

Profile of Photic Driving Inelectroence Phalography Records at Mohammad Hoesin Hospital Palembang

S Handayani¹, E Bahar², O Amanda³

¹Lecturer Staff of Neurology Department, Medical Faculty of Universitas Sriwijaya/Mohammad Hoesin Hospital, Palembang

²Lecturer Staff of Public Health Department, Medical Faculty of Universitas Sriwijaya, Palembang

³Resident of Neurology Department, Medical Faculty of Universitas Sriwijaya/Mohammad Hoesin Hospital, Palembang

E-mail: ummi.fatimah@yahoo.com

Abstract.

Photic driving (PD) is a normal electroencephalography phenomenon in the parietooccipital region during intermittent photic stimulation (IPS). The PD response is an indicator that is sensitive to age, brain maturity, certain abnormalities, changes in brain signal and brain complexity. Currently, there is not much data about the PD response based on individual characteristics. **Methods:** It is a cross-sectional study with secondary data from EEG and medical records, from January to December 2017. **Result:** Of 536 records, only 444 EEG records fulfilled the research criteria. PD response was more common in women (61.4%) and age group between 20-60 years (78.6%). Normal EEG result was 71.4%. PD responses were most commonly diagnosed with epilepsy etiology (33.8%). Only 28.6% of PD responses were found in abnormal EEG results. **Conclusion:** Distribution showed that the response of PD decreased in older age. The PD response is more common in patients with normal EEG results. The more abnormal results of EEG, PD response rarely arise.

1. Introduction

Photic driving is a normal electroencephalography phenomenon in the parietooccipital region during intermittent photic stimulation. Intermittent photic stimulation is an important functional test used in electroencephalography (EEG) recording to improve the manifestation of rhythmic sources of bioelectric activity including its pathological form.^[1]

Intermittent photic stimulation can trigger the occurrence of photic driving (PD), which is a physiological response consisting of rhythmic activities related to the stimulus given at a particular frequency or harmonically related to the stimulus. Intermittent photic stimulation application in normal subjects is related to electroencephalographic typology and individual psychophysiological characteristics.^[2] In the study reported by Hashmi et al, 2011 that a photic stimulation response was detected from EEG recording, where 49 (67%) had the photic driving response (PDR) and 24 (33%) had a photoparoxysmal response (PPR).^[3]

The PD response is an EEG indicator that is sensitive to age and brain maturity. And this PD response can also sometimes be

associated with some abnormalities, changes in brain signals and complexity of the brain. There are studies showing that this abnormal response is around 5-10% seen in the population of epilepsy, especially in generalized epilepsy and is not typical for focal epilepsy.^[2] Reported in the Itoh study, the incidence of photic driving was 35.7% of all subjects.^[4] Gender was also thought to have an effect on the photic stimulation response which caused a PD response in the brain.^[5]

At present, there is not much data regarding PD response during EEG recording that is related to individual characteristics when recording EEG. With these considerations, researchers feel the need to conduct research on the description of photic driving responses in patients who conduct EEG recordings in the EEG laboratory at Moh. Hoesin hospital Palembang.

1. Purpose of research

To describe the photic driving response profile in EEG records at the EEG laboratory of Moh. Hoesin hospital Palembang.

2. Methods and material

This is a cross-sectional descriptive study using secondary data from EEG and medical records of patients who performed EEG recordings in the EEG laboratory of Moh. Hoesin hospital Palembang in the period of January 1, to December 31, 2017

The population in this study were all EEG records of patients in the EEG laboratory of Moh. Hoesin hospital Palembang. The sample size is limited by the time span. Inclusion criteria in this study were all EEG records when photic stimulation was performed. Exclusion criteria in this study were patients who had one-eye or two-eye vision loss and incomplete data.

The EEG records were examined by an epilepsy division neurologist. Data collection was done manually by using data tables of research forms provided. Data analysis was performed using the SPSS 21 for Windows program which was carried out descriptively using univariate analysis, cross-tabs on patient characteristics described in the form of tables of the frequency distribution of each variable studied. Data obtained from the study are presented in descriptions in the form of frequency distribution and narrative tables.

