harding GF, Harding PF. Televised material and photosensitive epilepsy.Epilepsia. 1999;40 Suppl 4:65-9.
22. Moeller F, Siebner HR, Ahlgrimm N, Wolff S, Muhle H, Granert O et al. fMRI activation during spike and wave discharges evoked by photic stimulation.
Neuroimage. 2009 Dec;48(4):682-95.
23. Siniatchkin M, Groppa S, Jerosch B, Muhle H, Kurth C, Shepherd AJ, et al .Spreading photoparoxysmal EEG response is associated with an abnormal cortical excitability pattern.Brain. 2007 Jan;130(Pt 1):78-87.
24. Da Silva EA, Muller RA, Chugani DC, Shah J, Shah A, Watson C et al. Brain activation during intermittent photic stimulation: a [15O]-water PET study on photosensitive epilepsy. Epilepsia. 1999;40 Suppl 4:17-22.
25. Waltz S, Christen HJ, Doose H. The different patterns of photo-. paroxysmal response: a genetic study.
Electroencephalogr Clin. Neurophysiol 1992;83:138–45.
26. Pinto D, Westland B, de Haan GJ, Rudolf G, da Silva BM, Hirsch E,et al. Genome-wide linkage scan of epilepsy-related photoparoxysmal electroencephalographic response: evidence for linkage on chromosomes 7q32 and 16p13. 2005 Jan 1;14(1):171-8. Epub 2004 Nov 17.
27. Reilly EL, Peters JF. Relationship of some varieties of electroencephalographic photosensitivity to clinical convulsive disorders. Neurology. 1973 Oct;23(10):1050-7.
28. Takahashi, Y. ; Sato, T.; Goto, K.; Fujino, M.; Fujiwara, T.; Yamaga, M. et al. Optical filters inhibiting television-induced photosensitive seizures. Neurology: Journal of the American Heart Association.Issue: Volume 57(10), 27 November 2001, pp 1767-1773.

Author Information

Srinivasulu Naidu.S
Assistant professor of Physiology, Bangalore Medical College & Research Institute

Shashikala K.T
Assistant professor of Physiology, Bangalore Medical College & Research Institute

Shivakumar Veeraiah
Professor and HOD, Department of Physiology, Bangalore Medical College & Research Institute

Srinivasa R, M.S.
Prof & HOD, Dept of Neurology, Ramaiah Medical College

Rajeev Sharma, M.S.
Prof & HOD, Dept of Physiology, Ramaiah Medical College