

## A CONCISE REVIEW ON PHOTOSENSITIVE EPILEPSY

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Article Received on 11/01/2018

Article Revised on 01/02/2018

Article Accepted on 22/02/2018

## ABSTRACT

Seizures are effectively “A surge in electrical activity” of Brain & associated nerve cells that constitute Epilepsy, it is simply a bunch of circuits firing rapidly that trigger an untoward response. Photosensitive Epilepsy(PSE) is a form of Reflex epilepsy that induce seizures elicited by visual stimuli that include Strobe lights, flicker screens/flashing lights to name a few, susceptibility is not merely pronounced since it is paroxysmal and trigger that causes PSE may vary, as well one cannot deny the fact that we live in a world of fascination. Generally, PSE is not given due importance as with other forms of epilepsy owing to its incidence that may be five in a hundred-people predisposed to epilepsy has PSE, but, the fact that any photic (light) trigger may induce PSE in people who are neither photosensitive earlier nor previously at risk of being epileptic, particularly in middle age groups, is a concern. This may well be attributed to increased exposure to contrasting visual patterns in this technology driven world. The social stigma attached with epilepsy hinders the prevalence, affects quality of living. On the flip side, the management of PSE like other forms is wholly based on identification & reporting of suspected stimulus.

**KEYWORDS:** Seizures, Reflex epilepsy, Photosensitivity, Visual patterns, Triggers, Flicker.

## INTRODUCTION

Transient & Sudden recurrence of seizures is termed “Epilepsy” which is of various types based on aetiology and a Seizure is a Paroxysmal surge in electrical activity of neuronal cells which are further classified based on observation. In reality, to some extent we find flashing lights or some patterns of light strain our eyes and causes subtle light-headedness, this may be ignored in some but in individuals prone to epilepsy, the resulting seizure may be generalized rather than focal with “tonic-clonic” being the more frequent seizure, as with all epilepsies, the seizures are recurrent, paroxysmal, stop spontaneously, this type of seizures that are triggered by visual stimuli/photic(light) constitute “Photosensitive Epilepsy” (PSE) a form of Reflex Epilepsy. Reflex Epilepsy is characterized by seizures precipitated through sensory stimuli. This response can also occur in non-epileptics i.e. with no prior history of seizures, well, increasing trends in advancing world with greater exposure to photic stimuli in form of video-games, television etc. may be a reason, 3-5% prone to epilepsy are photosensitive and have seizures triggered by visual stimuli, has IGE (Idiopathic Generalized Epilepsy) like symptoms, the most common type in reflex epilepsy, although the risk of focal epilepsy cannot be necessarily ruled out.

## Reflex epilepsies

- A) Idiopathic photosensitive occipital lobe and other visual sensitive epilepsies
- B) Startle epilepsy

Figure 1: Classification of Reflex Epilepsies.

## Epidemiology

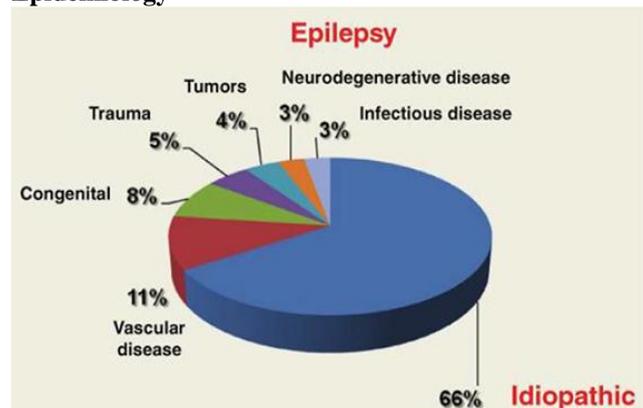


Figure 2: Statistical data of Epilepsy.

Statistical evidences<sup>[1]</sup> mean that Photosensitivity is present in a population with a frequency of about 1.1 in 100,000, and in the 7–19 years age group it is frequent with a ratio of 5.7 to 100,000 previously at risk for epilepsy. Children are at greater risk of Photo-paroxysmal response & subsequent seizures. Epilepsy associated with generalized tonic-clonic syndrome, about 13% may experience photoparoxysmal response.

Genetics also influence Photosensitivity, majority of epilepsies are idiopathic, in origin as depicted in fig.2 Demographics of PSE may change with ethnicity, gender with males being predominantly at risk.

### Terminology Photosensitive

Photosensitivity can only be applied when a person shows typical response to visual stimuli<sup>[2]</sup> on an EEG, further differentiated from other types of epilepsy, there may be cases more complex, in which EEG evidence of photosensitivity cannot be known, but seizures induced by photic stimuli which is a provoking (exciting) factor of epilepsy.