3. Result

During the period of January 1 to December 31, 2017, there were 536 EEG records with photic stimulation in the EEG laboratory of Moh. Hoesin Hospital, Palembang. Of the 536 records, there were 444 records that met the inclusion criteria and did not meet the

exclusion criteria in this study. In this study, more than half (59.9%) of patients who had EEG recordings were women. The mean age in this study was 37.39 ± 16.036 years with an age range between 12 and 89 years. Most of the patients (74.5%) were in the age group between 20-60 years, followed by the age group <20 years and > 60 years with percentages of 15.8% and 9.7% respectively.

The etiologic diagnosis, when sent for the most EEG examination was epilepsy (32.4%), followed by a headache (24.8%) and seizures in non-hemorrhagic stroke (13.7%). Seizures in space-occupying intracranial lesions and head trauma were found in 8.3% of records. The distribution of headache groups was divided into a migraine and non-migraine. The PD of non-migraine group was most often found (91.8%) than migraine group (8.2%). In this study, most records (63.3%) showed normal EEG results. Only 38.3% of records showed abnormal EEG results. The most common EEG abnormalities in this study were slowing (44.8%), followed by epileptiform (32.5%) and a combination of epileptiform and slowing (22.7%). Photic driving was found in 210 (47.3%) EEG recordings in this study. The most common types of photic driving are harmonic types with a percentage of 83.8%, followed by harmonic and superharmonic (9%) and the superharmonic type (7.2%). There were no subharmonic photic driving types in this study. The most common photic driving frequency was 10 Hz with a percentage of 36.2% (table 1).

Table 1. Distribution of subject according to photic driving frequency

| Photic Driving frequency | Frequency (n) | Percentage (%) |
|--------------------------|---------------|----------------|
| 5 Hz | 17 | 8,1 |
| 5, 10 Hz | 43 | 20,4 |
| 5, 10, 15 Hz | 28 | 13,3 |
| 5, 10, 15, 25 Hz | 11 | 5,2 |
| 5, 10, 15, 20, 25 Hz | 4 | 1,9 |
| 5,10,15,20,25, 30 Hz | 2 | 1 |

| | | |
|------------------|------------|------------|
| 10 Hz | 76 | 36,2 |
| 10, 15 Hz | 7 | 3,3 |
| 10, 20 Hz | 1 | 0,5 |
| 10, 30 Hz | 1 | 0,5 |
| 10, 25, 20 Hz | 7 | 3,3 |
| 10, 15, 20, 25Hz | 1 | 0,5 |
| 10, 20, 25, 30Hz | 4 | 1,9 |
| 15 Hz | 1 | 0,5 |
| 15, 20 Hz | 2 | 1 |
| 15, 20, 25 Hz | 3 | 1,4 |
| 20 Hz | 2 | 1 |
| Total | 210 | 100 |

Table 2. Photic driving according to the type of headache

| Type | Photic Driving | |
|--------------|----------------|------------|
| | Positive | Negative |
| Migraine | 5 (8,8%) | 4 (7,6%) |
| Non-migraine | 52 (91,2%) | 49 (92,4%) |

Table 3. Profile of photic driving according to sociodemography and clinical characteristic

| Variable | Photic Driving | |
|-------------------------------------|---------------------|---------------------|
| | Positive N = 210 | Negative N = 234 |
| Gender | | |
| Male | 81 (38,6%) | 97 (41,5%) |
| Female | 129 (61,4%) | 137 (58,5%) |
| Age | | |
| <20 years old | 34 (16,2%) | 36 (15,4%) |
| 20-60 years old | 165 (78,6%) | 166 (70,9%) |
| >60 years old | 11 (5,2%) | 32 (13,7%) |
| Etiology | | |
| Seizure in hemorrhage stroke | 7 (3,5%) | 8 (3,4%) |
| Seizure in non hemorrhage stroke | 19 (9%) | 42 (18%) |
| Recurrence Sincope | 6 (2,9%) | 8 (3,4%) |
| Headache | 57 (27,1%) | 53 (22,6%) |
| Seizure in cerebral infection | 4 (1,9%) | 5 (2,1%) |
| Epilepsy | 71 (33,8%) | 73 (31,2%) |
| Space occupying intracranial lesion | 19 (9%) | 18 (7,7%) |
| Brain trauma | 18 (8,6%) | 19 (8,1%) |
| Seizure in metabolic encephalopathy | 6 (2,9%) | 4 (8,1%) |
| Eclampsia | 2 (1%) | 3 (1,7%) |

