



Reflex epilepsy: a review

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ABSTRACT

Interesting phenomena of reflex epileptic syndromes are characterized by epileptic seizures each one induced by specific stimulus with a variety of types. Simple triggers, which lead to seizures within seconds, are of sensory type (most commonly visual, most rarely tactile or proprioceptive stimuli). Complex triggers, which are mostly of cognitive type such as praxis, reading, talking, and music, usually induce the epileptic event within minutes. It should differ from what most epileptic patients report as provocative precipitants for seizures (such as emotional stress, fatigue, fever, sleep deprivation, alcohol, and menstrual cycle).

The identification of a specific trigger is not only important for patients or their parents to avoid seizures, but also it might help neurologists to choose the most effective antiepileptic drug for each case. In addition, research in this area may possibly reveal some underlying pathophysiology of epileptic phenomena in the brain.

In this review, we briefly introduce reported reflex epileptic seizures, their clinical features and management.

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Introduction

Reflex epilepsy syndromes are referred to epileptic seizures that are consistently precipitated by identifiable and precise triggers, which may be exogenous sensory stimulus or endogenous mental activities (1). These interesting phenomena should be distinguished from provocative precipitants, which are reported by most patients with epilepsy. In other words, an epileptic seizure may be provoked in a certain situation or by general internal precipitants (such as emotional stress, fatigue, high body temperature, lack of sleep, specific stages of normal sleep, and menstrual cycle) or external precipitants (such as alcohol consumption, hyperventilation, flashing lights or specific foods) (2). While seizures may be provoked by these factors, unprovoked events also occur in the same patients. By definition, a reflex seizure is

exclusively triggered by a certain and exotic stimulation. Moreover, non-epileptic phenomena may also be triggered by certain factors such as febrile seizures of children, psychogenic nonepileptiform seizures, hypoglycemic or hypocalcemic seizures, and tramadol-induced seizures (1,3).

Reflex seizures may be provoked by a variety of stimuli. Simple triggers, which induce seizures within seconds, are of sensory type (most commonly visual, most rarely tactile or proprioceptive stimuli). Complex triggers, which are mostly of cognitive type such as praxis, reading, talking, and music, induce the attack within minutes. The event may present as generalized or partial seizure.

The study of these uncommon syndromes is interesting for researchers as may provide them better understanding of cortical brain function re-

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lated to the occurrence of some type of seizures. Moreover, the diagnosis of these types of epilepsies is attractive to clinicians and patients (or their parents) because of their potentially preventable nature. Some types of reflex epileptic seizures may preferably respond to certain antiepileptic drugs; however, this is not a rule.

From the clinical point of view, reflex seizures are indistinguishable from unprovoked seizures except for the presence of specific stimuli (1,4).

Literature Review

Reflex epilepsy may be seen observed in young adult, equally in each gender (1,2). These relatively rare seizures are often classified based on the stimuli induced them. The already previously known triggers are as follow: Visual stimuli-including flickering light, specific color, television, sunlight and patterns- leading to rapid blinking or eye closure, thinking, praxis, reading, somatosensory stimuli (including a brisk unexpected tap, sudden movement following sitting or lying still, and a prolonged tactile or thermal stimulus to a certain area of the body), proprioceptive stimulation, eating, music, hot water, startle (including sudden unexpected auditory stimuli)(1,4,5) and Miscellaneous. Visually provoked seizures are the most common reported type and are usually myoclonic (2).

The probable mechanisms of reflex epilepsies

In animal models, two mechanisms have been approached introduced: cortical hyperexcitability of special area to certain stimuli, and genetic susceptibility to reflex seizures.

