# 복잡한 사고에 의해 유발되는 간질발작 2예

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# Two Patients with Epilepsy Induced by Complex Thinking

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***- Abstract -***

Reflex epilepsies are distinct but not clearly understood clinical entity. Various cerebral activities induced by simple stimulation including visual, auditory, somatosensory stimulation, as well as diverse functional tasks such as reading, calculation, complex thinking are believed to be seizure-inducing factors. We experienced two patients whose seizures were readily precipitated by complex, strenuous thinking. Both patients was teen-aged boy at the onset of seizure(13, and 15 years of age each) with normal physical and mental growth. Although first seizure was precipitated by watching TV and playing puzzles in each patient, initial diagnosis was idiopathic generalized epilepsy, possibly juvenile myoclonic epilepsy(JME). For the first few years, seizures were infrequent but mostly precipitated by the tasks needs concentration such as playing computer games, decision-making, mathematics, reading, or during the examination. EEG revealed various thinking process including reading hard books, drawing complex figure, complex calculation induced epileptic discharges even if it usually needs certain period of concentration.

Phenytoin, valproic acid, clonazepam, vigabatrin, and lamotrigine sometimes abated their seizures but none of these made them seizure-free. Complex reflex epilepsy induced by thinking was proposed to be a separate type of epilepsy or a variant of JME. Age, sex, stereotypic seizure-inducing factors, clinical course, and refractory epilepsies in these patients highly suggested this type of epilepsy as a variant of JME but its refractoriness and unique provocation still needs more speculation.

**Key Words :** Reflex epilepsy, Complex thinking, Juvenile myoclonic epilepsy

## Introduction

Reflex epilepsy refers to seizures that are regularly precipitated by a specific identifiable stimulus. The term epilepsia arithmetices was introduced to describe a form of reflex epilepsy in which mental arithmetic can evoke both epileptiform discharges in the electroencephalogram and also clinical seizures[1]. This phenomenon also has been referred to as “seizure induced by thinking” and “decision-making epilepsy”. Various higher brain function may contribute to the precipitation of epileptic seizures. Common precipitants of epileptic

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attacks have included playing chess or card games, performing mathematical calculations, drawing complex figures, manipulating spatial information, and typing[2-7]. We experienced two patients whose seizures were readily precipitated by complex, strenuous thinking.

## Case summary

### Case I

A 25-year-old right-handed male had been experiencing sudden transient jerky movements of the body, the right arm in particular, with brief lapse of consciousness since the age of 14. Although the jerks occurred spontaneously, it coincided mainly with when he was faced with stressful situations; solving puzzles, doing complex calculation, reading hard texts, typing, complex thinking, and other tasks that needed decision making and mental concentration.

His school performance was outstanding before the development of seizure. However this has hindered his academic performances. Although he was able to control the seizure to some extent with the use of valproate, the fear of seizure has prevented the patient from trying hard academically and he has tried to avoid all tasks requiring mental concentration. The patient could anticipate the onset of seizure and prevent it by withdrawing from the precipitating situations.

His previous medical history and neurologic examination was nil significant. The brain MRI showed no abnormality.

EEG was recorded with video monitoring while the patient was given such tasks as typing, reading hard texts, and doing maths calculation. EEG at rest showed normal background rhythm and rarely some generalized spike-and-wave discharges. No photoconvulsive response was observed during intermittent photic stimulation.

Paroxysmal generalized burst of spikes and slows were observed during mental tasks accompanied sometimes by myoclonic jerks of both arms with brief lapse of consciousness(Fig. 1).

The patient was prescribed with valproate and clonazepam which showed relatively good response, although not completely seizure free.

### Case II

A 15-year-old male student has had seizures since the age of 13. He has had generalized tonic-clonic convulsions with the frequency of 4 ~ 5 times yearly, occasionally had myoclonic jerks. Myoclonic jerks occurred during mental concentration or emotionally stressful situations, such as, playing computer game, watching exciting scenes on the television, doing calculations, reading, sitting for examination and playing jigsaw puzzles. He had a simple febrile convulsion, otherwise unremarkable.

Physical and neurologic examination result was normal and brain MRI revealed normal finding.

EEG showed normal background rhythm and relatively frequent generalized 3.5 ~ 4 Hz spike-and-wave discharges(1 ~ 2/min) at resting state. While he was reading, generalized epileptiform discharges were increased to frequency of 5 ~ 6/min and sometimes myoclonic jerks of both arm and body were accompanied(Fig. 2).