| | | |
|------------------------|-------------|------------|
| Facial tic | 1 (0,5%) | 1 (0,5%) |
| EEG result | | |
| Normal | 150 (71,4%) | 131 (56%) |
| Abnormal | 60 (28,6%) | 103 (44%) |
| EEG abnormality | | |
| Epileptiform | 25 (41,7%) | 28 (27,2%) |
| Slowing | 23 (38,3%) | 50 (48,5%) |
| Epileptiform + slowing | 12 (20%) | 25 (24,3%) |

Table 3 shows that photic driving responses were more common in female patients (61.4%). Most photic driving responses (78.6%) were found in the age group between 20-60 years. the Photic driving response was most commonly found in patients with diagnosis of epilepsy etiology (33.8%), followed by a headache (27.1%) and seizures in non-hemorrhagic stroke (9%), space-occupying intracranial lesion (9%) and seizures in trauma head (8.6%). The photic driving responses were more common in patients with normal EEG results (71.4%). Only

28.6% of photic driving responses were found in patients who showed abnormal EEG results. The most common EEG abnormalities in patients who showed a photic driving response were epileptiform abnormalities with a percentage of 41.7% .

Based on this study, it was found that more photic driving responses were obtained in EEG records of patients with non-migraine pain types with a percentage of 91.2% (table 2). In the migraine group, most often occur at frequencies 5 and 10 Hz (40%). In the non-migraine subgroup, the highest frequency was 10 Hz (table 4).

Table 4 Photic driving frequency according to type of headache

| Variable | Headache type | |
|--------------------------|---------------|--------------|
| | Migraine | Non migraine |
| Photic Driving Frequency | | |
| 5 Hz | 0 (0%) | 2(3,9%) |
| 5 dan 10 Hz | 2 (40%) | 11 (21,2%) |
| 5, 10, dan 15 Hz | 0 (0%) | 12 (23,1%) |
| 5, 10, 15, dan 20 Hz | 1 (20%) | 3 (5,8%) |
| 5, 10, 15, 20, dan 25 Hz | 0 (0%) | 1 (1,9%) |
| 5,10,15,20,25, dan 30 Hz | 0 (0%) | 0 (0%) |
| 10 Hz | 1 (20%) | 15 (28,8%) |
| 10 dan 15 Hz | 0 (0%) | 3 (5,8%) |
| 10 dan 20 Hz | 0 (0%) | 0 (0%) |
| 10 dan 30 Hz | 0 (0%) | 1 (1,9%) |
| 10, 15, dan 20 Hz | 1 (20%) | 0 (0%) |
| 10, 15, 20, dan 25 Hz | 0 (0%) | 0 (0%) |
| 10, 20, 25, dan 30 Hz | 0 (0%) | 1 (1,9%) |
| 15 Hz | 0 (0%) | 0 (0%) |
| 15 dan 20 Hz | 0 (0%) | 1 (1,9%) |
| 15, 20, dan 25 Hz | 0 (0%) | 1 (1,9%) |
| 20 Hz | 0 (0%) | 1 (1,9%) |

4. Discussion

Photic driving is a normal electroencephalographic phenomenon during intermittent photic stimulation.^[1] Intermittent photic stimulation application in normal subjects is related to electroencephalographic typology and individual psychophysiological characteristics.^[2] PD response is an EEG indicator that is sensitive to age. PD response can also sometimes be associated with some abnormalities. There are studies showing that this abnormal response is around 5-10% seen in the population of epilepsy, especially in generalized epilepsy and is not typical for focal epilepsy. A study reported in Pakistan 2011, a photic stimulation response was detected from EEG recording, 49 (67%) had the photic driving response (PDR) and 24 (33%) had a photoparoxysmal response (PPR).^[3] Reported in a Japanese study, the incidence of photic driving was 35.7% of all subjects.^[4]

Based on the data obtained that photic driving response is more common in female patients with a percentage of 61,4%. This is similar to the Yuji Wada et al in Japan in 1994, a study of sex differences in EEG at rest and during photic stimulation at a healthy young age, with a sample of 20 men and 20 women. The results of the study reported that female gender generally had a higher amplitude at EEG at the same frequency or harmonic according to the stimulus frequency.