The first one has been applied since 1929, when Clementi showed that intermittent photic stimulation can induce convulsions after injection of strychnine in to the canine visual cortex (1). Furthered studies showed that epileptic events can arise from visual (6), auditory (7), olfactory (8) or gustatory strychninized cortex (9) by appropriate stimuli. Electroencephalic studies show a rapid transmission of epileptic discharges from such areas to frontorolandic and other related areas during the induced seizures (1). Hunter and Ingvar described an independent corticocortical pathway through probably thalami and reticular formation for the rapid radiation of visual evoked response respond to the motor areas (10). Functional Magnetic resonance imaging (fMRI) in photosensitive subjects may demonstrate regional hyperexcitability in the occipital lobe and abnormal neuronal synchronization (11).

In the second type of mechanisms studies, genetically tendency has been demonstrated in animals such as chicken with photosensitivity, rodents sensitive to auditory stimuli and the E1 mouse responsive

to vestibular provocations. Although these studies are interesting in the field of epilepsy, the relevance to human being is limited (1).

Common types of reflex seizure

1-Visual- induced seizures and epilepsies

These syndromes are the commonest and well known reflex epilepsy. Even before the era of electroencephalography, seizures induced by flickering light were recognized.

Visually evoked epilepsies are usually reported in children and the sensitivity of these epilepsies is reduced by age. There are Some studies that demonstrate the role of genetics, although a single gene has not been yet identified for photosensitivity (12).

There are different subtypes of visually evoked epilepsies. The commonest one is induced by flickering light, which may be clinically classified to pure photosensitive epilepsy (40%) and photosensitive epilepsy with spontaneous seizures (60%). The last one can be shown in an electroencephalography in patients who suffer from unprovoked attacks, like whom with juvenile myoclonic epilepsy and rarely with absence seizures (13,14). Pure photosensitive seizures are exclusively provoked by flickers and most of them are of generalized tonic-clonic type (15).

Television, video displays, computer screens and video games are the most common environmental visual triggers inducing seizures (1). It should be emphasized that first seizure, particularly juvenile myoclonic epilepsy, in a non-reflex epileptic patient may be precipitated by such electronic devices, in particular of juvenile myoclonic epilepsy (16).

Other visual triggers are sunlight, eye closure alone and blinking and specific colors including red, green or blue (1).

A dopaminergic mechanism in epileptic photosensitivity is proposed based on a transient effect of bromocriptin, apomorphine and parenteral L-dopa in stopping the attacks (17).

Epidemiology: About 2% of new epileptic cases are photosensitive. They are remarkably age dependent and are most commonly seen observed in young adults. There are few reports of about the photosensitive epilepsy before age 2 years (1).

Treatment: As Since, preventive measures are not always possible or practical, medication usually need to be administered. The recommended drug of choice is valproate, which can suppress photosensitivity (1). Lamotigine, topiramate, ethosuximide, benzodiazepines and levethiracetam may also be effective (2,18). The seizures can be usually controlled by appropriate treatment. In other words, in case of uncontrolled attacks, self-induction should be taken into consideration (1).

2-Reading induced seizures

Seizures usually begin in adolescence and are usually benign and limited to orofacial myoclonus (19). They may be mistaken for stuttering or tics (3). Neurologic examination and CT scan are normal in these types of seizures (1,19).

3-Startle epilepsy

This syndrome consists of seizure provoked by sudden sensory stimuli (20). The trigger is usually an unexpected sound. The seizures often last less than 30 seconds with clonic jerk and sometimes falling (5). Brain imaging may show abnormalities including mesial hypodensity or diffuse lesions. Startle epilepsy often accompany Down syndrome. This disorder should be distinguished from startle disease (hyperekplexia) (21). The drugs prescribed for focal seizures such as carbamazepine; also, lamotrigine, clobazam and clonazepam (22,23) are recommended; however, startle epilepsies are usually intractable (1,24).

4-Music-induced seizures

Musicogenic seizure is classified as a rare form of complex reflex seizures. Most of patients suffer also from spontaneous seizures as the initial presentation (25,26). Right temporal lesions are reported by in several authors studies (27). If preventive measures are not possible, the drugs for focal seizures are suggested, (1,25,26). Vagal nerve stimulation treatment is also successful in these patients (28).