## Comments

The genesis of individual seizures in humans is determined by complex, poorly understood, interplay of factors. There are those stimuli which in certain people evoke seizure directly, the correlation between stimulus and seizure induction being very high[8].

The discovery that seizures could be produced by conditioning in cats with epileptogenic brains (after injection of tetanus toxin) meant that psychological factors also had a part to play in this model[9]. Behavioral and psychological construct have an important part to play in seizure production(Fig. 3).

### Possible mechanisms of complex reflex seizures

Goossens et al.(1990) analyzed 25 patients where neuropsychological analysis of the stimuli

***Figure 1.*** *(Case I) Paroxysmal generalized burst of spikes and waves occurred during typing. Patient complained of abnormal feeling from inside while strenuous typing. Typing was transiently arrested with mild myoclonic jerk and phonation.*

***Figure 2.*** *(Case II) Generalized epileptiform discharges with myoclonic jerk during reading book. Patient usually could expect and felt escalation of these types of seizures while solving tough mathematics.*

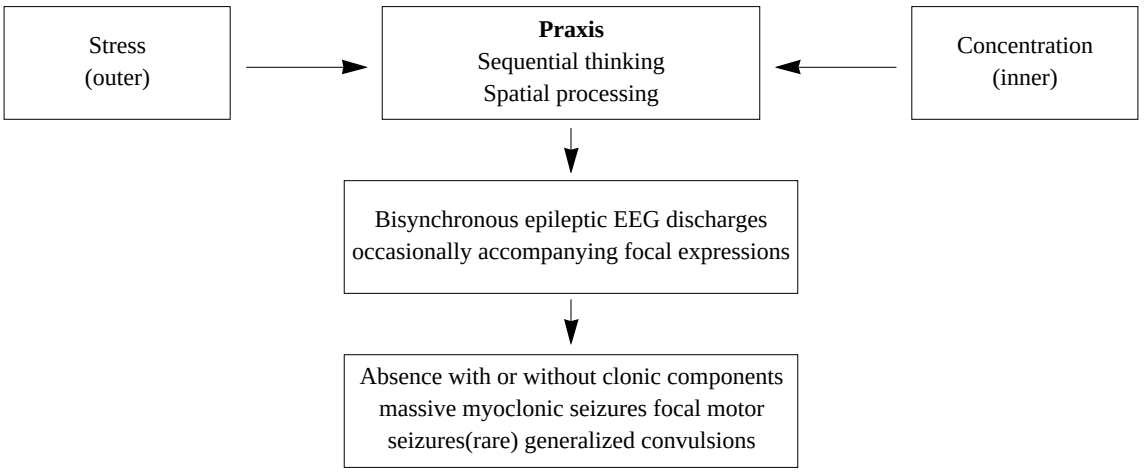


***Figure 3.*** *Schematic representation of precipitating processes and EEG and clinical expressions in praxis-induced epilepsy.*

points to parietal cortical dysfunction[4]. These stimuli lead to activation of a generalized epileptic process analogous to the occipital cortical participation in the activation of generalized epileptic abnormality occurring in patients with photosensitivity epilepsy. It has been suggested that the stressed decision complexity, strategic thinking associated with related stress, and processing of spatial information as crucial elements in seizure precipitation[8].

Inoue et al.(1994) studied 32 patients who had a history of seizures induced by non-verbal higher brain activities, called praxis-induced seizures. Two third of patients(21 of 32) were diagnosed as juvenile myoclonic epilepsy. Seizure onset occurs around puberty, with male preponderance. Clinical seizure types are absence seizure with or without clonic component, massive myoclonic jerks or generalized convulsions. The EEG shows a burst of bisynchronous spike-and-wave or polyspike-and-wave discharges[5].

For the patients presenting with predominantly myoclonus, valproate monotherapy has resulted in total control in some cases. The use of clobazam or clonazepam in monotherapy or polytherapy also has been effective. In our patients, these drugs were particularly effective, but sleep deprivation and long-term, complex, and deep thinking provoke their seizures occasionally.

Complex reflex epilepsy induced by thinking

might be a unique epileptic syndrome. Still whether this type of epilepsy is a subtype of JME is not clear. Demographic features suggest this type of epilepsy as a subtype of JME. But the partial refractoriness to the valproic acid, and unique provocation of seizure might suggest this complex thinking-induced epilepsy as an extreme spectrum of JME.

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