Hedera et al study reported that the largest photic percentage was in women, where this study looked at changes in MRI signals in photic stimulated patients. This is in accordance with the existing literature, mentioned indeed the differences in brain anatomy between genders, including about the weight and

size of the brain in men than women and the greater neuronal density in the basal frontal cortex in women.^[5]

It can be explained that the possibility of gender differences in PD response is due to the limited EEG recording location and is related to the average size of a smaller woman's head so that the amplitude appears to be higher when IPS is performed. It is not clear whether hormonal factors (estrogen and testosterone) are involved in gender differences in PD response, as well as visual evoked potential.^[6] But this also becomes biased due to the number of research subjects who came to the EEG Hospital Dr. Moh. Hospital with the highest frequency of women.

Most photic driving responses (78,6%) in this study were found in the age group between 20-60 years. This is similar to the 2011 Hashmi et al study in Pakistan which examined EEG recordings of patients over 15 years olds. Of the 5950 EEG records, there were 49 (67%) who had a PD response. PD incidence is recorded in a slightly wider age group, 15-75 years.^[3] In the study by Zappasoddi et al, which is performed to 40 healthy people between 16-85 years old reported that PD incidence increased between 20 and 50 years and decreased after age 50 years.^[7]

Takashi et al study said that the dynamic response of the brain to the influence of external stimuli will decrease according to the age. It can also be due to the PD response can be seen at a young age since the age of 3 months, and usually appears around the age where the alpha rhythm first develops. However, alpha rhythms in infants and children are not within the alpha frequency range, and this is usually referred to as the posterior dominant rhythm. Posterior dominant rhythms are in the theta rhythm range

when they first appear, and the frequency of PD response was slow. This shows that the complexity of nerve electrical activity will experience changes throughout his life which will increase to young adulthood and decrease during old age. EEG changes after photic stimulation in young people represent a good cortical response to the stimulus. The old patients show a decreased response according to the hypothesis that the ability of dynamic responses to external stimuli decreases with age.[8]

The Photic driving response is mostly found in EEG recordings of patients with etiology of epilepsy (33.8%, headache (27.1%), seizures in hemorrhage stroke and head trauma (9%). The most common photic driving frequency is 10 Hz (36.2%). This is different from the results of a study by Zappasodi in Italy that the PD response at a frequency of 20 Hz or more is close to 90% of idiopathic and migraine patients and epilepsy.[7] In contrast to the study of Ryotaro Takashima et al in Japan who examined the PD response in EEG of migraine patients, it can be concluded that the incidence of PD was higher in migraine patients. PD response increases easily along with the progression of a headache. This is because the reflection of central sensitization, in general, is caused by pain.[9] The existence of this difference is likely due to the most distribution of patients who performed the most EEG recording is epilepsy compared to pain due to a migraine itself, thus the limitations of this study in exploring the PD response itself in terms of etiological diagnosis variables.

Photic driving responses were more common in patients who had normal EEG results with a percentage of 71.4%. Only 28.6% of photic driving responses were found in patients who had abnormal EEG results. According to headache type, the sample study was divided into migraine groups and non-migraine groups, where

the distribution of the most spread in the non-migraine group was 101 people (91.8%) and migraine only 9 people (8,2%) .

In the non-migraine group there was a PD response of 91.2% and in the migraine group, there was a PD response of 8.8%. For the frequency of PD response alone in the group of migraines, the highest frequency was 5 and 10 Hz (40%). Because the number of distribution of migraine patients who came for EEG recording was small, the results expected to see the PD response were not large enough to see the reflection of sensitization caused by central pain.

5. Conclusion

The most photic stimulation frequency that produces the photic driving response was frequency of 10 Hz. The photic driving response was more common in female patients and were found in the age group between 20-60 years. The photic driving responses were more common in patients who show normal EEG results with a percentage of 71.4%. This shows the tendency that the more abnormal EEG results, photic driving response rarely occurred so that further analytical research is needed to assess the relationship between the incidence of photic driving with more specific clinical abnormalities.

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