### Triggers of Photosensitive epilepsy

Photosensitivity simply put forth is extreme degree of response elicited under the influence of light stimulus, it may be worth mentioning that visual stimuli,<sup>[2]</sup> such as flashing lights, moving visual patterns (e.g. escalators), venetian blinds, luminance change (dark to bright), and exposure to certain objects are exciting factors that can induce seizures in photo-sensitive subject, hence PSE can modestly be named “Visual Sensitive Epilepsy<sup>[2]</sup>” a common manifestation of IGE, (idiopathic generalized epilepsy).

The one best example of natural photic phenomena<sup>[2]</sup> is sunlight that flecks through foliage that could even trigger seizures if at all, visual sensitive.

Conditions that predispose individuals to seizure attacks while having a glance at a screen, one of the main factor being insomnia (Sleeplessness), intoxication, binge watching, gaming among patients with epilepsy.

### First Breakout and Subsequent need to assess Photosensitive Epilepsy

In Japan, while watching a famous cartoon,<sup>[4]</sup> several children & adolescents were struck with seizures due to the animations mostly using strobe effect & rapid flickering light, with some experiences reported to be dizzy & nauseous while several reported blurred vision & temporary blindness with seizures That triggered the safety concerns, sparked a debate & as the strobe lights to create virtual effects were the possible stimuli to mark the onset of seizures in affected kids.

### Seizures predominantly expressed in PSE

- ✓ Generalized Tonic-Clonic<sup>[3]</sup> -GTC (84% of patients),
- ✓ Absence (6%),
- ✓ focal (2.5 %), and
- ✓ Myoclonic (1.5%).

### Characteristic Symptoms

Visual manifestations are mostly felt including auras,<sup>[3]</sup> visual hallucinations, blurring of vision sometimes leading to temporary loss of vision (Amaurosis fugax),<sup>[2]</sup> illusionary palinopsia (a condition where recurrence image is felt even after the removal of stimuli).

Visual symptoms may be isolated, usually lasting for seconds, for about 1–3 min and lasts rarely longer (5–15min) which are accompanied by tonic & clonic deviation.

Avoid provoking factors particularly to videogames and TV strobe lights relaxing the eye wearing polarized or coloured glasses may mitigate the exposure to an extent.

However, avoidance of visual stimuli is not that easy in accordance with dependence, on them.

Visual sensitivity results due to the inability of visual cortex<sup>[8]</sup> to go through the afferent signals of contrasting patterns or flickers, it may also be noted that recurrent seizures may be observed.

### Responses elicited

Photo-paroxysmal response<sup>[5-6]</sup> indicates a sudden, recurrent spike in EEG.

Photo-myoclonic response<sup>[5-6]</sup> is characterized by abnormal muscle contortions, with eye flutter.

Partial seizure<sup>[7]</sup> (Photogenic) may occur when exposed to patterns of light.

### Mechanism of Photosensitivity induced seizures

Can a light flash provoke a seizure, may be yes, in normal neuronal firing, the nerve cells fire in independent patterns, but during a Surge as observed under EEG representing abnormal electrical activity of brain, the nerve cells fire in harmony triggering seizures, to keep it simple, individuals who are photosensitive whose visual acuity is normal, but, on exposure to higher contrasts or patterns of photic stimuli may elicit seizures, where cortical luminance gain control<sup>[8]</sup> is impaired.

The proposed postulate was that photosensitivity may also be triggered due to a lapse in GABAergic<sup>[9]</sup> inhibition, thus provoking sensory excitation & rapid firing of neurons as inhibition is impaired or remains unchecked.

There is varied evidence from experimental models,<sup>[9]</sup> and clinical experience to support the concept that photic or pattern stimuli can induce seizures in susceptible individuals.

However, there is no conclusive evidence suggesting that photic stimuli cause epilepsy, the characteristic transient & recurring seizure patterns.<sup>[9]</sup>

### Diagnosis

#### EEG (Electroencephalography)

It records brain wave patterns analysing the electrical activity of brain, (trigger movements).

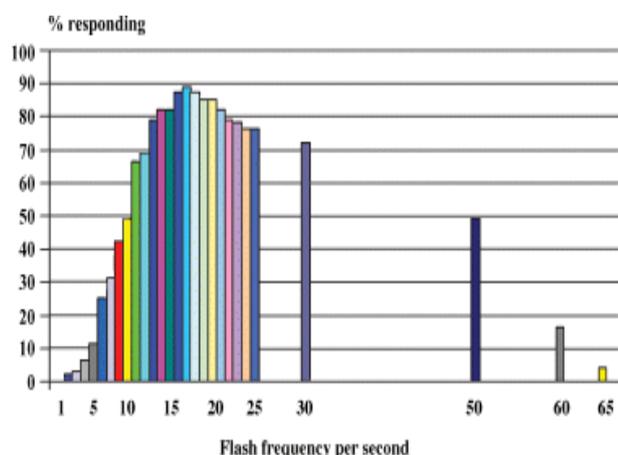
Whether a subject is found to be sensitive to light stimuli will depend on his testing in the EEG laboratory, the

EEG<sup>[10]</sup> gives somehow, a preliminary understanding of how stimulus provokes a seizure, the rate of excitation, the possible trigger, as different individuals are sensitive to different triggers that induce seizures.