5-Thinking and praxis-induced seizures

Higher cortical function is involved in these disorders by variety of tasks such as drawing, arithmetic, playing cards or chess and decision making (21). Seizures are mostly of generalized type (29,30) including juvenile myoclonic epilepsy. Accordingly, drugs effective on these syndromes are the treatment of choice of for praxis-induced seizures (1).

6-Movement induced seizures (proprioceptive stimuli)

This reflex seizure is rare and may be observed transiently with non-ketotic hyperglycemia (31). Non-ketotic hyperglycemia (NKHG) may increase the probability of seizures and movement disorders and could be misdiagnosed as neurological diseases. Almost all patients respond appropriately to insulin therapy and a few of them need antiepileptic drugs (32).

7-Hot water induced epilepsy

Most reports of this syndrome are from India, where young boys undergo ritual bathing (33). Hot water epilepsy is usually generalized and benign

(34). However, there are reports of non-Indian subjects with this interesting type of reflex seizures. According to few case reports, clobazam is helpful in prophylaxis (35).

8-Eating reflex seizures

This unusual type of seizure may be attributed to gastric distension (1). While the sufferers should be instructed to avoid overeating, drug administration is regularly required.

9-Miscellaneous

Other types of reflex seizures have been rarely reported. Some of them include olfactory (36), vestibular, caloric or rotatory, writing, somatosensory (37), gait (38), and very specific visual induced seizures (1,37).

Treatment and management

While avoiding the trigger is pivotal in preventing the events (39), it is reasonable to administer antiepileptic drugs (1). Similar to non-reflex seizures, the type of epileptic syndrome (focal or generalized epilepsy) should be determined. Nonetheless, triggering by some rare stimuli may help to choose the appropriate treatment (19,32). Visual light stimulation, thinking, and praxis induce generalized seizures that respond to valproate. A plenty of triggers can precipitate focal seizures for which, carbamazepine is the drug of choice. These triggers include reading, startle, somatosensory stimulation, proprioception, auditory stimuli, hot water, eating, and vestibular stimulation (37).

Conclusion

A detailed history is essential to make a proper diagnosis of seizure type. Preventive measures may explain the importance of appropriate diagnosis of reflex epilepsies in the field of neurology and pediatrics. The type of trigger may help to predict which medication may will be helpful. Moreover, research in this area may reveal some brain mechanisms of epileptic phenomena.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Engle JR, Pedley TA. *EPILEPSY, A Comprehensive Textbook*. 2nd ed. Philadelphia: Lippincott Williams & Wilkins; 2008.
2. Italiano D, Ferlazzo E, Gasparini S, et al. Generalized versus partial reflex seizures: a review. *Seizure*. 2014;23:512-520.
3. Wolf P, Koepp M. Reflex epilepsies. *Handb Clin Neurol*. 2012;107:257-276.
4. Kasteleijn-Nolst Trenité DG, Pinto D, Hirsch E, et al. photosensitivity, visual induced seizures and epileptic syndromes. In: Roger J, Bureau M, Dravet C, et al, editors. *Epileptic syndromes in infancy, Childhood and adolescence*. 4th ed. Montreux: John Libbey Eurotext; 2005.p. 395-422.
5. Sandhya M, Bharath RD, Panda R, et al. Understanding the

