“Sleep epileptology”—a new field of sleep medicine and epileptology

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Epilepsy is a chronic brain disease characterized by repetitive epileptic seizures. The cumulative incidence rate by age 85 years is high at 4.4%. Epileptic seizures tend to occur during sleep and exhibit abnormal motor and behavior symptoms (AMBS) during sleep [1].

The progress of the two research fields of sleep medicine and epileptology has been advancing with the recent development of long-term monitoring using video-polysomnography with full-montage EEG (V-PSG), various brain imaging technologies, and genetic screening systems. Great attention has been paid to the close relationship between the two fields, accumulating fruitful research findings. In light of these achievements, we are at the stage of creating a new research field, sleep epileptology. In this preface I give a brief outline of a number of key findings and significant achievements in sleep epileptology.

Janz [2] examined 2825 epilepsy patients with generalized tonic-clonic seizures and investigated the association between the seizures and the sleep/wake cycle through

clinical observation. Symptoms were classified into three groups: sleep epilepsy with seizures occurring during sleep (44%), awakening epilepsy with seizures occurring shortly after awakening (33%), and diffuse epilepsy with seizures occurring with no correlation to the sleep/waking cycle (23%). In the International Classification of Sleep Disorders (ICSD), third edition (ICSD-3, 2014), the most widely used classification system for sleep disorders, sleep-related epilepsy, which includes both sleep epilepsy (e.g., nocturnal frontal lobe epilepsy) and awakening epilepsy (e.g., juvenile myoclonic epilepsy), accounts for 77% of incidents of epilepsy.

Clinical seizures in nocturnal frontal lobe epilepsy occur mostly during non-REM sleep and rarely during REM sleep. The reason would be that thalamocortical hypersynchrony during non-REM sleep promotes epileptic seizure generation.

The introduction of V-PSG into clinical practice in the 1990s has enabled highly accurate differential analysis for AMBS during sleep; furthermore, it has played an important role in detecting a large body of useful clinical information for treating patients, which includes abnormal sleep architecture, sleep disorders (such as insomnias and sleep apneas), seizures and interictal/ictal EEG abnormalities which would often be overlooked in the daytime. For instance, the incidence rate of subjective sleep disorders was high among epileptic patients, at approximately 40%, and the disorders have been confirmed by several V-PSG diagnoses such as degradation in the quantity and quality of nocturnal sleep.

Recently, fine EEG changes called cyclic alternating pattern (CAP) in intractable epilepsy, which indicate unstable non-REM sleep, have been observed at a high rate among patients with intractable epilepsy. It has also been suggested that CAP may trigger epileptic seizures (CAP-related seizures). These sleep disorders are caused by epileptic seizures, whereas epileptic seizures can also be caused by the disorders. This mutually advancing relation holds between epileptic seizures and sleep disorders. Antiepileptics may affect nocturnal sleep architecture and cause excessive sleepiness during the day and subsequent nocturnal insomnia.

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Previous studies on V-PSG have made great contributions to the refinement of the criteria in the ICSD. In particular, it should be noted that nocturnal paroxysmal dystonia, which was originally in the category of parasomnias in ICSD-1 (1990), was reclassified into the category of nocturnal frontal lobe epilepsy in both ICSD-2 (2005) and ICSD-3 (2014), which implies that without V-PSG, it is extremely difficult to make a differential diagnosis of parasomnias from epilepsy.

Note also that a family was reported to have a high incidence of both (non- REM or REM-related) parasomnias and nocturnal frontal lobe epilepsy. Normally, both diseases are a target of a differential diagnosis and hence it was unexpected that they occur simultaneously in a single patient. This suggests nocturnal frontal lobe epilepsy and parasomnias share some common pathophysiologic substrate, which requires further investigation.

So far we have discussed a number of achievements and areas of research in sleep epileptology, a field which mainly targets the interface between sleep medicine and epileptology. I anticipate that the field will expand to develop its own

fields, accumulating findings and achievements, and contribute to the development of sleep medicine and epileptology.

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