However, the way EEG is performed varies,

1. Some use photic stimulation
2. Some use Visual patterns that could act as triggers.

The general procedure followed was,



**Figure 3: Graph depicting the response of EEG under the influence of photic stimuli.**

EEG was recommended to include a common reference montage of  $\geq 16$  channels distributed around the head (based on the standards),

- ✓ Position the respondent within the  $\geq 0.3$ m of photic stimuli, in a under lit/ low illuminated room.
- ✓ Deliver flashes of light in separate series of 10 s for each frequency with intervals of 7 s minimum.
- ✓ Make sure to open eyes at start, and then closed after 5 s until the light stops to stimulate.
- ✓ Testing frequency should include 1, 2, 3, 4, 6, 8, 10, 12, 14, 16, 18, and 20 flashes per second.
- ✓ A second sequence should begin at 60 Hz and decrease through variables of 10 flashes per second, record the % response in a graphical way as shown in fig.3.
- ✓ Cease stimulation if there are characteristic epileptic observations are noted.

The procedure lasts 6 minutes to a maximum, examiner should be aware that subjecting a frequency can lead to altered responses either enhanced or persisting or suppressed, but as known from the studies many of the photosensitive subjects are flicker sensitive that they are to patterns,

### Treatment

Much of the susceptible individuals are expected to exhibit a little sensitivity to photic stimuli, if they are to prevent that trigger, most may at the least may experience a mild seizure which does not warrant any drug treatment, on the contrary, being photosensitive at the broader range may require medical attention, since,

seizures may be recurrent characterized by epileptiform changes,

Treatment is mainly aimed at:

- ✓ Stimulus avoidance
- ✓ Stimulus modification
- Stimulus avoidance:<sup>[11-13]</sup>
  - ✓ Avoid provocative stimulus like varied colours, strobe lights, flickering lights,
  - ✓ Don't peek at screen for too long that takes away your field of vision as in gaming & binge watching.
  - ✓ If you feel enervated/tired try not to have a glance at something that could possibly trigger seizures
- Stimulus Modification:<sup>[11]</sup>
  - ✓ Wear polarized sun glasses or optical filters<sup>[11]</sup> that cover screen, help mitigate but cannot completely stop the visual field distortion,
  - ✓ Use flicker free screens with large refresh rates,
  - ✓ Cover one eye to avoid source that could act as a possible trigger.

Although the safety of screens with large refresh rates is still under debate concerning photosensitivity.

Then, anti-epileptic drug (AED) treatment becomes the last resort, that cannot totally quell, but can mitigate, where, Sodium valproate is the drug of choice, although drugs like trimethadione, phenytoin, diazepam may find effective. Owing to failure in GABAergic inhibitory transmission, Vigabatrin,<sup>[12]</sup> a drug that inhibits GABA metabolism further, that leads to increase in GABA mediated inhibitory processes, thus reducing photosensitive responses.

Majority of the cases don't require anti-convulsant therapy. Individuals with rundown history of epilepsy may have to take an EEG examination with photic stimulation, that could help identify Photosensitive epilepsy.

### Prognosis

PSE may influence the quality of life of an individual as one cannot predict the possible onset of a seizure or a trigger, exhibits a good prognosis but triggers are isolated, a possible trigger inducing a seizure in one may not likely precipitate the seizure in others, hence unlikely to predict but non-pharmacological therapy aimed at stimulus avoidance along with anti-epileptic drugs (AED) in required cases may well curtail onset of seizures.

### CONCLUSION

The core goal of stimulus avoidance and modification will depend on the degree to which an individual is photosensitive, but as said & done the visual sensitive epilepsy may not necessarily be a peril than other forms of epilepsy but can be with poorly understood mechanisms and the increasing global trends, this is sure a fodder for thought If at all poor prognosis can be detrimental, though intensity of photic stimuli is the one

that decides the eliciting of photoparoxysmal response. Fatigue, insomnia, occasional blackouts, visual distortion may well be the factors for PSE. The Epilepsy foundation of America reiterates that visual sensitive seizures are a significant health concern, with work aimed at developing standardized guidelines & education that could alleviate the risk of Photosensitive epilepsy.

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