- pathophysiology of reflex epilepsy using simultaneous EEG-fMRI. *Epileptic Disord.* 2014;16:19-29.
6. Carballosa-Gonzalez MM, Muñoz LJ, López-Alburquerque T, et al. EEG characterization of audiogenic seizures in the hamster strain GASH:Sal. *Epilepsy Res.* 2013;106:318-325.
 7. Ilik F, Pazarli AC. Reflex Epilepsy Triggered by Smell. *Clin EEG Neurosci.* 2015;46:263-265.
 8. Blauwblomme T, Kahane P, Minotti L, et al. Multimodal imaging reveals the role of γ activity in eating-reflex seizures. *J Neurol Neurosurg Psychiatry.* 2011;82:1171-1173.
 9. Herrick CE, Jeavons PM, Harding GF. Proceedings: Study of a photosensitive family. *Electroencephalogr Clin Neurophysiol.* 1975;39:428.
 10. Baykan B, Matur Z, Gürses C, et al. Typical absence seizures triggered by photosensitivity. *Epilepsia.* 2005;46:159-163.
 11. Oguni H, Hayashi K, Awaya Y, et al. Severe myoclonic epilepsy in infants--a review based on the Tokyo Women's Medical University series of 84 cases. *Brain Dev.* 2001;23:736-348.
 12. Ikeda H, Imai K, Ikeda H, et al. Lamotrigine is favourable for startle-induced seizures. *Epileptic Disord.* 2011;13:277-383.
 13. Wolf P, Inoue Y. Complex reflex epilepsies: reading epilepsy and praxis induction. In: Roger J, Bureau M, Dravet C, et al, editors. *Epileptic syndromes in infancy, Childhood and adolescence.* 4th ed. Montrouge: John Libbey Eurotext; 2005.p.347-358.
 14. Engel J Jr. A proposed diagnostic scheme for people with epileptic seizures and with epilepsy: report of the ILAE Task Force on Classification and Terminology. *Epilepsia.* 2001;42:796-803.
 15. Aguglia U, Tinuper P, Gastaut H. Startle-induced epileptic seizures. *Epilepsia.* 1984;25:712-720.
 16. Fought E. Lamotrigine for startle-induced seizures. *Seizure.* 1999;8:361-363.
 17. Labate A, Barone R, Gambardella A, et al. Startle epilepsy complicating aspartylglucosaminuria. *Brain Dev.* 2004;26:130-133.
 18. Caraballo R, Semprino M, Cersósimo R, et al. Hemiparetic cerebral palsy and startle epilepsy. *Rev Neurol.* 2004;31;38:123-127.
 19. Stern J. Musicogenic epilepsy. *Handb Clin Neurol.* 2015;129:469-477.
 20. Maguire MJ. Music and epilepsy: a critical review. *Epilepsia.* 2012;53:947-961.
 21. Ferlazzo E, Zifkin BG, Andermann E, et al. Cortical triggers in generalized reflex seizures and epilepsies. *Brain.* 2005;128:700-710.
 22. Nevler N, Gandelman-Martón R. Acute provoked reflex seizures induced by thinking. *Neurologist.* 2012;18:415-417.
 23. Brick JF, Gutrecht JA, Ringel RA. Reflex epilepsy and non-ketotic hyperglycemia in the elderly: a specific neuroendocrine syndrome. *Neurology.* 1989;39:394-399.
 24. Satishchandra P. Hot-water epilepsy. *Epilepsia.* 2003;44 1:29-32.
 25. Grosso S, Farnetani MA, Francione S, et al. Hot water epilepsy and focal malformation of the parietal cortex development. *Brain Dev.* 2004;26:490-493.
 26. Satishchandra P, Dilipkumar S, Subbakrishna DK, et al. Intermittent clobazam prophylaxis in hot water epilepsy is safe and effective: a prospective study. *Epilepsy Res.* 2014;108:1238-1242.
 27. Ilik F, Pazarli AC. Reflex Epilepsy Triggered by Smell. *Clin EEG Neurosci.* 2014.
 28. Xue LY, Ritaccio AL. Reflex seizures and reflex epilepsy. *Am J Electroneurodiagnostic Technol.* 2006;46:39-48.
 29. Iriarte J, Sánchez-Carpintero R, Schlumberger E, et al. Gait epilepsy. A case report of gait-induced seizures. *Epilepsia.* 2001;42:1087-1090.